EVALUATING THE IMPACTS OF SLEEP DISRUPTIONS IN WOMEN THROUGH AUTOMATED ANALYSIS (SJSL FRAMEWORK)

By

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Abstract

EVALUATING THE IMPACTS OF SLEEP DISRUPTIONS IN WOMEN THROUGH AUTOMATED ANALYSIS

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The proposed research suggests a solution for female sleep disruption by using automated analytics and attempts to improve our understanding of sleep disruption physiology. Although, sleep disruption monitoring is gaining attention with the use of sleep monitoring devices that track sleep disruptions. Automated technology can capture repeated measurements, evaluate sleep patterns, and make suggestions. However, facts revealed by clinical research suggest that it can measure sleep – disruption records, and sleep disorders. Moreover, this research can be useful for prescribing individual treatment, and hence improve individual healthcare optimization. In fact, some of the health tracking electronic devices assist individuals in tracking their sleep performance. Conceptually, our proposed research methodology provides a systematic analysis procedure for monitoring sleep disruption using RFID / Auto-ID technology. The broader impacts of this research are consistent and precise sleep disruption monitoring, it analyzes brain activities during different sleeping stages and, it provides daily sleep scores and charts that help the end user understand their sleep patterns, and synchronize information with their smartphone RFID technology. RFID based an automated technology can provide real time data and solutions to track sleeping patterns such as, how long and deeply you resting, how often you getting up and your brain resting activities. Sleeping well is imperative to a healthy body as well as for effective brain functions. However, persistent sleep disturbance can

affect mood, energy levels, and ability to face stressful situations. Neglecting sleep relevant issues may cause serious health ailments, increase the risk of accidents, and impaired relationships. Overall sleep is as necessary as other aspects to physical health. This crucial issue of sleep disruption can be improved by adopting a step by step procedure, 1) Measure symptoms and sleep patterns, 2) Provide sleep record analytics, and 3) Provide sleep performance matrices. Accordingly, healthy changes can be made to daytime habits and bedtime routines. In this research, we will attempt to investigate the following research on impacts of sleep disruptions in women through automated analysis. This research is a comprehensive analysis depicting a framework for developing wearable scarves and pillow case linens that can monitor sleep disruption in women. This system's functioning is mainly based on 3 major technologies -1) RFID technology based system, 2) sensors and 3) software that installed on a mobile device. This proposal suggests an idea of developing a wireless wearable RFID enabled scarf for recognizing sleep apneas pattern from EEG signals, which identifies sleep disruption in women. The suggested system of sleep monitoring detection uses a combination of EEG recording sensors, electronics, filters, transducers, software, RFID based Auto-ID technology system. A framework was developed for measuring various types of sleep stages. We suggest that based on results that the RFID enabled SJSL (Shalini Jones Smart Linen) scarf and pillow case system is feasible. The outcomes of this research is a viable framework for developing these types of products.

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Chapter 1 : INTRODUCTION

1.1 Prevalence of Sleep Disruption in United States and Relevant Expenditures

Most of the women have faced issues to get proper sleep and this problem can be due to many reasons such as social, biological, physical, psychological etc. [4]. But, if these extraneous factors persist, they may lead to serious health issues and sleep disorders [2].

Sleep disorders may cause more detrimental effects on overall health. Symptoms such as poor performance level, emotional imbalance, and health ailments; have been attributed primarily to lack of quality sleep [28]. Nowadays, sleep has been regarded as a standard measure of perfect health because people with good health get sufficient sleep, whereas those facing sleep deprivation issues, often, need to be treated for major or minor health problems [6].

RFID/ Automated technology can provide real life data and solutions to track the sleeping patterns such as how long and deeply an individual rests, how often an individual gets up, and even heart and respiration rates [43]. Sleeping well is imperative for a healthy body as well as to bright mind [3]. However, persistent disturbance can affect our mood, energy level, and capability to face stressful situations [14]. Neglecting sleep relevant issues may cause serious health ailment, risk of accidents, reduced productivity, and impaired relationships [13]. To resolve the sleep impairment issue, we need to measure sleep disorder symptoms, and sleep patterns.

1.1.1 Problem Statement

As per the previous research on sleep issues, the level of sleep disruption problem has been increased worldwide [1]. Based on the analysis conducted in the previous years, we have observed that sleep disruption issue has prevailed at a faster rate in developed countries such as USA, China, UK [26]. The sleep disruption issue is causing many health problems related to mental and social issues [20]. In fact, sleep disorder is a root cause

behind major chronical diseases. Moreover, Sleep disruption affects overall quality of life which is a combination of physical, mental, emotional and social aspects and causes disturbance in positive factors of healthy life [10]. Thus, causes further issues related to life satisfaction and positive emotions. It has been observed that women with sleep disruption have depicted short temper attitude as well as higher risk of mood swing. Many factors associated with sleep disruption [19]. In fact, researchers have proved that insufficient sleep has played a major role in obesity in women, children and young adults [15]. Moreover, perinatal factors and genetic factors also get affected by insufficient sleep. From the biological standpoint of view, sleep disruption is triggered mainly due to imbalanced diet intake, stress, workload, metabolism, and hormonal imbalance [11].

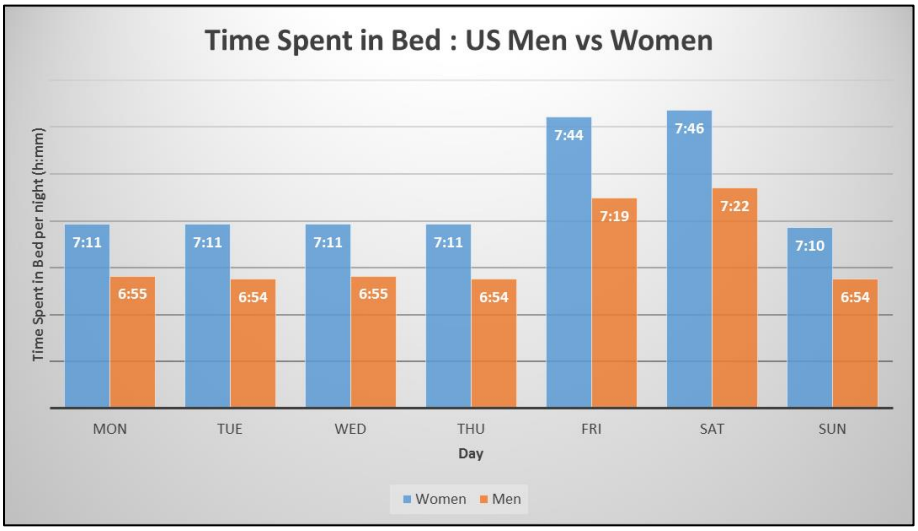

Figure 1-1: Estimated Time Spent in Bed: US Men vs Women, January 2016

Sleep disorders become more chronical as age increases, but with proper awareness, the effects of chronical sleep disorders can be suppressed up to a great extent [16]. Mostly women are more sensitive to age – related changes and these kind of changes makes a significant impact not only during the sleeping time but affects the awakening

states also [34]. However, by accumulating prior information about the sleep performance such as brain aging, in particular neuronal loss information can help us taking preventive actions for the sleep disorders [42].

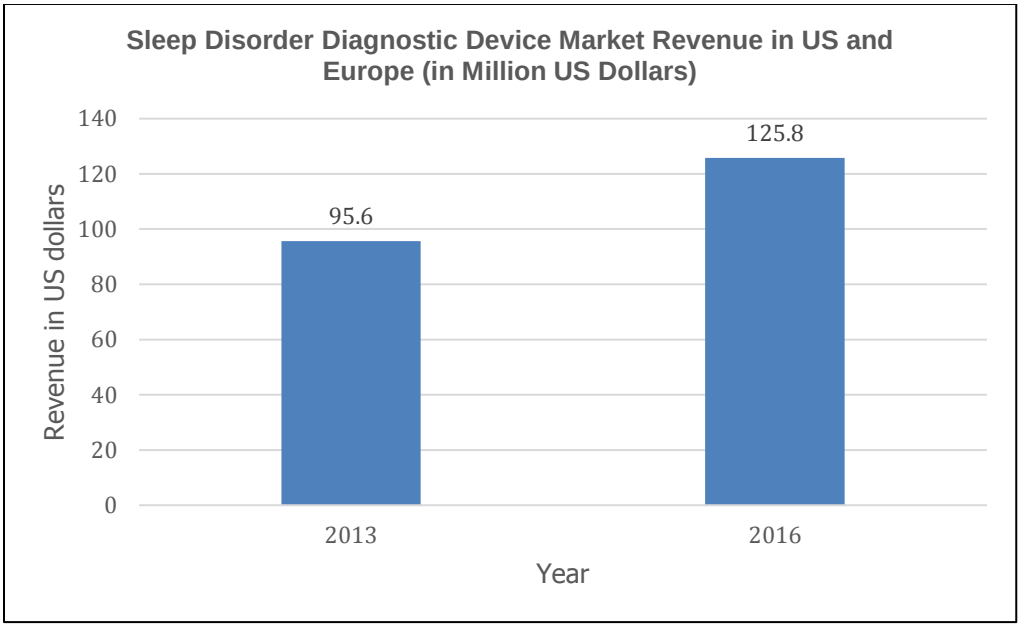

Figure 1-1: Sleep Diagnostic Device Market Revenue in US and Europe (in Million US $).

1.1.2 Research Significance

The proposed research suggests a solution for sleep disruption by using Automated / RFID analytics and attempts improving our understanding of sleep disruption physiology [44]. Sleep disruption monitoring is gaining attention among sleep monitoring devices that provide the opportunity for tracking sleep disruption consistently [43]. Automated technology allows repeated measurements, evaluation of sleep patterns, and suggestions [9]. However, facts revealed by clinical and research has the strong standpoint to measure sleep – disruption records, and this may helpful in treating sleep disorders [38]. Moreover, this analysis can also be useful for prescribing individual treatment, and hence

improvised individual health optimization [55]. In fact, some of the health tracking electronics gadgets assist individuals to track their own sleep performance [17]. Conceptually, the developed analytics provides models and correlation between variables such as EMG, ECG, EOG, EEG etc. By modeling sleeping data analytics; we may provide sleep performance. Accordingly, changes may be made to daytime habits and bedtime routine. This research aims at evaluating the impacts of sleep deprivation using RFID technology.

1.1.3 Research questions and Hypothesis

There are two primary research questions. We believe that these questions must be answered in order to meet our research objectives.

Research Question 1: What are impacts of implementing RFID enabled (Smart) technologies embedded in linen based beauty products to monitor sleep patterns on minimizing the negative impacts of sleep disorders on women?

Research Question 2: What are the benefits of the proposed SJSL framework that impact and improve sleep performance?

The research evaluated whether or not the implementation of SJSL framework will have a significant impact on health systems engineering research that investigate female sleep and human brain wave monitoring. SJSL refers to the Shalini/Jones “Smart” Linens. “Smart” refers to the automated transmissions enabled by RFID (Radio Frequency Identification) technologies. We use SJ to refer to the models developed by her and we use “Smart Linens” because others have labeled technologies “Smart” and we use the SJSL for convenience in the document.

To address these two research questions further, we have introduced two sets of hypotheses which assists to explore the research questions. As per the statistical hypothesis testing, null hypothesis and alternative hypothesis need to be compared.

Table 1-1**:** Hypothesis Statements

Hypothesis Statement	**Null Hypothesis**	**Alternative Hypothesis**	**Decision Rule**
Question # 1	H_0 : The implementation of Auto ID / RFID technology will not impact on measuring sleep disorders accurately.	H_1 : The implementation of Auto ID / RFID technology will impact on measuring sleep disorders accurately.	Reject H_0 : If the cost associated with Auto ID / RFID based sleep monitoring system is greater than 15 % of the currently available systems.
Question # 2	H_0 : The developed framework will not effectively address the critical sleep disorders monitoring requirements.	H_1 : The developed framework effectively addresses the critical sleep disorders monitoring requirements.	Reject H_0 : If the sleep performance provided by Auto ID / RFID based sleep monitoring system is less than 5 % counts.

These two hypotheses statement are stated as follow:

Hypothesis Statement for Objective # 1

Null Hypothesis

H_0 : The implementation of Auto ID / RFID technology will not impact on measuring sleep disorders accurately.

Alternative Hypothesis

H_1 : The implementation of Auto ID / RFID technology will impact on measuring sleep disorders accurately.

Decision Rule

Reject H_0 : If the cost associated with Auto ID / RFID based sleep monitoring system is greater than 15 % of the currently available systems.

Hypothesis Statement for Objective # 2

Null Hypothesis

H_0 : The developed framework will not effectively address the critical sleep disorders monitoring requirements.

Alternative Hypothesis

H_1 : The developed framework effectively addresses the critical sleep disorders monitoring requirements.

Decision Rule

Reject H_0 : If the sleep performance provided by Auto - ID / RFID based sleep monitoring system is less than 5 % counts.

In this research, we will attempt to answer the research questions by meeting our overall research objective of evaluating the impacts of sleep disruptions through RFID/ Auto-ID technology implementation. We research the overall objective by using the following three specific objectives.

Specific Objective 1:- Identify the factors affecting sleep disruptions and evaluate the model suitability for sleep performance.

Specific Objective 2:- Evaluate and identify the suitable automated analysis technique for sleep disorders measurement.

Specific Objective 3:- Develop a software for monitoring sleep disruption in women and evaluate the impact of proposed framework for Sleep disruption performance measurement.

1.2 Research Purpose

The main purpose of this research is to demonstrate the wireless RFID technology based sleep disruption monitoring system [8]. The proposed system is an application based technology that is able to use radio frequency power from a RF transmitter and use it to transfer EEG signals to the RF enabled receivers. Sleep disruption monitoring by using RFID technology is a unique way to provide sleep performance [12]. Conceptually, the major advantage of using RFID technology is that it does not require high sampling rates for analysis [36]. In this research, the suggested distance between the subject and RFID-based system should be less than 1 meter to gain the expected level of reading accuracy.

Overall, the results of this research experiments demonstrate the feasibility of multiple linear regression analysis and analytical Hierarchy process in the acquirement of EEG signals for automated analysis [99]. In particular, the analysis was performed to analyze EEG sleep data for developing the analytics for automated sleep disruption monitoring research. However, available methods also producing effective results, but the lack of a RF based EEG recording based self-sleep monitoring devices has attracted researchers' attention in this area. The analysis performed in this research shows that the level of accuracy can be maintained by statistical analysis for signal synthesis and refinement techniques. Based on the suggested framework, we can achieve better accuracy and produced effective results. However, the sensor complexity and severe power constraints forced on EEG capturing systems provide the designer of EEG recording systems a compromise [78]. Though, the appropriate modification can be made to the device features and the power quality concern can also be balanced with signal quality.

These achievements can compensate for power consumption limitations and provide many benefits.

1.3 Organization of this Dissertation

The dissertation contains a five-point engineering format of introduction, background, methodology, results, and conclusion.

Chapter 1 is the introduction and contains information regarding why this research is being performed. The section describes the topic of Prevalence of Sleep Disruption in United States and Relevant and Problem statement and research significance. It also explains the purpose of this dissertation and the need for developing RFID and Auto-ID enabled sleep disruption monitoring systems for women.

Chapter 2 discusses the dissertation's background. This is the literature review of Sleep disorders, Definition of sleep, Sleep disorders in women, Importance of good sleep. Also, the chapter discusses common sleep problems in women, and Sleep assessment methods. The background also discusses roles of brain waves in sleepiness and purpose of brain waves.

Chapter 3 defines the methodology to be used in the dissertation. This includes the specific objectives to be researched, the three-phase research methodology to be employed.

Chapter 4 Discusses and interprets the results of the experiments. Analysis and results provided by Multiple Linear Regression Analysis, Analytical Hierarchy Process and finally, the results obtained by the developed software.

Chapter 5 of the dissertation provides a conclusion, findings and recommendations. It includes discussing limitations of the research and describes the next steps in the sequence of the research.

Table 1-2**:** Organization of Dissertation

Number	Name of Chapters	Description
1	Introduction	• Topic of Prevalence of Sleep Disruption in United States • Relevant • Problem statement • Research significance • Purpose of this dissertation
2	Background and Relevant Research	• Discusses the dissertation's background. • Literature review of Sleep disorders • Definition of sleep • Sleep disorders in women • Importance of good sleep • Common sleep problems in women • Sleep assessment methods • Roles of brain waves in sleepiness • Purpose of brain waves
3	Methodology	• Defines the methodology • Specific objectives to be researched • The three-phase research methodology
4	Results	• Discusses and interprets the results of the experiments.

		• Analysis using Multiple linear regression • Analysis using Analytical Hierarchy Process • Results obtained by the developed software for monitoring sleep disruption
5	Contribution to the body of knowledge	• Conclusion • Findings • Recommendations. • Limitations of the research • Future Work

Chapter 2 : BACKGROUND

2.2. Common Sleep Problems in Women

More than 50 million of American admit that they are facing sleep disorder. Although, women are more sensitive to get affected than men [11]. Latest research studies suggest that sleep disorder need special attention. A proper tailored treatment should be recommended according to women's sleep experiences [2].

2.2.1. Insomnia

Insomnia is the most usual sleep problem [10]. In America, most of the women have been reporting insomnia issue as compared to men [26]. In terms of percentage, studies show that insomnia affects 63% women and 54 % men. Most of the women face this issue because of menstruation, pregnancy or menopause and feel uneasiness. However, sleep improving approaches such as exercise, well - maintained diet, good ambiance, meditation and a well-disciplined routine can be practiced by oneself [68]. In case, self – practiced approaches don't lead to significant improvements then proper treatments should be taken from a Physician. In some instances, there could be some inherent causes, such as hereditary aspects, depression, stress level, uneasiness, reflux, bladder problems or pain. However, these all problems can also be treated by appropriate medications [118].

2.2.2. Narcolepsy

Daytime sleepiness or feeling unenergetic may imply that this kind of issues should also be taken seriously [21]. These type of problems may be considered as narcolepsy, a neurological disorder with a probability of 0.0002 [66]. This disorder affects mostly teenagers and causes sometimes "sleep attacks", excessive sleep urge, lose strength and also affects night time sleep [53].

2.2.3. Nocturnal Sleep-Related Eating Disorder

In this problem, the patient notices an intense urge of eating food in night while they feel asleep. In this disorder, a particular part of brain that control memory partially gets inactive, so people with this disorder forget night time eating [100]. Previous studies show that majority of women get affected by this disorder. This issue may happen even during somnambulating as well.

2.2.4 PTSD and Sleep

The National Comorbidity Survey demonstrates a high prevalence of PTSD in the general population with a lifespan rate of 7.8% [6]. A recent survey from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) showed that the lifetime rate of PTSD in individuals 18 or older is 4.8% [14]. Women have an increased lifetime prevalence of PTSD, with 10% of women developing the disorder compared to 5% of men [14]. Additionally, women are more at risk of developing PTSD after experiencing trauma, with statistics showing 13-20% of women compared to 6-8% of men developing the disorder [6]. One study focused on new mothers' PTSD symptoms after an earthquake. Results from the study revealed that women with increased earthquake exposure had a higher likelihood of having PTSD and depression than women who did not experience an earthquake [11]. Depression and PTSD were significantly correlated with sleep quality, education, income, and employment [49]. Unemployed women, in addition to women with a lower monthly household income, had an increased risk of having PTSD and depression if they had poor sleep quality [87].

Previous researchers show that majority of women face pain during night time, 25 % women accepts that they cannot sleep well because of pain or uneasiness, quite often 3 nights in a week [6]. Pain could be because of stress, headaches, migraine, arthritis and rheumatic as well as heartburn. Because of pain, women feel tired and find difficulty in

getting up on time [11]. Many remedies such as meditation, relaxation techniques, biofeedback, cognitive therapy, and proper medication can also be very helpful to overcome pain [87]. Most of the remedies are used to treat pain, sleeping issue or both.

2.1. Sleep Disorders

2.1.1 Definition of Sleep

Sleep has been defined in different ways but every definition emphasise more over a particular fact that a restorative process of mutually dependent qualitative and quantitative functions can be defined as Sleep [116]. The functionalities of sleep process varies as age increases and this leads to more fragmented sleep, unusual awakening times, external factors and short sleep cycles. Sleep performance can be basically judged by measuring the extent of changes in normal sleep [114]. Conceptually, we try to measure the degree of deviation between normal sleep performances and sleep fragmentations in order to capture multifactorial sleep disturbances. However, sleep disturbances have been described as obstructive (OSA), periodic limb movements (PLMS) and restless legs syndrome (RLS), other medical illness, and psychological conditions etc. An extensive research revealed that excessive daytime sleep increases the chances of severe sleep disorder. (Fig 2-1)

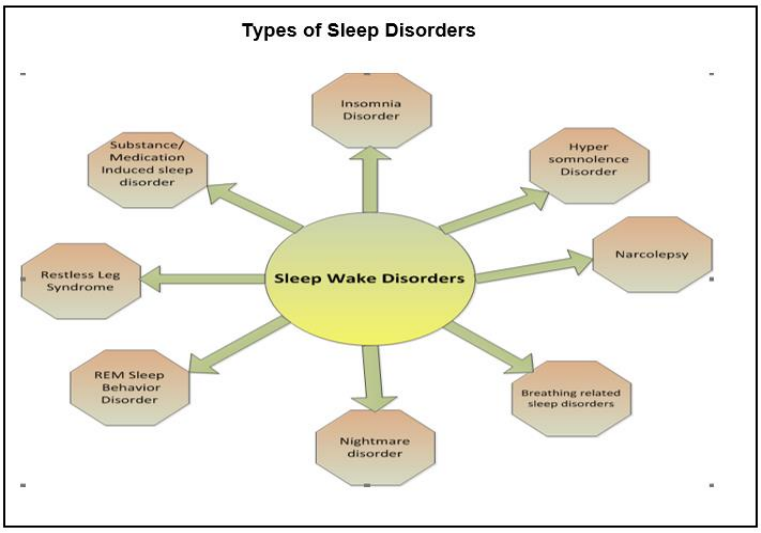

Figure 2-1 : Types of Sleep Disorders

2.1.2 Sleep Disorders in Women

Most of the major sleep attributes of sleep demonstrate that changes in the sleep occurs mainly when women gets older [34]. These all changes could be in any form such as short sleeping cycle, often gets disturbed by noise and light, take longer time to fall asleep etc. Irregular sleep cycles [38]. However, sleep performance recording methods have been very useful to capture the disturbances occurs during the sleep [39]. An extensive study conducted over 3,577 subjects, reveals that the quality of sleep deteriorate with increased age [46]. During the fragmented sleep hours, the higher level of disturbances and more fragmented sleep records have been captured during the last phase (latter part of night) of sleep and this causes difficulty in getting up easily [47]. Sometimes, in more severe cases subject gets headache and drowsiness throughout the day. Also, we can say even throughout the sleep the total awake time tend to last longer and more frequently. This is a major reason behind decreased sleep efficiency [53].

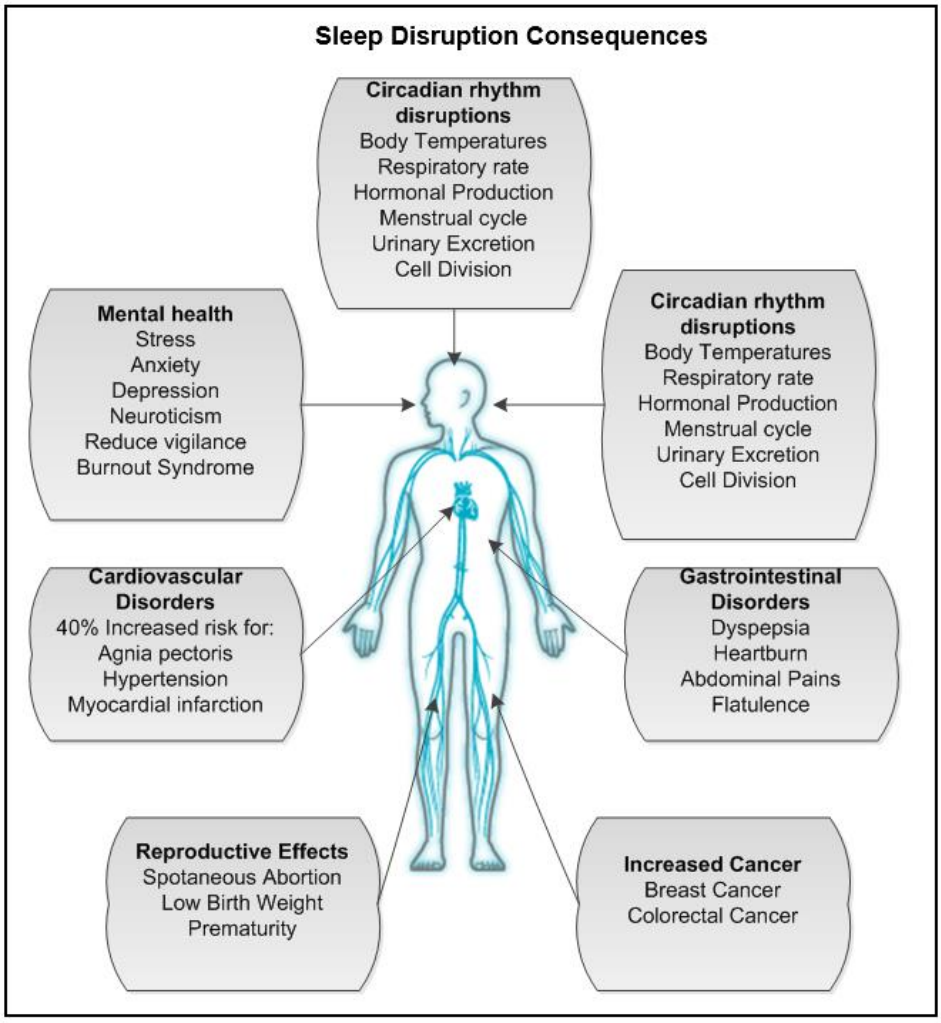

Figure 2-2 : Consequences of Sleep Disruptions

2.1.3. Importance of Good Sleep

Good sleep is as necessary as good diet and proper exercise. Even during the rest, we are active mentally while the body stays inactive [53]. Proper sleep is a major factor behind the healthy day. However, optimal hours of sleep depend on age group, gender, health status, and level of workload [59]. In fact, most people prefer to sleep for seven to nine hours so that they can be productive. A poll conducted by the National Sleep

Foundation (NSF) in 1998, *Women and Sleep*, observed that an average woman aged between the years 30-60 sleeps only six hours and forty-one minutes during the work week [76].

Previous studies conducted by NSF depict that woman face more difficulty than men to get proper sleep and this causes daytime sleepiness, problems, mood swing, higher risks of accidents, poor performance and sickness as well as other health issues [68].

Having adequate hours of sleep is essential, but at the same time quality of sleep also matters for achieving healthy biological conditions, especially in women [74]. Many other physical and mental health concerns can also get affected because of lack of proper sleep. The persistent sleep disruption may cause hormonal imbalance, and affect lifestyle habits as well [20].

2.2.5 Restless Legs Syndrome (RLS) and Periodic Limb Movement Disorder (PLMD)

More than 12 million Americans are suffering from RLS and PLMD issues [74]. In this type of disorder, uneasiness can be relieved by movement. Due to this type of problem, women face mood swings, daytime sleepiness, anxiety and depression [110]. However, the exact reason of RLS has not been identified yet, but latest studies show that due to iron deficiency, this kind of problems can occur [66]. For treating this disorder, proper medications containing vitamin and iron should be prescribed. Among 85% of those with RLS also have PLMD issue or leg twitching or jerking movements during sleep that can persist for 30- 40 seconds [87]. Due to this issue, bed partner can also get disturbance; although, this issue can also be manageable.

Figure 2-3 : Sleep Disorders Detection Devices available in Market

2.2.6 Shift Work

Early studies have found that shift workers tend to experience higher level of job stress, more alcohol use, more emotional problems, and poor sleep quality compared to non-shift workers [30]. Female shift workers also reported problems in their social life and an increased use of sleeping pill and tranquilizer [30]. Compared to day shifts, night shifts were found to be associated with higher risk of sleep and digestive disorders as well as disrupted social life [64]. The fact that a large segment of the modern western workforce work on non-standard schedules such as night shifts and rotating shifts has driven an increased volume of clinical and psychology studies on the effect of shift work on workers' physical and psychological wellbeing for the past few decades [80]. It has been identified

that shift work affects workers in various ways by causing sleep disturbance and circadian rhythm disruption [113].

In America, 20 % of the people working in odd times typically, not between 9 a. m. to 5 p. m. In this kind of situation, sleep disruption causes health issues [30]. Because of irregular routine and daytime sleeping hours, women get difficulty in getting quality sleep. In fact, studies show that women working on the night shift are hypersensitive towards mental and physical health issues and this leads to more illnesses and accidents [64]. However, women working on the night shifts find uneasiness to fulfill their responsibilities and get less time for family and social activities. This all aspects cause irregular menstrual cycles, infertility, breast cancer, pregnancy issues, critical risks associated with miscarriages, and premature births [80]. However, most of the night shift/ nontraditional shifts working women does not observe any kind of typical issues in their babies [113].

2.2.7 Shift Work and Sleep Disturbance

Sleep disturbance is among the most important problems of shift work that lasts a long period of time [28]. Workers who currently work during irregular hours reported the highest rates of having difficulties in falling asleep and early awakening compared to former shift workers and non-shift workers, with former shift workers falling in between [30]. Even after people resume to normal work hours, the sleep disturbance caused by previous shift work experience does not simply go away [33].

Current shift workers are affected the most by sleep disturbance and have high risk of work-related accidents [64]. Specifically, found that compared to rotating daytime shift, fixed nighttime shift and fixed daytime shift, workers on rotating daytime shift have the highest rate of work-related accidents and sick leave, followed by fixed nighttime shift workers, and with the fixed daytime shift the least prone to accidents [71]. The US National Transportation Safety Board reported that 20-30% of all transportation accidents with injury

are due to fatigue, which is one of the most common results of sleep disturbance [80]. In their population-based study among Canadians, Kling found the highest increased risk for work injury associated with trouble sleeping among women who work on rotating shifts [91]. Consistent findings have suggested that among all work schedules, rotating shift affects work performance and work safety the most, with changes in relevant variables including higher level of fatigue, loss of concentration, higher rates of heavy smoking, coffee/tea consumption, constipation, job stress, and poor sexual performance [113].

The effect of shift work varies a lot from individual to individual [28]. Factors such as gender, age, morningness / eveningness, circadian flexibility/ languidity, and resilience against environmental stressors all play a role in how shift work affects individuals [30]. Indeed, the effect of shift work shows trait-like qualities that parallels to the effect of OSA, with the subjective experience of individuals differs significantly in correspondence to their personal traits [33].

Some shift workers exhibit enough symptoms to be diagnosed with shift work disorder (SWD), which is characterized by sleepiness and insomnia due to work schedule. Flo found that about one-third of nurses reported symptoms that meet the criteria of SWD, which is significantly higher than the prevalence found within community sample by Drake and colleagues [64]. This might be partially explained by the interaction between gender and work stress. Past research has identified female gender, hectic work and physically strenuous work as the shared predictors of sleep disturbance and fatigue, suggesting that women, especially those who has stressful and physically demanding job, are more susceptible to sleep disturbance and fatigue [4]. As nurses are still predominantly female, they fall exactly into this category and are therefore more likely to have SWD than the overall shift worker population [64]. In addition, while non-night shift work is also associated with increased risk of SWD, there is a positive correlation between the number

of night shifts and risk of SWD among nurses. Thus, the researchers recommended putting a limit on the total number of night shifts per year as a way to protect nurses from SWD [113].

2.2.8 Shift Work and Cognitive Impairment

Sleep problem and circadian rhythm disruption are both identified to have detrimental effect on cognitive functioning. As mentioned in the effect of OSA, sleep disturbance can cause deficits in executive functions, working memory, long-term memory, attention, etc. [41]. Current shift workers were found to lower scores in cognitive speed, selective attention and memory than workers who had never worked on shift [41]. However, the researchers argued that the reduced cognitive efficiency may be due to the circadian rhythm disruption alone rather than together with sleep disturbance, because no association was found between subjective sleep quality and cognitive performance among the male shift workers assessed [42]. The lack of the association between sleep disturbance and cognitive functioning in this study may be partially due to the effect of gender, since males are less likely to report sleepiness and fatigue compared to females. Another explanation may be that the instrument used to assess subjective sleep quality is not comprehensive enough to capture the sleep problem of those shift workers and the strong effect of circadian rhythm disruption on cognitive functioning made the effect of the less severe sleep problems undetectable [84].

Studies on jet lag have identified alteration of brain structure that paralleled the memory deficits due to circadian rhythm disruption. Reduced cognitive performance, significantly higher salivary cortisol and smaller volume of the right temporal were observed among flight attendants with more than 3 years' of job experience. It was also found that former shift workers who have resumed to normal work schedule for more than 4 years showed increased cognitive performance, which may suggest the reversibility of cognitive

impairment due to shift work [91]. At the cellular level, Gibson observed reduction in hippocampal cell proliferation and neurogenesis that paralleled jet-lag induced memory deficits, suggesting that in suggesting that circadian rhythm disruption impairs cognitive functioning by impeding the birth and maturation of new cells [84].

2.2.9 Sleep Apnea

Obstructive sleep apnea is a common sleep disorder that is caused by complete or partial functional impairment of the upper airway dilator muscle, which leads to apnea/hypopnea-induced oxygen desaturation, repetitive micro-arousals, and disturbed sleep [3]. Thus, OSA patients suffer from sleep fragmentation and chronic sleep deprivation, with common symptoms of daytime sleepiness, tiredness, snoring, etc. [6]. When adequate apneas and hypopnea episodes are present together with these symptoms, OSA is labeled as obstructive sleep apnea syndrome (OSAS) [16]. Various factors have been identified as predictors of OSA including oropharyngeal narrowing, neck circumference, and BMI. In general, factors that predispose individuals to increased collapsibility of the upper airway are major risk factors for OSA [20]. Among all of them, obesity is the greatest risk factor for OSA due to its high prevalence [21]. Clinical diagnosis of OSA requires baseline polysomnography of patients and a CPAP titration study, while home studies are increasingly being used as screening test [34].

2.2.10 Detrimental Health Effects of Obstructive Sleep Apnea (OSA)

In the last decade, studies on OSA have identified associations between OSA and various cardiovascular complications, metabolic disturbances, and neuropsychologic deficits [39]. The effect of OSA on cardiovascular systems is a major topic in OSA studies where converging results have been found [47]. Atrial fibrillation is often observed after elective cardioversion in untreated OSA patients [53]. Although sleep apnea only happens during sleep, its effects extend into daytime body functioning [59]. OSA is recognized as a

treatable cause of hypertension by the Seventh Joint National Committee of Hypertension guidelines [64]. Both enhanced sympathetic tone and genetic factors contribute to this causation between OSA and hypertension [66]. Conduction abnormalities such as sinoatrial block, sinus arrest, AV conduction abnormalities, and asystole also occur during apnea in OSA patients [68]. The association between OSA and cerebrovascular events is also well studied [74]. OSA has been identified as a risk factor of cerebrovascular disease due to the high prevalence of pre-existing OSA among patients with stroke [79].

Patients with OSA have a higher risk of metabolic syndrome than people without OSA controlling the factor of BMI [81]. As the association between OSA and specific components of metabolic syndrome such as insulin resistance is well recognized, some even argue that OSA can be considered a component of metabolic syndrome [82]. OSA also plays a role in neurologic disorders, for example the onset and worsening of seizure [84]. Besides its detrimental effects on physical health, OSA is also associated with mood disturbance: the most common symptom reported is depression [85]. Among patients with relatively severe OSA, about half of them meet the clinical diagnosis criteria of depression [86].

2.2.11 Obstructive Sleep Apnea and Gender

OSA is a prevalent sleep disorder that that affects people across age groups but it affects males in middle age the most [88]. Among the population of 25 years old and over, 4% men are affected by OSA, which is twice the chance of women having OSA [89]. Female sex hormones such as progesterone affect respiratory control and correlate with upper airway stability, thus may have protective effect against OSA [90].

Besides the gender difference in the prevalence of OSA, the symptoms OSA are also gender-specific [94]. Women with OSA are more likely to report fatigue and men with OSA are more likely to report sleepiness, while men and women without OSA have similar

level of fatigue and sleepiness [97]. The finding suggests the importance of assessing fatigue in order to capture the experience of women with OSA [98]. Nonetheless, unlike the widely endorsed sleepiness evaluation, the assessment of fatigue has not yet been included in recent clinically guideline for the diagnosis and control of OSA [100]. Furthermore, it is suggested that sleepiness and fatigue are two independent symptoms that patients with similar severity of OSA may experience both or either or none of the two [101]. In addition, women have been found to prefer describing their experience of sleep-disordered breathing using terms like fatigue and lack of energy than sleepiness [102]. The under-recognition of OSA in women also has socioeconomic impact [103]. The Centers for Medicare and Medicaid Services (CMS) consider CPAP therapy necessary for patients with mild OSA when appropriate symptoms are present, which include sleepiness but not fatigue [104]. As CMS also set the standard for Medicare coverage which is adopted by other insurance providers, patients with mild OSA but experience fatigue rather than sleepiness may not get appropriate allowance from their insurance providers for CPAP treatment [105]. It is possible that some of the patients with mild OSA that expresses as fatigue, most likely women, will choose not to get CPAP therapy and thus suffer from the detrimental physical health effect and cognitive impairment due to OSA [107]. As mentioned before, night shift promotes the development of OSA symptoms [109]. Therefore, certain occupations that require night shift and rotating shift may have greater need of CPAP treatment [110]. The inappropriate documentation of OSA symptoms and the insufficient insurance allowance because of that may affect these occupations more, such as nurses, who are still predominately women and work in shifts [112].

It is mentioned earlier that more severe OSA episodes happen during REM sleep and patients with OSA also have significantly reduced REM sleep [117]. Recent study took a close look at the relationship between REM sleep and OSA and found significant gender

differences. Women with OSA experienced significantly less REM sleep and longer latency to the onset of REM sleep compared to men with OSA [118].

The particularly strong interaction between OSA and REM sleep among women may be related to female sex hormone. Netzer found an association between female sex hormone reduction and higher risk of sleep-disordered breathing (SDB) [120]. Specifically, significantly lower levels of progesterone, estradiol, and 17-OH progesterone have been found in women with obstructive sleep apnea/hypopnea syndrome (OSAHS). Therefore, hormone therapy may be an option to treat OSA and abnormalities in REM sleep [55].

2.2.12 Sleep Apnea

In the case of Sleep Apnea, person suffers by snoring, breathing interruption, and daytime sleepiness [114]. More than 20 million Americans have sleep Apnea problem and particularly 25 % of women over 50 years of age admit this issue [104]. The main reason behind sleep apnea is overweight and abdominal fat during menopause [117]. This causes a decrease in progesterone and further lead to higher risks of fluctuating blood pressure and cardiovascular disease and stroke [115]. However, a number of suitable treatments are available to manage this disorder.

2.3 Sleep Assessment Methods

Sleep is a complex phenomenon that could be described mainly in terms of two aspects firstly behavioral aspects that suggests relative lack of movements, awareness and responsiveness and, secondly brain aspects that can be observed through EEG activity [16]. A proper sleep can be assessed in terms of duration, and by its distribution throughout the day as well as sleep quality [23]. Sleep quality can be measured as consolidated versus fragmented. Various methods have been developed to measure the quality of sleep [26]. In this section of research, we are attempting to provide a brief description over sleep quality recording methods which are already available in market

such as polysomnography, video sonography, actigraphy, direct observations, sleep diaries and questionnaire [79]. However, we need to know the pros and cons associated with each method to realize their importance in order to get better sleep records [44]. Especially, a considerable attention has emerged in women towards the role of sleep. The best way to understand the quality of sleep is relevant to the degree of sleep performance. Additionally, the degree of performance can be described in terms of various dimension such as sleep duration, sleep quality, level of brain activities patterns, schedule or circadian aspects etc. [79].

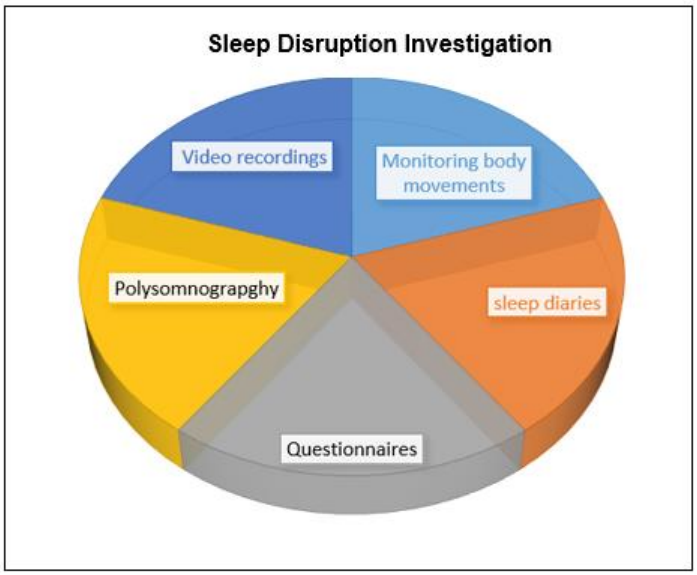

Figure 2-4 : Investigating Sleep Disruptions

2.3.1 Polysomnography

This method has been considered as the best method in terms of fulfilling the standards [79]. In this method, observations are recorded on laboratory or ambulatory recordings and mainly associated with different functions of the body and mind such as electrical brain activities EEG, muscle activation EMG, eye movements EOG, breathing flow, oxygen saturation sensors (oximetry), video recording, and additional observations

as per the research requirements [79]. In this method, sensors and electrodes are attached to different parts of body before sleeping and EEG signals were recorded [79]. This method is useful to provide comprehensive information about patterns of brain signals, sleep style, stages associated with sleep, qualitative and quantitative aspects of sleep, breathing pattern, oxygen absorption, eye movements and leg movements during sleep [94]. The information we record by this method is very useful in order to measure the variety of sleep disorders such as sleep apnea, periodic movements in sleep, parasomnia, narcolepsy ERM sleep disorders, insomnia and daytime sleeping habits. In terms of accuracy and details, this method an objective method used to incorporate information that can be essential for brain and sleep research. Variety of sleep disorders can not be scrutinized without having specific information [79]. However, laboratory set up, standardized situation and supervision are essential to perform this test [101]. Moreover, it required subject to tolerate the unusual laboratory environment, attached electrodes and sensors which can be uncomfortable to get proper normal sleep. This is an expensive test, so can not be performed on regular basis [79].

2.3.2 Videosomnography

In this method, a video recordings are done during the sleep in a natural environment. One or more cameras are used to understand the sleeping patterns as well as subject's behavior during night time [79]. Anders and colleagues have developed this method. Even direct depiction of activities such as excessive sweating, repetitive behaviors, REM (Rapid Eye Movement) behavior disorders, and other parasomnias [113]. The best aspect of this procedure is that it provides sleep information captured in comfortable natural environment unlike Polysomnography [79]. However, camera's position, installation, signal interference, and harmonics may impose some limitations. Additionally, some women feel that this can compromise their privacy [79].

2.3.3 Direct Behavioral Observation

The pattern capturing procedure in this method depends directly on REM random eye movements [79]. This method needs skillful and trained observer who can provide sleep rating and wakefulness states over a given period of time [42]. This method can not be performed overnight since it required consistent observations. In this method, REM and respiration are recorded, for respiration recording pressure sensitive sensor pad placed and the sleep record provides information such as alert, nonalert waking, fuss, cry, drowse, daze or sleep-wake transition, active sleep, quiet sleep as well as active sleep – wake transition [55]. The whole procedure can be performed either at home or in other sleep setting environment, thus make this method very convenient and provides detailed information about sleep states, as well as other behaviors. Due to labor intensive behavior and limited time period for conducting study, this method can not be usually preferred and seems impractical [106].

2.3.4 Actigraphy

This method uses a portable tool that enables us recording body movement and sleep – wake patterns. Initially, this method was used to record crib movements [79]. A wristwatch-like instrument is required to record activity data for a long period of time. Further, this data need to be scrutinized to understand sleep pattern [42]. In the first year of measurement period, we can identify active and quite sleep patterns as well. Previous research has depicted that actigraphy method reveals significant difference among reports prepared by various sources [55]. However, there is a set of standard guidelines for performing this test. Specifically, actigraphy is a strong tool to assess sleep disorder schedules as this test can be useful to monitor the subject for a long period of time. Sleep records for disorders such as insomnia can also be measured by this procedure [106].

2.4 Roles of Brain Waves in Sleepiness

As per the mental health studies, brain waves can be captured in five different types of patterns, this patterns are in the form of electrical signals containing different range of frequencies [106]. These five types of brain waves are across the cortex and arranged from highest frequency (lowest amplitude) to lowest frequencies (highest amplitude) as gamma, beta, alpha, theta, and delta [109]. The observatory procedure to record these waves is mainly through EEG “electroencephalograph” recording system [1].

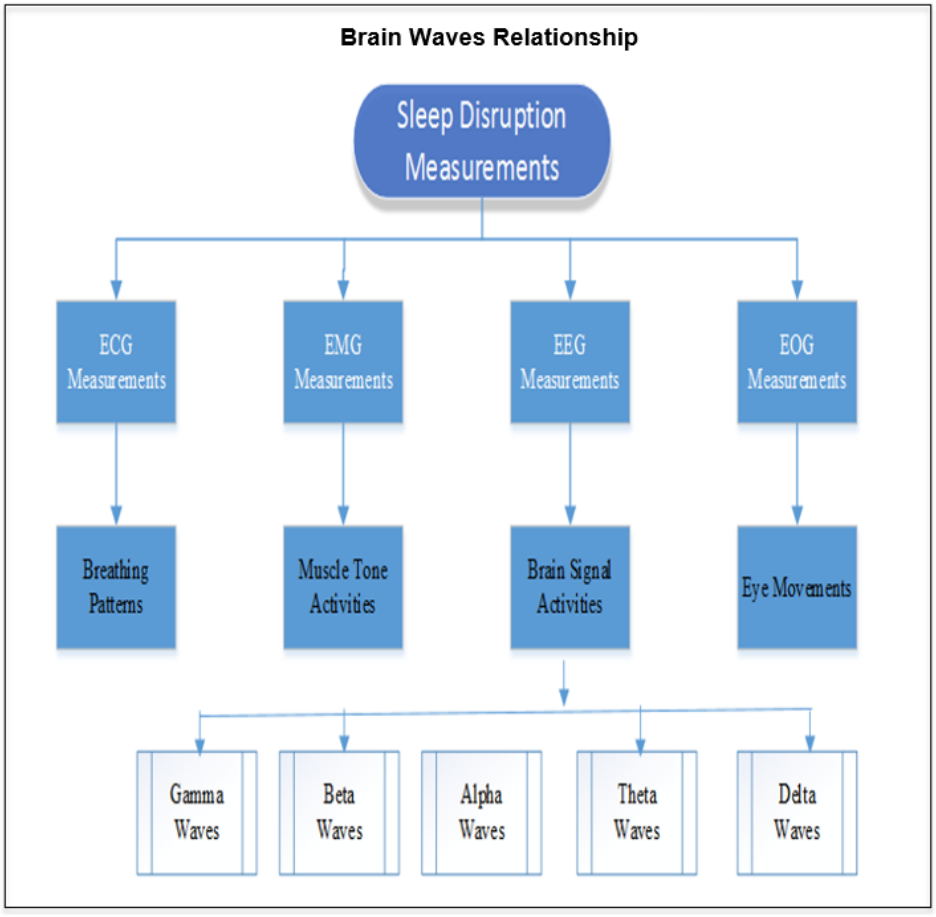

Figure 2-5 : Brain Waves Relationship Diagram

Conceptually, by analyzing these electrical waves, we can measure the sleep performance as well as degree of mental functioning [1]. The frequency range associated with each brain wave plays a vital role in understanding how well we sleep [102]. However, these brain waves analysis reveals more about capability to manage stress, focusing power, and mental aptness etc. [97]. However, a proper balance is required for all five brain waves as over production or underproduction of any of these electrical signal may cause severe consequences to overall health [74]. This concept make us realize that all five brain waves are equally important and can't consider anyone of these as superior than others [106].

2.5 Purpose of Brain Waves

Each individual wave has a unique purpose and contribution to various tasks such as processing, grasping power, control over emotions etc. To understand the functioning of each wave, a little description is required [79].

As per the studies conducted earlier, Gamma waves depict learning, memory and information processing capability and associated with cognitive functioning and higher processing tasks required 40 Hz gamma wave for achieving needed level of perception and grasping power [1]. In particular, below average level of gamma wave causes mentally disability and slow learning disorders [2]. However, Beta waves are high frequency and low amplitude waves that can be in the awakening state of brain. Commonly, associated with conscious thoughts, logical thinking and demonstrate stimulating effect [103].

An adequate level of beta waves helps us focus on studies and perform well over work - related activities [1]. However, excessive generation of beta waves cause higher level of stress and anxiety. Higher level of beta frequencies are generated in the proportional level of arousal. By drinking caffeine or another stimulant, the beta wave generation can be enhanced naturally [2].

These brain waves are fast brain waves that could be observed throughout the day and helps us accomplish conscious tasks recognized as critical thinking, writing, reading, and making harmonious social – relationship [2]. In fact, alpha brain waves causes transition from our conscious thinking and subconscious mind. The frequency ranges for this waves lies between beta and theta. Mostly, the state of deep relaxation and getting calm down when expected, can be attained due to adequate level of alpha brain waves [106].

There is an evident phenomenon called “alpha blocking” caused because of excessive stress level, wherein higher level of beta activity and lower level of alpha brain wave. Actually, the beta waves are dominant over alpha waves as they electrify at a faster rate. The next wave is Theta waves, associated with daydreaming and sleep [79]. This wave causes us feel emotions and higher level of theta waves are responsible for an intensified session of depression. However, some benefits have also been observed in theta waves such as improved level of intuition, creativity, and deep relaxation and inclined us towards natural state of brain [99]. Most importantly, causes restorative sleep, but excessive production of theta in waking state may have unfavorable effects [118].

Last brain wave is Delta wave, involved with regulating heartbeat, digestion, deepest level of relaxation, restorative and alleviating sleep. Delta sleep are slowest recorded waves mainly in infants and young children. Enough quantity of delta wave generation make us feel fresh after waking up. However, over or under generation of delta waves or brain injuries affects learning ability and more severe consequences may create difficulty in conscious awareness [120].

Table 2-1: Comparative Analysis among 5 Major Brain Waves recorded through EEG measurement

No.	Brain Wave	Frequency Ranges	Symptoms Above Average	Symptoms Below Average	Optimal	Remedies
1	Gamma Waves	40 Hz to 100 Hz (Highest)	Anxiety, high arousal, stress	ADHD, depression, learning disabilities	Binding senses, cognition, information processing, learning, perception, REM sleep	Meditation
2	Beta Waves	12 Hz to 40 Hz (High)	Adrenaline, anxiety, high arousal, inability to relax, stress	ADHD, daydreaming, depression, poor cognition	Conscious focus, memory, problem-solving	Coffee, energy drinks, various stimulants
3	Alpha Waves	8 Hz to 12 Hz (Moderate)	Daydreaming, inability to focus, too relaxed	Anxiety, high stress, insomnia, OCD	Relaxation	Alcohol, marijuana, relaxants, some antidepressants

4	Theta Waves	4 Hz to 8 Hz (Slow)	ADHD, depression, hyperactivity, impulsivity, inattentiveness	Anxiety, poor emotional awareness, stress	Creativity, emotional connection, intuition, relaxation	Depressants
5	Delta Waves	0 Hz to 4 Hz (Slowest)	Brain injuries, learning problems, inability to think, severe ADHD	Inability to rejuvenate body, inability to revitalize the brain, poor sleep	Immune system, natural healing, restorative / deep sleep	Depressants, sleep

Chapter 3 : RESEARCH METHODOLOGY

3.1 Research Objective and Hypothesis

In this research, we have developed a framework directing three phase strategy to evaluate sleep disorders in women. This research explores a unique procedure for measuring sleep disruption in women by using RFID and Auto-ID technology. A software was developed to provide the sleep performance of individual user and also, display overall degree of sleep criticality.

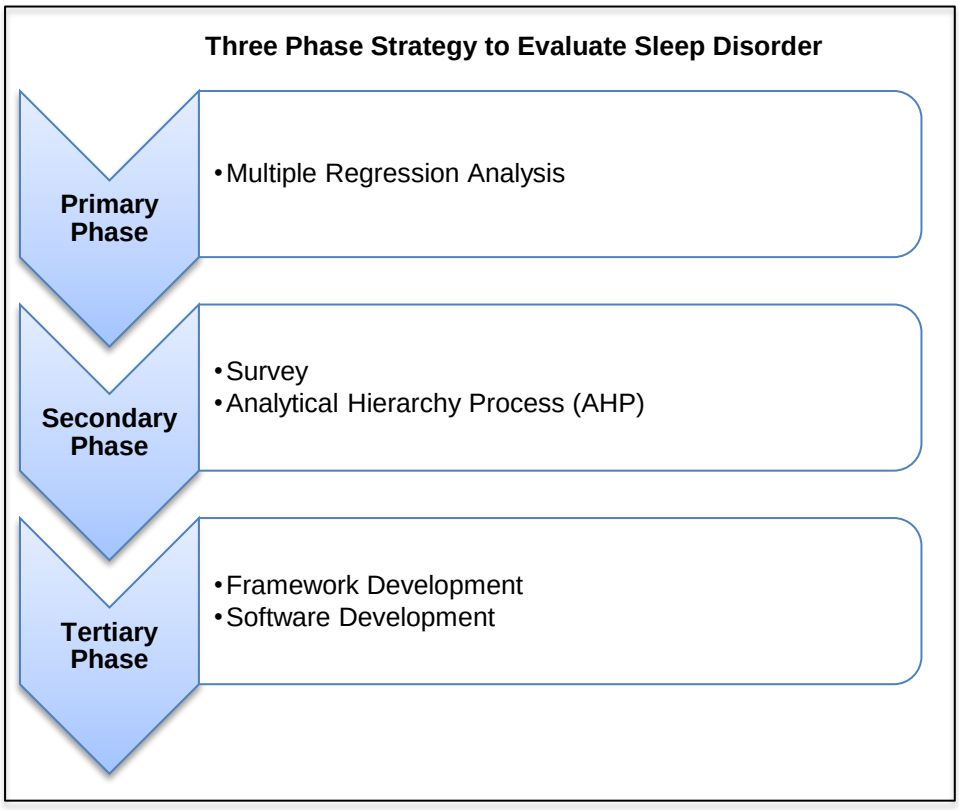

Figure 3-1: Three Phase Strategy to Evaluate Sleep Disorders in Woman

There are two primary research questions that we have to achieve in this section:

Research Question 1: What are impacts of implementing RFID enabled (Smart) technologies embedded in linen based beauty products to monitor sleep patterns on minimizing the negative impacts of sleep disorders on women?

Research Question 2: What are the benefits of the proposed SJSL framework that impact and improve sleep performance?

The research evaluated whether or not the implementation of SJSL framework will have a significant impact on health systems engineering research that investigate female sleep and human brain wave monitoring. SJSL refers to the Shalini/Jones "Smart" Linens. "Smart" refers to the automated transmissions enabled by RFID (Radio Frequency Identification) technologies. We use SJ to refer to the models developed by her and we use "Smart Linens" because others have labeled technologies "Smart" and we use the SJSL for convenience in the document.

Table 3-1**:** Hypothesis Statements

Hypothesis Statement	**Null Hypothesis**	**Alternative Hypothesis**	**Decision Rule**
Objective # 1	H_0 : The implementation of Auto ID / RFID technology will not impact on measuring sleep disorders accurately.	H_1 : The implementation of Auto ID / RFID technology will impact on measuring sleep disorders accurately.	Reject H_0 : If the cost associated with Auto ID / RFID based sleep monitoring system is greater than 15 % of the currently available systems.

Objective # 2	H_0 : The developed framework will not effectively address the critical sleep disorders monitoring requirements.	H_1 : The developed framework effectively addresses the critical sleep disorders monitoring requirements.	Reject H_0 : If the sleep performance provided by Auto ID / RFID based sleep monitoring system is less than 5 % counts.

These two hypotheses statement are stated as follow:

Hypothesis Statement for Objective # 1

Null Hypothesis

H_0 : The implementation of Auto ID / RFID technology will not impact on measuring sleep disorders accurately.

Alternative Hypothesis

H_1 : The implementation of Auto ID / RFID technology will impact on measuring sleep disorders accurately.

Decision Rule

Reject H_0 : If the cost associated with Auto ID / RFID based sleep monitoring system is greater than 15 % of the currently available systems.

Hypothesis Statement for Objective # 2

Null Hypothesis

H_0 : The developed framework will not effectively address the critical sleep disorders monitoring requirements.

Alternative Hypothesis

H_1 : The developed framework effectively addresses the critical sleep disorders monitoring requirements.

Decision Rule

Reject H_0 : If the sleep performance provided by Auto ID / RFID based sleep monitoring system is less than 5 % counts.

In this research, we will attempt to analyze the following research Objective, “Evaluating the impacts of sleep disruptions through RFID/ Auto-ID technology implementation”. We research the main objective by using the following three sub-objectives.

3.2 Research Criteria and Approach

In this research, step by step procedure was suggested to achieve Research objectives, we have introduced three specific objective and associated steps for accomplishing the research aim.

Long – Term Research Objective

Specific Objective 1:- Identify the factors affecting sleep disruptions and evaluate the model suitability for sleep performance.

Specific Objective 2:- Evaluate and identify the suitable automated analysis technique for sleep disorders measurement.

Specific Objective 3:- Develop a software for monitoring sleep disruption in women and evaluate the impact of proposed framework for Sleep disruption performance measurement.

To satisfy the above three specific objective, we approach several steps.

3.2.1 Phase 1

This particular phase will help us understanding the steps required to achieve Specific Objective 1. “Identify the factors affecting sleep disruptions and evaluate the model suitability for sleep performance.”

Table 3-2**:** Steps involved in Phase 1

Phase 1	
Step 1	Identify the ways to measure sleep disruption in women
Step 2	Evaluate the predicted model for the sleep disruption analysis
Step 3	Determine how the developed analytics provide significant insights into sleep disruption monitoring system.
Step 4	Propose the model suitable for measuring sleep disruption in women
Step 5	Perform preliminary analysis by using multiple regression analysis to validate the proposed model
Step 6	Obtain the results from a preliminary analysis of all critical variable for sleep monitoring method
Step 7	The results obtained by preliminary analysis will direct further research phases

3.2.1.1 Step 1 – Identify the ways to measure sleep disruption in women.

3.2.1.2 Step 2- Evaluate the predicted model for the sleep disruption analysis.

3.2.1.3 Step 3- Determine how the developed analytics provide significant insights into sleep disruption monitoring system.

3.2.1.4 Step 4- Propose the model suitable for measuring sleep disruption in women.

3.2.1.5 Step 5 – Perform preliminary analysis by using multiple regression analysis to validate the proposed model.

3.2.1.6 Step 6-Obtain the results from a preliminary analysis of all critical variable for sleep monitoring method.

3.2.1.7 Step 7 – The results obtained by preliminary analysis will direct further research phases.

3.2.2 Phase 2

In this phase, we introduce steps to achieve Specific Objective 2. “Evaluate and identify the suitable feature oriented automated analysis technique for sleep disorders measurement.”

Table 3-3**:** Steps involved in Phase 2

Phase 2	
Step 1	Questionnaire development
Step 2	Conduct a detail study for issues and symptoms to understand the critical sleep disruption issues
Step 3	Evaluate the Performance Level of Auto ID technology and also type of features to design appropriate Auto-ID technology
Step 4	Monitor the feedback provided by detailed study
Step 5	Development of strategy to find out the weights of various problems
Step 6	Administering the questionnaires to the experts
Step 7	Specify weights for relevant criteria and rank the factors and subfactors by AHP
Step 8	Analysis and reporting of the results

3.2.2.1 Step 1 - Questionnaire development

Conduct a survey to observe different types of issues and problems associated with women during sleep.

SLEEP DISRUPTION SURVEY FORM	
NAME	
AGE	
GENDER	
DEGREE OF SLEEP DISRUPTION (Note:1 is for low and 5 is for high)	1 2 3 4 5
ADDITIONAL ISSUES	
ADDITIONAL COMMENTS	

Figure 3-2: Sleep Disruption Evaluation Survey form

- Identify the major issues / problems causing Sleep disruption in women. From the survey, we know the critical problems and rate them in terms of degree of seriousness.
- The sleep disruption performance rating can be set by setting up a threshold level. The level of threshold in this research is 65 %.

3.2.2.2 Step 2 –Conduct a detail study for issues and symptoms observed by women during sleep and Implementation of Analytical Hierarchy Process to understand the critical sleep disruption issues.

3.2.2.3 Step 3 – Evaluate the Performance Level of Auto ID technology -From the survey, evaluate the type of features required to design appropriate Auto-ID technology for sleep disruption monitoring.

3.2.2.4 Step 4 - Monitor the feedback provided by detailed study and conducted survey in order to address the objective 2.

3.2.2.5 Step 5- Development of strategy to find out the weights of various problems associated with sleeping women.

3.2.2.6 Step 6 - Administering the questionnaires to the experts / women related to the relevant field.

3.2.2.7 Step 7-Specify weights for relevant criteria and rank the factors and subfactors by AHP.

3.2.2.8 Step 8 - Analysis and reporting of the results would help us design a Software system and Auto-ID enabled pillow case/ scarf for monitoring sleep disruption in women.

3.2.3 Phase 3

This phase will address the steps to achieve Specific Objective 3 “Develop a software for monitoring sleep disruption in women and evaluate the impact of proposed framework for Sleep disruption performance measurement.”

Table 3-4**:** Steps involved in Phase 3

Phase 3	
Step 1	Evaluate the different sleep monitoring methods and provide a comparative analysis among different methods
Step 2	Brian signals’ Capturing
Step 3	Design a suitable algorithm prior to designing a Software for monitoring sleep disruption especially for women
Step 4	Develop a suitable framework for Sleep disruption monitoring in women

3.2.3.1 Step 1 – Evaluate the different sleep monitoring methods and provide a comparative analysis among different methods for improving the efficiency of sleep disruption monitoring system.

For collecting data for understanding sleep disruptions, we choose a medical hospital for collecting data.

3.2.3.2 Step 2 –Brian signals’ Capturing

We have collected different sets of sleep data for monitoring sleep disruption in women. Different sleep stages can also be recognized by types of brain signals captured by EEG process.

3.2.3.3 Step 3 – Design a suitable algorithm prior to designing a Software for monitoring sleep disruption especially for women.

3.2.3.4 Step 4- Develop a suitable framework for Sleep disruption monitoring in women.

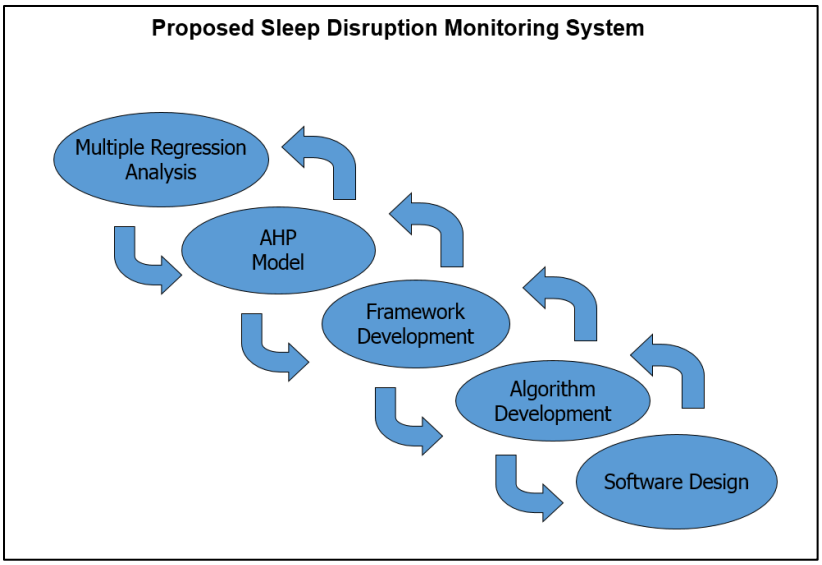

Figure 3-1 : Sleep Disorders Monitoring system in proposed methodology

The proposed sleep disruption monitoring system developed in this research is based on a major observation that sleep disorders prevailed at a faster rate due to avoidance and lack of proper attention at an early stage. First, we record EEG signals by using a wearable scarf which consists a set of EEG detection sensors. With the help of EEG signals detection, we are able to monitor brain waves and transmit that data using RFID. The principal is that we have sensors monitoring brain wave activity and these sensors then relay their information to the RFID tags and the RFID tags then send their information to the antenna / reader so it can be read out by the computer. Then, the computer synthesizes it. We need to attach sensors to the scarf having direct contact with head, but the system should also need to be comfortable. Afterword, EEG signal pattern analysis is used for identifying critical sleep stages for further analysis. These systems provides a self-assessment sleep performance at a high level of accuracy, the developed instrumented sleep disruption monitoring system provides a subjective way as well as an objective way to analyze the sleep status trends and period when major disruption causes

disturbance on a regular basis. However, in this research we attempt to focus on addressing the analytics development part of the process.

3.2.3.5 Step 5 – Data Collection

Sleep Disruption data are collected from different valid organizations such as Bombay Medical Hospital, National Sleep Foundation, Public Databases, the U.S. Sleep foundations Data Bank. Data sets contains EEG, EMG, ECG, and EOG Datasets and also contains Alpha, Beta, Gamma, Theta and Delta Waves.

3.2.3.6 Step 6 – Economic Analysis

Economic analysis was performed and the estimated cost of this research project was calculated by using standard assumptions and valid data records. We have used Microsoft Excel software for calculations and finding total cost for overall project including design and implementation of RFID / Auto-ID based systems for monitoring sleep disruption in women.

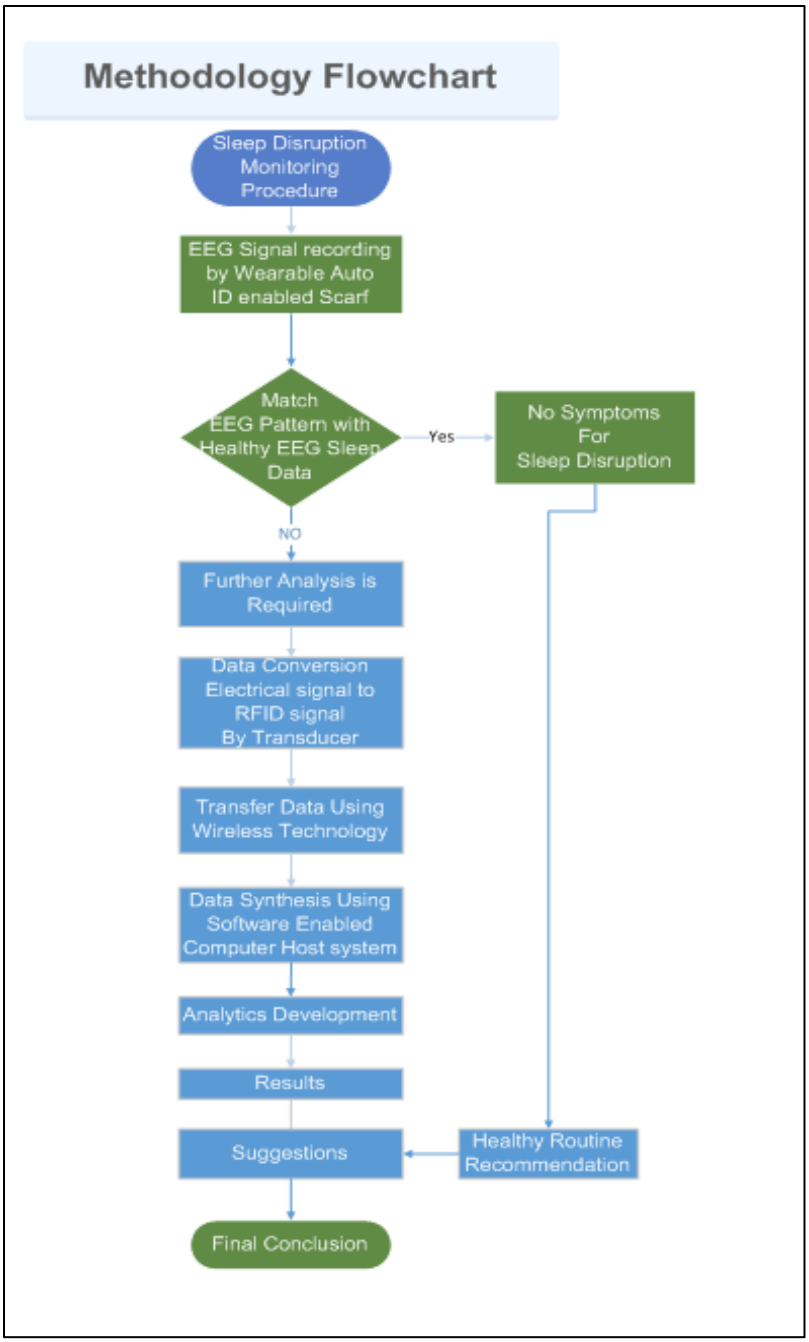

Figure 3-4 Framework for Evaluating Sleep Disruption

Chapter 4 : RESULTS

A software package, sleep status monitoring software has been developed to assist in various decision-making stages of the research. In the developed software package, the user can directly provide the input by using a RFID/Auto-ID enabled scarf / pillow case. The software explores its utility suited for a variety of program modules mutually incorporated to form an integrated software package. The complexity of the data and information flow generated in the developed software system is extremely high. They are driven by such frequent events as attempts to identify sleep status, associated sleep disruptions and integration of different features. The information synthesis is required to handle large data volume and is manageable with user-friendly software features. In this research, we seek to investigate the feasibility of a software-based sleep disruption monitoring that continuously and autonomously captures sleep data and synthesize data handling processes. The purpose of this research is to investigate a RFID / Automated technology based sleep disruption monitoring status application for mobile devices, including smartphones (such as iPhone, Android, Microsoft Mobile Phone, HTC smartphone, Blackberry, etc.) and the other handheld smart devices (such as iPad and some light/portable TabletPC) exchanging real-time information through the Auto-ID technology which is being used to make near-optimal decisions and send back information for required time period. Further, development of a mobile application of such data intensive operations necessitates exclusive multiple regression data manipulating techniques to provide the most critical information for decision makers. Also, we have implemented AHP (Analytical Hierarchy Process) for evaluating the critical features required to develop the software. The major impact of this research is the enhancement of mobile user capabilities driving improved productivity.

The integrated software package has specific modules that can be used to support the decision making for the case under consideration. The results provided by software module is obtained by the analysis of sleep patterns. This package can be further integrated with related modules to obtain parallel solutions, based on a wide range of methods and techniques, to solve more complex sleep disruption problems of different women of various age group.

The aim of this research is to develop sleep disruption monitoring system that can be used wirelessly, also evaluates the EEG signal patterns, the experimental phase involved capturing the brain activities by using a wearable RFID / Auto-ID enabled head scarf / pillow case. For preliminary testing, the designed RFID / Auto-ID enabled head scarf / pillow case was placed around the head of object to provide the required amount of comfort. By considering the effect of distance on the data transferring rate, the antennas of the wireless sensor nodes were placed at an optimal distance of 2m from the RF transmitter. The set up will be coupled with the software enabled computer to synthesize the data capture and display the sleep status. The software code was prepared using Dot net and visual basics platforms. The device will record the brain activities in the form of EEG signals and captures several episodes of sleep. The waveform pattern of sleep can be seen, also the major ripples in the waveforms suggests the cause of sleep disruption as it doesn't follow a normal pattern. Moreover, some distraction can be observed because of RF transmitter.

4.1 Phase 1 Analysis and Results – Multiple Linear Regression

Sleep disruption can be improvised by implementing RFID technology which will track sleep quality and their respective pretreatment medication and post treatment. Thus, reducing the risk of wrong medication and also decreasing unnecessary costs. This

tracking can be implemented after analyzing EEG, EMG, EOG and ECG (Electrocardiogram) data. Sleep disruption can be monitored by developing a sensor and RFID - enabled application. With the help of these devices, individual records can be stored, so as to reduce the chances of prescribing expensive treatment which would results in cost savings. Tracking of sleep performance with the help of comprehensive analysis of EEG, EMG, EOG and ECG signals can be done, so as to suggest appropriate treatment to avoid the risk of severe sleep relevant disorders.

For creating initial data analytics, mainly, we are required to measure 4 types of signals. Firstly, we need to capture EEG signals. This task can be done by using RFID sensor which can be used to measure electrical activities. Since electrical activities measured during the sleep shows different characteristics than the active state, EEG signals reveal different stages of sleep. In the traditional procedure, medical technicians attach electrodes to the head to measure signals. Secondly, we need to measure EMG (Electromyography) signals and this particular signal is used to capture muscle tone activities and these signals as well shows different records during the sleep. A final observation is for EOG (Electro-oculography), it shows the movement of eye during deep sleep, particularly when we dream. In fact, this aspect helps us understand Rapid Eye Movement (REM). Conceptually, eyeball movements nature indicates deep sleep. This type of measurement is considered as polysomnography (PSG).

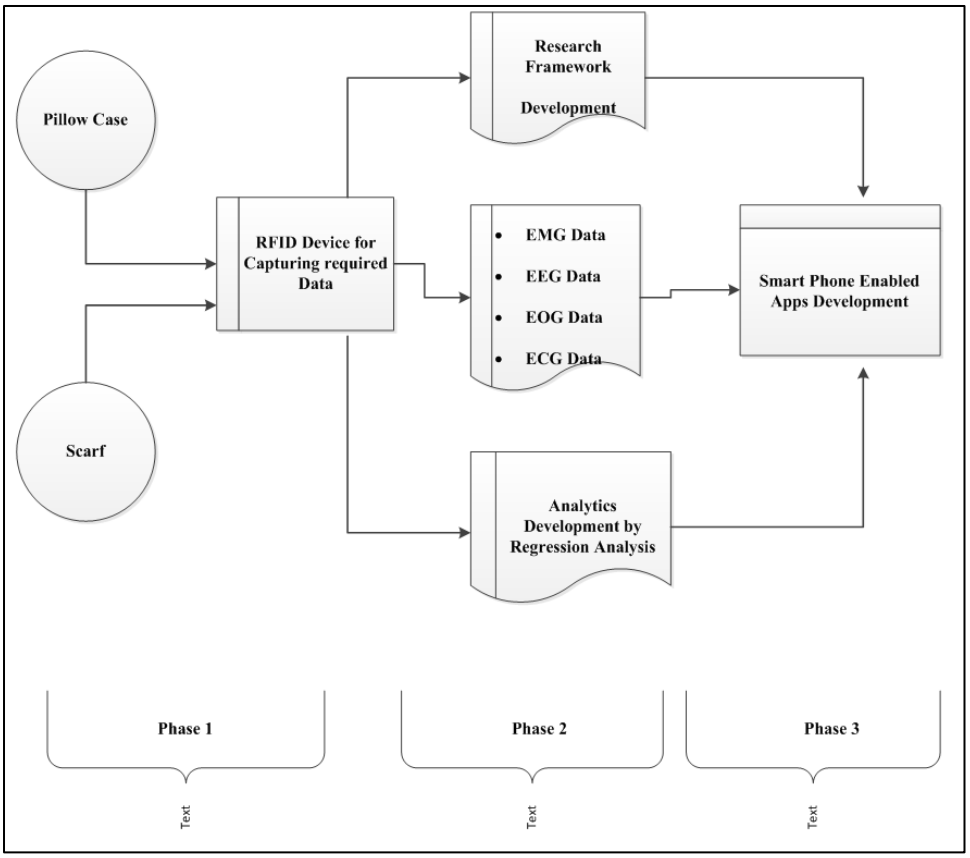

Figure 4-1: Conceptual diagram for Sleep monitoring Research

For this analysis, we have implemented the multiple linear regression. In this procedure, significance of four predictor variables was analyzed i.e., EEG, EMG, ECG, and EOG. This analysis is useful to understand sleep performance. Public data were used for 18 patients and the analysis was done with four - factor variables and one response variable. In this analysis, we will attempt to determine the effects of multiple predictor variables. The response variable is the sleep performance and the four predictor variables are as follows: (1) EEG, (2) EMG and (3) EOG, and (4) ECG. We have assumed 0.01 as the statistical significance level. Initially, we need to check whether the MLR model is suitable for this analysis or not. To understand this, we have performed a preliminary correlation analysis of all three variable for each sleep monitoring method.

We can observe that there is a good correlation between Sleep performance and EEG, EMG, EOG and ECG. Although, there is a lower correlation between sleep performance and EOG. In fact, these results could be valuable as they add value to our final model.

Table 4-1**:** Analysis SAS output

Variable	N	Mean	Std. Dev	Sum	Min.	Max.
Sleep Performance	18	9.069	4.237	163.250	2.500	20.000
EEG	18	4.616	5.367	83.089	0.330	18.014
EMG	18	2418	1573	43525	500.00	5500
EOG	18	20.461	21.311	368.300	1.700	90.900
ECG	18	0.553	0.243	9.950	0.100	0.850

Table 4-2**:** Analysis SAS output

	EEG	EMG	EOG	ECG
EEG	1.000	0.816	0.258	-0.0748
EMG	0.816	1.000	0.398	0.1607
EOG	0.258	0.3989	1.000	-0.0377
ECG	-0.074	0.1607	-0.037	1.000

Below are the results of a multiple linear regression of the RFID - enabled Sleep disruption monitoring system.

Let,

$\hat{y}$ = Sleep performance

X_i = Signals

X_1 =EEG

X_2= EMG

X_3= EOG

X_4= ECG

Regress $\hat{y}$ vs X1, X2, X3 and X4 to get the P- Values for independent variables X1, X2, X3 and X4. Below is the ANOVA table after the regressing $\hat{y}$ with X1 and X2. The assumptions for the Preliminary Model have been checked and we found that diagnostics have been performed and verified. Hence, we can move forward to develop this model.

The preliminary model is:

$$\hat{y} = 4.15175 + 0.57105\ X_1 + 0.00052319\ X_2 + 0.00482\ X_3 + 0.01762\ X_4$$

In a multiple linear regression model, a single response measurement $\hat{y}$ is related to multiple predictor variables. In the equation, we have derived the value of intercept is 4.15175 and the value of beta coefficients are 0.57105, 0.00052319, 0.00482, and 0.01762 respectively. The regression beta coefficient is the slope of the response line. The sufficient (positive value) of beta coefficient indicates that the interpretation suggests that for a substantial increase in the predictor variable, the dependent variable will also increase by the beta coefficient value. In order to address the research, equation contains the value of beta associated with first predictor variable EEG signal is 0.57105, this suggests that for every unit increment in the value of EEG signal the sleep performance will also increase by the beta value 0.57105. The equation implies that the sleep performance $\hat{y}$ can be determined by analyzing EEG, ECG, EOG and EMG signals. This equation provides the information that how the sleep performance vary around their mean values. This leads to a model in the form of an equation.

Table 4-3**:** ANOVA Analysis

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	4	240.03924	60.00981	11.97	0.0003
Error	13	65.18646	5.01434		
Corrected Total	17	305.22569			

Table 4-4 **:** ANOVA Analysis

Root MSE	2.23927	**R-Square**	0.7864
Dependent Mean	9.06944	**Adj R-Sq**	0.7207
Coefficient Variance	24.69030		

The values in the Correlation Matrix are the values for the Correlations between predictors. We are using 0.70 as our cutoff value for serious multicollinearity. EEG versus ECG are two predictor variables with serious multicollinearity. The value represents the increase in the parameters due to the correlation between the predictors.

We have tested the significance of the regression as the final test on the preliminary model for α=0.01.

H_0: $B_k = 0$ if F*> F (α-1, p-1, n-p) Reject H_0

H_i: $B_k \neq 0$

F* = MSR/MSE = 60.00981/5.01434 = 11.9676

F (1-α, 5-1, 18-5) = F (0.99, 4, 13) = 5.21

F* > F therefore we reject H0 and determine the regression is significant. We wanted to create a model that would be easy to use and we believe that requirement has been met. We have created a model which indicates the feasibility of future developments and satisfy requirements. With the help of this research, it could be considered that the analysis will be useful for creating an RFID-enabled sleep monitoring package.

4.2 Phase 2 Analysis and Results – Analytical Hierarchy Process

4.2.1 Weight -age evaluation of various broad measures, factors and subfactors

The data shown here is the average of the data collected from the women of different age groups. In this section the weights of various factors, subfactors and broad performance measures are specified as output. Also the consistency index and eigenvalues of each of the matrices is evaluated.

4.2.2 Measure: Overall Broad factors

Sleep Disorder major factors

Broad factors:

A. Sleep incompatibleness (waking activities)
B. Sleep-wake sensitivity
C. Irregular sleep habits
D. Effective coping skills
E. Wake system disengagement
F. Sleep Hygiene
G. Wake-sleep attribution
H. Efforts to sleep

Table 4-5: Interaction Matrix for Broad Factors of Sleep Disruption in Women

	A	B	C	D	E	F	G	H	WEIGHTS
A	1	1.67	2.12	3.56	3.72	1.5	3.2	3.67	0.309249
B	0.59	1	1.55	2.5	3.8	0.88	2.55	2.66	0.237297
C	0.47	0.64	1	2.12	2.35	0.45	1.67	2.8	0.16401
D	0.28	0.4	0.47	1	1.8	0.67	1.56	1.33	0.114786
E	0.26	0.263	0.42	0.55	1	0.263	0.47	0.74	0.064095
F	0.67	1.14	2.2	1.49	3.8	1	2.5	3.2	0.248393
G	0.31	0.39	0.59	0.64	2.1	0.4	1	1.8	0.112616
H	0.27	0.37	0.36	0.75	1.34	0.31	0.55	1	0.079287

Max Eigenvalue = 8.75 Consistency ratio = 0.047(Acceptable)

Sub-factors: Sleep incompatibleness (waking activities)

A. Reading

B. Watching TV

C. Eating

D. Talking

E. Problem solving

Table 4-6: Interaction Matrix for Sub -Factors of Sleep Disruption in Women

	A	B	C	D	E	WEIGHTS
A	1	1.24	1.67	2.34	2.88	0.30177
B	0.8	1	1.45	2.67	2.78	0.27388
C	0.59	0.68	1	1.67	2.74	0.19955
D	0.42	0.37	0.59	1	3.2	0.14608
E	0.34	0.35	0.36	0.312	1	0.07870

MAX Eigenvalue = 5.09 Consistency ratio =0.055 (Acceptable)

Sub-factors: Sleep-wake sensitivity

A. Environment Latitude

B. Wake Behaviors

C. Lying awake in bed (pre-sleep or upon wakening

D. Sleeping in the day

E. Sleeping elsewhere than in bed

Table 4-7: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	E	WEIGHTS
A	1	0.71	1.8	2.3	2.9	0.26883
B	1.4	1	1.6	2.1	2.8	0.29436
C	0.56	0.63	1	2.5	3.1	0.21690
D	0.44	0.47	0.4	1	3.4	0.14483
E	0.34	0.35	0.32	0.29	1	0.07506

Max Eigen value = 5.33 Consistency ratio =0.0054 (Acceptable)

Sub-factors: Irregular sleep habits

A. Variable patterns

B. Changing times for retiring and rising

C. Extending time in bed to catch up on sleep

D. Sleeping in at weekends

Table 4-8: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	WEIGHTS
A	1	1.12	2.5	1.6	0.34327
B	0.89	1	2.1	1.8	0.31888
C	0.4	0.47	1	0.89	0.15087
D	0.625	0.56	1.12	1	0.18697

Max Eigen value = 4.03 Consistency ratio = 0.0039 (Acceptable)

Sub-factors: Effective coping skills

A. Experiencing time pressure

B. Problems relaxing;

C. Worry, frustration and low mood

D. Active late in the evening

Table 4-.9: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	WEIGHTS
A	1	0.47	2.8	1.67	0.27240
B	2.1	1	2.9	2.46	0.43742
C	0.35	0.344	1	0.67	0.11990
D	0.59	0.4	1.49	1	0.17026

Max Eigenvalue = 4.0504 Consistency ratio =0.0034(Acceptable)

Sub-factors: Wake system disengagement

A. Active thinking

B. Self-monitoring of internal (bodily and mental) cues

C. Hypervigilance

D. Poor sleep hygiene

E. Anxiety

F. Trying too hard to sleep

Table 4-10: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	E	F	G	WEIGHTS
A	1	3.5	1.56	1.8	1.96	2.8	3.1	0.25544
B	0.28	1	0.26	0.39	0.47	0.68	0.74	0.05992
C	0.64	3.78	1	1.6	1.82	2.4	3.2	0.21563
D	0.55	2.56	0.625	1	1.67	2.89	3.54	0.18157
E	0.51	2.12	0.54	0.59	1	1.67	2.56	0.12879
F	0.35	1.45	0.42	0.34	0.59	1	3.34	0.09772
G	0.32	1.34	0.312	0.34	0.39	0.29	1	0.06089

Max Eigenvalue = 7.8095 Consistency ratio = 0.0898 (Acceptable)

Sub-factors: Sleep hygiene

A. Stimulants (e.g., caffeine, nicotine) in excess/near bedtime

B. Alcohol withdrawal symptoms during the night

C. Active exercise late evening

D. Bedroom stuffy

E. Bed uncomfortable

F. Bedroom temperature

Table 4-11: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	E	F	WEIGHT
A	1	1.89	1.55	2.41	2.89	3.6	0.28846
B	0.53	1	0.41	1.67	2.43	2.96	0.16622
C	0.66	2.45	1	2.67	2.89	3.78	0.26859
D	0.414	0.59	0.37	1	2.71	2.86	0.13774
E	0.34	0.42	0.35	0.36	1	1.56	0.07976
F	0.27	0.34	0.26	0.34	0.64	1	0.05924

Max Eigenvalue = 6.299815 Consistency ratio =0.0037 (Acceptable)

Sub-factors: Wake-sleep attribution

A. Attribution of impaired daytime mood,

B. Attention

C. Performance to quality of sleep

D. Fatigue

E. Perception of self as insomniac

Table 4-12: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	E	WEIGHTS
A	1	0.3	0.4	0.83	0.29	0.08489
B	3.25	1	2.46	3.1	1.5	0.34981
C	2.5	0.4	1	2.61	0.38	0.17953
D	1.21	0.33	0.38	1	0.58	0.10939
E	3.4	0.67	2.67	1.67	1	0.27636

Max Eigenvalue = 5.673 Consistency ratio = 0.00663 (Acceptable)

Sub-factors: Efforts to sleep

A. Attempts to suppress thoughts/suppress affect

B. Self-monitoring of alert/sleepiness state

C. Performance effort to fall asleep

D. Performance anxiety

Table 4-13: Interaction Matrix for Sub- Factors of Sleep Disruption in Women

	A	B	C	D	WEIGHTS
A	1	0.31	0.35	0.625	0.09849
B	3.2	1	1.78	2.56	0.35558
C	2.83	0.56	1	1.56	0.23477
D	1.6	0.39	0.64	1	0.14770

Max Eigen value = 4.1355 Consistency ratio = 0.00838 (Acceptable)

4.3 Phase 3 Analysis and Results - Software

A software package for monitoring sleep disruption has been developed to assist in various decision-making stages of this research. Software provides the functions and utility suited for a variety of decisions associated with sleep disruptions in women. In the developed software package, the user is able to provide input information. The developed software consists different program modules. This software has significant level of flexibility of application and fulfills the system requirements. Also, the software module produces the independent records of individual patient to assist in decision making associated with the sleep disruption monitoring purpose. This software has integrated modules that provides an overall assessment of patient sleep record. The result provided by the developed software contains data synthesizing procedure and obtain parallel solutions.

The developed software package which incorporates different modules are:

- Initial Screen
- EEG Input Screen
- Patient/ User detail screen

- EEG signal Graphs initialization Screen
- EEG signal Graphs captured by different sensors
- Port selection and baud rate selection
- Database Server Authentication
- Different waveform plots
- Enlarged view of signals captured by different sensors
- Recorded data in tabulated form
- Final output screen of sleep record analysis

From the phase 1 analysis, we found that the major analysis would be performed by analyzing EEG signals and phase 2 help us understand the critical problems faced mainly by majority of women. Based on the information we found from these two phase, a software module was prepared to display sleep performance.

The software requires an installer that sets up the supporting files on the system. The password is 123. The main executable file needs to be run to use the software and an introductory screen appears as shown below:

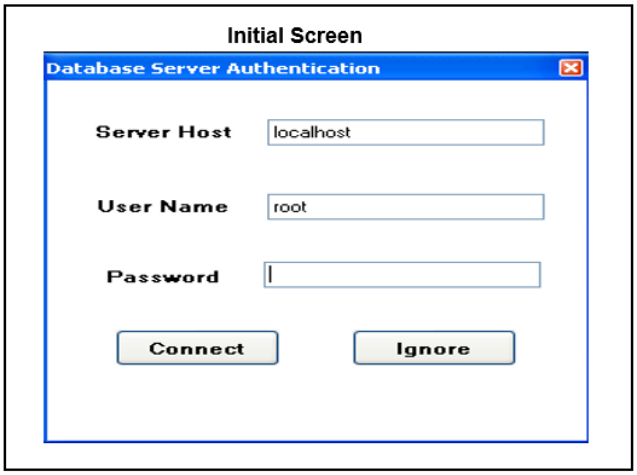

Figure 4-2: Screenshot of Initial Screen

In the next step, the sensor information will need to be entered in the EEG 1 through 8. Also, we enter the mac address information for executing software. In this software module, we can upload the logo / image as per our wish. I have uploaded University of Texas-Arlington logo as a reference for screen display. All the information, we entered should be saved in order to keep it in the record file. The screenshot is shown below.

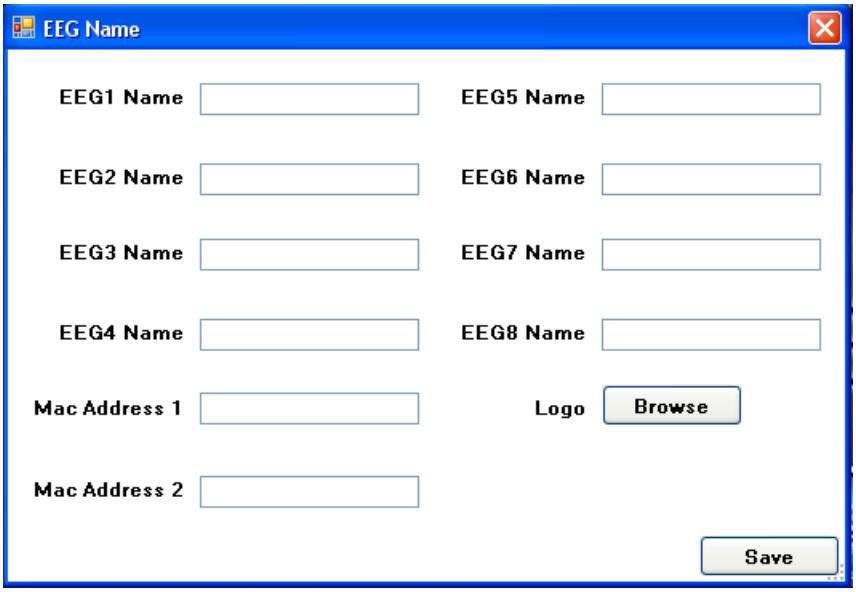

Figure 4-3: Screenshot of EEG Input Screen

The required information of EEG and Mac addresses is shown in the below screenshot. Mac addresses on backplane of the RF transmitter module is 40D8D637 for MAC Address 1 and 40E792EA. The screenshot is shown below:

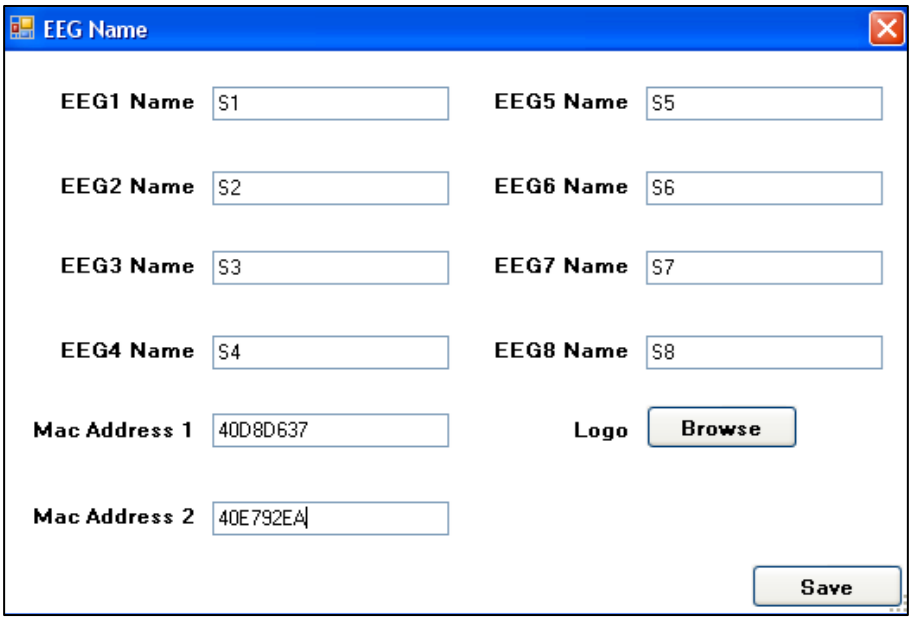

Figure 4-4: Screenshot of EEG Screen with Input Information

In the next step the patient details need to be entered such as name, patient ID, age, gender, sleep disorder – previous records, remarks- additional details and then the information can be saved. We can see four different options for addressing different functions. The Get detail option help software extract the complete information saved in the system for individual user. Delete entry enables us updating the records by deleting past and unused record of a patient. The data option provides the data record and relevant waveforms captured by different EEG sensors and other sensors such as temperature sensor and accelerometer sensor for capturing body temperature and body motion record during sleeping stage. CSV file provides complete information of any particular user and their respective brain activities information. The screenshot is shown below:

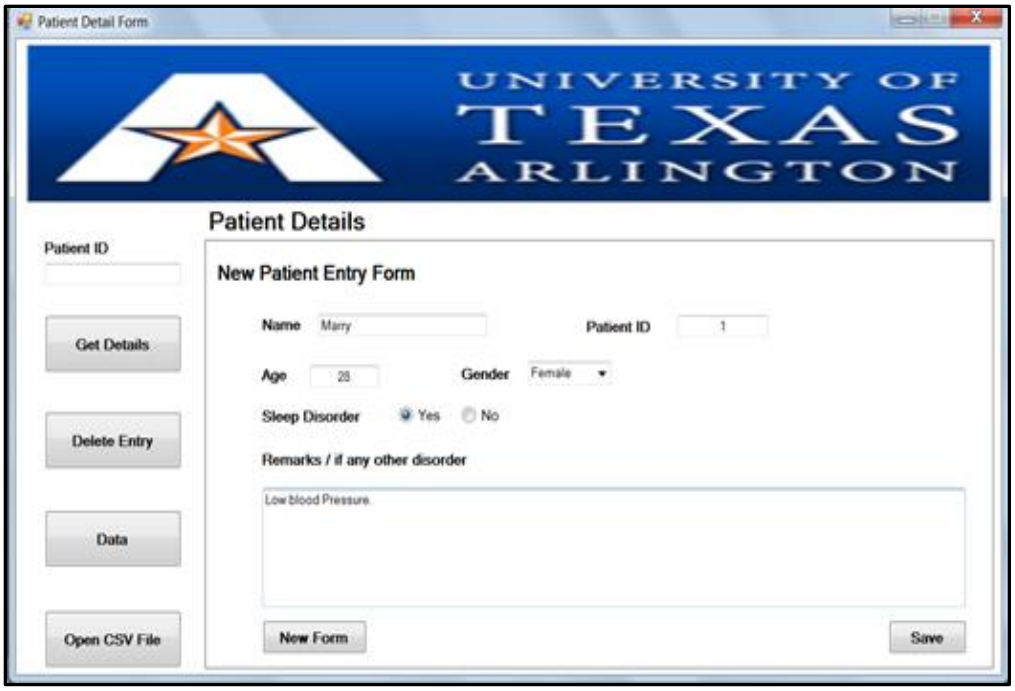

Figure 4-5: Screenshot of Patient / User Details

The software is coupled with Auto ID / RFID system and calculates sleep performance, extracts the data records by clicking on display them on the screen, as shown below. The final results “Sleep Performance” is displayed which reveals whether the user is attaining appropriate sleep or not. In this system, we have attempted to incorporate different ways to analyses sleep records. The systems developed in the past mostly focus on EEG signal measuring procedure. However, we have developed a system which contains 7 sensors, 4 EEG signal and 3 accelerometer sensor and 1 sensor for measuring body temperature. The function of accelerometer sensor is to measure the frequency of body movement during sleeping stage. The device developed to record and transfer the captured signals consists two sets of transmitters and sensors. First transmitter coupled with four sensor capture and transmit only EEG signals and other transmitter coupled with four sensors records and transmit temperature and frequency of body movement

information. There is a RF enabled receiver which is coupled with computer system and uses software for synthesizing data records. The transmitter can be placed 10 feet away from receiver and computer system in order to maintain optimum level of data transferring. This screen contains different options such as port selection option, start option for recording data, start logging option for saving data, search option for extracting user information, delete for removing data information if not significant to user record. Moreover, database connection option provides the detailed database information for individual user. Scan time option provides the time period selected for recording signals and brain activities. Also, reset option will clear all the information and provides data capturing from the beginning. The last option is show result, which display the sleep status in terms of threshold limits. The higher percentage of threshold indicates more chances to have critical sleep disruptions. The screenshot below shows when there is no connection between transmitters and receiver. Also, by choosing the load data option, we can directly upload the patient data file for analysis.

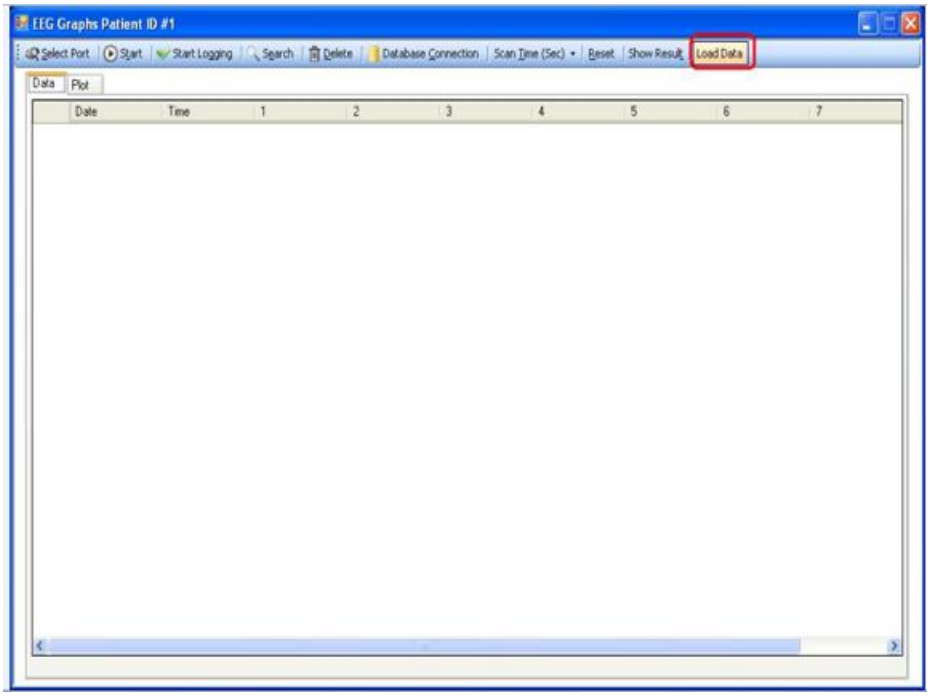

Figure 4-6: Screenshot of EEG signal Graphs initialization Screen

The subsequent screen shot shows the plot screen as well. In the plot screen, we can set the upper and lower limit of threshold level for each sensor separately. Since, there is no connection, so the waveform plot screen will be shown as below:

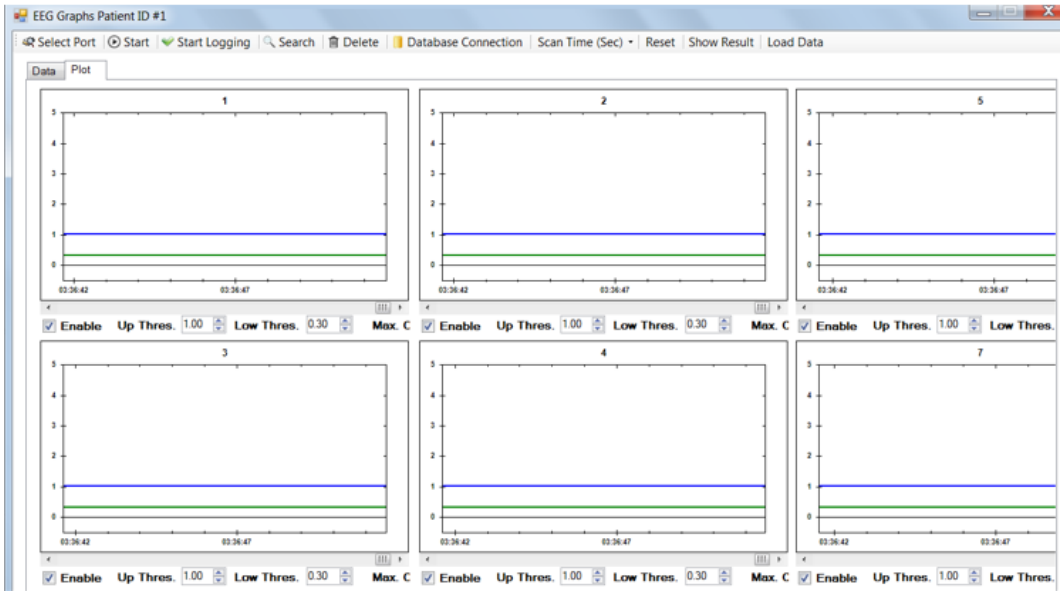

Figure 4-7: Screenshot of EEG signal Graphs captured by different sensors

In the select port option, we need to enter the information of a computer port of which device is connected. The computer ports are identified as COM1, COM2, COM 3, etc. The Baud rate is 9600 which shows the data transferring rate between the receiver and transmitter. The screen shot is shown below.

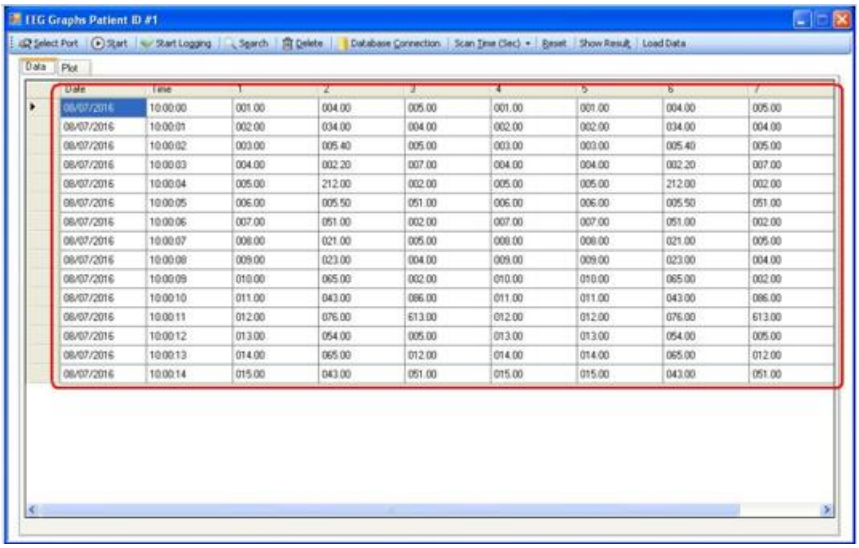

Figure 4-8: Screenshot of data uploading

Moreover, the database selection requires additional information related to server host, username and password. The same password 123 has been used for this screen as well. The purpose of this screen is to show the interface the system with current and past database records of individual user. The screen shot is shown below.

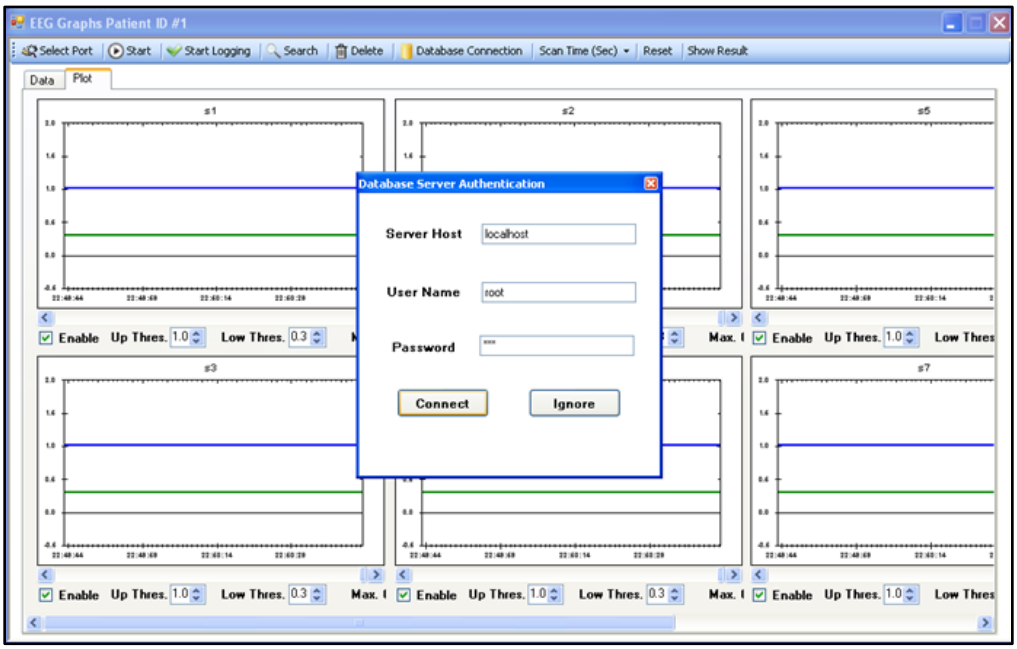

Figure 4-9: Screenshot of Database Server Authentication

In the next step, the software then extract input information of the patient from the RFID / Auto-ID enabled scarf / pillowcase, this EEG signals recorded by the device will be synthesized by software program. The each waveform can be seen in the screenshot provided below and also it shows the waveforms respective to data recorded by each sensor. The screen shot is shown below:

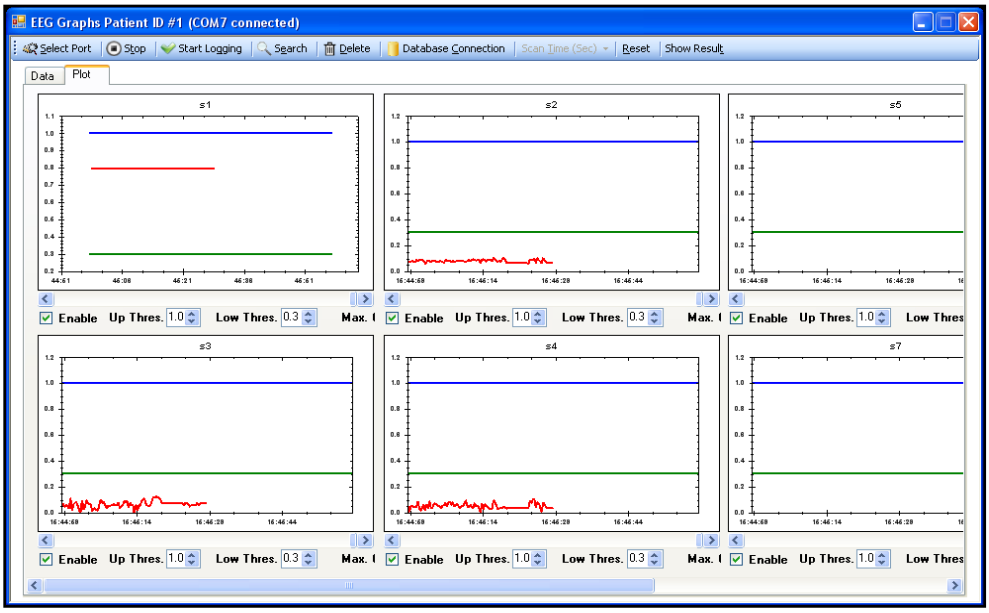

Figure 4-10: Screenshot of different waveform plots

Each screen can be enlarged by clicking twice. The enlarged view of the waveforms recorded through S2 and S4 sensors and is shown below.

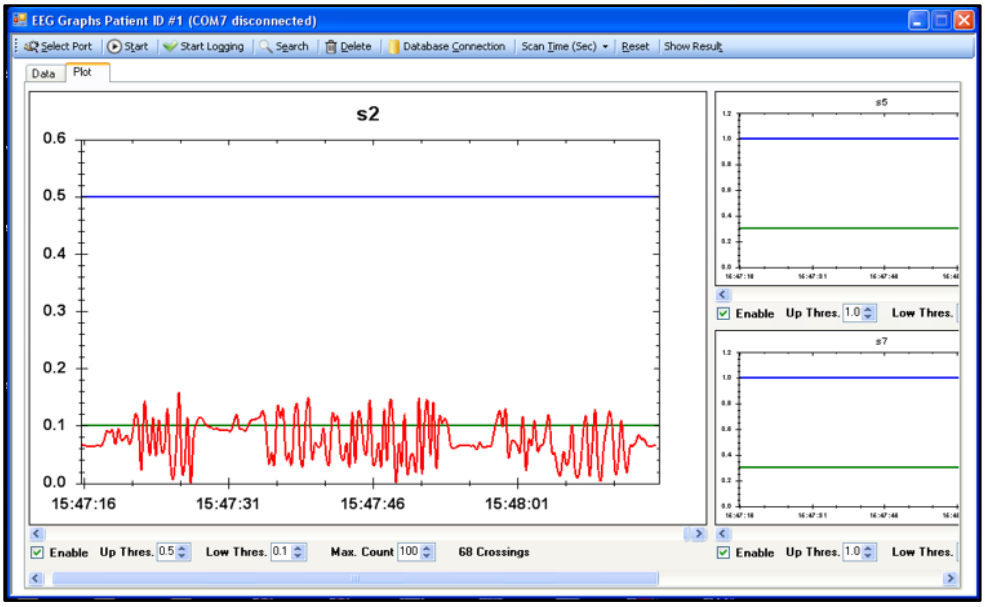

Figure 4-11: Screenshot of enlarged view of signals captured by S2 sensor

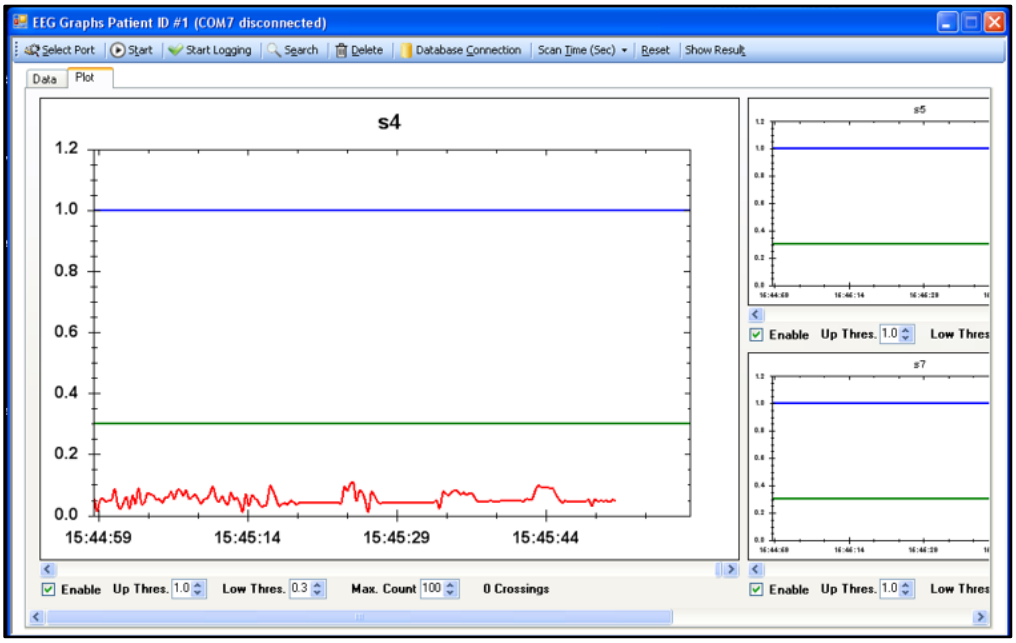

Figure 4-12: Screenshot of enlarged view of signals captured by S4 sensor

The screen shot shown below provide information of recorded database for an user. The system will record the time period in seconds and provide the data recorded by all the sensors.

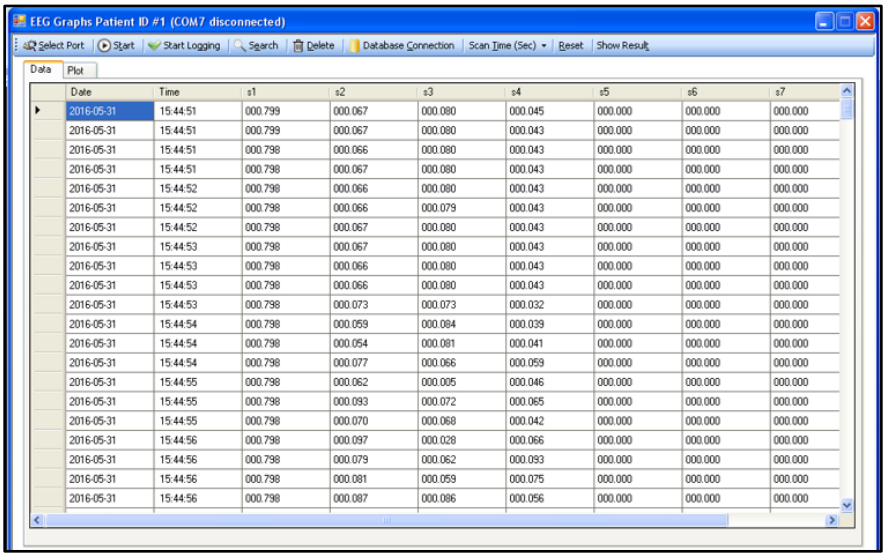

Figure 4-13: Screenshot of recorded data in tabulated form

The program now synthesizes the signals recorded by different sensors and thus provides an overall analysis by “average count screen”. The user might be having more critical sleep disorders If the percentage calculated in the screen is close 100 and need to consult a physician. Normal sleeping record will have the percentage close to 0. According to the concept of this technique, the software will synthesize and analyses the frequency level of alpha, beta, delta and gamma waves, and matches the recorded data with standard pattern of normal user who is of same age group and maintaining similar lifestyle. The normal user sleep records depicts sleep records of a women attaining optimum hours of sleep. Finally, the “calculate” button, depicts the sleep performance status. The data record can be saved in a separate file to view later on. The final output screen shot is shown below:

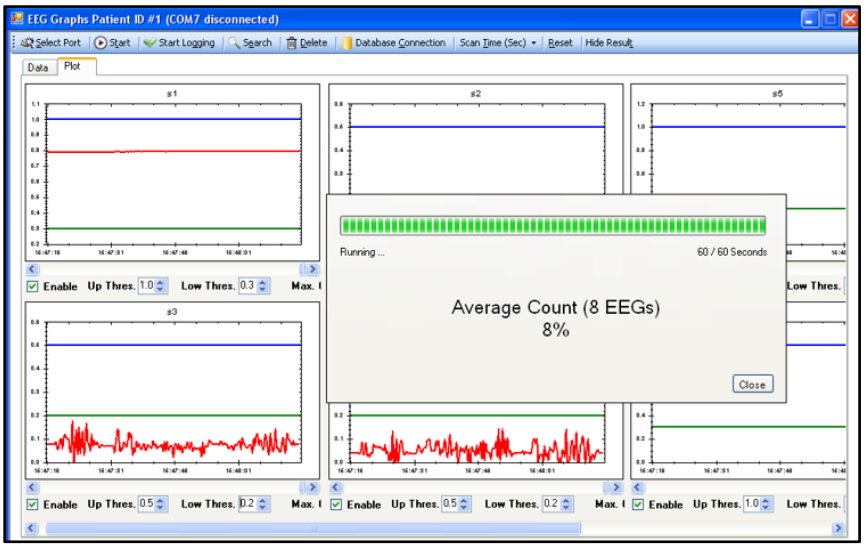

Figure 4-14: Screenshot depicting final output screen of sleep record analysis

4.4 Economic Analysis

In order to perform the economic analysis, the cost and budget plan associated with sleep disruption monitoring research project were calculated. This research needs

different resources. The main resources are as follows : equipment, manpower, machine, RFID Tags, Scarf/ Pillowcase, EEG recording Sensors, Reader antenna, scanner, software based app, RFID software enabled computer systems, Data management system DMS, RFID LAB for development & Monitoring, Linen testing, Minitab Software for Developing Analytics, Engineering Standard Documentation, Consultancy -Expert guidance and Other Services. The cost associated with each resource has been considered in order to prepare the budget plan for this research. The proposed sleep disruption monitoring system developed in this dissertation, is based on a major observation that sleep disorders prevailed at a faster rate due to avoidance and lack of proper attention at an early stage. The RFID-enabled sleep disruption monitoring system is expensive and demands an investment of approximately $600,000. The payback period is five years.

Table 4-14: Presented are details of all costs and benefits from project inception to end of evaluation period

No.	Name of Resource	Quantity	Cost	Extended Cost
1	RFID Tags	100	$0.10	$100
2	Scarf/ Pillow case	1	$ 15 - $ 80	$80
3	EEG recording Sensors	7	$395	$2,765
4	Reader antenna	4	$125 Per	$500
5	scanner	1	$1,700	$1,700
6	software based app	1	$2.00	$2.00
7	RFID software enabled computer systems	1	$500	$500
8	Data management system DMS Software	1	$299 per month	$3,588
9	RFID LAB	4	$250 per day	$91,250
10	Man power (Technically trained)	6	$100 Per day	$213,600

11	Linen testing	4	$10,000 per tag set	$40,000
12	Minitab Software for Developing Analytics	1	6682 Per year for 10 user	$6,682
13	Engineering Standard Documentation	1	12000 Per year	$12,000
14	Consultancy -Expert guidance	1	300 per Hour (8 hours/Week)	$124,800 per year
15	Service Cost	1	35040 per year	$35,040
16	Miscellaneous	1	$50,000	$50,000
	Total Cost			**$583,607**

After the initial consultation period, step by step procedure and systematic analysis were performed to prepare the budgetary restrictions $583,607 and interlinking. The table shows the costs and savings associated with this research project. The next steps present the summary of costs/benefits per project year plus other years project will be evaluated over and the net present value summary. A required rate of return of seven percent was used. Based on the positive net present value, the decision was made to move forward with the project.

Additionally, to truly understand the savings of this research, the issue has to be evaluated in subsequent years to gauge the savings to other improvements and to the long-term profitability and stability in the long-term. Although, there are numerous other savings that are too difficult to evaluate within the scope of this research. The NPV -Net present value are calculated based on a required return of 7%. The case inflow and outflow for five years are calculated for the required rate of return. The NPV>0, so this project was deemed worthy.

Chapter 5 : CONTRIBUTION TO THE BODY OF KNOWLEDGE

5.1 Conclusion

This research entitled “Evaluating the Impacts of Sleep Disruptions in Women through Automated Analysis” is an endeavor to study the significant analysis of sleep disruptions in women and capture the degree of sleep disorders with a view to map them using the Auto-ID techniques and RFID based techniques in a more responsive manner. In the process of analysis the following steps have been performed:

- Identification of the current techniques and the existing techniques.
- Identification of factors affecting sleep especially in women.
- Review of the possibilities and opportunities available with better responses as well as diverse viewpoints on fulfillment of accuracy requirements.
- In the selection of sleep disruption monitoring model, use of regression, Analytical Hierarchy process and developed an analytics assessment software to narrow down the sleep disruption causing parameters and the factors which are more critical so as to assess the process of sleep disruption monitoring. The outcomes of survey conducted among women of different age groups have been used to understand the problems associated with sleep.
- The use of Analytical Hierarchy Process provides a relative criticality of sleep related problems that provides direction for arriving at an optimum decision in regards to evaluate sleep disruptions.
- The feasibility of applying the regression model to evolve a unique factor affecting sleep disruption monitoring process, which is comparatively accurate, efficient, and scrutinize the sleep disruption monitoring process.

- The use of sensor-enabled scarf/ pillow case measures brain waves and developed software analyze the role of brain waves for capturing sleep disruption's degree of seriousness. The experiments were conducted in RFID and Auto ID laboratory.
- To arrive at the optimum decision and better accuracy the developed system has been useful extensively.
- The entire approach of sleep disruption monitoring has been explored by using regression modeling approach, Analytical Hierarchy Process, EEG capturing sensors enabled scarf / pillow case and Data synthesizing software which is an unique procedure provides detailed and accurate data analytics for sleep disruption monitoring.
- The entire process has been viewed from an integrated perspective to make the overall system more responsive and vibrant.

5.2 Hypothesis Conclusions

I met my research objective by investigating the specific aims and step by step procedures associated with each phase of analysis. There are some significant expected results from this research objectives and hypothesis.

- I met the **specific aim #1 -** Identify the factors affecting sleep disruptions and evaluate the model suitability for sleep performance. By performing the multiple linear regression analysis, I have identified the critical factor i.e. EEG signal for carrying out the further analysis. Also, the analytical hierarchy process was useful to figure out the major sleep disruption issues and their associated sub-factors for understanding the model suitability. Moreover, consistency index was used for validating the results obtained by the survey.

So, overall procedure and steps in the first phase helped us to achieve specific objective #1.

- I met the **specific aim #2 -** Evaluate and identify the suitable automated analysis technique for sleep disorders measurement. By investigating the different types of procedures available to monitor sleep disruption, we could figure out that RFID/ Auto-ID enabled technique would provide significant results in terms of accuracy. The procedure and steps associated with phase two was important to achieve specific objective #2.
- I met the **specific aim #3-** Develop a software for monitoring sleep disruption in women and evaluate the impact of proposed framework for Sleep disruption performance measurement. In order to achieve specific objective #3, I have developed a software package that provides overall sleep assessment in terms of an average count level. Also, the screenshots included in the results section guides the step by step procedure for installing and running the software system.
- We expected to reject our H_0 with respect to the predefined hypothesis for the first objective that the implementation of Auto ID / RFID technology will impact on measuring sleep disorders accurately. Also, the decision rule concerned with first objective states that, if the cost associated with Auto ID / RFID based sleep monitoring system is greater than 15 % of the currently available systems then we will reject the null hypothesis for the first objective.
- As we have performed the analysis and developed a software system for data synthesis, so we found that the cost of proposed system is lesser than the available techniques in the market that prompts us to reject null hypothesis for the first objective.

- The null hypothesis concerned with second research objective states that we expected the developed framework effectively addresses the critical sleep disorders monitoring requirements. Also, the decision rule for objective two mentioned clearly that if the sleep performance provided by Auto ID / RFID based sleep monitoring system is less than 5 % counts then the null hypothesis for objective two will be rejected.
- The results obtained by the developed software helps us comprehend the typical nature of sleep disruption monitoring and also provides a systematic procedure for monitoring sleep disruption.

5.3 Findings and Recommendations

The modeling of the sleep disruption monitoring process is relatively new in the field of technology and biomedical science. The reluctance to change and predominantly medical practices have not permitted any innovative thinking on the subject. The data management procedure for this system is extensive and requires highest level of accuracy. The challenges and issues associated with this procedure encourage us to delve into further studies and hence there is immense scope to use advanced level technical knowledge and experiments. The data management is not only lethargic due to the extensive range and depth but also because of procedural inadequacies.

For this analysis, we have implemented the multiple linear regression. In this procedure, significance of four predictor variables was analyzed i.e., EEG, EMG, ECG, and EOG. This analysis is useful to understand sleep performance. Data was collected for patients of different age groups and the analysis was done with four - factor variables and one response variable. In this analysis, we attempted to determine the effects of multiple

predictor variables. The response variable is the sleep performance and the four predictor variables are as follows: (1) EEG, (2) EMG (3) EOG, and (4) ECG. We have assumed 0.01 as the statistical significance level. Initially, we need to check whether the MLR model is suitable for this analysis or not. To understand this, we have performed a preliminary correlation analysis of all four variable for each sleep monitoring method. In fact, the results could be valuable as they add value to our final model. The research will show the benefits of RFID implementation in sleep monitoring and its increasing need in the business prospectus of the commercial and hospital industry. Thus, there is a vast scope in the use of such technology to convert the sleep monitoring into a more easy process and money saving technology. Use of RFID to improve sleep monitoring service, patient safety, cost reduction, real - time data management, timely service and process improvement can be deployed to make the tracking efficient.

The expected results obtained by this research would suggest the progressive and beneficial nature of the project in the next five years for the commercial purpose. The suggested analytics offers manifold reasons to address the challenges confronted by the healthcare organization. Especially, by utilizing the advantages of RFID application, Economic analysis and application package development. We can recognize this system as a very cost-effective tool to monitor sleep performance with points of sale solutions and serves sleep monitoring system globally from anywhere and at the very time. The analytics developed among four critical factors provides significant insights into how the sleep disruption monitoring and the RFID implementation impacts the overall sleep tracking characteristics and the quality of sleep.

The major conclusion from this study are summarized below:

1) Better evaluation implies better management of benefits, costs and risks.
2) Need for better tools of evaluation to assess process and product.

3) Need to understand the bottlenecks in sleep disruption monitoring procedure.

This research attempts to accomplish the above objective. This research proposed a systematic and flexible approach to solve the complex sleep disruption monitoring problem for women efficiently and effectively. It acquires the relationships by using AHP-based technique, which enables the inclusion of both quantitative and qualitative factors in the decision process. These factors are based on the current research experience in the sleep disorder monitoring fields. The presented approach discussed in this research has the ability to propose sleep disruption monitoring effectively. This approach is exemplified to provide a feasible quality solution and is to be applied to the real world application easily and expeditiously. In addition, it is very flexible, that permits to add more participators which locate in different geographical locations.

The focus of this research was mainly on the implementation of Auto ID / RFID in health care system. This includes scenarios where the RFID devices are used for data capture. The tags attached to a scarf or pillow case and can thus be close to the patient's head where they can measure the sleep disruption. The second theme of the research is to maintain the flow of patient EEG, ECG, EOG, and EMG data during the sleep using the RFID devices and transducers. The data captured will be stored on the tag and can be read off whenever the reader comes into contact with it. The third topic is about the management of RFID in hospitals that use the RFID enabled pillowcase / scarf. We will specifically look into the measuring sleep disruptions, treatment costs, improving efficiency of tracking, and the effects of RFID on humans. The design and implementation of RFID tags into linen is rather simple. Linen tags currently exist, and all that is required will be for them to be attached into pillowcases / scarves at the manufacturing level. Hospital-specific

phone applications can be built in order to maintain security and mishandling of the equipment for the procedure.

Sleep disorders become more chronical as age increases, but with proper awareness, the effects of chronical sleep disorders can be suppressed up to a great extent. Mostly women are more sensitive to age – related changes and these kind of changes makes a significant impact not only during the sleeping time, but affects the awakening states also. However, by accumulating prior information about the sleep performance such as brain aging, in particular neuronal loss information can help us taking preventive actions for the sleep disorders. Overall, the results of this research experiments demonstrate the feasibility of analysis and statistical analytics in the acquirement of EEG signals for automated analysis. In particular, the analysis was performed to analyze EEG sleep data for developing the analytics for automated sleep disruption monitoring research. However, available methods for sleep monitoring also producing effective results, but the lack of a RF based EEG recording based self-sleep monitoring devices has attracted researchers' attention in this area. The analysis performed in this research shows that the level of accuracy can be maintained by statistical analysis for signal synthesis and refinement. Based on the suggested framework, we can achieve better accuracy and produced effective results. However, the sensor complexity and severe power constraints forced on EEG capturing systems provide the designer of EEG recording systems a compromise. Though, the appropriate modification can be made to the device features and the power quality concern can also be balanced with signal quality. These achievements can compensate for power consumption limitations and provide many benefits.

5.4 Limitation

Although, the study supports key findings, there are some limitations associated with the RFID enabled sleep monitoring system in tracking real-time information, data,

sleep disruption & monitoring speed. The integration of ECG, EMG, EOG, EEG and RFID - enabled Sleep monitoring system is very helpful to suggest appropriate corrective actions by providing accessibility and data visibility. In fact, the sleep disruption can be accurately tracked. The RFID implementation acts as a paradigm of technology changeover to the dynamic data flow. One more thing that can be focused on in future in order to drive the efficiency of sleep monitoring system is the use of RFID-enabled system increase the ability to learn overall sleep performance. These RFID-enabled system lead to increasing in overall effectiveness of the health care organizations. So, it has been predicted that with the implementation of RFID technology, there can be expected benefits of

1. Increased sleep monitoring quality and accuracy.
2. Real-time performance visibility
3. Faster in recording real-time data

These can lead to an increase in overall efficiency, quality, and safety. A serious thought can be put into this to evaluate the economic impacts. Despite all the benefits touted for RFID, both within healthcare and other industries, there are many detractors to its implementation.

Although the uses of RFID enable a higher rate of patient safety and increased cost benefits, there are still some fundamental challenges faced to be able to utilize to its zenith. They include some implementation and ethical issues primarily. For example, for enabling RFID readers in pillows/scarves, it is required to have a consistent electrical supply, and patient safety could be called into question. Also, there have been patient and staff concerns about privacy, as RFID enables users to capture the sleep data. It is a genuine concern which needs to be addressed, so that the technology can be improved. RFID must also be evaluated so that policy regulations are not violated in terms of privacy. To maintain patient safety and privacy, there should be clear guidelines about its usage

and information should be provided to the patient about how they can track their sleep by the system. It is vital to encourage the suppliers to include RFID in their products so that the flow of data is smooth. Failure to have an effective RFID system might result in serious issues in a sleep disruption monitoring system and will thus not help in improving of data capturing.

The main Limitations of the project is the number of women under consideration. As mentioned in the research, we can record the sleep monitoring data in systematic manner for providing sleep performance. Depending on the manner in which we measure EEG signals, the sensors may not be able to perform as effectively. We feel confident with the ability of electronics transducers but, depending on the complexity of the circuits needed for the EEG recording, we may not be able to build a sensor that has a good level of resolution.

5.5 Future Work

This research is seen as a three-step process. The developed method using sensors and Auto –ID / RFID enabled scarf / pillow case provides an unique way to evaluate the sleep disruption monitoring and also suggests us a procedure to show how to develop the data management system for this system. In order to better understand the sleep performance, the future scope will be to take this understanding of the EEG signal recording process and begin incorporating additional memory into the sensors so that they can carry large number of data for systematic data management. We also expect this research to open up additional opportunities in the area of sleep disorders monitoring.

Appendix A: Software Code

1. EEGNameForm.vb (when this software is running for first time on machine)

1.1 Gets data entered by user in text boxes

```
 ' Browse button action to choose logo file (png, jpg, jpeg) '
    Private Sub BrowseButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles BrowseButton.Click
        'OpenFileDialog1.Filter = "(*.png)|*.png; |*.jpg; |*.jpeg"
        OpenFileDialog1.Filter = "PNG Image(*.png) |*.png|JPG Image(*.jpg) |*.jpg|JPEG
Image (*.jpeg)|*.jpeg|All Files (*.*) |*.*"
        OpenFileDialog1.FileName = ""
        If OpenFileDialog1.ShowDialog = Windows.Forms.DialogResult.OK Then
            PatientDetailForm.LogoImagePath = OpenFileDialog1.FileName
        End If
    End Sub
```

1.2 Save the data (prob name and MAC address) in EEGNames.txt file

```
 Private Sub SaveButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles SaveButton.Click
        If IsEntriesCompleted() = False Then
            MessageBox.Show(Me, "Please fill all entries", "Information",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
```

```
        Dim FilePath As String = Application.StartupPath + "\EEGNames.txt"
        SaveFileEEGNames(FilePath)
        NextForm = True
        Me.Close()
    End Sub

Private Sub SaveFileEEGNames(ByVal FilePath As String)
        Try
            Dim FileString As New StringBuilder
            FileString.AppendLine(EEGName1.Text)
            FileString.AppendLine(EEGName2.Text)
            FileString.AppendLine(EEGName3.Text)
            FileString.AppendLine(EEGName4.Text)
            FileString.AppendLine(EEGName5.Text)
            FileString.AppendLine(EEGName6.Text)
            FileString.AppendLine(EEGName7.Text)
            FileString.AppendLine(EEGName8.Text)
            FileString.AppendLine(MAC1.Text)
            FileString.AppendLine(MAC2.Text)
            FileString.AppendLine(PatientDetailForm.LogoImagePath)
            Dim FileWriter As New StreamWriter(FilePath)
            FileWriter.Write(FileString.ToString)
            FileWriter.Close()
        Catch ex As Exception
            File.Delete(FilePath)
```

```
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
    End Sub
```

2. PatientDetailForm.vb - Contains code for patient details entry and save

2.1 Initial settings

```
Public SQLconnection As MySqlConnection
    Public SQLreader As MySqlDataReader
    Public SQLcommand As MySqlCommand

    ' Connection string which contains user name, password, server (localhost or other),
database to initially connect with database '
    Public Shared SQLConnectionString, SQLInitConnectionString As String
    Public Shared DatabaseName As String

    ' EEG prob names of all 8 channel; this name is entered by the user if he is running the
software for the first time '
    Public Shared EEGName1, EEGName2, EEGName3, EEGName4, EEGName5,
EEGName6, EEGName7, EEGName8 As String

    ' MAC address of the sensor nodes which connects wireless to base station '
```

```
    Public Shared MacAddress1, MacAddress2 As String

    ' Path selected by user when running software first time '
    Public Shared LogoImagePath As String


    Private Sub Form1_Load(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        SQLconnection = New MySqlConnection
        LoadFileConnectionString()
        TestDatabaseConnection()
        CreateDatabase()
        LoadFileNames()
        GenderComboBox.SelectedIndex = 0
    End Sub


    Private Sub LoadFileConnectionString()
        Dim FilePath As String = Application.StartupPath + "\SQLConnectionString.txt"
        Try
            If System.IO.File.Exists(FilePath) Then
                Dim FileReader As New System.IO.StreamReader(FilePath)
                SQLConnectionString = FileReader.ReadLine()
                FileReader.Close()
```

```
            SQLInitConnectionString =
SQLConnectionString.Substring(SQLConnectionString.IndexOf(";") + 1)
            DatabaseName =
SQLConnectionString.Substring(SQLConnectionString.IndexOf("=") + 1)
            DatabaseName = DatabaseName.Substring(0, DatabaseName.IndexOf(";"))
        Else
            'MessageBox.Show(Me, "File SQLConnectionString.txt doesn't exist", "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error)
            System.IO.File.Create(FilePath)
            DatabaseName = "SleepDisorder_1v0"
        End If
    Catch ex As Exception
        MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
    End Try
  End Sub


  Private Sub TestDatabaseConnection()
    SQLconnection.ConnectionString = SQLInitConnectionString
    Try
      SQLconnection.Open()
    Catch ex As Exception
      ' If connection string from file contains incorrect password then it display a dialog
box to enter proper password '
```

```
            If ex.Message.Contains("Access denied") Then
                DatabaseConnection.ShowDialog()
            End If
        End Try
        SQLconnection.Close()
    End Sub


    Private Sub CreateDatabase()
        SQLconnection.ConnectionString = SQLInitConnectionString
        Try
            SQLconnection.Open()
            SQLcommand = New MySqlCommand("Create database " + DatabaseName,
SQLconnection)
            SQLcommand.ExecuteReader()
            SQLcommand.Dispose()
            SQLconnection.Close()
        Catch
        Finally
            SQLconnection.Close()
        End Try
        SQLconnection.ConnectionString = SQLConnectionString
        Try
            SQLconnection.Open()
```

```
            SQLcommand = New MySqlCommand("Create table " + DatabaseName +
".Patient_Detail(ID int,Name char(20),Gender char,Age int,Disorder char, Remark
char(30));", SQLconnection)
            SQLcommand.ExecuteReader()
        Catch
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()
        Try
            SQLconnection.Open()
            SQLcommand = New MySqlCommand("Create table " + DatabaseName +
".EEG(datetime datetime,ID int, Data1 double, Data2 double, Data3 double, Data4
double, Data5 double, Data6 double, Data7 double, Data8 double);", SQLconnection)
            SQLcommand.ExecuteReader()
        Catch
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()
        Try
            SQLconnection.Open()
            SQLcommand = New MySqlCommand("Create table " + DatabaseName +
".EEG_CSV(ID int, Data1 double, Data2 double, Data3 double, Data4 double, Data5
double, Data6 double, Data7 double, Data8 double);", SQLconnection)
            SQLcommand.ExecuteReader()
        Catch
```

```
    End Try
    SQLcommand.Dispose()
    SQLconnection.Close()
End Sub


Private Sub LoadFileNames()
    Dim FilePath As String = Application.StartupPath + "\EEGNames.txt"
    If File.Exists(FilePath) = False Then
        EEGNameForm.ShowDialog()
    End If
    If File.Exists(FilePath) Then
        Dim FileReader As New StreamReader(FilePath)
        EEGName1 = FileReader.ReadLine()
        EEGName2 = FileReader.ReadLine()
        EEGName3 = FileReader.ReadLine()
        EEGName4 = FileReader.ReadLine()
        EEGName5 = FileReader.ReadLine()
        EEGName6 = FileReader.ReadLine()
        EEGName7 = FileReader.ReadLine()
        EEGName8 = FileReader.ReadLine()
        MacAddress1 = FileReader.ReadLine()
        MacAddress2 = FileReader.ReadLine()
        LogoImagePath = FileReader.ReadLine()
        LogoPictureBox.Image = Image.FromFile(LogoImagePath)
```

```
            FileReader.Close()
        End If
    End Sub
```

2.2 Gets data entered by user in text boxes

2.3 New Form

```
    Private Sub NewFormButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles NewFormButton.Click
        NameTextBox.ReadOnly = False
        NameTextBox.Text = ""
        IDTextBox.ReadOnly = False
        IDTextBox.Text = ""
        AgeTextBox.ReadOnly = False
        AgeTextBox.Text = ""
        GenderComboBox.Enabled = True
        GenderComboBox.SelectedIndex = 0
        YesRadioButton.Enabled = True
        NoRadioButton.Enabled = True
        YesRadioButton.Checked = True
        OthersTextBox.ReadOnly = False
        OthersTextBox.Text = ""
        SaveButton.Text = "Save"
    End Sub
```

```
    Private Sub PatientIDTextBox_KeyDown(ByVal sender As Object, ByVal e As
System.Windows.Forms.KeyEventArgs) Handles PatientIDTextBox.KeyDown
        If e.KeyValue = Keys.Enter Then
            GetDetailsButton_Click(Nothing, Nothing)
        End If
    End Sub
```

2.4 Saves the data over MySQL data base at localhost (localPC)

```
    Private Sub SaveButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles SaveButton.Click
        If IsValidEntries() = False Then
            MessageBox.Show(Me, "Please fill proper entires", "Information",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
        Dim dt As String = ""
        dt = DateTime.Now().ToString("yyyy-MM-dd HH:mm:ss")
        Try
            SQLconnection.ConnectionString = SQLConnectionString
            SQLconnection.Open()
            Dim Gender As String = ""
            If GenderComboBox.SelectedIndex = 0 Then Gender = "M" Else Gender = "F"
            Dim Disorder As String = ""
```

```
            If YesRadioButton.Checked Then Disorder = "Y" Else Disorder = "N"
            Dim sql As String = ""
            sql = "insert into Patient_Detail (ID,Name,Gender,Age,Disorder,Remark) values("
+ IDTextBox.Text + ",'" + NameTextBox.Text + "','" + Gender + "'," + AgeTextBox.Text +
",'" + Disorder + "','" + OthersTextBox.Text + "');"
            SQLcommand = New MySqlCommand(sql, SQLconnection)
            SQLcommand.ExecuteReader()
        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()
    End Sub
```

2.5 Gets the entry when requested

```
 Private Sub GetDetailsButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles GetDetailsButton.Click
        If PatientIDTextBox.Text = "" Then
            MessageBox.Show(Me, "Please enter patient ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
        Try
```

```
            Dim test As Integer = CInt(PatientIDTextBox.Text)
        Catch ex As Exception
            MessageBox.Show(Me, "Please enter valid ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End Try
        NewFormButton_Click(Nothing, Nothing)
        SQLconnection.ConnectionString = SQLConnectionString
        SQLconnection.Open()
        Dim SQLQuery As String = ""
        Dim Gender, Disorder As String
        SQLQuery = "select * from Patient_Detail where ID=" + PatientIDTextBox.Text + ";"
        SQLcommand = New MySqlCommand(SQLQuery, SQLconnection)
        SQLcommand.CommandTimeout = 0
        SQLreader = SQLcommand.ExecuteReader()
        While SQLreader.Read
            IDTextBox.Text = SQLreader.GetString(0)
            IDTextBox.ReadOnly = True
            NameTextBox.Text = SQLreader.GetString(1)
            NameTextBox.ReadOnly = True
            Gender = SQLreader.GetString(2)
            If Gender = "M" Then GenderComboBox.SelectedIndex = 0 Else
GenderComboBox.SelectedIndex = 1
            GenderComboBox.Enabled = False
            AgeTextBox.Text = SQLreader.GetString(3)
```

```
            AgeTextBox.ReadOnly = True
            Disorder = SQLreader.GetString(4)
            If Disorder = "Y" Then YesRadioButton.Checked = True Else
NoRadioButton.Checked = True
            YesRadioButton.Enabled = False
            NoRadioButton.Enabled = False
            OthersTextBox.Text = SQLreader.GetString(5)
            OthersTextBox.ReadOnly = True
        End While
        SQLcommand.Dispose()
        SQLconnection.Close()
    End Sub
```

2.6 EEG plot from CSV file

```
    Private Sub EEGButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles EEGButton.Click
        If PatientIDTextBox.Text = "" Then
            MessageBox.Show(Me, "Please enter patient ID", "EEG Plotting",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
        Try
            Dim test As Integer = CInt(PatientIDTextBox.Text)
        Catch ex As Exception
```

```
            MessageBox.Show(Me, "Please enter valid ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End Try
        'Dim GraphsForm As EEGForm = New EEGForm
        'GraphsForm.PatientID = PatientIDTextBox.Text
        'GraphsForm.Show()
        EEGForm.PatientID = PatientIDTextBox.Text
        EEGForm.Show()
    End Sub

    Private Sub DeleteEntryButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles DeleteEntryButton.Click
        If PatientIDTextBox.Text = "" Then
            MessageBox.Show(Me, "Please enter patient ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
        Try
            Dim test As Integer = CInt(PatientIDTextBox.Text)
        Catch ex As Exception
            MessageBox.Show(Me, "Please enter valid ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End Try
```

```
        NewFormButton_Click(Nothing, Nothing)
        Try
            SQLconnection.ConnectionString = SQLConnectionString
            SQLconnection.Open()
            Dim SQLQuery As String = ""
            SQLQuery = "delete from Patient_Detail where ID=" + PatientIDTextBox.Text + ";"
            SQLcommand = New MySqlCommand(SQLQuery, SQLconnection)
            SQLcommand.CommandTimeout = 0
            SQLcommand.ExecuteReader()
        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()

        Try
            SQLconnection.Open()
            Dim SQLQuery = "delete from eeg where ID=" + PatientIDTextBox.Text + ";"
            SQLcommand = New MySqlCommand(SQLQuery, SQLconnection)
            SQLcommand.CommandTimeout = 0
            SQLcommand.ExecuteReader()
        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
```

```
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()
    End Sub

    Private Sub OpenCSVButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles OpenCSVButton.Click
        EEG_CSVForm.PatientID = PatientIDTextBox.Text
        EEG_CSVForm.Show()
    End Sub
```

2.7 Delete Entry

```
 Private Sub DeleteEntryButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles DeleteEntryButton.Click
        If PatientIDTextBox.Text = "" Then
            MessageBox.Show(Me, "Please enter patient ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End If
        Try
            Dim test As Integer = CInt(PatientIDTextBox.Text)
        Catch ex As Exception
```

```
            MessageBox.Show(Me, "Please enter valid ID", "Patient Details",
MessageBoxButtons.OK, MessageBoxIcon.Information)
            Exit Sub
        End Try
        NewFormButton_Click(Nothing, Nothing)
        Try
            SQLconnection.ConnectionString = SQLConnectionString
            SQLconnection.Open()
            Dim SQLQuery As String = ""
            SQLQuery = "delete from Patient_Detail where ID=" + PatientIDTextBox.Text + ";"
            SQLcommand = New MySqlCommand(SQLQuery, SQLconnection)
            SQLcommand.CommandTimeout = 0
            SQLcommand.ExecuteReader()
        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()

        Try
            SQLconnection.Open()
            Dim SQLQuery = "delete from eeg where ID=" + PatientIDTextBox.Text + ";"
            SQLcommand = New MySqlCommand(SQLQuery, SQLconnection)
            SQLcommand.CommandTimeout = 0
```

```
            SQLcommand.ExecuteReader()
        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
        SQLcommand.Dispose()
        SQLconnection.Close()
    End Sub
```

3. EEGForm - Contains code for receive sensor data (via serial port) and save to MySQL server

3.1 Initial Settings

```
Private Sub Form1_Load(ByVal sender As System.Object, ByVal e As System.EventArgs)
Handles MyBase.Load
        Me.Text = "EEG Graphs Patient ID #" + PatientID
        'Form7.ShowInTaskbar = True
        'Form7.ShowDialog()
        'If (Form7.authen = False) Then
        ' Me.Close()
        ' End If
        ' Form7.ShowInTaskbar = False
        'init()
```

```
'test()
'createdb()
'createtable()
'PatientDetailForm.ShowDialog()
Dim mypane As GraphPane = ZedGraphControl1.GraphPane
mycurve1 = mypane.AddCurve("IO1", list1, Color.Red, SymbolType.None)
Graph(ZedGraphControl1, ZedGraphControl1.GraphPane, mycurve1, "EEG 1", 50)

mypane = ZedGraphControl2.GraphPane
mycurve2 = mypane.AddCurve("IO2", list2, Color.Red, SymbolType.None)
Graph(ZedGraphControl2, ZedGraphControl2.GraphPane, mycurve2, "EEG 2", 50)

mypane = ZedGraphControl3.GraphPane
mycurve3 = mypane.AddCurve("IO3", list3, Color.Red, SymbolType.None)
Graph(ZedGraphControl3, ZedGraphControl3.GraphPane, mycurve3, "EEG 3", 50)

mypane = ZedGraphControl4.GraphPane
mycurve4 = mypane.AddCurve("IO4", list4, Color.Red, SymbolType.None)
Graph(ZedGraphControl4, ZedGraphControl4.GraphPane, mycurve4, "EEG 4", 50)

mypane = ZedGraphControl5.GraphPane
mycurve5 = mypane.AddCurve("IO5", list5, Color.Red, SymbolType.None)
Graph(ZedGraphControl5, ZedGraphControl5.GraphPane, mycurve5, "EEG 5", 50)

mypane = ZedGraphControl6.GraphPane
```

```
mycurve6 = mypane.AddCurve("IO6", list5, Color.Red, SymbolType.None)
Graph(ZedGraphControl6, ZedGraphControl6.GraphPane, mycurve6, "EEG 6", 50)

mypane = ZedGraphControl7.GraphPane
mycurve7 = mypane.AddCurve("IO7", list7, Color.Red, SymbolType.None)
Graph(ZedGraphControl7, ZedGraphControl7.GraphPane, mycurve7, "EEG 7", 50)

mypane = ZedGraphControl8.GraphPane
mycurve8 = mypane.AddCurve("IO8", list8, Color.Red, SymbolType.None)
Graph(ZedGraphControl8, ZedGraphControl8.GraphPane, mycurve8, "EEG 8", 50)

ZedGraphControl1.GraphPane.Title.Text = PatientDetailForm.EEGName1
ZedGraphControl2.GraphPane.Title.Text = PatientDetailForm.EEGName2
ZedGraphControl3.GraphPane.Title.Text = PatientDetailForm.EEGName3
ZedGraphControl4.GraphPane.Title.Text = PatientDetailForm.EEGName4
ZedGraphControl5.GraphPane.Title.Text = PatientDetailForm.EEGName5
ZedGraphControl6.GraphPane.Title.Text = PatientDetailForm.EEGName6
ZedGraphControl7.GraphPane.Title.Text = PatientDetailForm.EEGName7
ZedGraphControl8.GraphPane.Title.Text = PatientDetailForm.EEGName8

table.Columns.Item(2).HeaderText = PatientDetailForm.EEGName1
table.Columns.Item(3).HeaderText = PatientDetailForm.EEGName2
table.Columns.Item(4).HeaderText = PatientDetailForm.EEGName3
table.Columns.Item(5).HeaderText = PatientDetailForm.EEGName4
table.Columns.Item(6).HeaderText = PatientDetailForm.EEGName5
```

```
        table.Columns.Item(7).HeaderText = PatientDetailForm.EEGName6
        table.Columns.Item(8).HeaderText = PatientDetailForm.EEGName7
        table.Columns.Item(9).HeaderText = PatientDetailForm.EEGName8
    End Sub


    'Public Sub loadaddress()
    '    Dim FILE_NAME As String = Application.StartupPath + "\address.txt"
    '    Dim T(10) As String
    '    Dim i As Integer = 0
    '    If System.IO.File.Exists(FILE_NAME) = True Then
    '        Dim objReader As New System.IO.StreamReader(FILE_NAME)
    '        Do While i <> 10
    '            T(i) = objReader.ReadLine()
    '            address(i) = T(i)
    '            i = i + 1
    '        Loop
    '        objReader.Close()
    '    Else
    '        MessageBox.Show(Me, "File 'address.txt' Does Not Exist", "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error)
    '    End If
    'End Sub
```

```
    Public Sub setgraph(ByVal zed As ZedGraphControl, ByVal mypane As GraphPane,
ByVal mycurve As LineItem, ByVal adc As String, ByVal range As Integer)
        mypane.Title.Text = adc + " vs Time"
        mypane.YAxis.Title.Text = adc
        mycurve.Label.Text = adc
        mypane.YAxis.Scale.Max = range
    End Sub


    Public Sub Graph(ByVal zed As ZedGraphControl, ByVal mypane As GraphPane,
ByVal mycurve As LineItem, ByVal ADC As String, ByVal range As Integer)
        'Dim myPane As GraphPane = ZedGraphControl1.GraphPane
        mypane.Title.FontSpec.FontColor = Color.Black
        mypane.Legend.Position = ZedGraph.LegendPos.Bottom
        mypane.Legend.FontSpec.Size = 16
        mypane.Legend.FontSpec.IsBold = True
        'myPane.CurveList.Clear()
        mypane.Title.Text = ADC + " vs Time"
        mypane.XAxis.Title.Text = "Time"
        mypane.YAxis.Title.Text = ADC
        set_scale(mypane, range)

        'myCurve = myPane.AddCurve("ADC1", list1, Color.Red, SymbolType.None)
        'set_line(myCurve)
        mycurve.Label.Text = ADC
```

```
    set_line(mycurve)


    zed.IsAutoScrollRange = False
    zed.IsShowHScrollBar = True
    zed.IsSynchronizeXAxes = True
    zed.IsSynchronizeYAxes = True
    'ZedGraphControl1.IsAntiAlias = True
    zed.Refresh()
    zed.AxisChange()
End Sub



Private Sub set_scale(ByVal grph As GraphPane, ByVal range As Integer)
    With grph
        .XAxis.Title.Text = "Time"
        .XAxis.Type = AxisType.Date
        .XAxis.Scale.Format = "HH:mm:ss"
        .XAxis.Scale.MajorUnit = DateUnit.Hour
        .XAxis.Scale.MinorUnit = DateUnit.Second
        .XAxis.Scale.MinorStep = 1
        '.XAxis.Scale.MajorStep = 1
        '.XAxis.Scale.Min = New XDate(DateTime.Now)
        '.XAxis.Scale.Max = New XDate(DateTime.Now.AddHours(24))
        '.XAxis.MajorTic.IsBetweenLabels = True
        '.XAxis.MinorTic.Size = 0
```

```
        '.XAxis.MajorTic.IsInside = False
        '.XAxis.MajorTic.IsOutside = True
        .XAxis.Scale.FontSpec.IsBold = True
        .XAxis.Scale.FontSpec.Size = 14
        '.XAxis.Scale.Min = 0
        '.XAxis.Scale.Max = 100
        .YAxis.Scale.Min = -5
        .YAxis.Scale.Max = range
        '.YAxis.Scale.MajorStep = 10
        .YAxis.Scale.MinorStep = 1
        .Title.FontSpec.Size = 18

        .Title.FontSpec.IsBold = True
        .YAxis.Scale.FontSpec.IsBold = True
        .YAxis.Scale.FontSpec.Size = 14
    End With
End Sub



Private Sub set_line(ByVal lne As LineItem)
    With lne.Line
        ''.IsAntiAlias = True
        .IsSmooth = True
        .Width = 2.0
    End With
```

```
End Sub
```

3.2 Receive the data from serial port in a string format

```
Private Sub SerialPort1_DataReceived1(ByVal sender As Object, ByVal e As
System.IO.Ports.SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived
    Dim str As String = SerialPort1.ReadExisting
    System.Windows.Forms.Form.CheckForIllegalCrossThreadCalls = False
    'Display(str)
    'Dim str1 As String
    'str1 = StrToHex(str)
    'TextBox7.AppendText(str)
    ReceivedString = ReceivedString + StrToHex(str)
    Dim t As String
    Dim Len As Integer = 100
    Dim iii As Integer = ReceivedString.IndexOf("7E")
    If run Then
      If (iii >= 0) Then
        If (ReceivedString.Substring(iii).Length >= 6) Then
          Dim tempstr As String = ReceivedString.Substring(iii)
          If tempstr.StartsWith("7E") Then
            Len = Integer.Parse(ReceivedString.Substring(iii + 2, 4),
Globalization.NumberStyles.HexNumber) + 4
          Else
            ReceivedString = ""
```

```
                Exit Sub
            End If
        End If
        If (ReceivedString.Substring(iii).Length >= Len * 2) Then
            Display(ReceivedString.Substring(iii, Len * 2))
            ReceivedString = ""
            Len = 100
        End If
        If (ReceivedString.Length > 200) Then ReceivedString = ""
    End If
End If
End Sub
```

3.3 Break the data to get analog data to display and plot the values (8 channels)

```
Public Sub Display(ByVal ReceivedString As String)
CheckForIllegalCrossThreadCalls = False
Dim addstring As String = ""
addstring = ReceivedString.Substring(16, 8)
If addstring = PatientDetailForm.MacAddress1 Then
    Try
        ADC1 = (CDbl(Long.Parse(ReceivedString.Substring(38, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
```

```
            ADC2 = (CDbl(Long.Parse(ReceivedString.Substring(42, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
            ADC3 = (CDbl(Long.Parse(ReceivedString.Substring(46, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
            ADC4 = (CDbl(Long.Parse(ReceivedString.Substring(50, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
        Catch
        End Try
    ElseIf addstring = PatientDetailForm.MacAddress2 Then
        Try
            ADC5 = (CDbl(Long.Parse(ReceivedString.Substring(38, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
            ADC6 = (CDbl(Long.Parse(ReceivedString.Substring(42, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
            ADC7 = (CDbl(Long.Parse(ReceivedString.Substring(46, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
            ADC8 = (CDbl(Long.Parse(ReceivedString.Substring(50, 4),
Globalization.NumberStyles.HexNumber)) * 1.2) / 1023
        Catch
        End Try
    End If

    If log Then
        storetosql(ADC1, ADC2, ADC3, ADC4, ADC5, ADC6, ADC7, ADC8)
    End If
```

```
        Dim temp As String = Format(DateTime.Now, "yyyy-MM-dd HH:mm:ss").ToString
        Try
            If Me.InvokeRequired Then
                Me.BeginInvoke(New invokedelegate(AddressOf tablefill))
            Else
                table.Rows.Add(temp.Substring(0, 10), temp.Substring(10),
ADC1.ToString("000.000"), ADC2.ToString("000.000"), ADC3.ToString("000.000"),
ADC4.ToString("000.000"), ADC5.ToString("000.000"), ADC6.ToString("000.000"),
ADC7.ToString("000.000"), ADC8.ToString("000.000"))
            End If
            Dim tt As XDate = New XDate(DateTime.Now)
            list1.Add(CDbl(tt), CDbl(ADC1))
            list2.Add(CDbl(tt), CDbl(ADC2))
            list3.Add(CDbl(tt), CDbl(ADC3))
            list4.Add(CDbl(tt), CDbl(ADC4))
            list5.Add(CDbl(tt), CDbl(ADC5))
            list6.Add(CDbl(tt), CDbl(ADC6))
            list7.Add(CDbl(tt), CDbl(ADC7))
            list8.Add(CDbl(tt), CDbl(ADC8))
            ZedGraphControl1.AxisChange()
            ZedGraphControl1.Refresh()
            ZedGraphControl2.AxisChange()
            ZedGraphControl2.Refresh()
            ZedGraphControl3.AxisChange()
            ZedGraphControl3.Refresh()
```

```
            ZedGraphControl4.AxisChange()
            ZedGraphControl4.Refresh()
            ZedGraphControl5.AxisChange()
            ZedGraphControl5.Refresh()
            ZedGraphControl6.AxisChange()
            ZedGraphControl6.Refresh()
            ZedGraphControl7.AxisChange()
            ZedGraphControl7.Refresh()
            ZedGraphControl8.AxisChange()
            ZedGraphControl8.Refresh()
        Catch ex As Exception
        End Try
    End Sub


    Public Sub tablefill()
        CheckForIllegalCrossThreadCalls = False
        Dim temp As String = Format(DateTime.Now, "yyyy-MM-dd HH:mm:ss").ToString
        table.Rows.Add(temp.Substring(0, 10), temp.Substring(10),
ADC1.ToString("000.000"), ADC2.ToString("000.000"), ADC3.ToString("000.000"),
ADC4.ToString("000.000"), ADC5.ToString("000.000"), ADC6.ToString("000.000"),
ADC7.ToString("000.000"), ADC8.ToString("000.000"))
    End Sub
```

3.4 Stores the data over MySQL DBMS to localhost (local PC)

```
Private Sub storetosql(ByVal a1 As Double, ByVal a2 As Double, ByVal a3 As Double, ByVal a4 As Double, ByVal a5 As Double, ByVal a6 As Double, ByVal a7 As Double, ByVal a8 As Double)
    OleDbConnection = New MySqlConnection
    OleDbConnection.ConnectionString = PatientDetailForm.SQLConnectionString
'"Database=vga;Data Source=localhost;User Id=root;Password=parmar;Allow User Variables=True;"
    Try
        OleDbConnection.Open()
        Dim dt As String = Format(DateTime.Now, "yyyy-MM-dd HH:mm:ss").ToString()
        Dim sql As String = "insert into EEG(datetime, ID, Data1, Data2, Data3, Data4, Data5, Data6, Data7, Data8 ) values('" & dt & "'," & PatientID & "," & a1.ToString("0.00") & "," & a2.ToString("0.00") & "," & a3.ToString("0.00") & "," & a4.ToString("0.00") & "," & a5.ToString("0.00") & "," & a6.ToString("0.00") & "," & a7.ToString("0.00") & "," & a8.ToString("0.00") & ");"
        Dim objCmd As New MySqlCommand
        objCmd = New MySqlCommand(sql, OleDbConnection)
        objCmd.ExecuteReader()
    Catch ex As Exception
        MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK, MessageBoxIcon.Error)
        log = 0
        LoggingMenu.Image = My.Resources.log_start
```

```
            LoggingMenu.Text = "Start &Logging"
        End Try
        OleDbConnection.Close()
    End Sub
```

4 SearchForm.vb - Search the old data stores over MySQL DBMS of specific data and time

4.1 Initial Settings

```
    Private Sub Form4_Load(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        mypane = ZedGraphControl1.GraphPane
        myCurve1 = mypane.AddCurve("IO1", list1, Color.Red, SymbolType.None)
        Graph(ZedGraphControl1, ZedGraphControl1.GraphPane, myCurve1, "IO1", 50)

        mypane = ZedGraphControl2.GraphPane
        myCurve2 = mypane.AddCurve("IO2", list2, Color.Red, SymbolType.None)
        Graph(ZedGraphControl2, ZedGraphControl2.GraphPane, myCurve2, "IO2", 50)

        mypane = ZedGraphControl3.GraphPane
        myCurve3 = mypane.AddCurve("IO3", list3, Color.Red, SymbolType.None)
        Graph(ZedGraphControl3, ZedGraphControl3.GraphPane, myCurve3, "IO3", 50)

        mypane = ZedGraphControl4.GraphPane
```

```
myCurve4 = mypane.AddCurve("IO4", list4, Color.Red, SymbolType.None)
Graph(ZedGraphControl4, ZedGraphControl4.GraphPane, myCurve4, "IO4", 50)

mypane = ZedGraphControl5.GraphPane
myCurve5 = mypane.AddCurve("IO5", list5, Color.Red, SymbolType.None)
Graph(ZedGraphControl5, ZedGraphControl5.GraphPane, myCurve5, "IO5", 50)

mypane = ZedGraphControl6.GraphPane
myCurve6 = mypane.AddCurve("IO6", list6, Color.Red, SymbolType.None)
Graph(ZedGraphControl6, ZedGraphControl6.GraphPane, myCurve6, "IO6", 50)

mypane = ZedGraphControl7.GraphPane
myCurve7 = mypane.AddCurve("IO7", list7, Color.Red, SymbolType.None)
Graph(ZedGraphControl7, ZedGraphControl7.GraphPane, myCurve7, "IO7", 50)

mypane = ZedGraphControl8.GraphPane
myCurve8 = mypane.AddCurve("IO8", list8, Color.Red, SymbolType.None)
Graph(ZedGraphControl8, ZedGraphControl8.GraphPane, myCurve8, "IO8", 50)

fromdatebox.Text = ""
todatebox.Text = ""
filterbox.Items.Add("Data/Second")
filterbox.Items.Add("Data/Minute")
filterbox.Items.Add("Data/Hour")
filterbox.Items.Add("Data/Day")
```

```
        filterbox.SelectedIndex = 0

        TabPage2.Text = PatientDetailForm.EEGName1
        TabPage3.Text = PatientDetailForm.EEGName2
        TabPage4.Text = PatientDetailForm.EEGName3
        TabPage5.Text = PatientDetailForm.EEGName4
        TabPage6.Text = PatientDetailForm.EEGName5
        TabPage7.Text = PatientDetailForm.EEGName6
        TabPage8.Text = PatientDetailForm.EEGName7
        TabPage9.Text = PatientDetailForm.EEGName8

        table.Columns.Item(2).HeaderText = PatientDetailForm.EEGName1
        table.Columns.Item(3).HeaderText = PatientDetailForm.EEGName2
        table.Columns.Item(4).HeaderText = PatientDetailForm.EEGName3
        table.Columns.Item(5).HeaderText = PatientDetailForm.EEGName4
        table.Columns.Item(6).HeaderText = PatientDetailForm.EEGName5
        table.Columns.Item(7).HeaderText = PatientDetailForm.EEGName6
        table.Columns.Item(8).HeaderText = PatientDetailForm.EEGName7
        table.Columns.Item(9).HeaderText = PatientDetailForm.EEGName8
    End Sub

    Public Sub Graph(ByVal zed As ZedGraphControl, ByVal mypane As GraphPane,
ByVal mycurve As LineItem, ByVal ADC As String, ByVal range As Integer)
        mypane.Title.FontSpec.FontColor = Color.Black
        myPane.Legend.Position = ZedGraph.LegendPos.Bottom
```

```
    myPane.Legend.FontSpec.Size = 16
    myPane.Legend.FontSpec.IsBold = True
    'myPane.CurveList.Clear()
    mypane.Title.Text = ADC + " vs Time"
    mypane.XAxis.Title.Text = "Time"
    mypane.YAxis.Title.Text = ADC
    set_scale(mypane, range)

    'myCurve = myPane.AddCurve("ADC1", list1, Color.Red, SymbolType.None)
    'set_line(myCurve)
    mycurve.Label.Text = ADC
    set_line(mycurve)

    zed.IsAutoScrollRange = False
    zed.IsShowHScrollBar = True
    zed.IsSynchronizeXAxes = True
    zed.IsSynchronizeYAxes = True
    'ZedGraphControl1.IsAntiAlias = True
    zed.Refresh()
    zed.AxisChange()
End Sub


Private Sub set_scale(ByVal grph As GraphPane, ByVal range As Integer)
    With grph
```

```
.XAxis.Title.Text = "Time"
.XAxis.Type = AxisType.Date
.XAxis.Scale.Format = "HH:mm:ss"
.XAxis.Scale.MajorUnit = DateUnit.Hour
.XAxis.Scale.MinorUnit = DateUnit.Second
.XAxis.Scale.MinorStep = 1
'.XAxis.Scale.MajorStep = 1
'.XAxis.Scale.Min = New XDate(DateTime.Now)
'.XAxis.Scale.Max = New XDate(DateTime.Now.AddHours(24))
'.XAxis.MajorTic.IsBetweenLabels = True
'.XAxis.MinorTic.Size = 0
'.XAxis.MajorTic.IsInside = False
'.XAxis.MajorTic.IsOutside = True
.XAxis.Scale.FontSpec.IsBold = True
.XAxis.Scale.FontSpec.Size = 14
'.XAxis.Scale.Min = 0
'.XAxis.Scale.Max = 100
.YAxis.Scale.Min = -5
.YAxis.Scale.Max = range
'.YAxis.Scale.MajorStep = 10
.YAxis.Scale.MinorStep = 1
.Title.FontSpec.Size = 18

.Title.FontSpec.IsBold = True
.YAxis.Scale.FontSpec.IsBold = True
```

```
            .YAxis.Scale.FontSpec.Size = 14
        End With
    End Sub

    Private Sub set_line(ByVal lne As LineItem)
        With lne.Line
            ''.IsAntiAlias = True
            .IsSmooth = True
            .Width = 2.0
        End With
    End Sub

    Public Sub setgraph(ByVal zed As ZedGraphControl, ByVal mypane As GraphPane,
ByVal mycurve As LineItem, ByVal adc As String, ByVal range As Integer)
        mypane.Title.Text = adc + " vs Time"
        mypane.YAxis.Title.Text = adc
        mycurve.Label.Text = adc
        mypane.YAxis.Scale.Max = range
    End Sub
```

4.2 Select the data of date entered by user and displays it in graphical and tabular format

```
    Private Sub SearchButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles SearchButton.Click

        Dim ttemp1 As String = ""
        Dim ttemp2 As String = ""
        Dim dtemp1 As String = ""
        Dim dtemp2 As String = ""

        Try
            dtemp1 = DateTime.Parse(fromdatebox.Text).ToString("yyyy-MM-dd")
            dtemp2 = DateTime.Parse(todatebox.Text).ToString("yyyy-MM-dd")
            If fromtxtbox.Text <> "  :  :" Then DateTime.Parse(fromtxtbox.Text)
            If totxtbox.Text <> "  :  :" Then DateTime.Parse(totxtbox.Text)
        Catch
            MessageBox.Show(Me, "Please enter valid date and time", "Invalid Expression",
MessageBoxButtons.OK, MessageBoxIcon.Error)
            Exit Sub
        End Try

        If totxtbox.Text = "  :  :" Then
            ttemp2 = " 23:59:59"
        Else
            ttemp2 = " " + totxtbox.Text
        End If
```

```
        If fromtxtbox.Text = "  :  :" Then
            ttemp1 = " 00:00:00"
        Else
            ttemp1 = " " + fromtxtbox.Text
        End If

        Try
            'Dim filter As String = "0"
            If filterbox.SelectedIndex = 0 Then
                sql1 = "select * from EEG where datetime>='" + dtemp1 + ttemp1 + "' and
datetime<='" + dtemp2 + ttemp2 + "'"
            ElseIf filterbox.SelectedIndex = 1 Then
                sql1 = "select * from EEG where datetime>='" + dtemp1 + ttemp1 + "' and
datetime<='" + dtemp2 + ttemp2 + "' and second(time(datetime))=0"
            ElseIf filterbox.SelectedIndex = 2 Then
                sql1 = "select * from EEG where datetime>='" + dtemp1 + ttemp1 + "' and
datetime<='" + dtemp2 + ttemp2 + "' and minute(time(datetime))=0 and
second(time(datetime))=0"
            ElseIf filterbox.SelectedIndex = 3 Then
                sql1 = "select * from EEG where datetime>='" + dtemp1 + ttemp1 + "' and
datetime<='" + dtemp2 + ttemp2 + "'"
            End If

                If filterbox.SelectedIndex = 3 Then
```

```
            sql1 += " and ID like '" + EEGForm.PatientID.ToString + "' group by
date(datetime);"
            Else
            sql1 += " and ID like '" + EEGForm.PatientID.ToString + "';"
            End If

        Catch ex As Exception
            MessageBox.Show(Me, ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)
        End Try
        Dim fromstring As String = ""
        Dim tostring As String = ""
        Try
            fromstring = dtemp1.Substring(8, 2) + " " + MonthName(dtemp1.Substring(5, 2)) +
" " + dtemp1.Substring(0, 4)
            tostring = dtemp2.Substring(8, 2) + " " + MonthName(dtemp2.Substring(5, 2)) + "
" + dtemp2.Substring(0, 4)
        Catch
        End Try

        If dtemp1 = dtemp2 Then
            ZedGraphControl1.GraphPane.Title.Text = fromstring
            ZedGraphControl2.GraphPane.Title.Text = fromstring
            ZedGraphControl3.GraphPane.Title.Text = fromstring
            ZedGraphControl4.GraphPane.Title.Text = fromstring
```

```
    ZedGraphControl5.GraphPane.Title.Text = fromstring
    ZedGraphControl6.GraphPane.Title.Text = fromstring
    ZedGraphControl7.GraphPane.Title.Text = fromstring
    ZedGraphControl8.GraphPane.Title.Text = fromstring
Else
    ZedGraphControl1.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl2.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl3.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl4.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl5.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl6.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl7.GraphPane.Title.Text = fromstring + " - " + tostring
    ZedGraphControl8.GraphPane.Title.Text = fromstring + " - " + tostring
End If

table.Rows.Clear()
list1.Clear()
list2.Clear()
list3.Clear()
list4.Clear()
list5.Clear()
list6.Clear()
list7.Clear()
list8.Clear()
OleDbConnection = New MySqlConnection
```

```
        OleDbConnection.ConnectionString = PatientDetailForm.SQLConnectionString
'"Database=vga;Data Source=localhost;User Id=root;Password=parmar;Allow User
Variables=True;"
        If dtemp1 <> dtemp2 Then
            ZedGraphControl1.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl2.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl3.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl4.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl5.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl6.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl7.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
            ZedGraphControl8.GraphPane.XAxis.Scale.Format = "dd/MM/yyyy HH:mm:ss"
        Else
            ZedGraphControl1.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl2.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl3.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl4.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl5.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl6.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl7.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
            ZedGraphControl8.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
        End If
        LoadingProgressBar.Style = ProgressBarStyle.Marquee
        LoadingProgressBar.MarqueeAnimationSpeed = 30
        WaitPanel.Visible = True
```

```
        SearchThread = New Thread(AddressOf Search)
        SearchThread.IsBackground = True
        SearchThread.Start()
    End Sub



    Dim SearchThread As Thread
    Private Sub Search()
        CheckForIllegalCrossThreadCalls = False
        Try
            OleDbConnection.Open()
            Dim objCmd As New MySqlCommand
            objCmd = New MySqlCommand(sql1, OleDbConnection)
            objCmd.CommandTimeout = 0
            reader = objCmd.ExecuteReader()
            While reader.Read
                If Me.InvokeRequired Then Me.Invoke(New UpdateUIDelegate(AddressOf
UpdateUI))
            End While
        Catch ex As Exception
        End Try
        OleDbConnection.Close()
        ZedGraphControl1.AxisChange()
        ZedGraphControl1.Refresh()
        ZedGraphControl2.AxisChange()
```

```
        ZedGraphControl2.Refresh()
        ZedGraphControl3.AxisChange()
        ZedGraphControl3.Refresh()
        ZedGraphControl4.AxisChange()
        ZedGraphControl4.Refresh()
        ZedGraphControl5.AxisChange()
        ZedGraphControl5.Refresh()
        ZedGraphControl6.AxisChange()
        ZedGraphControl6.Refresh()
        ZedGraphControl7.AxisChange()
        ZedGraphControl7.Refresh()
        ZedGraphControl8.AxisChange()
        ZedGraphControl8.Refresh()
        WaitPanel.Visible = False
    End Sub


    Private Delegate Sub UpdateUIDelegate()
    Private Sub UpdateUI()
        table.Rows.Add(DateTime.Parse(reader.GetString(0)).ToString("yyyy-MM-dd"),
DateTime.Parse(reader.GetString(0)).ToString("HH:mm:ss"), reader.GetString(2),
reader.GetString(3), reader.GetString(4), reader.GetString(5), reader.GetString(6),
reader.GetString(7), reader.GetString(8), reader.GetString(9))
        Dim tt As DateTime
        If fromtxtbox.Text <> totxtbox.Text Then
```

```
            tt = DateTime.Parse(reader.GetDateTime(0).ToString("yyyy-MM-dd HH:mm:ss"))
        Else
            tt = DateTime.Parse(reader.GetDateTime(0).ToString("HH:mm:ss"))
        End If
        list1.Add(tt.ToOADate(), CDbl(reader.GetString(2)))
        list2.Add(tt.ToOADate(), CDbl(reader.GetString(3)))
        list3.Add(tt.ToOADate(), CDbl(reader.GetString(4)))
        list4.Add(tt.ToOADate(), CDbl(reader.GetString(5)))
        list5.Add(tt.ToOADate(), CDbl(reader.GetString(6)))
        list6.Add(tt.ToOADate(), CDbl(reader.GetString(7)))
        list7.Add(tt.ToOADate(), CDbl(reader.GetString(8)))
        list8.Add(tt.ToOADate(), CDbl(reader.GetString(9)))
    End Sub
```

5 Data Analysis

```
 Dim ScanTime As Integer = 60
    Private Sub ScanTimeTextBox_TextChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles ScanTimeTextBox.TextChanged
        Try
            ScanTime = CInt(ScanTimeTextBox.Text)
            If ScanTime < 10 Then Throw New Exception("Data not in range")
            ScanTimeTextBox.BackColor = Color.White
        Catch ex As Exception
```

```
            ScanTime = 60
            ScanTimeTextBox.BackColor = Color.Red
        End Try
    End Sub



    Dim ScanCount As Integer = 0
    Private Sub ScanTimer_Tick(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles ScanTimer.Tick
        ScanCount += 1
        If ScanCount >= ScanTime Then
            run = True
            StartStopMenu_Click(Nothing, Nothing)
        End If
        ScanProgressBar.Value = ScanCount
        TimeLabel.Text = ScanCount & " / " & ScanTime & " Second"
        TimeLabel.Left = ScanProgressBar.Right - TimeLabel.Width
        If ScanCount > 1 Then TimeLabel.Text += "s"
    End Sub



 Private Sub CalculateResult()
        Dim AverageCount As Integer = 0
```

```
        Dim TotalEEGEnabled As Integer = 0
        Dim TempEEGGraph As EEGGraph.EEGGraph
        For i = 1 To 8
            TempEEGGraph = CType(plot.Controls("EegGraph" & i), EEGGraph.EEGGraph)
            If TempEEGGraph.IsEnabled = True Then
                AverageCount += TempEEGGraph.CountPercentage
                TotalEEGEnabled += 1
            End If
        Next
        Dim EEGString As String = "EEG"
        If TotalEEGEnabled > 1 Then EEGString += "s"
        AverageCount = AverageCount / TotalEEGEnabled
        AverageCountLabel.Text = "Average Count (" & TotalEEGEnabled & " " +
EEGString + ")" + Environment.NewLine & AverageCount & "%"
        AverageCountLabel.Left = ResultPanel.Width / 2 - AverageCountLabel.Width / 2
    End Sub



 Dim PreviousYValue As Double
    Dim xMin, xMax As Double
    Public Sub AddPoint(ByVal x As Double, ByVal y As Double)
        If x > ZedGraphControl1.GraphPane.XAxis.Scale.Max Then
            xMin = DateTime.Now.ToOADate()
            xMax = DateTime.Now.AddMinutes(1).ToOADate()
            ZedGraphControl1.GraphPane.XAxis.Scale.Min = xMin
```

```
            ZedGraphControl1.GraphPane.XAxis.Scale.Max = xMax
            LpThLineItem.Clear()
            LpThLineItem.AddPoint(ZedGraphControl1.GraphPane.XAxis.Scale.Min,
LThUpDown.Value)
            LpThLineItem.AddPoint(ZedGraphControl1.GraphPane.XAxis.Scale.Max,
LThUpDown.Value)
            UpThLineItem.Clear()
            UpThLineItem.AddPoint(ZedGraphControl1.GraphPane.XAxis.Scale.Min,
UThUpDown.Value)
            UpThLineItem.AddPoint(ZedGraphControl1.GraphPane.XAxis.Scale.Max,
UThUpDown.Value)
        End If
        'ZedGraphControl1.GraphPane.XAxis.Scale.Min = DateTime.Now.ToOADate()
        'ZedGraphControl1.GraphPane.XAxis.Scale.Max =
DateTime.Now.AddMinutes(1).ToOADate()
        If (y >= UThUpDown.Value And PreviousYValue <= UThUpDown.Value) Or (y <=
UThUpDown.Value And PreviousYValue >= UThUpDown.Value) Then
            Crossed += 1
        End If
        If (y >= LThUpDown.Value And PreviousYValue <= LThUpDown.Value) Or (y <=
LThUpDown.Value And PreviousYValue >= LThUpDown.Value) Then
            Crossed += 1
        End If
        CrossingLabel.Text = Crossed & " Crossings"
        MyLineItem.AddPoint(x, y)
```

```
    ZedGraphControl1.RestoreScale(ZedGraphControl1.GraphPane)
    ZedGraphControl1.GraphPane.XAxis.Scale.Format = "HH:mm:ss"
    ZedGraphControl1.GraphPane.XAxis.Scale.Min = xMin
    ZedGraphControl1.GraphPane.XAxis.Scale.Max = xMax
    ZedGraphControl1.Refresh()
    PreviousYValue = y
End Sub
```

Appendix B: Sensors Data

Date	Time	S1	S2	S3	S4	S5	S6	S7	S8
6/5/2016	21:54:00	0.833	0.052	0.12	0.07	0.673	0.629	0.606	0.643
6/5/2016	21:54:00	0.833	0.052	0.118	0.073	0.604	0.643	0.663	0.663
6/5/2016	21:54:01	0.833	0.049	0.116	0.069	0.603	0.644	0.663	0.659
6/5/2016	21:54:01	0.833	0.052	0.118	0.074	0.601	0.652	0.676	0.642
6/5/2016	21:54:01	0.833	0.052	0.118	0.073	0.664	0.678	0.633	0.596
6/5/2016	21:54:01	0.833	0.052	0.118	0.073	0.659	0.676	0.639	0.605
6/5/2016	21:54:02	0.833	0.052	0.12	0.069	0.692	0.637	0.617	0.624
6/5/2016	21:54:02	0.833	0.052	0.12	0.073	0.622	0.619	0.656	0.692
6/5/2016	21:54:02	0.833	0.052	0.121	0.074	0.653	0.672	0.643	0.609
6/5/2016	21:54:03	0.833	0.052	0.12	0.074	0.662	0.624	0.608	0.65
6/5/2016	21:54:03	0.834	0.052	0.121	0.074	0.619	0.658	0.684	0.632
6/5/2016	21:54:03	0.833	0.052	0.12	0.074	0.686	0.63	0.606	0.637
6/5/2016	21:54:03	0.833	0.052	0.12	0.074	0.599	0.651	0.673	0.644
6/5/2016	21:54:03	0.833	0.052	0.12	0.074	0.664	0.678	0.635	0.598
6/5/2016	21:54:04	0.833	0.052	0.118	0.073	0.658	0.623	0.61	0.651
6/5/2016	21:54:04	0.833	0.052	0.12	0.073	0.601	0.652	0.677	0.642
6/5/2016	21:54:04	0.833	0.052	0.12	0.072	0.696	0.637	0.613	0.628
6/5/2016	21:54:04	0.833	0.052	0.12	0.072	0.601	0.645	0.666	0.655
6/5/2016	21:54:05	0.833	0.05	0.12	0.073	0.684	0.643	0.618	0.611
6/5/2016	21:54:05	0.833	0.05	0.12	0.072	0.63	0.605	0.64	0.669
6/5/2016	21:54:05	0.834	0.05	0.12	0.072	0.624	0.66	0.682	0.629
6/5/2016	21:54:05	0.833	0.052	0.12	0.073	0.693	0.633	0.61	0.632
6/5/2016	21:54:06	0.833	0.052	0.12	0.073	0.605	0.642	0.663	0.664
6/5/2016	21:54:06	0.833	0.052	0.12	0.073	0.667	0.674	0.63	0.587
6/5/2016	21:54:06	0.833	0.052	0.118	0.073	0.633	0.608	0.638	0.665
6/5/2016	21:54:06	0.833	0.052	0.12	0.073	0.642	0.664	0.658	0.616
6/5/2016	21:54:07	0.833	0.052	0.12	0.073	0.694	0.637	0.615	0.628
6/5/2016	21:54:07	0.833	0.052	0.12	0.073	0.624	0.609	0.651	0.684
6/5/2016	21:54:07	0.833	0.052	0.12	0.073	0.653	0.674	0.642	0.608
6/5/2016	21:54:07	0.833	0.052	0.12	0.073	0.656	0.623	0.611	0.652
6/5/2016	21:54:08	0.834	0.052	0.12	0.073	0.609	0.656	0.682	0.637
6/5/2016	21:54:08	0.834	0.052	0.12	0.073	0.682	0.645	0.619	0.605
6/5/2016	21:54:08	0.833	0.052	0.12	0.074	0.625	0.606	0.649	0.682
6/5/2016	21:54:09	0.834	0.052	0.12	0.073	0.645	0.665	0.652	0.613
6/5/2016	21:54:09	0.834	0.052	0.12	0.073	0.692	0.633	0.611	0.632
6/5/2016	21:54:09	0.833	0.052	0.12	0.073	0.605	0.642	0.663	0.664
6/5/2016	21:54:09	0.833	0.052	0.118	0.073	0.673	0.657	0.623	0.587
6/5/2016	21:54:09	0.834	0.05	0.118	0.072	0.63	0.605	0.64	0.667

6/5/2016	21:54:10	0.833	0.053	0.121	0.072	0.646	0.666	0.65	0.612
6/5/2016	21:54:10	0.833	0.052	0.124	0.075	0.657	0.624	0.61	0.652
6/5/2016	21:54:10	0.833	0.05	0.124	0.076	0.628	0.66	0.68	0.626
6/5/2016	21:54:11	0.834	0.055	0.126	0.081	0.687	0.631	0.608	0.636
6/5/2016	21:54:11	0.834	0.055	0.126	0.081	0.601	0.644	0.665	0.656
6/5/2016	21:54:11	0.833	0.053	0.126	0.077	0.67	0.667	0.626	0.582
6/5/2016	21:54:11	0.834	0.053	0.127	0.076	0.629	0.603	0.644	0.672
6/5/2016	21:54:12	0.834	0.053	0.122	0.075	0.642	0.664	0.659	0.616
6/5/2016	21:54:12	0.834	0.053	0.122	0.075	0.665	0.625	0.606	0.648
6/5/2016	21:54:12	0.834	0.052	0.116	0.073	0.598	0.646	0.667	0.651
6/5/2016	21:54:12	0.833	0.059	0.122	0.063	0.69	0.642	0.617	0.618
6/5/2016	21:54:13	0.834	0.059	0.135	0.067	0.624	0.606	0.65	0.682
6/5/2016	21:54:13	0.833	0.059	0.134	0.072	0.655	0.674	0.642	0.606
6/5/2016	21:54:13	0.833	0.059	0.134	0.072	0.643	0.618	0.628	0.659
6/5/2016	21:54:13	0.833	0.057	0.13	0.074	0.635	0.662	0.672	0.622
6/5/2016	21:54:13	0.834	0.054	0.129	0.073	0.692	0.633	0.61	0.633
6/5/2016	21:54:14	0.834	0.054	0.13	0.07	0.656	0.624	0.611	0.652
6/5/2016	21:54:14	0.834	0.054	0.13	0.07	0.623	0.61	0.651	0.685
6/5/2016	21:54:14	0.833	0.055	0.129	0.073	0.677	0.65	0.622	0.599
6/5/2016	21:54:14	0.834	0.053	0.133	0.072	0.616	0.633	0.659	0.684
6/5/2016	21:54:15	0.834	0.057	0.126	0.07	0.657	0.674	0.64	0.606
6/5/2016	21:54:15	0.834	0.055	0.128	0.074	0.623	0.612	0.652	0.687
6/5/2016	21:54:15	0.834	0.055	0.129	0.072	0.652	0.67	0.644	0.61
6/5/2016	21:54:16	0.833	0.057	0.133	0.075	0.678	0.626	0.604	0.642
6/5/2016	21:54:16	0.834	0.06	0.128	0.072	0.615	0.635	0.659	0.683
6/5/2016	21:54:16	0.834	0.06	0.128	0.072	0.648	0.666	0.649	0.612
6/5/2016	21:54:16	0.834	0.055	0.128	0.073	0.635	0.61	0.636	0.664
6/5/2016	21:54:16	0.834	0.063	0.127	0.073	0.66	0.679	0.637	0.601
6/5/2016	21:54:17	0.834	0.049	0.129	0.07	0.638	0.613	0.633	0.662
6/5/2016	21:57:57	0.835	0.086	0.134	0.107	0.677	0.65	0.621	0.599
6/5/2016	21:57:58	0.835	0.087	0.133	0.107	0.622	0.615	0.653	0.691
6/5/2016	21:57:58	0.835	0.087	0.133	0.107	0.667	0.659	0.623	0.582
6/5/2016	21:57:58	0.835	0.087	0.134	0.107	0.617	0.629	0.658	0.687
6/5/2016	21:57:58	0.835	0.086	0.134	0.107	0.665	0.677	0.63	0.59
6/5/2016	21:57:58	0.835	0.087	0.134	0.107	0.642	0.617	0.628	0.66
6/5/2016	21:57:59	0.835	0.087	0.134	0.107	0.63	0.66	0.678	0.623
6/5/2016	21:57:59	0.835	0.087	0.134	0.107	0.652	0.622	0.612	0.655
6/5/2016	21:57:59	0.835	0.087	0.134	0.108	0.645	0.666	0.649	0.611
6/5/2016	21:57:59	0.835	0.087	0.134	0.107	0.645	0.619	0.623	0.658
6/5/2016	21:58:00	0.835	0.087	0.134	0.107	0.625	0.659	0.683	0.626
6/5/2016	21:58:00	0.835	0.087	0.134	0.107	0.679	0.628	0.602	0.64
6/5/2016	21:58:00	0.835	0.087	0.134	0.107	0.598	0.645	0.666	0.651

6/5/2016	21:58:00	0.835	0.086	0.134	0.107	0.67	0.666	0.624	0.581
6/5/2016	21:58:01	0.835	0.087	0.134	0.108	0.624	0.605	0.65	0.683
6/5/2016	21:58:01	0.835	0.087	0.134	0.108	0.644	0.664	0.651	0.612
6/5/2016	21:58:01	0.835	0.087	0.134	0.107	0.648	0.621	0.619	0.657
6/5/2016	21:58:01	0.835	0.087	0.134	0.107	0.635	0.66	0.672	0.619
6/5/2016	21:58:01	0.835	0.087	0.133	0.107	0.666	0.625	0.603	0.648
6/5/2016	21:58:02	0.835	0.087	0.134	0.107	0.612	0.656	0.684	0.633
6/5/2016	21:58:02	0.835	0.087	0.134	0.108	0.655	0.623	0.61	0.653
6/5/2016	21:58:02	0.835	0.087	0.134	0.107	0.638	0.662	0.666	0.617
6/5/2016	21:58:03	0.835	0.087	0.134	0.107	0.646	0.621	0.621	0.657
6/5/2016	21:58:03	0.835	0.087	0.134	0.107	0.633	0.66	0.673	0.621
6/5/2016	21:58:03	0.835	0.087	0.134	0.107	0.664	0.624	0.604	0.649
6/5/2016	21:58:03	0.835	0.087	0.134	0.107	0.615	0.657	0.684	0.632
6/5/2016	21:58:04	0.835	0.087	0.134	0.107	0.685	0.63	0.604	0.638
6/5/2016	21:58:04	0.835	0.086	0.134	0.108	0.598	0.649	0.672	0.643
6/5/2016	21:58:04	0.835	0.087	0.134	0.107	0.655	0.623	0.609	0.652
6/5/2016	21:58:04	0.835	0.087	0.134	0.107	0.597	0.648	0.669	0.648
6/5/2016	21:58:05	0.835	0.087	0.134	0.107	0.677	0.648	0.619	0.599
6/5/2016	21:58:05	0.835	0.087	0.134	0.107	0.618	0.626	0.658	0.69
6/5/2016	21:58:05	0.835	0.087	0.134	0.107	0.664	0.679	0.632	0.594
6/5/2016	21:58:05	0.835	0.087	0.134	0.107	0.623	0.606	0.65	0.684
6/5/2016	21:58:06	0.835	0.087	0.134	0.107	0.667	0.671	0.626	0.582
6/5/2016	21:58:06	0.835	0.087	0.134	0.107	0.625	0.604	0.648	0.679
6/5/2016	21:58:06	0.835	0.087	0.134	0.108	0.651	0.671	0.643	0.608
6/5/2016	21:58:07	0.836	0.087	0.133	0.107	0.649	0.621	0.618	0.657
6/5/2016	21:58:07	0.835	0.087	0.134	0.107	0.601	0.652	0.676	0.64
6/5/2016	21:58:07	0.835	0.087	0.134	0.107	0.693	0.636	0.612	0.628
6/5/2016	21:58:07	0.835	0.086	0.134	0.108	0.599	0.65	0.673	0.643
6/5/2016	21:58:07	0.835	0.087	0.134	0.107	0.687	0.631	0.605	0.637
6/5/2016	21:58:08	0.835	0.087	0.134	0.107	0.598	0.65	0.672	0.643
6/5/2016	21:58:08	0.835	0.087	0.133	0.107	0.673	0.628	0.602	0.645
6/5/2016	21:58:08	0.835	0.087	0.134	0.107	0.625	0.659	0.682	0.626
6/5/2016	21:58:09	0.835	0.087	0.134	0.107	0.656	0.623	0.609	0.652
6/5/2016	21:58:09	0.835	0.087	0.134	0.107	0.604	0.653	0.679	0.638
6/5/2016	21:58:09	0.835	0.087	0.134	0.107	0.679	0.629	0.602	0.642
6/5/2016	21:58:09	0.835	0.087	0.134	0.108	0.601	0.652	0.677	0.64
6/5/2016	21:58:10	0.835	0.087	0.133	0.107	0.685	0.643	0.617	0.615
6/5/2016	21:58:10	0.835	0.087	0.133	0.107	0.623	0.606	0.65	0.683
6/5/2016	21:58:10	0.835	0.087	0.134	0.107	0.662	0.679	0.635	0.598
6/5/2016	21:58:10	0.835	0.086	0.134	0.107	0.625	0.603	0.646	0.678
6/5/2016	21:58:11	0.836	0.087	0.134	0.107	0.669	0.666	0.624	0.581
6/5/2016	21:58:11	0.835	0.087	0.133	0.107	0.637	0.611	0.633	0.663

6/5/2016	21:58:11	0.835	0.087	0.133	0.107	0.643	0.664	0.653	0.612
6/5/2016	21:58:11	0.835	0.087	0.133	0.107	0.642	0.617	0.628	0.66
6/5/2016	21:58:12	0.835	0.087	0.133	0.107	0.663	0.678	0.631	0.591
6/5/2016	21:58:12	0.835	0.087	0.134	0.107	0.621	0.617	0.655	0.692
6/5/2016	21:58:12	0.835	0.087	0.134	0.107	0.677	0.65	0.621	0.599
6/5/2016	21:58:13	0.835	0.087	0.134	0.107	0.602	0.642	0.663	0.659
6/5/2016	21:58:13	0.835	0.087	0.134	0.107	0.67	0.664	0.624	0.581
6/5/2016	21:58:13	0.835	0.087	0.134	0.107	0.646	0.619	0.621	0.657
6/5/2016	21:58:13	0.835	0.087	0.134	0.107	0.629	0.659	0.679	0.624
6/5/2016	21:58:14	0.835	0.087	0.134	0.107	0.693	0.635	0.611	0.631
6/5/2016	21:58:14	0.835	0.087	0.133	0.107	0.615	0.632	0.659	0.683
6/5/2016	21:58:14	0.836	0.087	0.134	0.107	0.669	0.666	0.625	0.581
6/5/2016	21:58:14	0.836	0.087	0.134	0.108	0.631	0.604	0.639	0.667
6/5/2016	21:58:15	0.836	0.087	0.134	0.108	0.644	0.674	0.639	0.605
6/5/2016	21:58:15	0.835	0.086	0.134	0.107	0.632	0.608	0.637	0.665
6/5/2016	21:58:15	0.835	0.087	0.133	0.107	0.636	0.662	0.669	0.618
6/5/2016	21:58:15	0.835	0.088	0.135	0.106	0.651	0.622	0.613	0.655
6/5/2016	21:58:15	0.835	0.088	0.135	0.106	0.622	0.658	0.683	0.629
6/5/2016	21:58:16	0.835	0.087	0.134	0.107	0.672	0.653	0.621	0.588
6/5/2016	21:58:16	0.835	0.087	0.135	0.106	0.622	0.612	0.652	0.689
6/5/2016	21:58:16	0.836	0.087	0.134	0.106	0.663	0.678	0.632	0.594
6/5/2016	21:58:16	0.835	0.088	0.135	0.106	0.64	0.616	0.629	0.66
6/5/2016	21:58:17	0.836	0.089	0.134	0.106	0.638	0.662	0.664	0.617
6/5/2016	21:58:17	0.836	0.087	0.134	0.106	0.649	0.622	0.617	0.656
6/5/2016	21:58:17	0.835	0.088	0.135	0.107	0.629	0.659	0.679	0.625
6/5/2016	21:58:18	0.835	0.088	0.135	0.107	0.679	0.628	0.603	0.64
6/5/2016	21:58:18	0.836	0.088	0.134	0.102	0.599	0.65	0.672	0.643
6/5/2016	21:58:18	0.836	0.083	0.133	0.103	0.689	0.639	0.616	0.622
6/5/2016	21:58:18	0.835	0.083	0.134	0.106	0.619	0.624	0.657	0.691
6/5/2016	21:58:19	0.836	0.084	0.137	0.108	0.662	0.679	0.635	0.597
6/5/2016	21:58:19	0.836	0.084	0.137	0.108	0.623	0.611	0.652	0.687
6/5/2016	21:58:19	0.836	0.091	0.136	0.103	0.655	0.673	0.64	0.606
6/5/2016	21:58:35	0.836	0.083	0.136	0.103	0.673	0.626	0.602	0.644
6/5/2016	21:58:35	0.836	0.083	0.136	0.103	0.603	0.653	0.678	0.638
6/5/2016	21:58:36	0.836	0.084	0.136	0.103	0.692	0.636	0.612	0.628
6/5/2016	21:58:36	0.836	0.086	0.134	0.106	0.629	0.658	0.68	0.625
6/5/2016	21:58:36	0.836	0.087	0.135	0.104	0.638	0.613	0.631	0.662
6/5/2016	21:58:36	0.836	0.087	0.135	0.104	0.642	0.663	0.655	0.613
6/5/2016	21:58:37	0.836	0.089	0.134	0.104	0.685	0.629	0.604	0.637
6/5/2016	21:58:37	0.836	0.088	0.14	0.102	0.609	0.655	0.682	0.636
6/5/2016	21:58:37	0.836	0.087	0.14	0.1	0.69	0.632	0.606	0.635
6/5/2016	21:58:37	0.836	0.081	0.129	0.101	0.603	0.652	0.678	0.639

6/5/2016	21:59:03	0.836	0.086	0.135	0.104	0.669	0.656	0.622	0.584
6/5/2016	21:59:03	0.836	0.086	0.135	0.106	0.616	0.631	0.659	0.684
6/5/2016	21:59:03	0.836	0.086	0.135	0.106	0.671	0.659	0.623	0.584
6/5/2016	21:59:03	0.836	0.086	0.135	0.104	0.598	0.645	0.667	0.649
6/5/2016	21:59:04	0.836	0.086	0.135	0.104	0.692	0.635	0.61	0.631
6/5/2016	21:59:04	0.838	0.086	0.135	0.106	0.618	0.626	0.657	0.69
6/5/2016	21:59:04	0.836	0.086	0.135	0.104	0.673	0.652	0.621	0.594
6/5/2016	21:59:04	0.836	0.086	0.135	0.106	0.601	0.642	0.664	0.657
6/5/2016	21:59:05	0.836	0.086	0.135	0.104	0.691	0.638	0.615	0.625
6/5/2016	21:59:05	0.836	0.086	0.135	0.104	0.598	0.648	0.67	0.646
6/5/2016	21:59:05	0.836	0.086	0.136	0.106	0.689	0.639	0.616	0.621
6/5/2016	21:59:05	0.836	0.086	0.135	0.106	0.606	0.653	0.68	0.637
6/5/2016	21:59:06	0.836	0.086	0.135	0.104	0.656	0.623	0.609	0.652
6/5/2016	21:59:06	0.836	0.086	0.135	0.104	0.644	0.664	0.651	0.612
6/5/2016	21:59:06	0.836	0.086	0.135	0.104	0.625	0.604	0.648	0.679
6/5/2016	21:59:06	0.836	0.087	0.135	0.104	0.666	0.673	0.628	0.584
6/5/2016	21:59:06	0.836	0.086	0.135	0.104	0.605	0.64	0.663	0.662
6/5/2016	21:59:07	0.836	0.086	0.135	0.104	0.69	0.632	0.608	0.635
6/5/2016	21:59:07	0.836	0.086	0.135	0.104	0.598	0.648	0.67	0.646
6/5/2016	21:59:07	0.836	0.086	0.135	0.106	0.69	0.632	0.606	0.635
6/5/2016	21:59:07	0.836	0.087	0.135	0.104	0.598	0.648	0.67	0.646
6/5/2016	21:59:08	0.836	0.086	0.135	0.106	0.678	0.644	0.618	0.604
6/5/2016	21:59:08	0.836	0.086	0.135	0.106	0.617	0.63	0.659	0.686
6/5/2016	21:59:08	0.836	0.086	0.135	0.106	0.677	0.648	0.619	0.602
6/5/2016	21:59:08	0.836	0.086	0.135	0.104	0.626	0.602	0.644	0.673
6/5/2016	21:59:09	0.838	0.086	0.136	0.106	0.667	0.667	0.625	0.581
6/5/2016	21:59:09	0.836	0.086	0.135	0.104	0.602	0.642	0.664	0.657
6/5/2016	21:59:09	0.836	0.086	0.135	0.104	0.678	0.645	0.618	0.603
6/5/2016	21:59:09	0.836	0.086	0.135	0.106	0.617	0.629	0.658	0.687
6/5/2016	21:59:09	0.836	0.086	0.135	0.106	0.674	0.65	0.621	0.597
6/5/2016	21:59:10	0.838	0.087	0.135	0.104	0.612	0.636	0.66	0.677
6/5/2016	21:59:10	0.838	0.087	0.135	0.104	0.68	0.645	0.619	0.606
6/5/2016	21:59:10	0.836	0.086	0.135	0.106	0.692	0.635	0.609	0.632
6/5/2016	21:59:10	0.836	0.086	0.136	0.106	0.601	0.651	0.676	0.64
6/5/2016	21:59:11	0.836	0.086	0.135	0.104	0.686	0.631	0.604	0.637
6/5/2016	21:59:11	0.836	0.086	0.135	0.104	0.626	0.659	0.682	0.625
6/5/2016	21:59:11	0.836	0.086	0.135	0.104	0.69	0.632	0.608	0.633
6/5/2016	21:59:11	0.836	0.086	0.135	0.106	0.601	0.651	0.677	0.64
6/5/2016	21:59:12	0.836	0.086	0.135	0.104	0.652	0.622	0.612	0.655
6/5/2016	21:59:12	0.836	0.087	0.135	0.104	0.638	0.662	0.666	0.617
6/5/2016	21:59:12	0.836	0.087	0.135	0.104	0.648	0.621	0.619	0.657
6/5/2016	21:59:12	0.838	0.086	0.135	0.106	0.642	0.663	0.656	0.613

6/5/2016	21:59:12	0.836	0.086	0.135	0.104	0.669	0.625	0.603	0.646
6/5/2016	21:59:13	0.836	0.086	0.135	0.106	0.625	0.658	0.683	0.626
6/5/2016	21:59:13	0.838	0.086	0.135	0.104	0.649	0.621	0.617	0.657
6/5/2016	21:59:13	0.838	0.086	0.135	0.104	0.649	0.669	0.645	0.61
6/5/2016	21:59:13	0.838	0.086	0.135	0.106	0.621	0.622	0.656	0.691
6/5/2016	21:59:14	0.836	0.084	0.135	0.104	0.671	0.658	0.622	0.585
6/5/2016	21:59:14	0.838	0.086	0.134	0.106	0.622	0.613	0.653	0.69
6/5/2016	21:59:14	0.838	0.086	0.134	0.106	0.646	0.666	0.648	0.61
6/5/2016	21:59:14	0.838	0.087	0.135	0.106	0.645	0.619	0.623	0.658
6/5/2016	21:59:15	0.838	0.086	0.133	0.106	0.635	0.66	0.673	0.619
6/5/2016	21:59:15	0.836	0.086	0.137	0.106	0.642	0.617	0.628	0.66
6/5/2016	21:59:15	0.838	0.086	0.135	0.106	0.655	0.674	0.64	0.605
6/5/2016	21:59:15	0.838	0.086	0.135	0.106	0.625	0.603	0.646	0.678
6/5/2016	21:59:15	0.836	0.086	0.135	0.106	0.664	0.677	0.63	0.588
6/5/2016	21:59:16	0.836	0.084	0.133	0.107	0.623	0.606	0.651	0.685
6/5/2016	21:59:16	0.838	0.086	0.135	0.104	0.659	0.679	0.636	0.601
6/5/2016	21:59:16	0.838	0.086	0.135	0.104	0.637	0.611	0.633	0.663
6/5/2016	21:59:17	0.838	0.087	0.136	0.106	0.651	0.671	0.643	0.608
6/5/2016	21:59:17	0.838	0.086	0.135	0.104	0.619	0.624	0.657	0.691
6/5/2016	21:59:17	0.838	0.083	0.134	0.106	0.678	0.648	0.619	0.603
6/5/2016	21:59:17	0.838	0.086	0.135	0.106	0.61	0.637	0.662	0.672
6/5/2016	21:59:17	0.838	0.086	0.135	0.106	0.66	0.678	0.636	0.599
6/5/2016	21:59:18	0.838	0.084	0.131	0.108	0.651	0.621	0.612	0.655
6/5/2016	21:59:18	0.838	0.086	0.133	0.107	0.598	0.645	0.667	0.649
6/5/2016	21:59:18	0.836	0.087	0.137	0.106	0.685	0.63	0.604	0.637
6/5/2016	21:59:18	0.836	0.087	0.137	0.106	0.606	0.655	0.682	0.637
6/5/2016	21:59:19	0.838	0.086	0.135	0.107	0.692	0.637	0.613	0.628
6/5/2016	21:59:19	0.836	0.088	0.133	0.106	0.605	0.653	0.68	0.637
6/5/2016	21:59:19	0.836	0.088	0.135	0.107	0.684	0.63	0.603	0.638
6/5/2016	21:59:19	0.838	0.086	0.134	0.107	0.605	0.64	0.663	0.664
6/5/2016	21:59:20	0.838	0.086	0.134	0.107	0.673	0.652	0.621	0.592
6/5/2016	21:59:20	0.836	0.086	0.134	0.107	0.621	0.617	0.655	0.692
6/5/2016	21:59:20	0.838	0.086	0.134	0.106	0.658	0.677	0.638	0.602
6/5/2016	21:59:43	0.838	0.047	0.109	0.075	0.637	0.612	0.632	0.663
6/5/2016	21:59:43	0.838	0.049	0.109	0.076	0.642	0.664	0.653	0.612
6/5/2016	21:59:43	0.838	0.048	0.113	0.081	0.632	0.606	0.637	0.665
6/5/2016	21:59:44	0.838	0.048	0.113	0.081	0.663	0.679	0.631	0.591
6/5/2016	21:59:44	0.838	0.05	0.103	0.077	0.621	0.622	0.657	0.692
6/5/2016	21:59:44	0.838	0.043	0.103	0.069	0.69	0.64	0.617	0.622
6/5/2016	21:59:44	0.838	0.046	0.115	0.073	0.604	0.653	0.679	0.638
6/5/2016	21:59:45	0.838	0.047	0.122	0.072	0.683	0.629	0.602	0.638
6/5/2016	21:59:45	0.838	0.047	0.122	0.072	0.64	0.662	0.659	0.615

6/5/2016	21:59:45	0.838	0.043	0.116	0.066	0.63	0.604	0.639	0.669
6/5/2016	21:59:45	0.838	0.053	0.116	0.073	0.659	0.679	0.637	0.601
6/5/2016	21:59:45	0.838	0.046	0.116	0.075	0.636	0.61	0.635	0.663
6/5/2016	21:59:46	0.838	0.046	0.116	0.075	0.665	0.674	0.628	0.584
6/5/2016	21:59:46	0.838	0.052	0.115	0.062	0.628	0.602	0.643	0.672
6/5/2016	21:59:46	0.838	0.048	0.111	0.077	0.652	0.672	0.642	0.606
6/5/2016	21:59:46	0.838	0.047	0.115	0.077	0.633	0.608	0.636	0.665
6/5/2016	21:59:47	0.838	0.05	0.116	0.073	0.655	0.674	0.64	0.605
6/5/2016	21:59:47	0.838	0.05	0.116	0.073	0.646	0.619	0.621	0.658
6/5/2016	21:59:47	0.838	0.054	0.127	0.059	0.648	0.667	0.646	0.61
6/5/2016	21:59:47	0.838	0.041	0.106	0.063	0.624	0.605	0.649	0.682
6/5/2016	22:01:17	0.834	0.049	0.114	0.081	0.667	0.624	0.605	0.648
6/5/2016	22:01:17	0.834	0.048	0.114	0.08	0.596	0.646	0.667	0.651
6/5/2016	22:01:17	0.834	0.048	0.114	0.08	0.694	0.632	0.609	0.631
6/5/2016	22:01:17	0.835	0.048	0.113	0.081	0.608	0.656	0.683	0.637
6/5/2016	22:01:18	0.835	0.05	0.113	0.081	0.657	0.623	0.611	0.652
6/5/2016	22:01:18	0.835	0.05	0.114	0.081	0.626	0.66	0.682	0.626
6/5/2016	22:01:18	0.835	0.05	0.114	0.081	0.677	0.626	0.603	0.644
6/5/2016	22:01:18	0.834	0.05	0.113	0.081	0.596	0.648	0.67	0.648
6/5/2016	22:01:40	0.835	0.049	0.115	0.08	0.598	0.651	0.674	0.644
6/5/2016	22:01:40	0.835	0.049	0.115	0.08	0.679	0.649	0.621	0.597
6/5/2016	22:01:40	0.835	0.05	0.115	0.08	0.597	0.648	0.67	0.649
6/5/2016	22:01:41	0.835	0.048	0.114	0.08	0.685	0.644	0.618	0.608
6/5/2016	22:01:41	0.835	0.049	0.117	0.077	0.599	0.643	0.665	0.657
6/5/2016	22:01:41	0.835	0.049	0.117	0.077	0.69	0.642	0.617	0.615
6/5/2016	22:01:41	0.835	0.049	0.115	0.079	0.605	0.639	0.663	0.667
6/5/2016	22:01:42	0.835	0.049	0.115	0.079	0.673	0.658	0.624	0.584
6/5/2016	22:01:42	0.835	0.048	0.115	0.077	0.63	0.603	0.642	0.671
6/5/2016	22:01:42	0.835	0.049	0.115	0.079	0.658	0.678	0.639	0.603
6/5/2016	22:01:42	0.835	0.049	0.115	0.079	0.64	0.613	0.631	0.662
6/5/2016	22:01:42	0.835	0.05	0.115	0.079	0.655	0.674	0.642	0.606
6/5/2016	22:01:43	0.835	0.05	0.115	0.079	0.636	0.609	0.636	0.664
6/5/2016	22:01:43	0.835	0.049	0.115	0.079	0.651	0.671	0.645	0.609
6/5/2016	22:01:43	0.835	0.049	0.115	0.079	0.624	0.606	0.65	0.684
6/5/2016	22:01:43	0.835	0.05	0.114	0.079	0.665	0.679	0.632	0.591
6/5/2016	22:01:44	0.835	0.05	0.115	0.079	0.635	0.608	0.637	0.665
6/5/2016	22:01:44	0.835	0.049	0.115	0.079	0.644	0.665	0.653	0.613
6/5/2016	22:01:44	0.835	0.049	0.115	0.079	0.646	0.619	0.625	0.658
6/5/2016	22:01:44	0.835	0.049	0.115	0.079	0.649	0.669	0.648	0.61
6/5/2016	22:01:45	0.835	0.049	0.115	0.079	0.64	0.613	0.631	0.662
6/5/2016	22:01:45	0.835	0.049	0.114	0.077	0.665	0.679	0.632	0.591
6/5/2016	22:01:45	0.835	0.049	0.115	0.079	0.622	0.616	0.655	0.692

6/5/2016	22:01:45	0.835	0.049	0.115	0.079	0.657	0.676	0.64	0.605
6/5/2016	22:01:45	0.835	0.049	0.114	0.077	0.622	0.615	0.655	0.692
6/5/2016	22:01:46	0.835	0.05	0.115	0.079	0.67	0.669	0.626	0.579
6/5/2016	22:01:46	0.835	0.049	0.115	0.077	0.622	0.617	0.656	0.692
6/5/2016	22:01:46	0.835	0.049	0.115	0.079	0.67	0.667	0.626	0.579
6/5/2016	22:01:46	0.835	0.049	0.115	0.079	0.612	0.635	0.66	0.68
6/5/2016	22:01:47	0.835	0.05	0.114	0.079	0.696	0.635	0.612	0.63
6/5/2016	22:01:47	0.835	0.049	0.115	0.077	0.598	0.651	0.674	0.644
6/5/2016	22:01:47	0.835	0.049	0.115	0.079	0.694	0.639	0.615	0.621
6/5/2016	22:01:47	0.835	0.049	0.115	0.079	0.601	0.652	0.678	0.642
6/5/2016	22:01:48	0.835	0.049	0.114	0.079	0.697	0.637	0.613	0.624
6/5/2016	22:01:48	0.835	0.049	0.115	0.077	0.605	0.639	0.663	0.667
6/5/2016	22:01:48	0.835	0.049	0.115	0.079	0.687	0.644	0.618	0.611
6/5/2016	22:01:48	0.835	0.049	0.114	0.077	0.596	0.648	0.67	0.649
6/5/2016	22:01:48	0.835	0.049	0.114	0.077	0.687	0.643	0.617	0.612
6/5/2016	22:01:49	0.835	0.05	0.115	0.079	0.613	0.633	0.66	0.683
6/5/2016	22:01:49	0.835	0.05	0.114	0.077	0.68	0.65	0.621	0.598
6/5/2016	22:01:49	0.835	0.05	0.114	0.077	0.599	0.644	0.666	0.656
6/5/2016	22:01:50	0.835	0.05	0.114	0.077	0.694	0.639	0.615	0.622
6/5/2016	22:01:50	0.835	0.05	0.115	0.079	0.625	0.659	0.682	0.628
6/5/2016	22:01:50	0.835	0.049	0.115	0.077	0.665	0.624	0.606	0.649
6/5/2016	22:01:50	0.835	0.05	0.115	0.077	0.649	0.667	0.648	0.611
6/5/2016	22:01:51	0.835	0.049	0.115	0.079	0.646	0.619	0.624	0.658
6/5/2016	22:01:51	0.835	0.049	0.115	0.079	0.636	0.662	0.671	0.621
6/5/2016	22:01:51	0.835	0.049	0.114	0.077	0.635	0.608	0.637	0.665
6/5/2016	22:01:51	0.835	0.048	0.115	0.077	0.658	0.678	0.639	0.603
6/5/2016	22:01:51	0.835	0.048	0.114	0.077	0.615	0.633	0.66	0.683
6/5/2016	22:01:52	0.835	0.048	0.114	0.077	0.694	0.64	0.617	0.621
6/5/2016	22:01:52	0.835	0.05	0.115	0.08	0.635	0.66	0.672	0.621
6/5/2016	22:01:52	0.835	0.05	0.115	0.077	0.643	0.616	0.629	0.66
6/5/2016	22:01:52	0.835	0.05	0.115	0.079	0.658	0.677	0.64	0.604
6/5/2016	22:01:53	0.835	0.049	0.114	0.077	0.621	0.622	0.657	0.692
6/5/2016	22:01:53	0.835	0.049	0.114	0.077	0.694	0.635	0.612	0.63
6/5/2016	22:01:53	0.835	0.049	0.114	0.077	0.601	0.652	0.677	0.642
6/5/2016	22:01:54	0.835	0.049	0.115	0.079	0.691	0.631	0.605	0.635
6/5/2016	22:01:54	0.835	0.049	0.115	0.079	0.597	0.65	0.672	0.646
6/5/2016	22:01:54	0.835	0.049	0.115	0.077	0.682	0.628	0.603	0.64
6/5/2016	22:01:54	0.835	0.049	0.114	0.077	0.633	0.66	0.674	0.623
6/5/2016	22:01:54	0.835	0.049	0.115	0.077	0.653	0.622	0.615	0.655
6/5/2016	22:01:55	0.835	0.05	0.111	0.076	0.629	0.66	0.679	0.625
6/5/2016	22:01:55	0.835	0.05	0.111	0.076	0.638	0.611	0.635	0.663
6/5/2016	22:01:55	0.835	0.049	0.115	0.073	0.672	0.663	0.624	0.581

6/5/2016	22:01:55	0.835	0.053	0.115	0.079	0.628	0.602	0.644	0.673
6/5/2016	22:01:56	0.835	0.049	0.114	0.075	0.645	0.666	0.652	0.612
6/5/2016	22:01:56	0.835	0.049	0.114	0.075	0.669	0.625	0.606	0.648
6/5/2016	22:01:56	0.835	0.055	0.116	0.073	0.624	0.659	0.683	0.629
6/5/2016	22:01:56	0.835	0.055	0.114	0.063	0.666	0.625	0.606	0.649
6/5/2016	22:01:56	0.835	0.057	0.107	0.06	0.626	0.659	0.682	0.628
6/5/2016	22:01:57	0.835	0.053	0.109	0.056	0.653	0.622	0.616	0.655
6/5/2016	22:01:57	0.835	0.053	0.109	0.056	0.623	0.659	0.683	0.629
6/5/2016	22:01:57	0.835	0.053	0.107	0.054	0.694	0.637	0.615	0.623
6/5/2016	22:01:57	0.835	0.054	0.103	0.05	0.61	0.637	0.662	0.676
6/5/2016	22:01:58	0.835	0.054	0.103	0.053	0.68	0.649	0.621	0.598
6/5/2016	22:01:58	0.835	0.054	0.103	0.053	0.61	0.656	0.684	0.636
6/5/2016	22:01:58	0.835	0.053	0.104	0.05	0.653	0.622	0.616	0.655
6/5/2016	22:01:58	0.835	0.053	0.104	0.05	0.635	0.662	0.673	0.622
6/5/2016	22:01:59	0.835	0.055	0.103	0.05	0.694	0.632	0.609	0.632
6/5/2016	22:01:59	0.835	0.042	0.104	0.039	0.63	0.66	0.678	0.625
6/5/2016	22:01:59	0.835	0.042	0.104	0.039	0.642	0.615	0.631	0.66
6/5/2016	22:01:59	0.835	0.053	0.11	0.081	0.644	0.665	0.653	0.613
6/5/2016	22:02:00	0.835	0.047	0.114	0.076	0.656	0.622	0.613	0.653
6/5/2016	22:02:00	0.835	0.047	0.113	0.074	0.63	0.66	0.678	0.624
6/5/2016	22:02:00	0.835	0.047	0.113	0.074	0.665	0.624	0.608	0.649
6/5/2016	22:02:00	0.835	0.049	0.111	0.074	0.624	0.659	0.683	0.629
6/5/2016	22:02:00	0.835	0.049	0.113	0.074	0.693	0.631	0.606	0.635
6/5/2016	22:02:01	0.835	0.048	0.114	0.074	0.601	0.652	0.677	0.643
6/5/2016	22:02:01	0.835	0.049	0.111	0.073	0.693	0.639	0.615	0.619
6/5/2016	22:02:01	0.835	0.049	0.111	0.073	0.598	0.65	0.674	0.645
6/5/2016	22:02:01	0.835	0.049	0.113	0.073	0.687	0.629	0.604	0.638
6/5/2016	22:02:02	0.835	0.048	0.114	0.073	0.605	0.64	0.663	0.667
6/5/2016	22:02:02	0.835	0.049	0.113	0.073	0.683	0.646	0.619	0.603
6/5/2016	22:02:02	0.835	0.049	0.113	0.073	0.624	0.609	0.651	0.686
6/5/2016	22:02:02	0.835	0.05	0.113	0.073	0.671	0.665	0.625	0.579
6/5/2016	22:02:02	0.835	0.048	0.113	0.072	0.615	0.632	0.66	0.684
6/5/2016	22:02:03	0.835	0.05	0.111	0.07	0.696	0.639	0.616	0.623
6/5/2016	22:02:03	0.835	0.048	0.111	0.07	0.609	0.637	0.662	0.674
6/5/2016	22:02:03	0.835	0.048	0.111	0.07	0.66	0.678	0.638	0.601
6/5/2016	22:02:03	0.835	0.054	0.108	0.068	0.649	0.621	0.622	0.657
6/5/2016	22:02:04	0.835	0.042	0.104	0.04	0.63	0.66	0.678	0.624
6/5/2016	22:02:04	0.835	0.057	0.102	0.055	0.642	0.615	0.63	0.66
6/5/2016	22:02:04	0.835	0.057	0.102	0.055	0.664	0.68	0.633	0.594
6/5/2016	22:02:04	0.835	0.054	0.102	0.052	0.626	0.602	0.645	0.676
6/5/2016	22:02:05	0.835	0.053	0.103	0.053	0.646	0.666	0.651	0.612
6/5/2016	22:02:05	0.835	0.054	0.102	0.053	0.644	0.617	0.629	0.66

6/5/2016	22:03:56	0.838	0.06	0.129	0.089	0.618	0.625	0.659	0.693
6/5/2016	22:03:56	0.838	0.06	0.129	0.089	0.667	0.68	0.632	0.59
6/5/2016	22:03:57	0.838	0.06	0.129	0.089	0.638	0.611	0.635	0.663
6/5/2016	22:03:57	0.838	0.06	0.129	0.089	0.657	0.676	0.643	0.605
6/5/2016	22:03:57	0.838	0.06	0.129	0.09	0.625	0.605	0.65	0.684
6/5/2016	22:03:57	0.838	0.06	0.129	0.09	0.664	0.682	0.636	0.596
6/5/2016	22:03:58	0.838	0.06	0.129	0.09	0.63	0.603	0.643	0.671
6/5/2016	22:03:58	0.838	0.06	0.129	0.09	0.676	0.658	0.624	0.583
6/5/2016	22:03:58	0.838	0.06	0.129	0.089	0.612	0.633	0.662	0.684
6/5/2016	22:03:58	0.838	0.06	0.129	0.088	0.676	0.658	0.624	0.583
6/5/2016	22:03:59	0.838	0.06	0.129	0.089	0.619	0.621	0.657	0.694
6/5/2016	22:03:59	0.838	0.06	0.129	0.089	0.676	0.658	0.624	0.583
6/5/2016	22:03:59	0.838	0.06	0.129	0.09	0.613	0.633	0.662	0.684
6/5/2016	22:03:59	0.838	0.061	0.129	0.089	0.694	0.632	0.61	0.633
6/5/2016	22:03:59	0.838	0.06	0.129	0.089	0.596	0.651	0.674	0.646
6/5/2016	22:04:00	0.838	0.06	0.129	0.089	0.694	0.631	0.606	0.635
6/5/2016	22:04:00	0.838	0.06	0.13	0.09	0.64	0.663	0.663	0.617
6/5/2016	22:04:00	0.838	0.06	0.129	0.09	0.657	0.622	0.613	0.653
6/5/2016	22:04:52	0.838	0.06	0.129	0.089	0.63	0.662	0.679	0.625
6/5/2016	22:04:52	0.838	0.06	0.129	0.09	0.699	0.637	0.613	0.624
6/5/2016	22:04:52	0.838	0.061	0.129	0.089	0.597	0.651	0.676	0.645
6/5/2016	22:04:52	0.838	0.061	0.13	0.09	0.645	0.617	0.629	0.66
6/5/2016	22:04:52	0.838	0.06	0.13	0.086	0.652	0.671	0.646	0.61
6/5/2016	22:04:52	0.838	0.06	0.13	0.086	0.628	0.602	0.645	0.676
6/5/2016	22:04:53	0.838	0.06	0.13	0.086	0.662	0.68	0.639	0.601
6/5/2016	22:04:54	0.838	0.059	0.13	0.089	0.635	0.608	0.637	0.665
6/5/2016	22:04:54	0.838	0.06	0.129	0.09	0.65	0.67	0.649	0.61
6/5/2016	22:04:55	0.838	0.06	0.129	0.089	0.638	0.61	0.636	0.664
6/5/2016	22:04:55	0.838	0.06	0.129	0.089	0.666	0.682	0.633	0.59
6/5/2016	22:04:55	0.838	0.06	0.129	0.09	0.624	0.606	0.652	0.687
6/5/2016	22:04:55	0.838	0.06	0.129	0.09	0.672	0.67	0.626	0.578
6/5/2016	22:04:56	0.838	0.06	0.128	0.089	0.599	0.643	0.666	0.659
6/5/2016	22:04:56	0.838	0.06	0.129	0.09	0.7	0.637	0.613	0.625
6/5/2016	22:04:56	0.838	0.06	0.128	0.089	0.611	0.636	0.662	0.68
6/5/2016	22:04:56	0.838	0.06	0.129	0.09	0.687	0.646	0.619	0.605
6/5/2016	22:04:57	0.838	0.06	0.129	0.09	0.612	0.635	0.662	0.683
6/5/2016	22:04:57	0.838	0.061	0.131	0.089	0.697	0.633	0.61	0.632
6/5/2016	22:04:57	0.838	0.062	0.131	0.089	0.623	0.66	0.684	0.629
6/5/2016	22:04:57	0.838	0.061	0.131	0.087	0.683	0.628	0.604	0.642
6/5/2016	22:04:58	0.838	0.061	0.131	0.087	0.597	0.646	0.667	0.655
6/5/2016	22:04:58	0.838	0.061	0.131	0.089	0.69	0.644	0.618	0.609
6/5/2016	22:04:58	0.838	0.06	0.13	0.088	0.61	0.636	0.662	0.679

6/5/2016	22:04:59	0.838	0.06	0.13	0.088	0.685	0.648	0.619	0.602
6/5/2016	22:04:59	0.838	0.06	0.131	0.088	0.622	0.616	0.656	0.693
6/5/2016	22:04:59	0.838	0.061	0.13	0.088	0.67	0.677	0.63	0.583
6/5/2016	22:04:59	0.838	0.061	0.131	0.088	0.605	0.639	0.664	0.67
6/5/2016	22:05:00	0.838	0.061	0.131	0.088	0.666	0.625	0.608	0.649
6/5/2016	22:05:00	0.838	0.061	0.131	0.089	0.653	0.672	0.645	0.609
6/5/2016	22:05:00	0.838	0.061	0.131	0.089	0.626	0.603	0.648	0.679
6/5/2016	22:05:01	0.838	0.061	0.13	0.089	0.673	0.663	0.625	0.579
6/5/2016	22:05:01	0.838	0.061	0.13	0.089	0.616	0.63	0.66	0.689
6/5/2016	22:05:01	0.838	0.06	0.131	0.089	0.676	0.66	0.624	0.581
6/5/2016	22:05:01	0.838	0.061	0.129	0.088	0.621	0.619	0.657	0.694
6/5/2016	22:05:02	0.838	0.061	0.129	0.089	0.671	0.673	0.628	0.579
6/5/2016	22:05:02	0.838	0.061	0.129	0.089	0.624	0.606	0.652	0.687
6/5/2016	22:05:02	0.838	0.061	0.131	0.089	0.666	0.68	0.633	0.59
6/5/2016	22:05:02	0.838	0.061	0.129	0.088	0.623	0.609	0.653	0.691
6/5/2016	22:05:02	0.838	0.061	0.13	0.088	0.669	0.678	0.63	0.584
6/5/2016	22:05:03	0.838	0.061	0.13	0.088	0.622	0.612	0.655	0.692
6/5/2016	22:05:03	0.838	0.061	0.13	0.088	0.674	0.663	0.624	0.579
6/5/2016	22:05:03	0.838	0.061	0.13	0.088	0.603	0.64	0.664	0.667
6/5/2016	22:05:03	0.838	0.061	0.13	0.089	0.659	0.623	0.613	0.653
6/5/2016	22:05:04	0.838	0.061	0.131	0.089	0.66	0.678	0.64	0.603
6/5/2016	22:05:04	0.838	0.061	0.131	0.089	0.626	0.602	0.646	0.678
6/5/2016	22:05:04	0.838	0.061	0.13	0.089	0.683	0.649	0.621	0.599
6/5/2016	22:05:04	0.838	0.061	0.13	0.089	0.621	0.621	0.657	0.694
6/5/2016	22:05:05	0.838	0.061	0.13	0.088	0.687	0.645	0.619	0.606
6/5/2016	22:05:05	0.838	0.061	0.13	0.088	0.597	0.645	0.667	0.656
6/5/2016	22:05:05	0.838	0.061	0.13	0.088	0.692	0.643	0.617	0.611
6/5/2016	22:05:05	0.838	0.061	0.13	0.089	0.617	0.63	0.66	0.69
6/5/2016	22:05:05	0.838	0.061	0.13	0.088	0.684	0.649	0.621	0.601
6/5/2016	22:05:06	0.838	0.061	0.13	0.089	0.621	0.618	0.657	0.694
6/5/2016	22:05:06	0.838	0.061	0.13	0.089	0.676	0.658	0.624	0.583
6/5/2016	22:05:06	0.838	0.061	0.13	0.089	0.597	0.651	0.676	0.645
6/5/2016	22:05:06	0.838	0.061	0.13	0.089	0.655	0.622	0.616	0.655
6/5/2016	22:05:07	0.838	0.06	0.13	0.089	0.65	0.67	0.648	0.61
6/5/2016	22:05:07	0.838	0.06	0.13	0.089	0.644	0.617	0.629	0.66
6/5/2016	22:05:07	0.838	0.06	0.13	0.089	0.651	0.671	0.648	0.61
6/5/2016	22:05:07	0.838	0.061	0.13	0.089	0.624	0.609	0.652	0.689
6/5/2016	22:05:08	0.838	0.061	0.13	0.089	0.672	0.67	0.626	0.577
6/5/2016	22:05:08	0.838	0.061	0.13	0.089	0.621	0.618	0.657	0.694
6/5/2016	22:05:08	0.838	0.061	0.13	0.089	0.664	0.682	0.637	0.598
6/5/2016	22:05:08	0.838	0.061	0.13	0.089	0.628	0.602	0.648	0.678
6/5/2016	22:05:08	0.838	0.061	0.129	0.088	0.672	0.67	0.626	0.577

6/5/2016	22:05:09	0.838	0.06	0.13	0.089	0.625	0.603	0.65	0.682
6/5/2016	22:05:09	0.838	0.061	0.13	0.089	0.68	0.652	0.622	0.594
6/5/2016	22:05:09	0.838	0.061	0.13	0.089	0.619	0.623	0.658	0.694
6/5/2016	22:05:09	0.838	0.061	0.13	0.089	0.674	0.662	0.624	0.579
6/5/2016	22:05:10	0.838	0.06	0.129	0.088	0.618	0.626	0.659	0.692
6/5/2016	22:05:10	0.838	0.061	0.13	0.089	0.671	0.674	0.629	0.581
6/5/2016	22:05:10	0.838	0.061	0.13	0.089	0.617	0.629	0.659	0.691
6/5/2016	22:05:10	0.838	0.061	0.13	0.089	0.699	0.638	0.616	0.623
6/5/2016	22:05:11	0.838	0.06	0.13	0.089	0.615	0.631	0.66	0.687
6/5/2016	22:05:11	0.838	0.06	0.13	0.089	0.691	0.644	0.619	0.611
6/5/2016	22:05:11	0.838	0.061	0.13	0.088	0.613	0.633	0.662	0.685
6/5/2016	22:05:11	0.838	0.061	0.13	0.088	0.674	0.664	0.625	0.578
6/5/2016	22:05:11	0.838	0.06	0.13	0.089	0.618	0.625	0.659	0.693
6/5/2016	22:05:12	0.838	0.059	0.13	0.089	0.696	0.642	0.618	0.617
6/5/2016	22:05:12	0.838	0.06	0.129	0.088	0.609	0.637	0.663	0.677
6/5/2016	22:05:13	0.838	0.06	0.129	0.088	0.685	0.648	0.619	0.601
6/5/2016	22:05:13	0.838	0.06	0.13	0.089	0.606	0.639	0.663	0.673
6/5/2016	22:05:13	0.838	0.061	0.13	0.089	0.678	0.655	0.623	0.587
6/5/2016	22:05:35	0.838	0.055	0.122	0.091	0.599	0.653	0.677	0.644
6/5/2016	22:05:36	0.838	0.055	0.122	0.091	0.676	0.662	0.624	0.579
6/5/2016	22:05:36	0.838	0.055	0.122	0.09	0.625	0.604	0.65	0.683
6/5/2016	22:05:36	0.838	0.055	0.121	0.09	0.667	0.68	0.632	0.59
6/5/2016	22:05:36	0.838	0.055	0.121	0.09	0.643	0.616	0.63	0.66
6/5/2016	22:05:37	0.838	0.055	0.12	0.09	0.625	0.66	0.683	0.629
6/5/2016	22:05:37	0.838	0.055	0.121	0.09	0.694	0.631	0.608	0.635
6/5/2016	22:05:37	0.838	0.055	0.12	0.09	0.597	0.646	0.667	0.655
6/5/2016	22:05:37	0.838	0.055	0.12	0.09	0.676	0.659	0.624	0.581
6/5/2016	22:05:38	0.838	0.056	0.12	0.089	0.621	0.619	0.657	0.693
6/5/2016	22:05:38	0.838	0.055	0.118	0.089	0.667	0.68	0.633	0.591
6/5/2016	22:05:38	0.838	0.054	0.118	0.09	0.629	0.602	0.645	0.676
6/5/2016	22:05:38	0.838	0.054	0.118	0.09	0.669	0.678	0.631	0.585
6/5/2016	22:05:39	0.838	0.054	0.12	0.09	0.632	0.604	0.64	0.669
6/5/2016	22:05:39	0.838	0.054	0.12	0.09	0.638	0.664	0.666	0.618
6/5/2016	22:05:39	0.838	0.054	0.118	0.09	0.696	0.632	0.609	0.632
6/5/2016	22:05:40	0.838	0.054	0.118	0.09	0.611	0.636	0.662	0.68
6/5/2016	22:05:40	0.838	0.054	0.118	0.089	0.689	0.644	0.619	0.609
6/5/2016	22:05:40	0.838	0.055	0.118	0.089	0.608	0.638	0.663	0.674
6/5/2016	22:05:40	0.838	0.053	0.12	0.09	0.682	0.651	0.622	0.595
6/5/2016	22:05:41	0.838	0.053	0.12	0.09	0.618	0.629	0.659	0.69
6/5/2016	22:05:41	0.838	0.054	0.118	0.09	0.673	0.664	0.625	0.578
6/5/2016	22:05:41	0.838	0.055	0.12	0.091	0.628	0.603	0.646	0.678
6/5/2016	22:05:41	0.838	0.054	0.12	0.09	0.669	0.678	0.631	0.585

6/5/2016	22:05:42	0.838	0.054	0.12	0.09	0.626	0.603	0.648	0.679
6/5/2016	22:05:42	0.838	0.054	0.118	0.09	0.644	0.666	0.656	0.615
6/5/2016	22:05:42	0.838	0.054	0.118	0.09	0.686	0.629	0.605	0.639
6/5/2016	22:05:43	0.838	0.054	0.118	0.09	0.605	0.64	0.663	0.67
6/5/2016	22:05:43	0.838	0.054	0.118	0.09	0.682	0.65	0.622	0.595
6/5/2016	22:05:43	0.838	0.054	0.118	0.089	0.626	0.603	0.648	0.679
6/5/2016	22:05:43	0.838	0.053	0.12	0.09	0.662	0.68	0.638	0.601
6/5/2016	22:05:43	0.838	0.054	0.118	0.09	0.643	0.616	0.63	0.66
6/5/2016	22:05:44	0.838	0.054	0.118	0.09	0.644	0.665	0.656	0.615
6/5/2016	22:05:44	0.838	0.055	0.12	0.089	0.689	0.629	0.606	0.638
6/5/2016	22:05:44	0.838	0.053	0.121	0.09	0.601	0.653	0.678	0.643
6/5/2016	22:05:44	0.838	0.054	0.117	0.09	0.699	0.636	0.612	0.628
6/5/2016	22:05:45	0.838	0.052	0.117	0.086	0.601	0.653	0.678	0.643
6/5/2016	22:05:45	0.838	0.052	0.117	0.086	0.692	0.643	0.617	0.612
6/5/2016	22:05:45	0.838	0.06	0.118	0.09	0.619	0.626	0.659	0.692
6/5/2016	22:05:45	0.838	0.055	0.12	0.09	0.65	0.669	0.649	0.611
6/5/2016	22:05:46	0.838	0.055	0.121	0.091	0.676	0.625	0.606	0.645
6/5/2016	22:05:46	0.838	0.055	0.121	0.091	0.621	0.622	0.657	0.693
6/5/2016	22:05:46	0.838	0.056	0.121	0.091	0.648	0.667	0.651	0.612
6/5/2016	22:05:46	0.838	0.052	0.121	0.09	0.663	0.624	0.611	0.651
6/5/2016	22:05:46	0.838	0.054	0.127	0.081	0.635	0.662	0.676	0.623
6/5/2016	22:05:47	0.838	0.062	0.131	0.081	0.655	0.623	0.617	0.655
6/5/2016	22:05:47	0.838	0.062	0.131	0.081	0.639	0.663	0.665	0.618
6/5/2016	22:05:47	0.838	0.066	0.134	0.08	0.662	0.624	0.61	0.651
6/5/2016	22:05:47	0.838	0.061	0.131	0.089	0.597	0.646	0.667	0.656
6/5/2016	22:05:48	0.838	0.063	0.131	0.084	0.678	0.655	0.623	0.587
6/5/2016	22:05:48	0.838	0.063	0.131	0.084	0.631	0.604	0.642	0.669
6/5/2016	22:05:48	0.838	0.062	0.133	0.088	0.643	0.665	0.659	0.616
6/5/2016	22:05:49	0.838	0.061	0.133	0.088	0.696	0.632	0.609	0.632
6/5/2016	22:05:49	0.838	0.061	0.133	0.088	0.608	0.639	0.663	0.673
6/5/2016	22:05:49	0.838	0.061	0.133	0.088	0.666	0.68	0.636	0.596
6/5/2016	22:05:49	0.838	0.062	0.131	0.088	0.656	0.622	0.616	0.655
6/5/2016	22:05:49	0.838	0.061	0.131	0.088	0.596	0.648	0.67	0.652
6/5/2016	22:05:50	0.838	0.062	0.131	0.088	0.687	0.645	0.619	0.606
6/5/2016	22:05:50	0.838	0.062	0.131	0.088	0.628	0.603	0.646	0.677
6/5/2016	22:05:50	0.838	0.062	0.131	0.088	0.637	0.663	0.671	0.621
6/5/2016	22:05:51	0.838	0.062	0.131	0.088	0.677	0.626	0.605	0.644
6/5/2016	22:05:51	0.838	0.061	0.133	0.088	0.608	0.639	0.663	0.674
6/5/2016	22:05:51	0.838	0.061	0.133	0.088	0.672	0.672	0.629	0.581
6/5/2016	22:05:51	0.838	0.062	0.131	0.088	0.646	0.618	0.626	0.658
6/5/2016	22:05:52	0.838	0.062	0.133	0.088	0.597	0.646	0.667	0.656
6/5/2016	22:07:23	0.836	0.061	0.131	0.093	0.672	0.67	0.628	0.579

6/5/2016	22:07:23	0.836	0.062	0.13	0.09	0.615	0.632	0.66	0.686
6/5/2016	22:07:24	0.836	0.062	0.13	0.089	0.67	0.678	0.631	0.585
6/5/2016	22:07:24	0.836	0.061	0.131	0.09	0.629	0.602	0.645	0.674
6/5/2016	22:07:24	0.836	0.061	0.131	0.089	0.639	0.664	0.667	0.619
6/5/2016	22:07:24	0.836	0.061	0.131	0.089	0.699	0.633	0.61	0.63
6/5/2016	22:07:25	0.836	0.061	0.131	0.089	0.597	0.645	0.667	0.657
6/5/2016	22:07:25	0.836	0.062	0.13	0.089	0.673	0.67	0.626	0.579
6/5/2016	22:07:25	0.836	0.061	0.131	0.09	0.63	0.602	0.643	0.671
6/5/2016	22:07:25	0.836	0.061	0.13	0.09	0.657	0.676	0.644	0.606
6/5/2016	22:07:26	0.836	0.061	0.13	0.09	0.622	0.616	0.656	0.693
6/5/2016	22:07:26	0.836	0.062	0.13	0.09	0.67	0.677	0.63	0.584
6/5/2016	22:07:26	0.836	0.062	0.131	0.09	0.626	0.603	0.648	0.679
6/5/2016	22:07:27	0.836	0.062	0.131	0.09	0.644	0.665	0.657	0.615
6/5/2016	22:07:27	0.836	0.061	0.13	0.089	0.666	0.624	0.609	0.65
6/5/2016	22:07:27	0.836	0.061	0.13	0.09	0.601	0.655	0.68	0.642
6/5/2016	22:07:28	0.836	0.062	0.13	0.089	0.65	0.621	0.623	0.657
6/5/2016	22:07:28	0.836	0.062	0.13	0.089	0.665	0.682	0.636	0.597
6/5/2016	22:07:28	0.836	0.062	0.13	0.089	0.625	0.605	0.651	0.684
6/5/2016	22:07:28	0.836	0.062	0.131	0.09	0.666	0.682	0.633	0.592
6/5/2016	22:07:28	0.836	0.061	0.13	0.089	0.629	0.602	0.645	0.673
6/5/2016	22:07:29	0.836	0.061	0.13	0.089	0.672	0.671	0.628	0.578
6/5/2016	22:07:29	0.836	0.061	0.13	0.09	0.61	0.637	0.663	0.677
6/5/2016	22:07:29	0.836	0.061	0.13	0.089	0.682	0.652	0.622	0.592
6/5/2016	22:07:29	0.836	0.061	0.13	0.09	0.608	0.639	0.663	0.673
6/5/2016	22:07:30	0.836	0.061	0.131	0.089	0.674	0.666	0.626	0.579
6/5/2016	22:07:30	0.836	0.061	0.131	0.089	0.624	0.61	0.653	0.69
6/5/2016	22:07:30	0.836	0.061	0.13	0.09	0.66	0.678	0.64	0.603
6/5/2016	22:07:30	0.836	0.062	0.13	0.089	0.624	0.61	0.653	0.69
6/5/2016	22:07:31	0.836	0.062	0.13	0.089	0.682	0.651	0.622	0.595
6/5/2016	22:07:32	0.836	0.061	0.13	0.089	0.605	0.64	0.664	0.67
6/5/2016	22:07:32	0.836	0.061	0.13	0.09	0.685	0.648	0.621	0.601
6/5/2016	22:07:32	0.836	0.061	0.131	0.089	0.599	0.644	0.666	0.659
6/5/2016	22:07:32	0.836	0.061	0.13	0.089	0.7	0.636	0.612	0.629
6/5/2016	22:07:33	0.836	0.062	0.131	0.089	0.595	0.649	0.671	0.651
6/5/2016	22:07:33	0.836	0.062	0.131	0.089	0.693	0.631	0.606	0.636
6/5/2016	22:07:33	0.836	0.061	0.13	0.089	0.618	0.659	0.685	0.632
6/5/2016	22:07:33	0.836	0.061	0.13	0.089	0.699	0.633	0.61	0.631
6/5/2016	22:07:34	0.836	0.062	0.13	0.089	0.613	0.635	0.662	0.684
6/5/2016	22:07:34	0.836	0.062	0.13	0.089	0.68	0.653	0.622	0.591
6/5/2016	22:07:34	0.836	0.061	0.131	0.089	0.603	0.642	0.664	0.666
6/5/2016	22:07:35	0.836	0.062	0.13	0.089	0.699	0.638	0.616	0.623
6/5/2016	22:07:35	0.836	0.062	0.13	0.089	0.596	0.648	0.669	0.653

6/5/2016	22:07:35	0.836	0.063	0.13	0.09	0.697	0.632	0.609	0.633
6/5/2016	22:07:36	0.836	0.065	0.13	0.089	0.637	0.663	0.672	0.621
6/5/2016	22:07:36	0.836	0.065	0.13	0.089	0.692	0.63	0.606	0.637
6/5/2016	22:07:37	0.836	0.062	0.131	0.09	0.596	0.649	0.671	0.65
6/5/2016	22:07:38	0.836	0.063	0.13	0.091	0.674	0.665	0.625	0.579
6/5/2016	22:07:38	0.836	0.062	0.131	0.09	0.63	0.603	0.643	0.671
6/5/2016	22:07:39	0.836	0.062	0.131	0.09	0.674	0.663	0.625	0.581
6/5/2016	22:07:39	0.836	0.062	0.131	0.09	0.61	0.637	0.663	0.677
6/5/2016	22:07:40	0.836	0.062	0.131	0.089	0.686	0.646	0.621	0.603
6/5/2016	22:07:40	0.836	0.062	0.131	0.09	0.616	0.631	0.66	0.689
6/5/2016	22:07:41	0.836	0.062	0.131	0.09	0.689	0.645	0.619	0.609
6/5/2016	22:07:41	0.836	0.062	0.131	0.089	0.608	0.657	0.684	0.638
6/5/2016	22:07:41	0.836	0.062	0.133	0.089	0.663	0.624	0.61	0.651
6/5/2016	22:07:42	0.836	0.062	0.133	0.089	0.651	0.671	0.648	0.611
6/5/2016	22:07:42	0.836	0.062	0.131	0.089	0.63	0.602	0.644	0.673
6/5/2016	22:07:42	0.836	0.062	0.131	0.089	0.671	0.674	0.629	0.581
6/5/2016	22:07:42	0.836	0.062	0.131	0.089	0.615	0.632	0.662	0.686
6/5/2016	22:07:43	0.836	0.062	0.131	0.089	0.684	0.65	0.621	0.599
6/5/2016	22:07:43	0.836	0.063	0.134	0.084	0.618	0.628	0.659	0.691
6/5/2016	22:07:43	0.836	0.063	0.134	0.084	0.673	0.669	0.626	0.578
6/5/2016	22:07:44	0.836	0.063	0.134	0.084	0.621	0.623	0.658	0.694
6/5/2016	22:07:44	0.836	0.063	0.135	0.084	0.677	0.658	0.624	0.584
6/5/2016	22:07:44	0.836	0.063	0.134	0.084	0.622	0.618	0.657	0.694
6/5/2016	22:07:45	0.836	0.063	0.134	0.084	0.676	0.662	0.625	0.581
6/5/2016	22:07:45	0.836	0.063	0.134	0.084	0.633	0.606	0.639	0.666
6/5/2016	22:07:45	0.836	0.062	0.134	0.084	0.659	0.679	0.64	0.604
6/5/2016	22:07:46	0.836	0.063	0.134	0.084	0.63	0.603	0.643	0.672
6/5/2016	22:07:46	0.836	0.063	0.134	0.086	0.665	0.682	0.636	0.596
6/5/2016	22:07:47	0.836	0.063	0.134	0.086	0.626	0.603	0.649	0.68
6/5/2016	22:07:47	0.836	0.062	0.134	0.086	0.67	0.677	0.63	0.583
6/5/2016	22:07:47	0.836	0.062	0.134	0.086	0.623	0.612	0.655	0.692
6/5/2016	22:07:47	0.836	0.062	0.131	0.088	0.669	0.679	0.631	0.588
6/5/2016	22:07:48	0.836	0.062	0.131	0.088	0.629	0.602	0.645	0.674
6/5/2016	22:07:48	0.836	0.062	0.131	0.089	0.667	0.68	0.632	0.588
6/5/2016	22:07:48	0.836	0.062	0.131	0.088	0.608	0.638	0.663	0.674
6/5/2016	22:07:49	0.836	0.062	0.133	0.088	0.692	0.643	0.618	0.612
6/5/2016	22:07:49	0.836	0.062	0.133	0.088	0.598	0.652	0.677	0.644
6/5/2016	22:07:49	0.836	0.062	0.131	0.088	0.692	0.63	0.606	0.637
6/5/2016	22:07:50	0.836	0.062	0.133	0.089	0.615	0.658	0.685	0.633
6/5/2016	22:07:50	0.836	0.062	0.133	0.089	0.645	0.618	0.629	0.659
6/5/2016	22:07:50	0.836	0.062	0.133	0.088	0.63	0.662	0.679	0.625
6/5/2016	22:07:50	0.836	0.062	0.131	0.088	0.676	0.626	0.606	0.645

6/5/2016	22:07:51	0.836	0.062	0.131	0.088	0.628	0.66	0.682	0.626
6/5/2016	22:07:51	0.836	0.062	0.131	0.088	0.68	0.628	0.605	0.644
6/5/2016	22:07:51	0.836	0.063	0.131	0.088	0.648	0.666	0.652	0.613
6/5/2016	22:07:51	0.836	0.062	0.131	0.089	0.643	0.615	0.631	0.662
6/5/2016	22:07:52	0.836	0.062	0.133	0.089	0.643	0.665	0.659	0.616
6/5/2016	22:07:52	0.836	0.062	0.133	0.089	0.637	0.61	0.636	0.664
6/5/2016	22:07:52	0.836	0.062	0.133	0.089	0.657	0.677	0.643	0.606
6/5/2016	22:07:53	0.836	0.062	0.131	0.089	0.626	0.604	0.65	0.683
6/5/2016	22:07:53	0.836	0.062	0.131	0.088	0.682	0.651	0.622	0.598
6/5/2016	22:07:53	0.836	0.062	0.131	0.088	0.608	0.639	0.663	0.673
6/5/2016	22:07:53	0.836	0.061	0.133	0.089	0.679	0.653	0.623	0.591
6/5/2016	22:07:53	0.836	0.062	0.131	0.088	0.612	0.635	0.662	0.683
6/5/2016	22:07:54	0.836	0.062	0.131	0.088	0.697	0.64	0.617	0.619
6/5/2016	22:07:54	0.836	0.062	0.131	0.088	0.617	0.63	0.66	0.689
6/5/2016	22:07:54	0.836	0.062	0.131	0.088	0.673	0.669	0.626	0.578
6/5/2016	22:07:55	0.836	0.062	0.131	0.088	0.621	0.621	0.657	0.693
6/5/2016	22:07:55	0.836	0.063	0.131	0.088	0.684	0.649	0.621	0.601
6/5/2016	22:07:55	0.836	0.063	0.131	0.088	0.597	0.646	0.669	0.655
6/5/2016	22:08:06	0.836	0.063	0.135	0.084	0.665	0.682	0.636	0.596
6/5/2016	22:08:06	0.836	0.063	0.135	0.084	0.63	0.602	0.643	0.672
6/5/2016	22:08:06	0.836	0.063	0.135	0.084	0.66	0.679	0.639	0.602
6/5/2016	22:08:06	0.836	0.063	0.134	0.084	0.631	0.604	0.64	0.669
6/5/2016	22:08:07	0.836	0.063	0.135	0.084	0.665	0.683	0.635	0.595
6/5/2016	22:08:07	0.836	0.063	0.134	0.084	0.629	0.602	0.644	0.673
6/5/2016	22:08:07	0.836	0.063	0.134	0.084	0.642	0.665	0.66	0.616
6/5/2016	22:08:08	0.836	0.063	0.134	0.084	0.652	0.622	0.619	0.657
6/5/2016	22:08:08	0.836	0.063	0.134	0.084	0.595	0.649	0.67	0.652
6/5/2016	22:08:08	0.836	0.063	0.134	0.084	0.686	0.646	0.619	0.602
6/5/2016	22:08:09	0.836	0.063	0.134	0.084	0.597	0.651	0.676	0.645
6/5/2016	22:08:09	0.836	0.063	0.134	0.084	0.7	0.636	0.612	0.628
6/5/2016	22:08:09	0.836	0.063	0.134	0.084	0.616	0.63	0.66	0.69
6/5/2016	22:08:09	0.836	0.062	0.134	0.084	0.698	0.64	0.618	0.621
6/5/2016	22:08:10	0.836	0.062	0.134	0.084	0.613	0.658	0.685	0.633
6/5/2016	22:08:10	0.836	0.063	0.134	0.084	0.686	0.629	0.605	0.64
6/5/2016	22:08:10	0.836	0.063	0.134	0.084	0.605	0.657	0.683	0.638
6/5/2016	22:08:10	0.836	0.063	0.134	0.086	0.674	0.626	0.606	0.646
6/5/2016	22:08:11	0.836	0.063	0.134	0.086	0.596	0.648	0.669	0.653
6/5/2016	22:09:05	0.835	0.062	0.134	0.086	0.662	0.68	0.638	0.602
6/5/2016	22:09:05	0.835	0.063	0.134	0.086	0.644	0.618	0.63	0.662
6/5/2016	22:09:06	0.835	0.063	0.134	0.086	0.64	0.664	0.664	0.618
6/5/2016	22:09:06	0.835	0.063	0.134	0.086	0.677	0.629	0.608	0.646
6/5/2016	22:09:07	0.835	0.063	0.134	0.086	0.598	0.648	0.669	0.652

6/5/2016	22:09:07	0.835	0.062	0.134	0.086	0.687	0.645	0.619	0.613
6/5/2016	22:09:08	0.835	0.062	0.135	0.086	0.626	0.606	0.65	0.682
6/5/2016	22:09:08	0.835	0.062	0.135	0.086	0.662	0.68	0.639	0.603
6/5/2016	22:09:08	0.835	0.062	0.134	0.086	0.638	0.612	0.637	0.665
6/5/2016	22:09:09	0.835	0.063	0.134	0.086	0.646	0.666	0.655	0.615
6/5/2016	22:09:09	0.835	0.062	0.134	0.086	0.689	0.631	0.609	0.64
6/5/2016	22:09:09	0.835	0.063	0.134	0.086	0.615	0.636	0.662	0.683
6/5/2016	22:09:10	0.835	0.063	0.134	0.086	0.655	0.672	0.645	0.611
6/5/2016	22:09:10	0.835	0.062	0.134	0.086	0.672	0.628	0.608	0.649
6/5/2016	22:09:10	0.835	0.063	0.134	0.086	0.598	0.65	0.671	0.65
6/5/2016	22:09:11	0.835	0.063	0.134	0.086	0.679	0.652	0.623	0.598
6/5/2016	22:09:11	0.835	0.063	0.134	0.086	0.625	0.61	0.653	0.687
6/5/2016	22:09:13	0.835	0.062	0.134	0.086	0.663	0.68	0.638	0.602
6/5/2016	22:09:13	0.835	0.062	0.134	0.086	0.655	0.623	0.616	0.657
6/5/2016	22:09:14	0.835	0.066	0.131	0.088	0.605	0.656	0.682	0.64
6/5/2016	22:09:14	0.835	0.066	0.131	0.088	0.678	0.653	0.623	0.595
6/5/2016	22:09:15	0.835	0.066	0.134	0.09	0.632	0.606	0.642	0.67
6/5/2016	22:09:15	0.835	0.066	0.134	0.09	0.601	0.653	0.676	0.644
6/5/2016	22:09:35	0.835	0.067	0.135	0.089	0.664	0.68	0.638	0.602
6/5/2016	22:09:35	0.835	0.067	0.135	0.089	0.628	0.606	0.65	0.682
6/5/2016	22:09:36	0.835	0.066	0.135	0.089	0.639	0.664	0.671	0.621
6/5/2016	22:09:36	0.835	0.066	0.135	0.089	0.679	0.63	0.606	0.646
6/5/2016	22:09:37	0.835	0.066	0.135	0.089	0.605	0.644	0.665	0.664
6/5/2016	22:09:37	0.835	0.066	0.135	0.089	0.677	0.656	0.624	0.591
6/5/2016	22:09:37	0.835	0.066	0.135	0.089	0.631	0.606	0.644	0.672
6/5/2016	22:09:38	0.835	0.066	0.135	0.088	0.628	0.662	0.684	0.628
6/5/2016	22:09:38	0.835	0.066	0.135	0.088	0.685	0.646	0.622	0.61
6/5/2016	22:09:38	0.835	0.066	0.135	0.089	0.623	0.623	0.658	0.694
6/5/2016	22:09:38	0.835	0.066	0.136	0.089	0.642	0.664	0.669	0.619
6/5/2016	22:09:39	0.835	0.066	0.135	0.089	0.676	0.629	0.606	0.648
6/5/2016	22:09:39	0.835	0.066	0.135	0.089	0.612	0.658	0.685	0.637
6/5/2016	22:09:39	0.835	0.066	0.135	0.089	0.685	0.646	0.622	0.612
6/5/2016	22:09:40	0.835	0.066	0.136	0.09	0.622	0.625	0.659	0.693
6/5/2016	22:09:40	0.835	0.066	0.135	0.089	0.65	0.669	0.651	0.613
6/5/2016	22:09:40	0.835	0.066	0.135	0.089	0.696	0.639	0.618	0.628
6/5/2016	22:09:40	0.835	0.066	0.135	0.089	0.622	0.625	0.659	0.693
6/5/2016	22:09:41	0.835	0.066	0.135	0.089	0.666	0.68	0.635	0.596
6/5/2016	22:09:41	0.835	0.066	0.135	0.089	0.637	0.611	0.639	0.666
6/5/2016	22:09:42	0.835	0.066	0.135	0.089	0.611	0.658	0.684	0.637
6/5/2016	22:09:42	0.835	0.066	0.135	0.089	0.677	0.657	0.624	0.59
6/5/2016	22:09:43	0.835	0.066	0.135	0.089	0.631	0.606	0.644	0.671
6/5/2016	22:09:43	0.835	0.065	0.136	0.089	0.649	0.667	0.652	0.615

6/5/2016	22:09:44	0.835	0.066	0.135	0.089	0.648	0.623	0.625	0.66
6/5/2016	22:09:44	0.835	0.066	0.135	0.089	0.604	0.645	0.665	0.664
6/5/2016	22:09:45	0.835	0.066	0.135	0.089	0.665	0.68	0.638	0.601
6/5/2016	22:09:46	0.835	0.066	0.135	0.089	0.628	0.606	0.651	0.682
6/5/2016	22:09:46	0.835	0.066	0.135	0.089	0.656	0.673	0.645	0.611
6/5/2016	22:09:46	0.835	0.066	0.135	0.09	0.642	0.617	0.633	0.664
6/5/2016	22:09:47	0.835	0.066	0.135	0.09	0.622	0.66	0.685	0.631
6/5/2016	22:09:47	0.835	0.066	0.135	0.089	0.669	0.678	0.632	0.591
6/5/2016	22:09:47	0.835	0.065	0.135	0.089	0.653	0.624	0.617	0.658
6/5/2016	22:09:48	0.835	0.065	0.135	0.089	0.621	0.629	0.659	0.692
6/5/2016	22:09:48	0.835	0.067	0.135	0.089	0.659	0.678	0.642	0.608
6/5/2016	22:09:48	0.835	0.066	0.135	0.089	0.638	0.612	0.638	0.665
6/5/2016	22:09:49	0.835	0.066	0.135	0.089	0.599	0.652	0.673	0.646
6/5/2016	22:09:49	0.835	0.066	0.135	0.089	0.671	0.674	0.63	0.587
6/5/2016	22:09:49	0.835	0.066	0.135	0.089	0.662	0.626	0.61	0.653
6/5/2016	22:09:49	0.835	0.067	0.134	0.089	0.608	0.642	0.664	0.67
6/5/2016	22:09:50	0.835	0.066	0.135	0.089	0.672	0.666	0.628	0.584
6/5/2016	22:09:51	0.835	0.066	0.135	0.089	0.629	0.605	0.648	0.676
6/5/2016	22:09:51	0.835	0.066	0.135	0.089	0.616	0.659	0.685	0.636
6/5/2016	22:09:52	0.835	0.066	0.135	0.089	0.676	0.657	0.625	0.591
6/5/2016	22:09:53	0.835	0.066	0.135	0.089	0.632	0.606	0.643	0.671
6/5/2016	22:09:53	0.835	0.066	0.135	0.089	0.645	0.666	0.657	0.617
6/5/2016	22:09:53	0.835	0.066	0.135	0.089	0.687	0.631	0.608	0.643
6/5/2016	22:09:54	0.835	0.066	0.135	0.089	0.625	0.611	0.653	0.687
6/5/2016	22:09:54	0.835	0.066	0.135	0.09	0.642	0.664	0.666	0.619
6/5/2016	22:09:54	0.835	0.065	0.135	0.089	0.684	0.631	0.606	0.644
6/5/2016	22:09:54	0.835	0.066	0.135	0.088	0.621	0.629	0.659	0.692
6/5/2016	22:09:55	0.835	0.066	0.135	0.088	0.658	0.677	0.643	0.608
6/5/2016	22:09:55	0.835	0.066	0.135	0.089	0.65	0.623	0.623	0.659
6/5/2016	22:09:55	0.835	0.066	0.135	0.089	0.601	0.655	0.677	0.644
6/5/2016	22:09:55	0.835	0.066	0.135	0.089	0.671	0.672	0.629	0.585
6/5/2016	22:09:56	0.835	0.066	0.135	0.089	0.643	0.618	0.632	0.663
6/5/2016	22:09:56	0.835	0.066	0.135	0.089	0.633	0.663	0.68	0.625
6/5/2016	22:09:57	0.835	0.066	0.135	0.089	0.694	0.64	0.619	0.625
6/5/2016	22:09:57	0.835	0.066	0.135	0.089	0.618	0.632	0.66	0.69
6/5/2016	22:09:57	0.835	0.066	0.135	0.089	0.663	0.678	0.64	0.605
6/5/2016	22:09:57	0.835	0.066	0.135	0.089	0.669	0.628	0.608	0.651
6/5/2016	22:09:58	0.835	0.066	0.135	0.089	0.601	0.651	0.672	0.649
6/5/2016	22:09:58	0.835	0.065	0.135	0.09	0.67	0.676	0.631	0.589
6/5/2016	22:09:58	0.835	0.066	0.135	0.089	0.644	0.619	0.631	0.663
6/5/2016	22:09:58	0.835	0.066	0.135	0.089	0.601	0.652	0.674	0.646
6/5/2016	22:09:59	0.835	0.066	0.135	0.089	0.676	0.659	0.625	0.588

6/5/2016	22:09:59	0.835	0.066	0.135	0.089	0.635	0.609	0.642	0.669
6/5/2016	22:10:00	0.835	0.066	0.135	0.089	0.617	0.66	0.685	0.635
6/5/2016	22:10:00	0.835	0.066	0.135	0.089	0.684	0.648	0.622	0.609
6/5/2016	22:10:00	0.835	0.065	0.136	0.089	0.628	0.606	0.65	0.68
6/5/2016	22:10:01	0.835	0.067	0.134	0.088	0.662	0.68	0.639	0.604
6/5/2016	22:10:01	0.835	0.067	0.135	0.088	0.645	0.621	0.629	0.662
6/5/2016	22:10:01	0.835	0.067	0.135	0.088	0.63	0.662	0.683	0.628
6/5/2016	22:10:02	0.835	0.066	0.136	0.087	0.682	0.649	0.623	0.605
6/5/2016	22:10:02	0.835	0.066	0.136	0.087	0.636	0.611	0.639	0.667
6/5/2016	22:10:02	0.835	0.066	0.134	0.089	0.642	0.664	0.666	0.619
6/5/2016	22:10:03	0.835	0.067	0.133	0.089	0.693	0.64	0.619	0.626
6/5/2016	22:11:14	0.834	0.059	0.129	0.089	0.67	0.676	0.631	0.588
6/5/2016	22:11:14	0.834	0.062	0.129	0.09	0.639	0.616	0.636	0.665
6/5/2016	22:11:14	0.834	0.066	0.135	0.093	0.631	0.663	0.683	0.628
6/5/2016	22:11:14	0.834	0.066	0.135	0.093	0.687	0.633	0.61	0.642
6/5/2016	22:11:15	0.834	0.065	0.135	0.09	0.621	0.631	0.66	0.692
6/5/2016	22:11:15	0.834	0.065	0.133	0.089	0.67	0.677	0.631	0.588
6/5/2016	22:11:15	0.834	0.065	0.133	0.089	0.657	0.626	0.613	0.657
6/5/2016	22:11:16	0.834	0.065	0.134	0.09	0.602	0.653	0.676	0.645
6/5/2016	22:11:16	0.834	0.065	0.133	0.09	0.673	0.667	0.628	0.584
6/5/2016	22:11:16	0.834	0.065	0.134	0.091	0.64	0.618	0.633	0.664
6/5/2016	22:11:17	0.834	0.065	0.134	0.091	0.64	0.664	0.672	0.621
6/5/2016	22:11:17	0.834	0.066	0.134	0.091	0.67	0.629	0.608	0.651
6/5/2016	22:11:17	0.834	0.065	0.134	0.09	0.611	0.642	0.664	0.674
6/5/2016	22:11:18	0.834	0.065	0.134	0.09	0.67	0.676	0.631	0.588
6/5/2016	22:11:18	0.834	0.066	0.134	0.09	0.637	0.613	0.638	0.666
6/5/2016	22:11:18	0.834	0.065	0.133	0.09	0.655	0.672	0.648	0.612
6/5/2016	22:11:19	0.834	0.065	0.133	0.09	0.638	0.613	0.638	0.666
6/5/2016	22:11:19	0.834	0.065	0.134	0.09	0.652	0.671	0.649	0.613
6/5/2016	22:11:19	0.834	0.065	0.134	0.09	0.649	0.624	0.623	0.66
6/5/2016	22:11:20	0.834	0.065	0.134	0.09	0.601	0.652	0.672	0.649
6/5/2016	22:11:20	0.834	0.065	0.133	0.089	0.672	0.671	0.629	0.585
6/5/2016	22:11:21	0.834	0.065	0.134	0.09	0.636	0.611	0.64	0.667
6/5/2016	22:11:22	0.834	0.066	0.135	0.087	0.656	0.676	0.645	0.611
6/5/2016	22:11:23	0.834	0.065	0.135	0.088	0.644	0.621	0.63	0.663
6/5/2016	22:11:23	0.834	0.065	0.135	0.088	0.599	0.65	0.671	0.652
6/5/2016	22:11:24	0.834	0.066	0.134	0.088	0.671	0.673	0.63	0.587
6/5/2016	22:11:24	0.834	0.066	0.135	0.088	0.652	0.624	0.618	0.659
6/5/2016	22:11:25	0.834	0.065	0.135	0.088	0.609	0.657	0.682	0.639
6/5/2016	22:11:26	0.834	0.065	0.135	0.088	0.666	0.68	0.637	0.599
6/5/2016	22:11:27	0.834	0.066	0.135	0.088	0.683	0.632	0.61	0.643
6/5/2016	22:11:28	0.834	0.066	0.135	0.088	0.619	0.632	0.662	0.69

6/5/2016	22:16:40	0.832	0.065	0.134	0.091	0.64	0.664	0.665	0.617
6/5/2016	22:16:41	0.832	0.065	0.134	0.09	0.657	0.623	0.613	0.655
6/5/2016	22:16:41	0.832	0.065	0.134	0.09	0.648	0.667	0.652	0.613
6/5/2016	22:16:42	0.832	0.066	0.134	0.091	0.698	0.632	0.611	0.633
6/5/2016	22:39:01	0.836	0.06	0.133	0.08	0.667	0.625	0.603	0.646
6/5/2016	22:39:02	0.836	0.061	0.131	0.08	0.629	0.659	0.68	0.624
6/5/2016	22:39:02	0.836	0.061	0.131	0.08	0.674	0.626	0.601	0.643
6/5/2016	22:39:03	0.836	0.06	0.131	0.08	0.606	0.655	0.68	0.637
6/5/2016	22:39:03	0.836	0.06	0.133	0.08	0.678	0.628	0.603	0.642
6/5/2016	22:39:03	0.836	0.06	0.133	0.08	0.623	0.658	0.683	0.628
6/5/2016	22:39:04	0.836	0.06	0.133	0.08	0.648	0.621	0.619	0.657
6/5/2016	22:39:04	0.836	0.06	0.133	0.08	0.651	0.671	0.643	0.608
6/5/2016	22:39:05	0.836	0.061	0.131	0.081	0.616	0.632	0.659	0.683
6/5/2016	22:39:05	0.836	0.061	0.133	0.08	0.69	0.639	0.617	0.622
6/5/2016	22:39:05	0.836	0.061	0.133	0.08	0.602	0.642	0.663	0.658
6/5/2016	22:39:06	0.838	0.06	0.133	0.08	0.667	0.67	0.626	0.582
6/5/2016	22:39:06	0.838	0.06	0.133	0.081	0.623	0.606	0.65	0.685
6/5/2016	22:39:07	0.836	0.06	0.133	0.08	0.664	0.679	0.631	0.592
6/5/2016	22:39:07	0.836	0.061	0.133	0.081	0.623	0.61	0.652	0.689
6/5/2016	22:39:08	0.838	0.06	0.133	0.08	0.677	0.649	0.619	0.601
6/5/2016	22:39:08	0.838	0.06	0.131	0.08	0.597	0.648	0.67	0.645
6/5/2016	22:39:09	0.838	0.06	0.131	0.08	0.692	0.638	0.615	0.625
6/5/2016	22:39:09	0.836	0.06	0.131	0.084	0.612	0.656	0.684	0.633
6/5/2016	22:39:10	0.838	0.059	0.13	0.084	0.665	0.625	0.603	0.649
6/5/2016	22:39:10	0.838	0.06	0.13	0.084	0.635	0.66	0.673	0.621
6/5/2016	22:39:10	0.838	0.06	0.131	0.084	0.658	0.623	0.606	0.651
6/5/2016	22:39:11	0.838	0.06	0.131	0.086	0.637	0.66	0.666	0.617
6/5/2016	22:39:12	0.838	0.06	0.131	0.084	0.667	0.625	0.603	0.648
6/5/2016	22:39:12	0.838	0.06	0.131	0.084	0.616	0.657	0.684	0.632
6/5/2016	22:39:12	0.838	0.06	0.131	0.084	0.66	0.624	0.605	0.65
6/5/2016	22:39:12	0.838	0.06	0.13	0.084	0.643	0.664	0.652	0.612
6/5/2016	22:39:13	0.838	0.06	0.13	0.084	0.63	0.603	0.64	0.669
6/5/2016	22:39:13	0.838	0.06	0.131	0.082	0.671	0.657	0.622	0.585
6/5/2016	22:39:13	0.838	0.061	0.131	0.081	0.621	0.619	0.656	0.692
6/5/2016	23:32:11	0.838	0.05	0.104	0.06	0.666	0.625	0.609	0.649
6/5/2016	23:32:11	0.839	0.05	0.104	0.06	0.599	0.646	0.667	0.655
6/5/2016	23:32:11	0.839	0.05	0.104	0.06	0.672	0.669	0.628	0.582
6/5/2016	23:32:12	0.839	0.05	0.104	0.06	0.637	0.611	0.637	0.664
6/5/2016	23:32:12	0.839	0.05	0.103	0.06	0.642	0.664	0.663	0.617
6/5/2016	23:32:12	0.838	0.049	0.104	0.06	0.69	0.631	0.609	0.637
6/5/2016	23:32:13	0.839	0.05	0.104	0.06	0.625	0.61	0.652	0.686
6/5/2016	23:32:13	0.839	0.05	0.104	0.06	0.642	0.664	0.662	0.617

6/5/2016	23:32:22	0.838	0.049	0.104	0.061	0.662	0.625	0.611	0.651
6/5/2016	23:32:22	0.839	0.05	0.103	0.06	0.623	0.659	0.684	0.63
6/5/2016	23:32:23	0.839	0.049	0.104	0.06	0.679	0.629	0.606	0.644
6/5/2016	23:32:23	0.839	0.05	0.104	0.06	0.613	0.636	0.66	0.682
6/5/2016	23:32:23	0.839	0.05	0.104	0.06	0.665	0.68	0.635	0.595
6/5/2016	23:32:23	0.838	0.05	0.104	0.06	0.644	0.617	0.63	0.659
6/5/2016	23:32:24	0.838	0.05	0.104	0.06	0.643	0.665	0.658	0.616
6/5/2016	23:32:24	0.838	0.05	0.106	0.06	0.642	0.616	0.632	0.66
6/5/2016	23:32:24	0.838	0.05	0.106	0.06	0.638	0.663	0.67	0.621
6/5/2016	23:32:25	0.838	0.05	0.104	0.06	0.693	0.632	0.61	0.635
6/5/2016	23:32:25	0.838	0.049	0.106	0.061	0.601	0.652	0.676	0.643
6/5/2016	23:44:08	0.838	0.052	0.107	0.059	0.686	0.629	0.606	0.637
6/5/2016	23:44:08	0.838	0.052	0.106	0.057	0.606	0.64	0.663	0.669
6/5/2016	23:44:08	0.838	0.052	0.106	0.059	0.646	0.666	0.652	0.612
6/5/2016	23:44:08	0.838	0.052	0.106	0.059	0.678	0.651	0.622	0.592
6/5/2016	23:44:09	0.838	0.05	0.106	0.059	0.597	0.649	0.673	0.646
6/5/2016	23:44:09	0.838	0.052	0.106	0.059	0.643	0.664	0.657	0.615
6/5/2016	23:44:09	0.838	0.052	0.104	0.057	0.686	0.644	0.618	0.608
6/5/2016	23:44:09	0.838	0.052	0.104	0.057	0.596	0.648	0.67	0.65
6/5/2016	23:44:10	0.838	0.052	0.106	0.057	0.689	0.63	0.605	0.637
6/5/2016	23:44:10	0.838	0.052	0.106	0.059	0.602	0.643	0.664	0.662
6/5/2016	23:44:10	0.838	0.052	0.106	0.057	0.662	0.678	0.638	0.601
6/5/2016	23:44:11	0.838	0.052	0.106	0.057	0.698	0.635	0.612	0.629
6/5/2016	23:44:11	0.838	0.052	0.106	0.057	0.633	0.608	0.638	0.666
6/5/2016	23:44:11	0.838	0.052	0.104	0.057	0.697	0.637	0.615	0.628
6/5/2016	23:44:11	0.838	0.05	0.106	0.059	0.637	0.611	0.635	0.663
6/5/2016	23:44:12	0.838	0.05	0.106	0.059	0.655	0.673	0.643	0.608
6/5/2016	23:44:12	0.838	0.052	0.104	0.056	0.696	0.639	0.617	0.622
6/5/2016	23:44:12	0.838	0.05	0.106	0.057	0.638	0.612	0.633	0.663
6/5/2016	23:44:12	0.838	0.05	0.106	0.059	0.601	0.655	0.678	0.64
6/5/2016	23:44:13	0.838	0.05	0.106	0.059	0.689	0.643	0.617	0.612
6/5/2016	23:44:13	0.838	0.052	0.106	0.057	0.638	0.613	0.633	0.663
6/5/2016	23:44:13	0.838	0.052	0.106	0.057	0.597	0.646	0.667	0.653
6/5/2016	23:44:13	0.838	0.053	0.104	0.057	0.69	0.643	0.617	0.612
6/5/2016	23:44:14	0.838	0.053	0.104	0.057	0.602	0.642	0.665	0.662
6/5/2016	23:44:14	0.838	0.052	0.104	0.057	0.693	0.642	0.617	0.616
6/5/2016	23:44:14	0.838	0.052	0.106	0.057	0.657	0.624	0.613	0.653
6/5/2016	23:44:15	0.838	0.052	0.106	0.057	0.61	0.637	0.662	0.677
6/5/2016	23:44:15	0.838	0.052	0.106	0.057	0.642	0.664	0.662	0.616
6/5/2016	23:44:15	0.838	0.052	0.106	0.059	0.698	0.637	0.613	0.626
6/5/2016	23:44:15	0.838	0.05	0.106	0.059	0.622	0.613	0.653	0.691
6/5/2016	23:44:15	0.838	0.05	0.106	0.057	0.619	0.659	0.684	0.631

6/5/2016	23:44:16	0.838	0.05	0.106	0.057	0.67	0.674	0.629	0.584
6/5/2016	23:44:16	0.838	0.052	0.106	0.057	0.698	0.636	0.613	0.626
6/5/2016	23:44:16	0.838	0.052	0.106	0.057	0.601	0.643	0.665	0.659
6/5/2016	23:44:17	0.838	0.052	0.104	0.057	0.694	0.639	0.617	0.621
6/5/2016	23:44:17	0.838	0.052	0.104	0.057	0.631	0.605	0.639	0.667
6/5/2016	23:44:17	0.838	0.05	0.106	0.059	0.652	0.672	0.644	0.609
6/5/2016	23:44:17	0.838	0.052	0.106	0.057	0.642	0.615	0.631	0.662
6/5/2016	23:44:18	0.838	0.05	0.106	0.059	0.653	0.672	0.645	0.609
6/5/2016	23:44:18	0.838	0.05	0.106	0.059	0.693	0.632	0.609	0.633
6/5/2016	23:44:18	0.838	0.052	0.106	0.057	0.608	0.656	0.684	0.637
6/5/2016	23:44:18	0.838	0.05	0.106	0.057	0.657	0.674	0.642	0.606
6/5/2016	23:44:19	0.838	0.052	0.106	0.057	0.689	0.629	0.606	0.637
6/5/2016	23:44:19	0.838	0.052	0.106	0.057	0.625	0.605	0.649	0.682
6/5/2016	23:44:19	0.838	0.052	0.104	0.057	0.633	0.662	0.674	0.622
6/5/2016	23:44:19	0.838	0.05	0.106	0.057	0.682	0.646	0.621	0.601
6/5/2016	23:44:20	0.838	0.052	0.106	0.057	0.64	0.615	0.631	0.662
6/5/2016	23:44:20	0.838	0.052	0.106	0.057	0.644	0.666	0.653	0.613
6/5/2016	23:44:20	0.838	0.052	0.106	0.057	0.683	0.629	0.606	0.639
6/5/2016	23:44:21	0.838	0.052	0.106	0.057	0.604	0.642	0.663	0.665
6/5/2016	23:44:21	0.838	0.05	0.106	0.059	0.697	0.639	0.616	0.622
6/5/2016	23:44:21	0.838	0.05	0.106	0.059	0.606	0.656	0.683	0.638
6/5/2016	23:44:21	0.838	0.052	0.104	0.057	0.678	0.626	0.604	0.644
6/5/2016	23:44:21	0.838	0.05	0.106	0.059	0.613	0.636	0.66	0.682
6/5/2016	23:44:51	0.838	0.049	0.102	0.059	0.678	0.655	0.622	0.588
6/5/2016	23:44:51	0.838	0.049	0.102	0.059	0.639	0.613	0.633	0.663
6/5/2016	23:44:52	0.838	0.048	0.104	0.067	0.596	0.651	0.672	0.646
6/5/2016	23:44:52	0.838	0.041	0.091	0.072	0.69	0.63	0.605	0.637
6/5/2016	23:44:52	0.838	0.05	0.102	0.087	0.604	0.656	0.682	0.638
6/5/2016	23:44:52	0.838	0.052	0.075	0.086	0.678	0.655	0.622	0.589
6/5/2016	23:44:52	0.838	0.052	0.075	0.086	0.66	0.624	0.611	0.652
6/5/2016	23:44:53	0.838	0.053	0.081	0.082	0.619	0.622	0.657	0.693
6/5/2016	23:44:53	0.838	0.05	0.083	0.083	0.679	0.652	0.622	0.595
6/5/2016	23:44:53	0.838	0.052	0.083	0.084	0.597	0.646	0.669	0.653
6/5/2016	23:44:53	0.838	0.052	0.083	0.084	0.674	0.659	0.624	0.582
6/5/2016	23:44:54	0.838	0.052	0.082	0.084	0.617	0.63	0.66	0.689
6/5/2016	23:44:54	0.838	0.053	0.082	0.083	0.683	0.65	0.621	0.599
6/5/2016	23:44:54	0.838	0.052	0.082	0.083	0.604	0.64	0.664	0.666
6/5/2016	23:44:54	0.838	0.053	0.082	0.083	0.698	0.635	0.612	0.63
6/5/2016	23:44:55	0.838	0.053	0.082	0.083	0.606	0.639	0.663	0.671
6/5/2016	23:44:55	0.838	0.052	0.082	0.083	0.673	0.667	0.625	0.578
6/5/2016	23:44:55	0.838	0.053	0.082	0.083	0.637	0.61	0.636	0.664
6/5/2016	23:44:55	0.838	0.053	0.082	0.083	0.665	0.68	0.633	0.592

6/5/2016	23:44:56	0.838	0.053	0.082	0.083	0.619	0.622	0.658	0.693
6/5/2016	23:44:56	0.838	0.052	0.081	0.083	0.672	0.67	0.626	0.579
6/5/2016	23:44:56	0.838	0.053	0.082	0.084	0.619	0.623	0.658	0.693
6/5/2016	23:44:57	0.838	0.052	0.082	0.084	0.699	0.638	0.616	0.625
6/5/2016	23:44:57	0.838	0.052	0.082	0.084	0.616	0.658	0.685	0.632
6/5/2016	23:44:57	0.838	0.053	0.082	0.084	0.686	0.629	0.604	0.64
6/5/2016	23:44:57	0.838	0.052	0.082	0.084	0.623	0.659	0.684	0.629
6/5/2016	23:44:57	0.838	0.053	0.082	0.084	0.659	0.623	0.612	0.652
6/5/2016	23:44:58	0.838	0.053	0.082	0.084	0.639	0.663	0.665	0.617
6/5/2016	23:44:58	0.838	0.053	0.081	0.084	0.656	0.622	0.615	0.655
6/5/2016	23:44:58	0.838	0.053	0.081	0.083	0.631	0.662	0.678	0.624
6/5/2016	23:44:59	0.838	0.053	0.081	0.084	0.69	0.631	0.608	0.637
6/5/2016	23:44:59	0.838	0.053	0.081	0.084	0.633	0.608	0.638	0.666
6/5/2016	23:44:59	0.838	0.052	0.081	0.083	0.667	0.679	0.631	0.587
6/5/2016	23:44:59	0.838	0.053	0.081	0.083	0.626	0.602	0.646	0.678
6/5/2016	23:45:00	0.838	0.053	0.081	0.084	0.66	0.679	0.638	0.601
6/5/2016	23:45:00	0.838	0.053	0.081	0.084	0.633	0.606	0.638	0.666
6/5/2016	23:45:00	0.838	0.053	0.081	0.083	0.643	0.665	0.657	0.615
6/5/2016	23:45:00	0.838	0.053	0.081	0.083	0.643	0.617	0.629	0.66

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