Automated Screening Tests for Post-traumatic Stress Disorder

and Patient Diagnosis Management System

for the Usage of

Clinical Neurologists

by

Taha Nasir

Dissertation submitted in partial fulfillment of

the requirements for the

Bachelor of Technology (Hons)

(Business Information Systems)

SEPTEMBER 2011

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CERTIFICATION OF APPROVAL

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Approved by,

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Dr. Alan Giffin Downe

UNIVERSITI TEKNOLOGI PETRONAS

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SEPTEMBER 2011

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CERTIFICATION OF ORGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

TAHA NASIR

Abstract

This project aims to provide help to clinical neurologists in the form of a multi-purpose system whereby the clinician will have an ease going through the vast number of patients with all sorts of neurological conditions. The system itself is very versatile and can be used for various types of neurological conditions depending on what the clinician intends to practice in. The system perpetuates the tracking of the condition of a patient once entered into the system by means of questionnaires and retrieval of data from past visits. The end point of the system means to generate a report for the doctor's perusal prior to the consultation period. In this way time consumption is decreased per patient and thus more patients can be attended to. The main contribution of the project will be to provide a manageable interface for clinicians, patients and nurses so that the above solutions can be achieved. The project expands onto using the system to research on Post Traumatic Stress Disorder (PTSD), and its diagnosis.

It also allows a comparative study between the conventional methods of diagnosis against the automated one. The current results after the trial run of the automated show that neither method seems so different, further research with a new set of subjects is needed to determine the efficiency of automated screening tests. The user interface evaluation suggests that improvisations are needed in the areas of adaptability and reliability.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

In recent times, clinicians have not the time to view all patients that come to their clinic on a particular day, let alone find out about the patient in depth. Despite all the technology they have for information collection and patient records, they still ultimately must key in most of the information themselves. Gathering of that information itself can be a nuisance as the only way to collect is through discussions with the patient themselves. In this case, information collected may not be hundred percent accurate as there is a human tendency to miss out on certain pieces of information.

Taking the neurologist's clinic, this project seeks to provide a system whereby the clinician would have obtained sufficient information about the patient prior to the consultation period. This can only be done when the patient themselves cooperate accordingly and key in their particulars themselves. This project has sought to track patient records, history, medical test results, and current patient condition, perform screening tests, database the patient records, and lastly to aid the clinician by generating reports in a clustered manner so as to be more organized categorically. The system proposed will consist of three interfaces, one each for the nurse, the clinician and the patient. The nurse's interface will basically be the parent interface consisting of the full database of screening tests and patient details. The patient interface will contain questionnaires to fill in personal particulars and specific screening tests uploaded by the nurse. The clinician's interface will show clustered information divided into specific sectors of information such as patient history, patient medication, recent events, patient particulars, diagnosis and results.

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Patients whom will be using this system for testing for the time being are those that are suffering from post traumatic stress disorder (PTSD). The adaptability of the system will be useful for future works where the system may be used for other diseases in the neurological context. For the successful usage and collection of accurate information, the interface of the system is a highly important factor as that alone can determine the success and failure. To ensure the finalized system is user-friendly, especially the interface for the patient, the prototypes of the system will be used to conduct a short research study about the effect of interface design on patients that suffer from PTSD. This will in turn benefit the project as a more accurate interface may be designed for attaining a highly user-friendly system.

Lastly the project is taking a step forward from the conventional methods of screening tests for PTSD and creating a computerized version of the tests in order to assist the patients answer more accurately and comfortably. This brings about a comparative study between the effectiveness of computerized screening tests against conventional, paper-pencil based tests.

1.2   Problem Statement

Clinical doctors have a large number of patients visiting per day. Normal physicians might not indulge too much in one single patient as the illness is usually common or easily diagnosed. For clinicians who are neurologists on the other hand, their tasks are more intense and thus for them to see each patient thoroughly and assess their illness then diagnose it takes a certain amount of time. Furthermore, for new patients they must first probe into the patient history and background by conversing with them. This ultimately takes a great deal of time.

Assessing current systems of patient tracking and further advanced patient monitoring systems that are in place in the hospitals or clinics today, deems that those systems are still inefficient when concerned with time consumption. The doctor still has to record everything during the consultation period and that defeats the purpose of the system apart from it being automated.

With regards to developing an interface with screening tests and questionnaires for patients, Kovera et al [28] stated that when using the conventional paper-and-pencil format, the tendency to be confused due to seeing all the answers to be chosen and the inappropriateness of the questions being asked was observed in many subjects. It was also argued that patients being interviewed might produce more accurate results but evidence collected is against those speculations and proved the contrary that computer assisted assessments were more complete and accurate [28].   Many conventional questionnaires, specifically for PTSD screening purposes, were assessed and a big loophole was found. Each questionnaire for PTSD asked one basic question which was whether the patient had experienced any particular traumatic event; a large number responded that they did not understand what a traumatic experience is as pointed out by Dam et al [18]. This concludes that, to develop a system with a systematic questioning method and an efficient answering scheme is most highly recommended.

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Patients as human beings have the tendency to forget taking their medications and some have the nature to even ignore it. Thus such a system as proposed would act in a reverse psychological manner and thus remind the patients to keep a watch on their medication period and be responsible in following suit.

PTSD patients are known to suspend and ignore their medications and treatments and develop phobia like symptoms towards it. They become afraid of doctors and losses of confidence in the therapies provided cause them to drop out [18], [28], [57-58].There have been studies that reported the usage of latest innovations and technologies, for the purpose of self assessment of PTSD patients, were more helpful as compared to face-to-face sessions [5] and [58].

Lastly, current diagnostic methods of PTSD have proven to be insufficient as the disorder has been misused to gain benefits [35]. Interviewing which is a mid-order diagnosis method has also faced complications with many patients and some patients for their advantages can even make up stories that are convincing enough. This would prove misleading to make a conclusion on whether one does suffer from PTSD. According to Nemeroff et al. [38], neuro-imaging such as fMRI and EEG should be used in the diagnosis of PTSD that is for the purpose to determine whether a person has PTSD or not.

1.3 Objectives

The objectives for this project are as follows:

- To successfully develop a system for the sole purpose of neurologists for aiding them in patient information collection and patient management.
- To help the clinician increase productivity by developing the system for their usage.
- To conduct a comparative study between the effectiveness of computerized screening tests for PTSD against the conventional, paper-pencil method.
- To develop a system with future extension of electroencephalography (EEG) equipment that enables further research in the area of PTSD and misdiagnosis and other stressor-related disorders. This system would enable behavioral tracking too.

1.3 Scope of Study

Due to time constraint, the project is limited to PTSD patients only even though it claims it is usable for a variety of neurological symptoms. The reason why PTSD was specifically chosen is due to the very conventional methods it uses to screen the potential patients. Thus it'll be easier to observe the difference between using a computerized way than the conventional paper-and-pencil method.

The testing of the system can only be done on a limited number of subjects over a limited period thus the system's *full potential* may not show. One other thing that limits this would be the vastness of PTSD conditions itself and thus the project will only cover a certain aspect.

CHAPTER 2

LITERATURE REVIEW

2.1   Post Traumatic Stress Disorder (PTSD)

Post Traumatic Stress Disorder, a particularly common and serious psychological disorder that affects anywhere between 1 and 15 percent of the world's population today and first became a official disorder in 1980 [12, 58]. The occurrence of PTSD is due to a traumatic experience through various forms such as injuries, abuse, witnessed events e.g. murder, disasters (both manmade and natural) and acts of war. PTSD has various occurrences, in some it may occur immediately after trauma in others it could take more than 6 months, which is known as the delayed onset. Those who suffer from it immediately following the traumatic event tends to get stable within 3 months, though there have been cases where it can last for years. Till now the exact cause of PTSD is unknown, but it is discussed that many factors such as psychological, social and even physical are involved. These factors affect neurotransmitters in the human nervous system, specifically in the regions of the synapses, and the stress hormones within them become unstable thus resulting to lead to PTSD.

Klein and Alexander [27] have mentioned in their research, that an adult has a chance of anywhere between 3.9-89.6% to be exposed to a traumatic event during their lifetime and between 1.0-11.2% for PTSD. Bisson [6], in his works included a United States Nation Co-Morbidity survey with a sample of 5877, 15-54 year olds where in that sample just over 60% of males and 50% of females had been exposed to a traumatic event and a lifetime prevalence of PTSD of 10% of those females and just 5% of those males. Based upon the studies of Tarrier et al., it was noted that women were on the

greater risk of developing PTSD after traumatic exposure as compared to men, though on the other hand, men were exposed far greater to traumatic events as compared to women [45, 58], which has now been justified from the survey results [6].

2.2   Stressor Criterion for PTSD Diagnosis

For a person to be diagnosed with PTSD he must first meet the criteria set either by the *Diagnostic and Statistical Manual of Mental Disorders IV* (DSM-IV) or the *International Classification of Diseases 10* (ICD-10).

DSM-IV states that a person should experience an event which either involved death or a threatening of death or any serious injury or a threat to *"physical integrity of self or others"* where the person's response would include intense fear, helplessness or horror [3, 27].

ICD-10 defined the criterion to be *"A stressful event or situation (either short or long-lasting) of an exceptionally threatening or catastrophic nature, which is likely to cause pervasive distress in almost anyone"* [27].

PTSD would be considered a disorder by which various other disorders may produce in a patient due to the external factors of the surroundings or events that took place. To obtain a clearer picture, this basically implies that if a patient of PTSD is exposed to a certain process or environment, it may lead to further complications such as hyper arousal, hyper vigilance, startling responses, re-experiencing flashbacks and feelings, numbing sensations in emotional context, feelings of detachment, avoidance of

places and people that remind of the traumatic event (dissociation), hopelessness and lastly loss of interest in daily activities [45]. According to J.L. Steel et al. [55], for a person to be diagnosed with PTSD, he or she must be having the symptoms mentioned above for at least a month. These can be other forms of criteria in diagnosing one to have PTSD.

2.3 Predictors of PTSD

When discussing the predictors of PTSD, one must look at three main phases, pre-, peri- and post-trauma. Pre-trauma basically is any event or factors before the traumatic event that could play a role in the development of PTSD, factors could even include a previous trauma. Other factors are history or family history of any psychiatric disorder, family violence or childhood abuse, being female gender, lower socioeconomic status, and lower having EQ and IQ.

For predictors such as IQ levels and cognitive ability, it was found out that correlation between IQ and PTSD is negatively proportionate, meaning that those with a higher IQ have the cognitive ability to confront effects of trauma and thus avoid falling into the trap of PTSD as compared to those with lower IQ levels. Assumptions that those with lower IQ also tend to have limited health resources and due to such, intervention in time is not possible and thus PTSD cannot be prevented.

Peri-trauma factors are those occurring during the time of the traumatic event, factors may include; severity of the trauma, trauma being life threatening, dissociation immediately after trauma, and emotional distress. Lastly, for post-trauma factors such as life stress and lack of social support may play a big role in PTSD development [6, 27].

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Even though with the mentioned factors, there is always a difference from individual to individual and this has left researchers still finding the answer to. According to studies, peri-traumatic and post-traumatic factors play a greater role as compared to pre-traumatic which do not entirely affect a person after trauma, or at least will affect the least [9, 27].

2.4 Trauma

Recent studies have shown that trauma as described in the past was not fully understood, according to Diagnostic and Statistical Manual of mental disorders third edition (DSM-III), trauma is a "recognizable stressor that would evoke significant symptoms of distress in almost anyone". That is to say that any form of stress-related event or experience can cause a person to have trauma due to the "distress". In the revised version of DSM-III the definition of trauma was further elaborated which said that the stress-related event or experience is "outside the range of usual human experience and that would be markedly distressing to almost anyone". Again they refer to stress-related events, but this time, one that is not in the daily workings of life such as disasters, near death situations, etc. DSM-IV had reviewed the previous definition and brought about the definition of a traumatic event which comprises of: "(1) the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others (criterion A1), and (2) the person's response involved intense fear, helplessness, or horror (criterion A2)", [1], [2], [3] and [39].

With DSM-V being developed and to be released in 2012, one can expect more changes to this definition with more parameters such as situational factors, family background, educational background and personality. As discussed in the data analysis

later, these factors have proven to be a major difference in establishing whether a traumatic event is the same for all, or different as per the individual.

2.5   Effects of PTSD on a Patient

As discussed earlier, there were some factors such as hyper arousal considered to be used for diagnosis criterion, but concurrently they can be side effects of PTSD too. These side effects would indefinitely be a major issue to everyday lives of the victims. Apart from the mentioned effects, there are more severe ones too; one of them is known as dissociation. This can be developed immediately after trauma too as previously stated; otherwise it can occur once a person has PTSD. "Dissociation" can refer to temporary breakdown in the emotional state of a being. Usually this is concerned with perceptions of the world with relations to past events and links to future thoughts; these thought processes get disfigured during dissociation. Other symptoms of dissociation are emotional numbing, derealization, depersonalization and *'out-of-body'* experiences. This particular problem may occur as peri-traumatic or post-traumatic [10].

The works of Brewin and Holmes [10] suggested that 'helplessness' another symptom of PTSD, is closely related to 'mental defeat'. "Mental defeat" basically refers to when one looses or gives up his identity in his mind and perceives himself as a senseless object, depriving one's nature of being a human. This can lead to many other issues, such as anger, shame, and disbelief. Delving deeper into the realms of disbelief, a patient suffering from this may have had shattered beliefs and assumptions [10, 43]. This opens another theory known as the *Theory of Shattered Assumptions*. Based on Janoff-Bulman's work, there are three main theories or assumptions; (1) that the world is benevolent, (2) the world is meaningful, and (3) the self is worthy. A mentally stable person would regard these well, and they would carve a path in the world under the

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comfort of those beliefs. Bolton and Hill added to this, they pointed out that one's will to act is solely based on a set of beliefs; (1) the self is competent to act, (2) the world is predictable and (3) the world provides satisfaction of needs. This implies further that a person with such beliefs would no doubt become comfortable in life and his subconscious and conscious self would not perceive any apart from those beliefs. Thus when one would face trauma, the burden would be too heavy to bear on the mind, and that the person would then be filled with disbelief. Acceptance would be hard, and the person would be in a dilemma as to whether the traumatic experience really happened or not.

Usually as mentioned by Janoff-Bulman, the person to suffer most would be one who has had mostly positive experiences, and based on that built cities of assumptions in his mind, which would only feed the person with the particular set of beliefs and illusions. On the other hand, those with negative experiences or those with early trauma history might not fall into the same issue as the former as their curtain of illusion upon the world has already been raised beforehand. This comes back to the baseline on disbelief, when a person who suffers from such, his eyes would only look at the negative side of the world, and might even overlook the positive intentions of people, surroundings or self. This sense usually begins on post-traumatic times and usually would last long, whereas if they were to develop during peri-traumatic period, the disbeliefs could reoccur whenever the person were to re-experience the trauma [10].

When one suffers from PTSD he also goes through a mental war; the mind concurrently performs two processes, (1) to bring forth and promote the traumatic information to the mind so that the person ponders over it and (2) to suppress that information as to avoid any re-experience of the trauma [10]. This is better explained in the formation of fear network or structures that reside in the brain after a traumatic event; this is in relation to "information-processing" theories. Both the works of Foa et al and Lang stipulated that fear and frightening events are formed into memory via

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interconnections of various nodes. These nodes represented three types of information: (1) stimulus information of the traumatic event, (2) information about the person's reaction and response whether it is emotional, physical or psychological towards the traumatic event and (3) any meaningful information about the severity of the threat faced. When one probes memories, especially implicit memory, he might activate the fear network above its 'threshold of conscious awareness'. This in turn causes the person to re-experience the traumatic event with the same physiological and behavioral reactions and perpetuates the original memory. Those suffering from PTSD have permanent activation of these fear networks and sounds and sights can be simple stimuli to bring back the experience of the traumatic event [10, 12].

As for the relation between memory and PTSD, stress and trauma relations to memory must first be undermined. Studies showed that those who repeatedly went through trauma since childhood were regularly stressed out, and this impaired their short-term memory. Those that went on to suffer from PTSD showed signs of hippocampal volume reductions, and thus when they got exposed to conditioned stimuli, the neuroendocrine response would cause a short term memory loss [12]. Another study also measured the corticotrophin-releasing factor (CRF) levels in the hypothalamus and amygdala and CRF concentrations in cerebrospinal fluid (CSF), whereby it was found out that those with increased stressed had increased levels of CRF concentration in all the areas, which in turn stated that these were more likely due to early life trauma. These implied the fact that stress in early life had reduced hippocampal neurogenesis, hippocampal mossy fiber development and GABA receptor binding thus reducing their IQ and increasing chances of PTSD. The CRF CSF levels were higher among women too [38].

PTSD can have an independent occurrence, but that is rarely seen, usually, it develops in context of co-morbidity. The most common disorder along with PTSD that occurs is depression, and nearly 50% of those suffering from PTSD would develop

depression. Other seen disorders are anxiety, psychotic, and substance misuse disorder. Recent studies show that chronic pain, circulatory and musculoskeletal symptoms are starting to increasingly appear with those suffering from PTSD [27].

2.6   PSTD Screening Tests and Diagnosis

Today there are certain methods to assess and diagnose PTSD; one is the conventional paper-and-pencil screening tests and the other interviews and consultations. The screening tests are the common methods used and as such they fall in accordance to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD). In Appendix 1, samples of these conventional paper-and-pencil tests are shown. Ouimette et al. [42] pointed out that specific screening tests should be used in different conditions accordingly and this is a vital point in the diagnosis of PTSD.

Recently a new project was initiated by the National Institutes of Health, US, named Patient-Reported Outcomes Measurement System (PROMIS). This particular system is being made to accommodate tools to assess the reliability and validity of patient-reported outcomes (PRO). The information is obtained from patients, which being given questions, subjected to health-related quality of life, must answer according to their condition. The results are then assessed by another arm of PROMIS known as the PROMIS Statistical Center and later on stored by the PROMIS Technical Center. PROMIS is being developed to be used for multiple diseases and conditions.

A study conducted by Sharda et al [52] described the method of clinical narratives, obtained from interview sessions conducted with patients, being automated

into an effective electronic format. The study also proved the inefficiency of having clinical narratives in the first place as compared to structured interviews. This shows the ineffectiveness of interviews and makes a way forward for research into human-computer interaction specifically for the use of developing computer assisted screening tests for the patient and management system with results and data clusters for the clinicians.

There have been very few computerized screening tests for PTSD. One particular system is known as the Health Screening System (HSS) [28]. A simple system which exhibits questions similar to the pencil-paper tests but just on a screen. An exact duplication has been made only that the patient would know use keys on a keyboard (numerical) to answer the questions. The system has the capability to add on more tests and also to export results into an Excel spreadsheet. There is a catch though, according to Dam et al [18] patients tend to get confused when they look at all the possible answers at the same time and this system does exactly that. Though the system has increased efficiency against paper-pencil tests, there is room for further improvement.

PTSD currently is diagnosed with a 'top-down' approach of using questionnaires and surveys. For example in the PTSD Civilian Checklist, a standardized self-reporting scale, a score of 50 and above out of 85 suggests that the person has PTSD. Similar diagnosis questionnaires have been developed and they all indicate that 70% of those who take it have PTSD. Whether that number is credible or not one cannot say till further research. Life is full of traumas and stress that does not mean every single human would actually suffer from PTSD. With the release of DSM-V, PTSD is set to be reviewed; perhaps the APA would place PTSD in a more clear position as opposed to now.

The issue of diagnosis with only questionnaires led to the 'bottom-up' approach where psychiatrists would interview the patients to find more answers about their condition. Yet again, problems in interviewing have always been there especially with those whom suffer from any psychological disorders. Singh and Kirkby [53] have listed out various obstacles when concerning diagnostic interviews; lack of trust, tearfulness, anger and hostility, over familiarity, non-communication, and problems with the interviewer.

2.7   Treatments for PTSD

There are various treatments for PTSD and most of them are therapies compared to medicines. Among the tops ones are *Psycho-education,* where information and teachings are given on psychological reactions and responses to trauma. In this way, a person suffering from PTSD will be better equipped mentally to tackle the threatening stimuli [58]. On the other hand, Buckley et al. [12] argued on the fact that no matter what information is given to those with PTSD, as long as their IQ is low, they will have difficulty in responding anyhow. Information processing is also another problem, where any words with threatening stimuli may cause memory dysfunction as the neuroendocrine response would be triggered, thus the idea of instilling information can be waved off as they would not take any of it in.

The next treatment discussed is known as *In vivo exposure therapy;* basically the concept applies as to 'fight fire with fire'. Here therapists take the patient back into a state of trauma-related situations. In this way patients are trained to confront any stimuli and not avoid it. The effectiveness of this has been known throughout and is better called as trauma-focused cognitive behavioral therapy (TFCBT).

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Another key treatment is *cognitive therapy with exposure,* which will be utilized in this project indirectly for the patient interface for the purpose of information retrieval. The therapy involves examination of thoughts by a therapist to understand how they affect the patient's emotions. Though there is a certain disadvantage to this, but with a computerized method, as proposed by this project, the patient will be able to go at their own pace and thus not feel the pressure of another person trying to extract information out [58].

Pharmacological treatments are also there but not used as much as therapeutic treatments. One suggested hydrocortisone to be a good medication to prevent PTSD [6] another mentioned serotonin-norepinephrine reuptake inhibitors (SSRI) would decrease the adverse behavioral effects of trauma [38]. Other ways are using placebos to have a psychological effect on patients whereby they would think they are taking medicines to improve, and thus shall be self-healed [61].

According to studies conducted by Tarrier et al. [58], cognitive behavior therapy (CBT) has proved to be the most successful and accepted one by patients, and the least accepted was the eye movement desensitization (EMD-R). The studies also mentioned that by gaining prior knowledge about the particular treatment, a patient might be biased towards it. As in this case, the patients knew about CBT and had either previous experience or knowledge relating to it as compared to EMD-R.

2.8   Challenges of PTSD

From the birth of PTSD as an official disorder in the DSM-III (1980), PTSD has been the most challengeable disorder according to its definitions. The many forms of PTSD

(acute, chronic, complex, subdromal and "masked") has caused psychiatrists to consider and reconsider this disorder many times over. This is due to the fact that PTSD is on the borderline with various other disorders such as personality disorder, anxiety, acute stress disorder and many more [49]. According to McHugh and Treisman [35], PTSD has been formulated from 3 main elements; fear, anxiety and emotional reactions that a person would face when in shock or trauma. They claim that medical reasons were not the spark that paved a path for PTSD but social and political interventions. Since the term has been coined it has been abused at every level, from a normal case of backbiting to political propaganda [25].

PTSD has been described in many literatures as a politically and socially created disorder coined by the West. One point of view states that since this is a psychological disorder, culture and ethnicity needs to be involved. That is why PTSD is regarded as a disorder of the West. According to Kienzler [25], PTSD treatments and diagnosis in other parts of the world did not work due to the psychiatrists standardizing techniques with respect to Western culture, and many NGOs thus challenged the 'Western-style counseling'. Some researchers also misjudged populations suffering from domestic violence to be traumatized and hopeless. This again raises the question as to whether PTSD is valid or not.

With the weakness in the judiciary system of today's world, individuals have used PTSD as a means to gain benefits in all ways. McHugh and Treisman had pointed out in their literature that in 1988 according to a study, 479,000 of 3.14 million men that served in Vietnam still had "diagnosable PTSD" 15 years later and that a million had PTSD at one point or another in the post-Vietnam era. The ironic part was that only 300,000 had served as a combatant. Apparently, veterans who had PTSD were revered above those with other conditions and benefits were targeted more towards them. This particular study had already raised questions to whether the diagnosis of PTSD was valid or not and that whether veterans had used PTSD as a means to claim the benefits.

Another author pointed out that PTSD was more likely to reoccur due to reminders that were provoked by either the society or the government. Taking September 11 attacks on the World Trade Center as an example, the author inclined to say that the annual anniversary that the government of the United States holds are in a way provocations to ignite people to feel the horrors again of the dreadful day. That indirectly invokes those suffering from PTSD due to the event to feel more disturbed and thus leading to them not being fully cured. One may ponder whether that is a political intervention again. McHugh and Treisman also studied that psychiatrists 'assume' more than they can confirm, such as those who rush to natural disasters trying to meet the people who suffered in order to 'prevent' PTSD from occurring. As the anonymous author mentioned, reminding would just cause more harm and in this case psychiatrists are already influencing people by assumptions. Perhaps the sufferers might not even get close to PTSD later, but because of those psychiatrists they just might.

Lastly, with the various literatures pointing out that PTSD is a very individualistic disorder, meaning that one may suffer from PTSD with the same symptoms as one not suffering from PTSD, but due to culture, background history and mental capacity, the former had developed the disorder. Many a times due to similar symptoms and hazy criteria given by both the DSM-IV and ICD-10, one can be misdiagnosed as having PTSD even though he might not. On the other hand, one may develop PTSD even after facing non-traumatic events such as divorce, or simple things like scolding from a boss [36]. Again whether there is PTSD or is it just mere forms of emotion regulation out of control, researchers are yet to find out. This is the most challenging part of PTSD yet after its validity [9, 35, 49 and 59].

2.9   User Interface Design and Human Behavior

Human-Computer Behavior, it is responses and approaches of humans with regards to user interfaces on a computer. For every software developer, this area is a vulnerable point needed to be address with utmost caution as the user-interface alone can decide the success of the software. If example the user interface is disoriented, studies have shown that people develop computer related anxiety. This anxiety or stress may lead to other forms of problems such as lack of motivation, decreased performance and absenteeism [14].

Chalmers [14] quotes "viewing a good screen design enables automatic processing, whereas viewing poor designs encourages a manual and therefore, less efficient processing." To enable developers to make good screen designs a set of areas need to be covered by them. The first being *layout;* this area concerns mainly with the arrangement of objects within the interface and their attributes, such as their fonts, font size, colors, and even interactivity. The next area covers *consistency,* in which Chalmers points out to use a consistent format for each screen i.e. placement of objects, colors, backdrops, etc. Lastly *color,* this area completes the other two as it acts as a balance between interest and distraction. There is one catch within this area, when developing the interface one has to be specific about for whom the interface is being made as certain colors may be a problem for some, example the color blind [14].

Other factors should be taken into consideration when designing an interface such as *age of user, gender, level of education, affect, and user motivation.* Age defines the experience rather than physical age. This is derived from the amount of exposure the user has with computers and thus those with less, their interface would be hectic to design. Chalmers citing previous works pointed out evidence of that "men and women respond differently to computers." He also mentioned the amount of anxiety in women is greater than in men and men usually tend to use computers for games and competitive

work as compared to women who use it for leaning. The reason why level of education is important here is because interface designs if made for an expert user then the amateur user will have difficulties coping up. Moods (affect) play a part in interface design too. A study conducted with 600 management information students found that mood influenced a person's "level of effort expended on a computer related task" [14]. In turn the effects of moods are in likeness to the sense of motivation i.e. they are directly proportional to each other. If the mood is elevated, then the motivation would automatically be increased and thus so would performance.

For the designing of interfaces for health workstations, Tang & Patel [56] have mentioned the fact that clinicians have a strenuous task when concerning with data entry. They suggest using pen-based devices instead of the keyboard for this purpose due to the limitations of movement by using a desktop computer. The other thing they pointed out was the clear problem of information presentation on the interface. Clinicians spend most of the time finding information about patients from the records rather than attending to the patient. The suggestion made was to present the information in a "context-sensitive" manner, meaning that the information shown must be specific to the patient and their condition thus increasing efficiency.

Tang & Patel [56] elaborated more on interfaces by commenting about user customizability. They observed that users have personal preferences as to the interface design, in this particular context it is known as aesthetics, and that the system should have the capability to allow users to "fine tune" the interface according to their liking. This will increase the chances of the system being used at optimum. Lastly they emphasized on user feedback as a progression towards developing more friendly and easy to use interfaces.

2.10   User Interface Usability Tests

Usability here refers to the amount of guaranteed realization of interaction between computers and humans, whereby the users may be able to evaluate whether the interface is easy, efficient and consistent. The question to ponder is how the interface expresses its functions to users. When designing interfaces, the developer must keep in mind that the user may not understand many things and as such good communication between the developer and user have to be maintained to understand the needs and expectations of users. Only then would the interface created be effective and accurate.

To test the interface design, usability tests have been created so that interfaces may be improved, thus increasing user satisfaction and system efficiency. For the developers themselves, they can use these tests as tools to understand better the needs of users and thus can reduce development time, expenditures and increase the potential of marketability.

The first test to be highlighted is *Virtual Test Method*. This is by which developers use imaginary users to predict problems with the interaction process between humans and computers. Situations are put forward to test this interaction, and through feedbacks, developers can reduce development time and achieve a good product.

User Examine Method, is a test whereby users are monitored and observed while they use the system itself. The behaviors, actions and expressions are captured and assessed. Along with this, a psychological aspect is also taken. Users are asked to fill in questionnaires, go through interviews and are surveyed to obtain their thoughts on the system. In this way user needs and satisfaction levels may be determined.

The last test is the *Experimental Comparison Method*, by which developers assess other related products before developing the new interface. The assessment of products will amplify the differences and problems with those products so as to ensure that the new interface does not have the same complications [15].

2.11   User Interface Evaluation

When evaluating user interfaces, one must observe various aspects namely; Ease of use, Operation, Speed, Interface type, Problem areas, Choice and Preference. From these areas evaluation results may be classified into the following: Conceptual model, Task level, Cosmetic level, Technology level and Functionality [24, 51]. For conceptual model this is basically concerned knowledge of user needed to perform a correct task and things that user should do and things that should be automated. Task level was again mentioning about automation and correction of mistakes by users. Cosmetic level is more concerned with the aesthetics, layout and terminology used. Technology level is basically to do with the devices needed and their feasibility to run the system. Lastly functionality is about what was currently in the system and what the user felt should be added. Data is usually gathered through semi-structured interviews, or surveying [51].

CHAPTER 3

METHODOLOGY

The project has been fragmented into four main phases. Phase 1 mainly involves the planning of the project itself. Phase 2 implements research into the project. Phase 3 is the developmental stage of the system and lastly phase 4 will be implementation, testing and evaluation of the system. As the project comprises of a study and the development of a system, there are two planning phases as noted. The first mentioned covers the project as a whole and the second, in the developmental stage, covers the system development only.

The methodology being adapted by the project is based on prototyping development under Rapid Application Development (RAD) method. This will be mainly focused during the developmental stage which consists of planning, feasibility study, analysis and designing of the system. The reason prototyping is being chosen compared to the other RAD approaches is due to that prototyping provides a system for users to use quickly and thus refinements can be made after obtaining user feedback. On top of that the project deals with actual clinicians who will be the pioneers to use the system, thus the collaboration insists on the recommendations of both sides and thus prototyping is the best option so that a more detailed and accurate system functionality can be brought about. This in turn takes the project closer to achieving its ultimate goal.

23
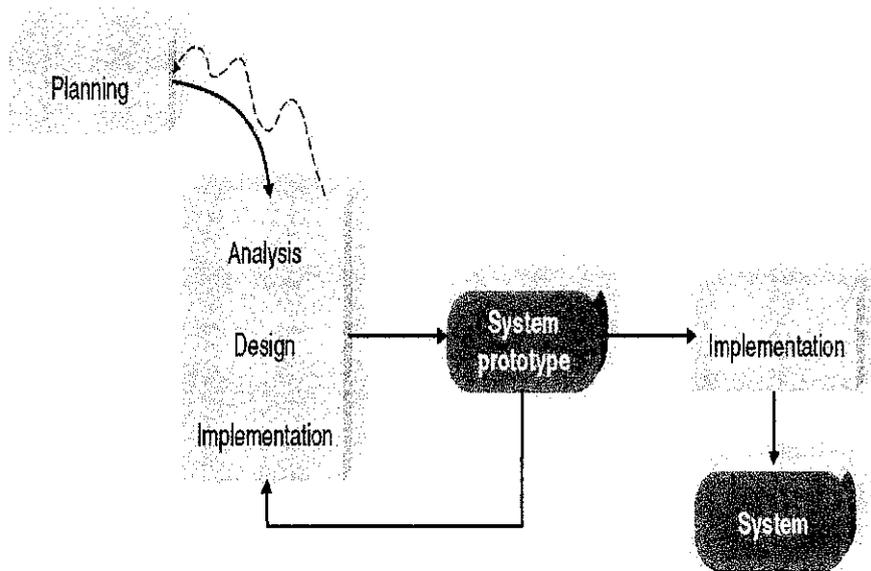
Figure 3.1 Prototyping approach in RAD

3.1   Phase 1: Project Planning

This phase comprises of surveying and interviewing clinicians, and obtaining information about what they require. Under this phase, the systems that clinicians are currently using were observed so as to acquire a clearer picture of what the clinician might require. This phase is now completed.

3.11   Requirements Gathering

An unstructured interview was conducted with a clinician named Dr. Zakaria Abdul Kadir, a neurologist at Ipoh Specialist Hospital who is among the collaborators for the project. The interview deduced that Dr. Zakaria needs a system whereby "everything is available at my touch". Another point should be highlighted is that Dr. Zakaria is currently using Lotus notes and according to

him they are not user-friendly enough, this again stresses upon the earlier mention of the importance of a good user-interface. With this information a prototype was developed as described later.

3.2 Phase 2: Project Research and Critical Review of Related Works

This particular phase initiates research into PTSD and aesthetics. Conventional methods of screening and diagnosis were studied in depth to find out the flaws within them. Human-computer interaction was researched to obtain knowledge on how to develop interfaces for people suffering from PTSD and for clinical neurologists. Problems with current interface designs were assessed and noted so as not to repeat it in the project.

3.3 Phase 3: System Development

As discussed earlier this phase consists of planning, feasibility study, analysis and design. The system was planned accordingly to specify what components it must contain, the interface design based on the research findings and the screening questions needed to be asked in the patient's interface. The analysis and design was then carried out making sure that the system falls within range with regards to the feasibility study. The prototyping took place within this phase, and after each design the prototype was passed to the clinician to assess it. The prototype will also be installed for the PTSD patient to observe the necessary changes needed to suit the patient. Once feedback is obtained, the prototype will be refined. The testing and evaluation of the prototypes was conducted with 5 different patients suffering from PTSD. In the case of testing with the clinician, one clinician was the principle collaborator whom assisted in the design of the

prototype, once the clinician is satisfied, the prototype will be passed to other neurologists to try out the system and provide feedback. The interface usability test that is used is the User Examine Method. Figure 3.3 outlines the process roughly.
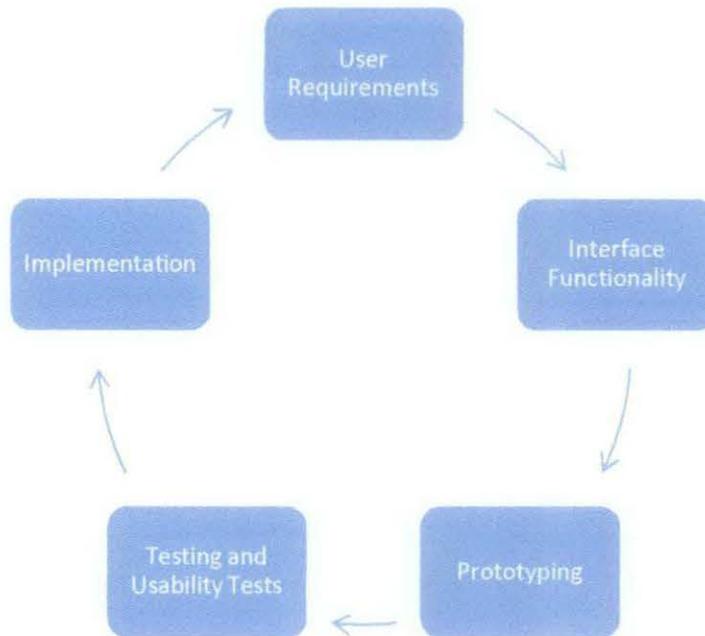
**Figure 3.3 User Interface Design process**

3.31   Planning Phase – Proposed System Functionalities

The system will consist of three interfaces linked with each other. The interfaces will be with each; nurse, patient and the clinician. A brief insight on the proposed system is as follows, it is planned in accordance to the interview with Dr. Zakaria. The overview of the system is displayed in Figure 3.31.

Nurse:

The system at the nurse's desk would be such that holds the full database of the patients. The system also holds the key reports and history of the patient, and the different type of questionnaires that may be given to the patient depending on the visit.

Patient:

The system here comprises with a friendly interface for the patient to use. During the first visit the patient will be given a set of general questions. These questions will be in 2 sets, one for diagnosed patients with PTSD the other will be for undiagnosed patients. For diagnosed patients they will be asked based on their medical history and past records of the PTSD era and referrals to past clinicians and medications. For undiagnosed, it'll be general questions to see what problems the patient is going through (later used for diagnosis purposes). Both sets of questions will ask the patient demographics and family background, and a bit of personal information.

During the second visit (specifically for PTSD diagnosed patients ONLY for this project due to time constraint but can be customized for various other conditions) the set of questions will be different. The first set will be majorly aimed to confirm diagnosis of PTSD; this will be a screening test for more accurate results. The other set will ask the patient about any event that occurred since the last visit and whether the patient has been taking his/her medications regularly.

The follow up visits will be similar to the second visit, only that the screening test will no longer be applicable for now. Once the term of medication is completed the patient will go through a similar screening test as the second

visit to determine whether the intensity of trauma has decreased or if the patient is fully cured.

Another interface designed for the patient will be for issues and behavior tracking; this will assist in the research and diagnosis of the patient for the clinician. It will consist of a desktop and mobile application whereby the patient may key in issues that he might face on a certain day. The interface will be remotely linked with the system of the clinician. The concept is that of a journal entry system.

Clinician:

The clinician's interface will be a simple one, it basically shows the report generated after the patient has answered the questions and filled in his/her particulars. This will be provided to the clinician for pre-consulting purposes so that the clinician already has a clear idea of what to probe into. This will save time during the consultation period and other issues can be discussed instead. The report will contain patient details, results and statistics of the questionnaire, confirmation of diagnosis (for second visit and after medication period only) and other information about the patient condition. It will also contain medication and tests history. The information will be organized in cluster format for easy and quick access. The report will be printable.
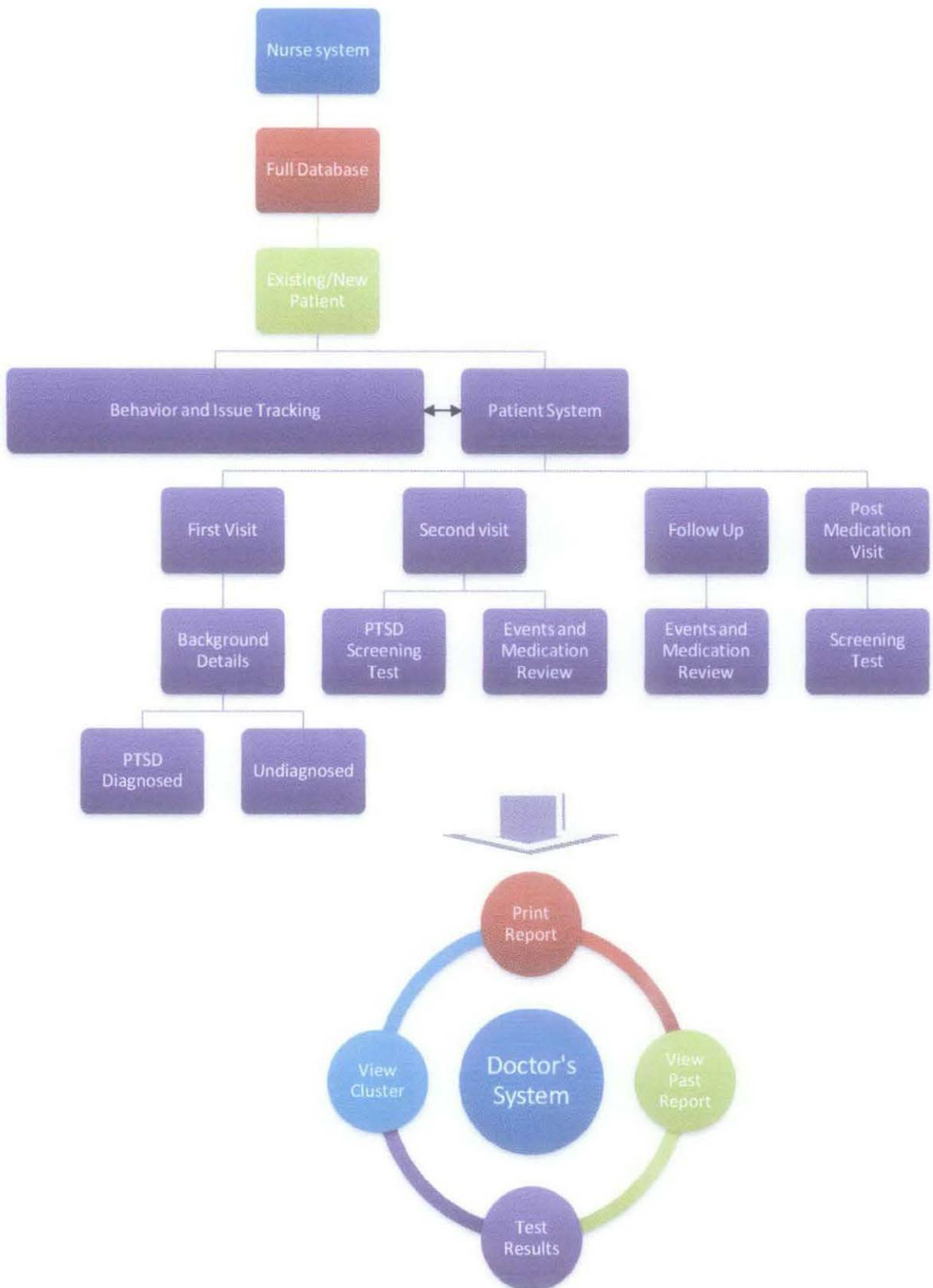
Figure 3.31 System Overview

3.32 Data Gathering and Experimentation

In this part, 5 patients of both genders shall be given the conventional paper-pencil questionnaire and then assessed. They shall also go through a very brief interview that will evaluate their views on the conventional method. After the system is fully developed, the patients will then try out the automated questionnaires and again shall be interviewed to find out how different that was as compared to the conventional.

3.33 User-Interface Usability Evaluation

In light to the development of prototypes, a user satisfaction model has been drafted to be used to assess whether the interface is user-friendly enough or not. There are two concerning variables being used, user satisfaction and user expectation. User satisfaction is whether the user after using the system, will feel satisfied with the design layout of the interface, the accessibility and the color scheme, or not. User expectation on the other hand is the perceived design of the system by the user before even using the system itself. For each of the variable, questionnaires are developed. The questionnaire for user expectation will be given prior to the testing of each of the prototypes. The prototype will then be introduced to the user and the questionnaire of user satisfaction will then be given.

Once the results are in, they will be compared to assess the user friendliness of the interface. If the user satisfaction is low, the user expectation will be heeded to develop the next prototype, which will be more towards the liking of the user. For the questionnaires, user expectation questionnaire will be one where the user has to write down his expectation for the system. For the user

satisfaction questionnaire, questions will be answered by the user by shading a scale of 1 to 5, where 1 is "highly dissatisfied" and 5 being "highly satisfied". The components of each questionnaire will be related to those shown in table 3.3. Other factors such as *Universability, Usability, Communication, Motivation, Speed, and Documentation* will also be covered during the evaluation.

User Expectation	User Satisfaction
Simplification	Easy to learn
Consistency	Easy to understand
Help Features	Easily adaptable
Compatibility	Comfortable to the eyes (color)
Feasibility	Predictable
Structure	Reliable

Table 3.3 Components of interface evaluation questionnaires

3.34   Color Scheming for User Interface

This section is of utmost importance as color itself can be the point of failure in user friendliness of the interface. The user interface consists of three main parts, the background, the foreground, and the input/output sections. For the background, light colors are chosen such as white, as for the foreground, something that contrasts the background and yet does not provoke the eyes to be uncomfortable thus a soft color like light purple, sky blue or light yellow are some that may be used. As for the input/output a color apart from the fore- and background should distinct it. For the words of all, deep colors should be chosen so to be easily seen by the user.

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3.4   Phase 4: Implementation, Testing and Evaluation

This phase consists of the final installation of the system. The study about the effect of interface design in PTSD patients which started out in Phase 3 will be concluded here. The system will be tested for reliability and efficiency and lastly compared to the conventional methods and past systems. The final study will determine whether a computerized screening test is more effective as compared to the conventional paper-pencil method. To close the project on this milestone, the system shall go through a full test to validate whether it works smoothly, and future research and expansion shall be noted.

3.5   Tools

Two programs shall be used, one which is a software development kit and a database creator while the other is a software used for experimenting neurological disorders, which will be used to create the automated questionnaires.

3.51   FileMaker Pro Advanced

The tool chosen for constructing the system is called FileMaker Pro Advanced. It is off-the-shelf database software with scripting features. The software enables developers to create customized databases, for multiple interface applications. The software is a whole package and has cross-platform features, means can work both on Windows and Mac. Data can be imported directly into the software from MS Excel files, XML, .CSV, and even Oracle Database and MySQL. The

interface can be developed within the software and is fully customizable according to the user's needs. The software has the ability to generate reports from the data collected and will display it in an interface. An internal script debugger is installed for those who need to customize the interface further.

The reason why FileMaker Pro Advanced was chosen over other software such as Visual Basic and Netbeans IDE, was due to the fact that FileMaker Pro Advanced has a feature which none of the others have. It is that the end-user may customize the interface time to time without the need of a developer to be present. Apart from that, the software is a complete package, for Visual Basic and Netbeans IDE, they need to be connected to a database server, either Oracle or MySQL, for it to store data. Another plus point in FileMaker Pro Advanced over the other two software is that the interfaces can be linked over multiple devices. Lastly, FileMaker Pro Advanced has the ability to accept third party vendor interfaces to be part of its own unlike Visual Basic or Netbeans IDE. It also has applications for iPhone and iPad, whereby users may transfer and share data between their PC and phone or tablet.

3.52   E-Prime 2.0

Developed by Psychology Software Tools Inc. E-Prime 2.0 is software package for clinical and research use for neurology. Experiments can be created in this software that enables a clinician or researcher to study the brain more closely. They can design customizable interfaces for the experiment which will include stimuli and collect responses from the subject. The response time is recorded per stimulus, and so each can be reviewed separately, the precision being in milliseconds. Slideshows, video and audio can be embedded into the experiment acting as stimuli. Voice recording feature is also available should an interview be done concurrently with the experiment. The experiment can also be run on multiple screens should the clinician like to view what the subject is doing. The

script behind the interface is similar to Visual Basic and thus the script can be edited if needed for more complex experiments. E-Primes' best feature is the ability to be synchronized with EEG equipment and record the results simultaneously.

3.6   Feasibility Analysis

Since this project concerns biomedical applications, it carries a certain expense to it. The current expenses described in Table 3.6 below are for the sole purpose of system development only and the prices for FileMaker Pro Advanced is for educational licenses not for commercialization. For further research and improvisation to the system more funds will be needed. As for where commercialization is concerned, that will be another matter, for that will include marketing budget, development and installation fees, various other costs that will cover legal expenses, etc.

Product/Tool	Price (USD)
FileMaker Pro Advanced	299
FileMaker Go (Mobile)	19.99
E-Prime 2.0 Professional	995
E-Prime 2.0 Runtime	125
Total	1438.99

Table 3.6 Project Expenses

CHAPTER 4

RESULTS AND DISCUSSION

4.1   Experimentation, Data Gathering and Analysis

So far, five subjects have been given the PTSD questionnaire, two of them males and the
other three females. Each of the subjects has faced different traumatic events upon the
description of DSM-IV on what a traumatic event should be like. The first female, aged
20, had been through a car accident in April 2011 due to drink driving and had faced
serious injuries to her spinal cord which made her disable (legs) temporarily for a few
months. The second female, aged 41, who is the more serious case, has had over 8 heart
attacks, has AIDS, loss of a child (death), and divorced. And the third female, aged 27
had also gone through a car accident during her teenage years, the outcome being a
death of a loved one. The first male, aged 34, had served as a soldier in the Indian Army
and had fought in the Kargil War in 1999 on the front line. He had seen his comrades
and friends killed in action and had been shot too, which was the reason for his survival
as his injuries took him off the line. The last male is a university student, who was once
a brilliant student in his early days, but one failure had nearly destroyed him; till today,
he is in a mental war with himself. Prior to the questionnaire all of them were first talked
to, to make them calm and secure.

For both of the first two females, the questionnaires proved a disaster as both
were not successful. For the first female, she was being given the questionnaire but she
had declined, she said she would rather be interviewed as she is not comfortable with
questionnaires. Thus the interview was conducted, in an unstructured manner by the
author, but the author could not prove whether she has had PTSD. This subject thus

became null and void since the results gave no indication about the objectives of this project. The second female was then given the questionnaire and after reading through the whole questionnaire at first glance she said she might not be able to answer all and felt discomfort. Apparently Question 12 from the questionnaire; "Feeling as if your future might somehow be cut short?" gave her the discomfort and lost her confidence in answering the rest of the questions, she did not even succumb for an interview after. This proved that the paper pencil method is already causing issues with the subjects. The method displays all the questions at one time and the subjects might see a question that would not suit them, thus they might avoid even taking the questionnaire as in the case of the second female.

The last female, she claimed that the only time she ever felt the particular symptoms asked in the questionnaire was during the day of the year when the accident occurred. As the person whom died was a loved one, she always remembers that person and due to the remembrance feels those symptoms. When given the questionnaire she answered it fully, but the results do not indicate whether she has got PTSD as her total severity result totaled to 43 out of 85.

As for the first male, he was given the military version of the checklist (PCL-M) and the results turned out to be much different as compared to the civilians. Firstly he answered the questionnaire without any second thoughts, and then surprisingly enough his overall results showed that he does not have PTSD, though we cannot say whether he had at one point. There were though moments where he seemed lost, and moments where he did display vigilance. He claimed to have most of the symptoms of PTSD at one point of his life, but slowly decreased due his increased involvement in religion. This shows two things, first that the questionnaire is not fully capable of providing the stimulus that will trigger the subject to answer with more precision and the other is that factors such as religion and even background might need to be taken into consideration for further research. Since this was a war veteran, the question also rises that asks

whether the subject had answered in a more disciplined manner, as people from the armed forces uphold honor highly, having PTSD might be a black spot on their chivalry.

Lastly, the second male had also completed the questionnaire and his results had shown that he was sitting on the fence with a total score of 49. In some questions it looked like he did have PTSD and some questions proved quite the contrary. He reported to only have dreams when reminded of the event and that affected his emotions, he became more subdued when such happened compared to his usual lively self. Feelings for others were not affected at all, he still had the love and care he had before, but he reported of dissociation. He would go into complete cut-off from friends and family when he had the event on mind only to submerge himself in his books, he mentioned that this period only lasted a week the most, after that he would be back to normal. He claimed that he had the occasional anger outbursts and that at times he would have trouble sleeping. Overall, his results proved his symptoms to be 'moderate' and seemed pretty much balanced. Again this shows that the questionnaire was not able to diagnose or classify the subject as one suffering from PTSD. Figure 4.1 is a charted version of the results.

As for the automated screening tests the interface is simple and constructed using E-Prime 2.0 and only displays 1 question per screen preview and the user has been given a keyboard whereby they can key in the severity of the scale between 1 and 5. The system records the response time and with that the question with the longest response time is the area which needs to be addressed according to the individual as that shows that it is that area they had most thoughts upon. Based upon the test runs conducted, the results had not proved any different from the conventional method of diagnosis, expect for the fact that it has helped clinicians probe further into response time research with relations to the questions. Apart from that since it was the same people whom the conventional diagnosis was tried upon, the automated version was predictable for them and thus the same results appeared. The main thing would be if a different set of subjects were used to conduct the experiment then one may see the difference.
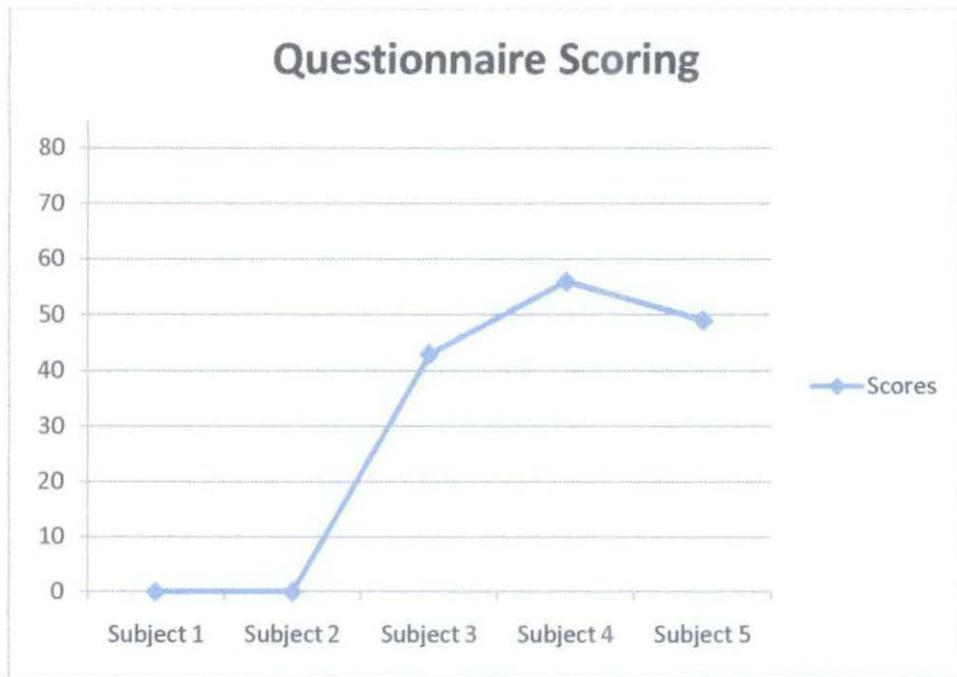
Figure 4.1 Questionnaire scores
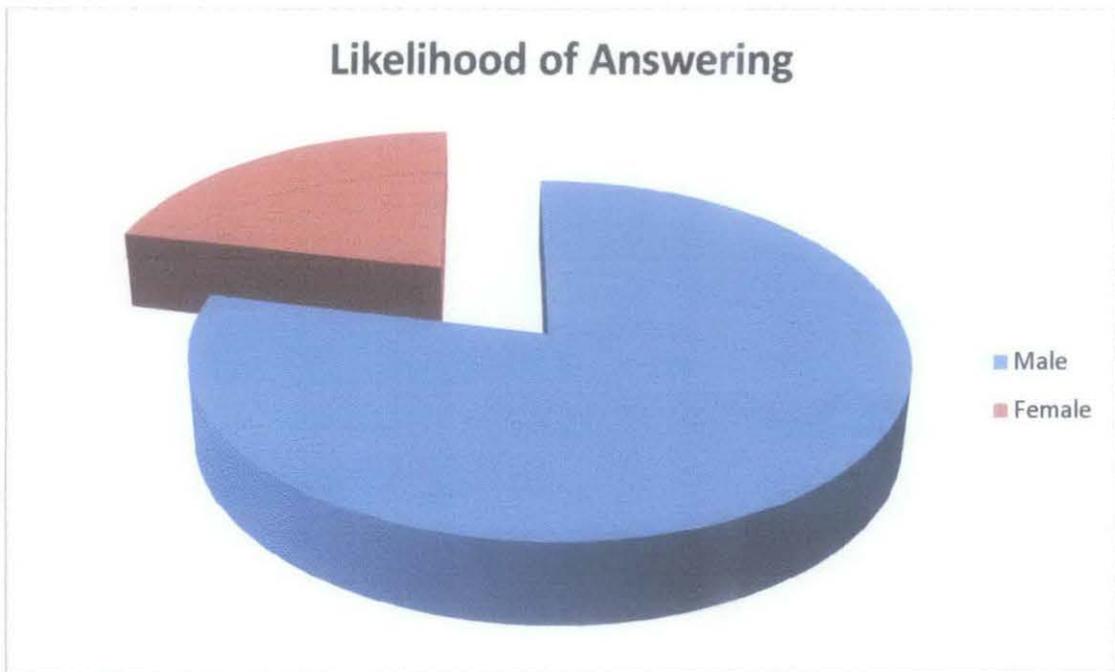
Figure 4.2 Chart on likelihood of answering the questionnaire

4.2   Prototype

With the use of FileMaker Pro Advance, a functional prototype was created; this prototype is the database and records management side of the project where the clinician and his nurses may key in information relating to the patient. The information shall be stored into a built in database which is packaged into the software so that the clinician does not have loss of data if the database is external.

The current functionalities allow the clinician to input real time data and view past data as well as to convert the records into a Portable Document Format (PDF) or into Excel format and save it externally; this enables proper hardcopy documentation when printed.   To view the records in a more suitable format that can be used for printing or for PDF conversion, the system generates a report using the information of the particular patient that the clinician had keyed in. Figure 4.31 below shows a screen shot of the basic information Layout View; this is where the nurse will key in the personal information of the patient during the first visit. Figure 4.32 shows the Preview of the basic information Layout View, the difference being that in the Preview, the clinician or nurse may choose to print and convert into PDF or Excel formats, just with a click of the respective button in the toolbar as displayed in the red box.

The other two Layouts and their previews are the Treatment and Diagnosis and Reports, where the clinician can key in information relating to the patient's condition. As for the Reports Layout, links are provided with the results that will open a new window previewing the file, report or image pertaining to the individual result. Another link in the reports section links the clinician's system to the behavior and issues tracking system of the patient. Figure 4.25 displays the Reports Layout view and Figure 4.26 the view of the Patient Issues and Behavior Tracking system.

The PDF format displays the record as it is shown in the Layout or Preview, whereas in the Excel format the information is displayed in tabular form. Tabular or list form can also be viewed in the system itself, where it displays all the patient's names, date of last visit, medical condition and medical provider as shown in Figure 4.33. The fields can be customized to display according to what the clinician desires.

All systems created have a mobile application that runs on iOS and also has web compatibility which can be accessed if the host system (clinician's) is connected to the internet. The clinician can access it then from anywhere in the world using his IP address keyed into the web browser. This will then open a page with a user login and password, he can then view the various databases and systems once in, this can also be used through an Android based web browser. Apart from that the system can create runtime solutions to provide portability of the database which can be carried around in a pen-drive.
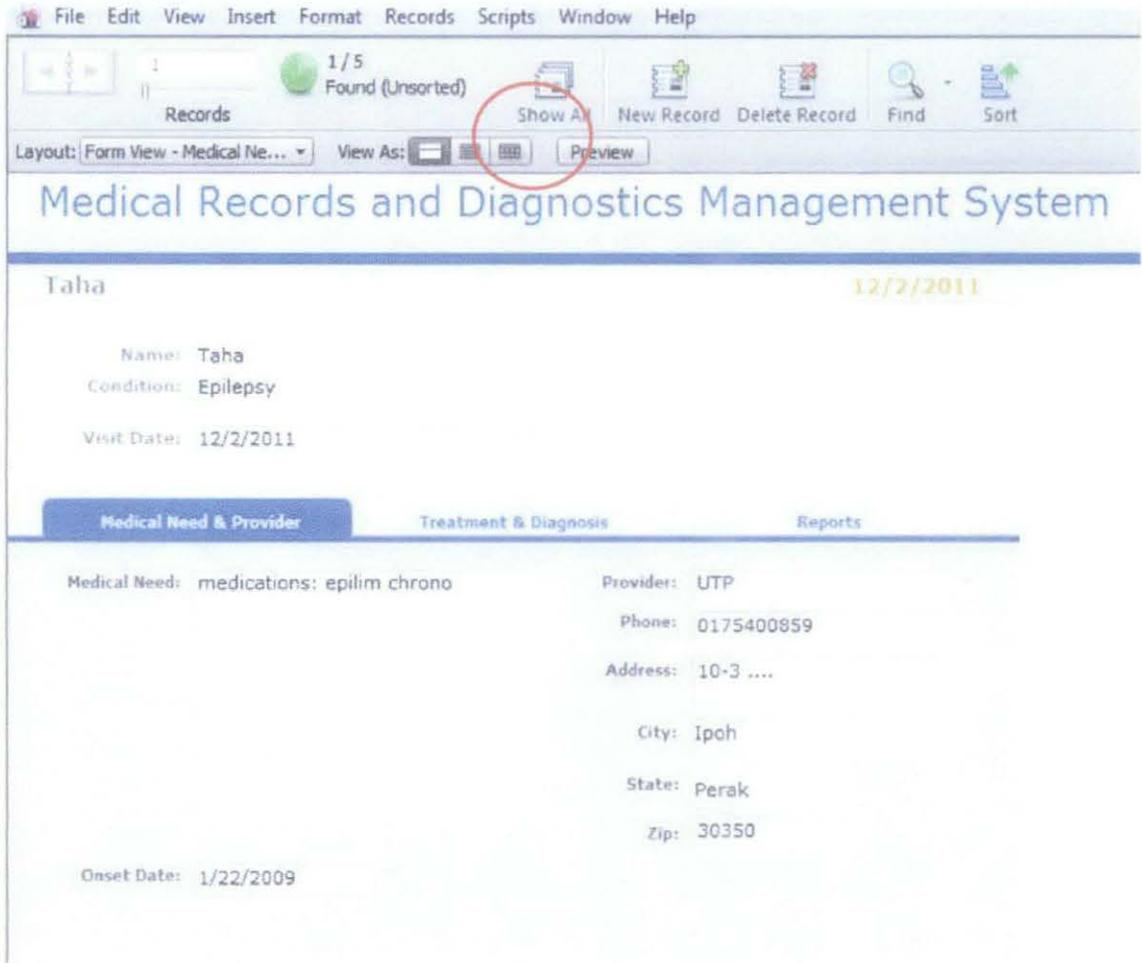
Figure 4.21 Medical needs and basic information layout
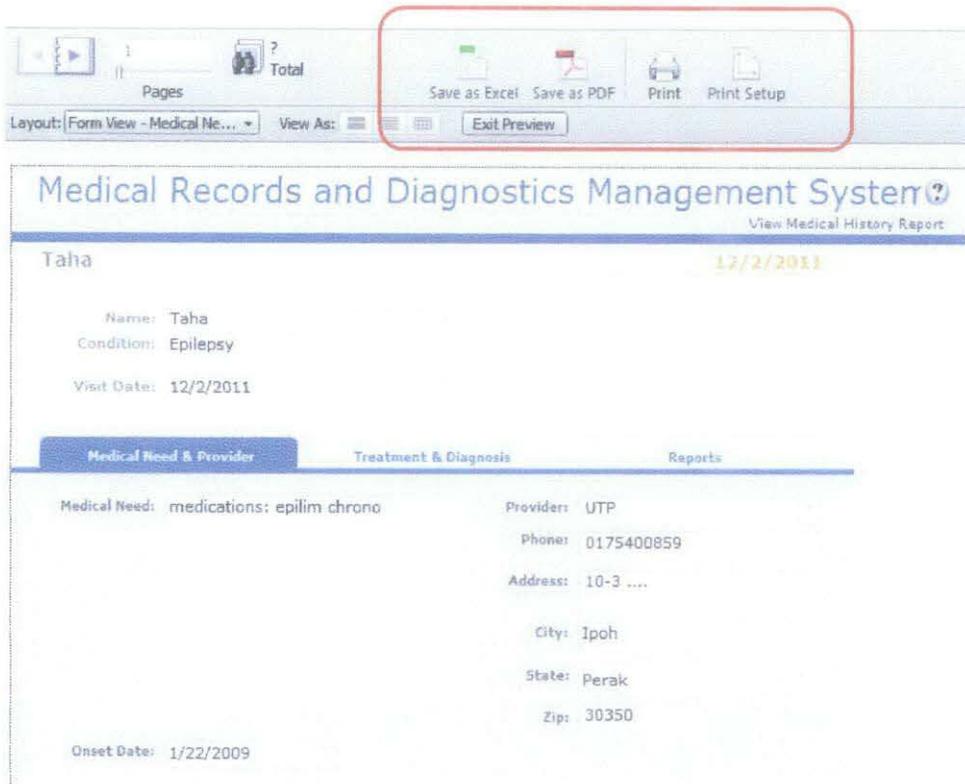
Figure 4.22 Preview of basic information Layout
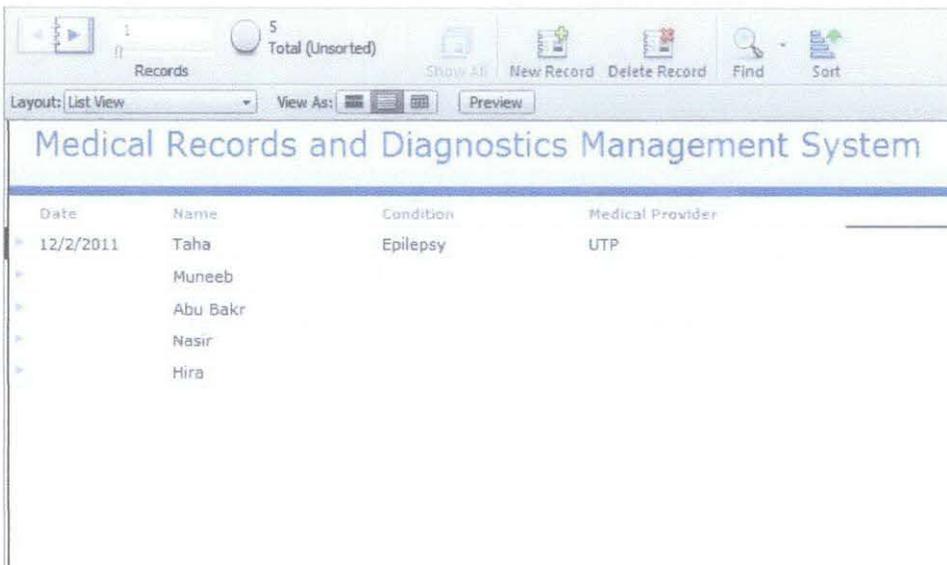
Figure 4.23 List View

Figure 4.34 below shows the Medical History Preview where the auto-generated reports mentioned above are. The clinician may choose to view the whole history of one particular patient or can view all the reports of all patients that visited on a specified date. These are all convertible into PDF and Excel format plus printable too. In the Layout View of this function, the clinician or nurse can still key in information directly.

Figure 4.24 Medical History Preview
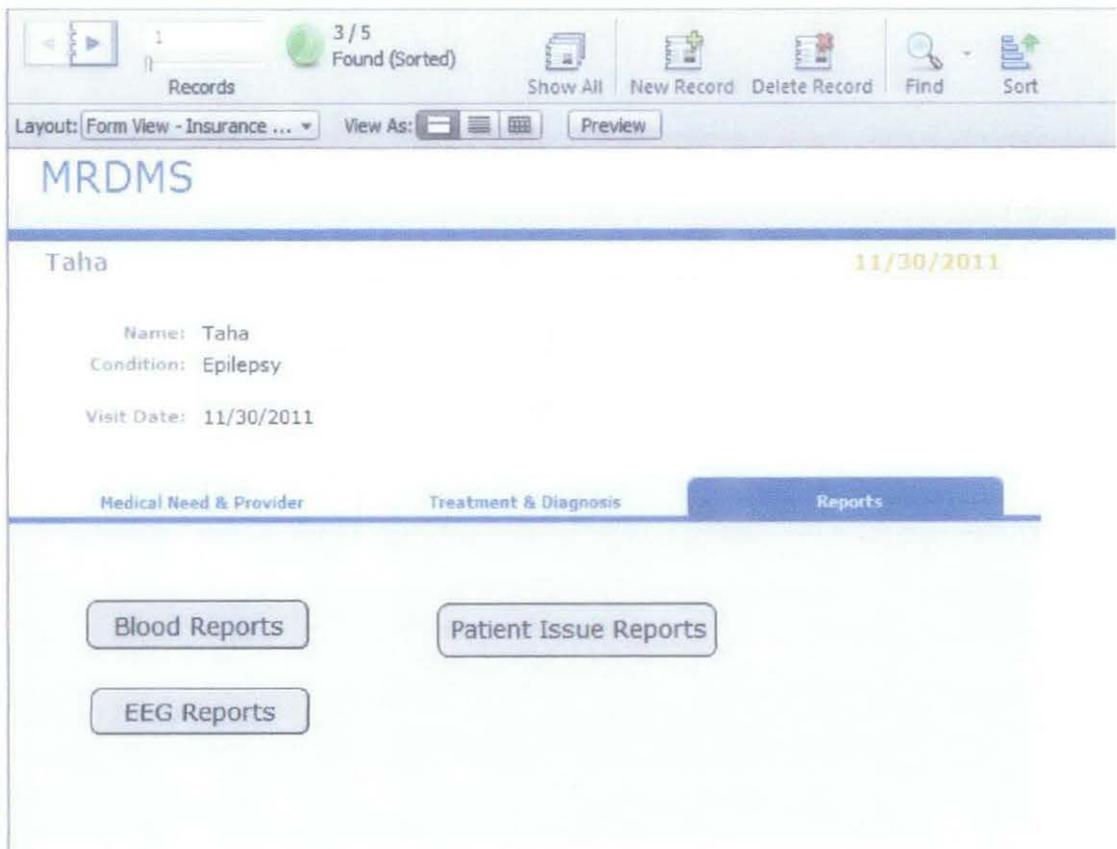
Figure 4.25 Reports Layout View
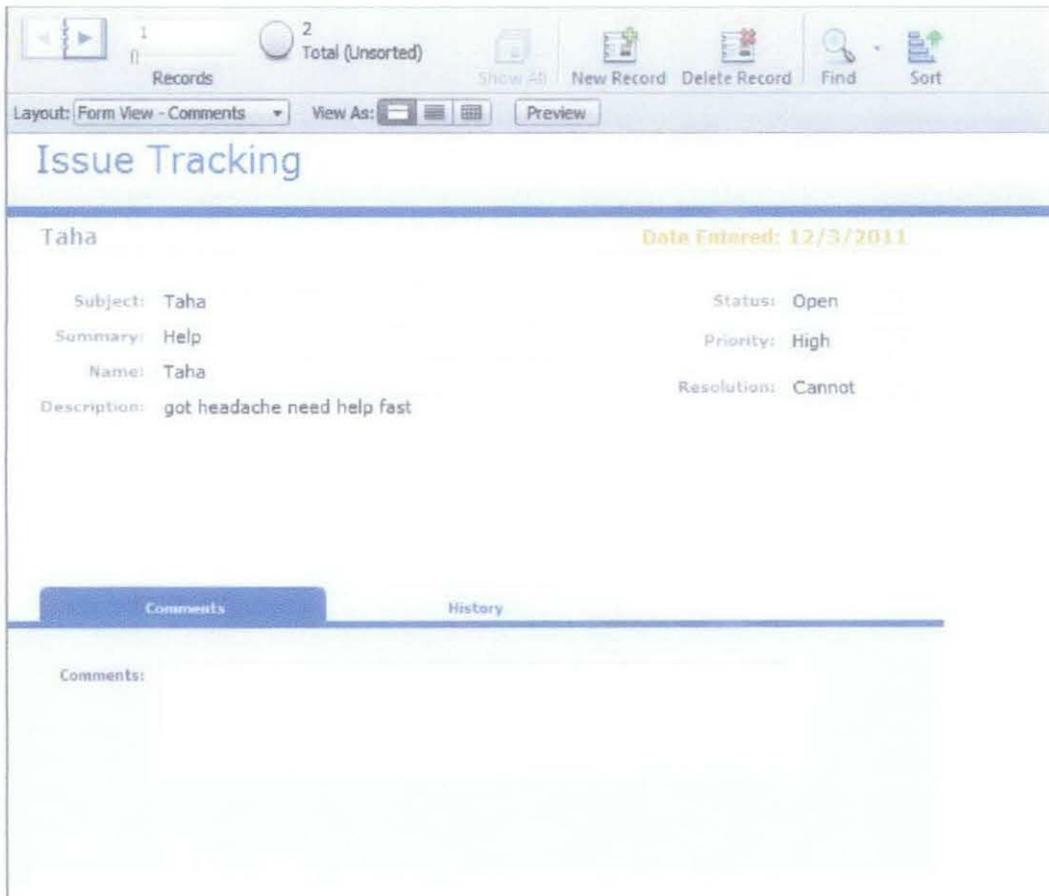
Figure 4.26 Patient Issues and Behavior Tracking

Issues Report

Subject	Summary	Status	Priority	Resolution
Name: Taha				
Taha	Help	Open	High	Cannot

Figure 4.27 Patient Issues Report

This Preview had scripts running to it; Figure 4.28 below shows the script that enables the developer to sort the report. These scripts are specifically for FileMaker Pro developers.

```
✦ Allow User Abort [Off]
✦ Go to Layout ["Medical History Report"]
✦ Perform Script ["Sort for Medical History"]
✦ Print Setup [Restore; No dialog]
✦ Enter Preview Mode []
✦ Adjust Window [Resize to Fit]
✦ Pause/Resume Script [Indefinitely]
✦ Go to Layout [original layout]
✦ Enter Browse Mode []
✦ Adjust Window [Resize to Fit]
✦ Move/Resize Window [Current Window; Width: 909]
```

Figure 4.28 Script for Medical History sorting

Apart from sorting functions, functions like Find also are scripted; Figure 4.36 shows how the script is like for that function.

```
✦ Set Error Capture [On]
✦ If [Get(WindowMode)=0]
✦     #We're in Browse Mode: Enter Find Mode
✦     Enter Find Mode [Pause]
✦ Else
✦     #We're already in Find Mode. Let the Find button function the same as the Continue button.
✦ End If
✦ Perform Find []
✦ If [Get(LastError)=400]
✦     Show Custom Dialog ["Message"; "No find criteria were entered. All records will be displayed."]
✦     Show All Records
✦ Else If [Get(FoundCount) = 0]
✦     Show Custom Dialog ["Message"; "No records match this request."]
✦     Show All Records
✦ Else If [Get(FoundCount) = 1]
✦     Go to Layout [original layout]
✦ Else
✦     Go to Layout ["List View"]
✦ End If
```

Figure 4.29 Find function script

Question 1

Have you had repeated, disturbing *memories, thoughts, or images* of a stressful experience from the past?

1 – Not at all   2 – A little bit
3 – Moderately   4 – Quite a bit
5 – Extremely

Figure 4.210 Automated questionnaire sample

4.3   User Interface Evaluation

A systematic random sampling method was used to select 40 candidates to try out the systems and questionnaires. 20 of them were given the conventional questionnaire to be filled in, and the other 20 were given the automated questionnaire. The candidates were asked to rate each variable given using the Likert Scale (1-5). The variables are as follows:

1. Easy to learn.
2. Easy to understand.
3. Easily Adaptable.
4. Comfortable to the eyes (color).
5. Predictable.
6. Reliable.

The results collected were then processed through an unpaired two-tailed T-test statistical analysis to determine which system would be the better one. The null hypothesis being that the two systems are the same and the alternative hypothesis being that the automated system is more preferred if the analysis proved to be statistically significant. The results of the mean answers are shown in Figure 4.30 below.
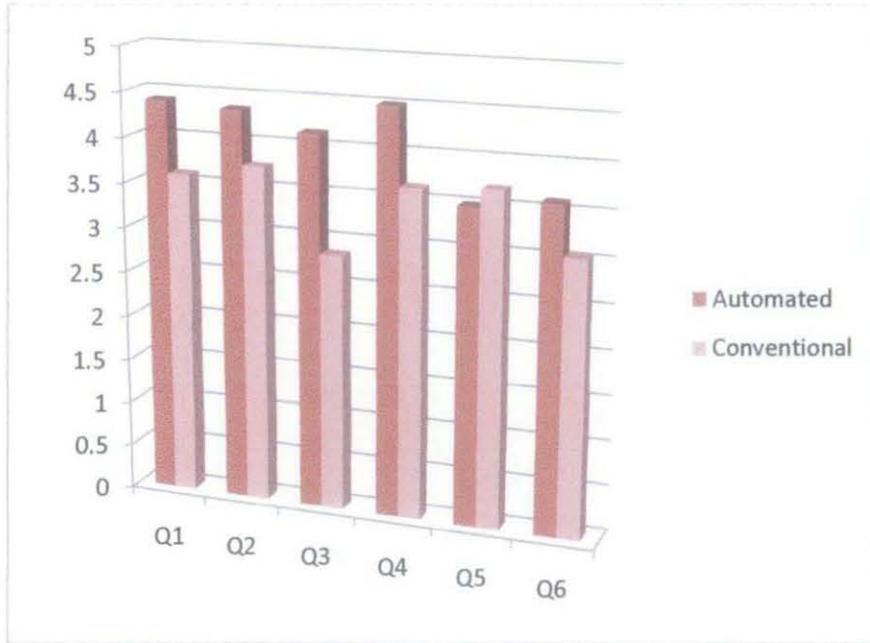
Figure 4.30 Mean of answers

The mathematical equations used to calculate the T-test are as follows:

- Pooled standard deviation:

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

- Standard error of difference between means:

$$SE(\bar{x}_1 - \bar{x}_2) = s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

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- T-statistic:

$$T = \frac{\bar{x}_1 - \bar{x}_2}{SE(\bar{x}_1 - \bar{x}_2)}$$

Based on the above equations each question is analyzed, the results are below:

1. Easy to learn:

Group	Automated	Conventional
Mean	4.40	3.60
SD	0.60	1.23
SEM	0.13	0.28
N	20	20

Table 4.3 Analysis for Q1

Confidence interval:

The mean of Automated minus Conventional equals 0.80.

95% confidence interval of this difference: From 0.18 to 1.42.

Intermediate values used in calculations:

t = 2.6137

df (degree of freedom) = 38

standard error of difference = 0.306

P value and statistical significance:

The two-tailed P value equals 0.0128. By conventional criteria, this difference is considered to be statistically significant. The automated version is preferred according to this question and thus it is easier to learn.

2. Easy to understand:

Group	Automated	Conventional
Mean	4.35	3.75
SD	0.75	0.91
SEM	0.17	0.20
N	20	20

Table 4.31 Analysis for Q2

Confidence interval:

The mean of Automated minus Conventional equals 0.60.

95% confidence interval of this difference: From 0.07 to 1.13.

Intermediate values used in calculations:

t = 2.2807

df = 38

standard error of difference = 0.263

P value and statistical significance:

The two-tailed P value equals 0.0283. By conventional criteria, this difference is considered to be statistically significant. The automated is preferred in this question thus it is easier to understand.

3. Easily adaptable:

Group	Automated	Conventional
Mean	4.15	2.85
SD	0.59	1.23
SEM	0.13	0.27
N	20	20

Table 4.32 Analysis for Q3

Confidence interval:

The mean of Automated minus Conventional equals 1.30.

95% confidence interval of this difference: From 0.68 to 1.92.

Intermediate values used in calculations:

t = 4.2774

df = 38

standard error of difference = 0.304.

P value and statistical significance:

The two-tailed P value equals 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. The automated system is preferred here thus it is much easier to adapt to.

4. Comfortable to eyes (color):

Group	Automated	Conventional
Mean	4.50	3.65
SD	0.89	1.23
SEM	0.20	0.27
N	20	20

Table 4.33 Analysis for Q4

Confidence interval:

The mean of Automated minus Conventional equals 0.85.

95% confidence interval of this difference: From 0.16 to 1.54.

Intermediate values used in calculations:

t = 2.5108

df = 38

standard error of difference = 0.339.

P value and statistical significance:

The two-tailed P value equals 0.0164. By conventional criteria, this difference is considered to be statistically significant. The automated system is preferred here thus it is more comfortable to the eyes in terms of color, also possible that it is the only one with color thus the results are such.

5. Predictable:

Group	Automated	Conventional
Mean	3.50	3.70
SD	0.83	0.86
SEM	0.18	0.19
N	20	20

Table 4.34 Analysis of Q5

Confidence interval:

The mean of Automated minus Conventional equals -0.20.

95% confidence interval of this difference: From -0.74 to 0.34.

Intermediate values used in calculations:

$t = 0.7475$

$df = 38$

standard error of difference = 0.268.

P value and statistical significance:

The two-tailed P value equals 0.4593. By conventional criteria, this difference is considered to be not statistically significant. The conventional system is preferred here, this is due to the many interfaces or layouts of the automated system and since the conventional is just a single paper test, logically it is more predictable.

6. Reliable:

Group	Automated	Conventional
Mean	3.60	3.05
SD	0.75	1.28
SEM	0.17	0.29
N	20	20

Table 4.35 Analysis of Q6

Confidence interval:

The mean of Automated minus Conventional equals 0.55.

95% confidence interval of this difference: From -0.12 to 1.22.

Intermediate values used in calculations:

t = 1.6593

df = 38

standard error of difference = 0.331.

P value and statistical significance:

The two-tailed P value equals 0.1053. By conventional criteria, this difference is considered to be not statistically significant. Again the conventional system is preferred here; the reason for this could be that the automated system still needs to be revised again for a more holistic system to be made.

CHAPTER 5

CONCLUSION

With light to the literature review, and the current data collection in accordance with the PTSD questionnaires, further research should be done in order to find out the underlying factor on how to effectively diagnose PTSD. With the many postulates of PTSD lying on the borderline between various other disorders or even being made up of them [37], the APA should revise its definitions to clarify PTSD in a more subtle manner. In that way, diagnosis would become more direct, and more effective methods as compared to the questionnaire can be used. According to McHugh and Treisman [27], one author by the name of Kolb had proposed that "Posttraumatic" conditions are due to the psychological effects of head injuries. Perhaps this should be taken back into consideration as according to recent studies, one may develop PTSD without actually going through the trauma as described in DSM-IV. People have developed PTSD or at least claimed to suffer from it from even small cases of tensions and arguments, which were not really 'life-threatening' but apparently, had enough strength in it to cause mental harm. Other factors such as personality, family background, psychiatric history, and social status should be taken into consideration during diagnosis. By knowing this information, a more steady diagnosis can be made effectively.

Analysis of the experiment shows that subjects might even suffer from other disorders, but due to the similarities between PTSD and other disorders a clinician might presume that the subject does suffer from PTSD, and that is the shortcoming of the questionnaire. Though one may argue that the questionnaire helps to find probing questions that can be asked during an interview, but then again the questionnaire might just make the subject avoid all related talks as it did with the second female. As for the credibility of the questionnaire, both the males displayed results that did not prove

anything close to having PTSD. Once more further research into gender and personality with relations to diagnosis of PTSD must be looked into along with the possibility that the questionnaire can be answered to display the intended results that the subjects desire, as might be the case with the veteran.

Overall this has raised concerns on whether the past 31 years of research in the area of PTSD has been proven misleading and thus all prognosis and diagnosis of this disorder to be wrong. This would have an effect on the treatments of the disorder which might not help the patient at all but perhaps make it worse. Again the question of political and social interventions comes up, challenging the essence of the disorder whether it is or a mere means of gain. Until a complete revision is done and further research to actually find the correct causes of PTSD and its diagnosis, one cannot diagnose an individual with the current methods.

These findings display the importance of replacing the current questionnaires with automated ones as the advantages would be that (1) automated ones might not be as disturbing as the conventional ones (as in case of the second female) and (2) if by using E-Prime and EEG, much more information can be found, and the questions can be probed further accordingly. It may also become a method whereby false PTSD claims can be found out. As Nemeroff et al. [29] mentioned about neuro-imaging to be used in the diagnosis of PTSD, psychiatrists should look into these 'high-tech' methods of diagnosis along with a 'bottom-up' approach aligned to match each individual's conditions and backgrounds. Only then perhaps can PTSD be truly diagnosed correctly and treated effectively.

After running a test on the automated screening test, it was concluded that the automated version still proved better than the conventional, but again it could not indicate whether the person suffers from PTSD or not.

CHAPTER 6

RECOMMENDATIONS

Based on the project studies and results, further research is needed into correct diagnosis of PTSD and also a more effective system of measuring. The proposed way is to use ECG and EEG in the diagnosis which can in fact be linked up to the E-Prime system for further experimentation. According to Coronas et al. [16] measuring ECG and heart rate immediately after trauma has proved to be a good factor in determining whether one will develop PTSD. If the same concept is applied to when a stimulus is given, the effects should be notable and thus a more solid diagnosis of PTSD is possible.

As for EEG, Okamoto et al. [41] have conducted studies by using EEG as a method to diagnose PTSD in Japanese earthquake survivors. So far it has proved well for them and the same method should be applied here. Questionnaires and interviews have proved to be quite backwards and new methods should be taken along with different stimuli such as sounds and visual synchronized with EEG and ECG. Apart from that since this system has developed a behavior and issue tracking interface for patients that should be used to further research into behavioral therapies and how they can be used to its maximum potential.

The management system should be developed on Android OS too, due to the rising interest and usage of the system. After gaining feedback from experts upon the system, they claimed that due to doctor and patient confidentiality agreements, the nurses should not have access to reports and treatments of the patient. The recommendation was taken into consideration and Dr. Zakaria was reproached for further clarification. Previously he agreed to the initial system, but after revising back

the patient-doctor confidentiality agreement, he confirmed the experts' advice onto revising the system to make another account specifically for the nurse. Thus according to the system, the nurse will only have access to the features displayed in Figure 4.21.

Lastly, the questionnaire system in E-Prime 2.0 should be revised. It is recommended that the developer should devise a more interactive based system that will enable better help features and decision support features. Better stimulus and information into each question of the standardized questionnaires would prove more efficient as the patients will be able to fully understand the question. Apart from that, questions to the patient should be given in line to their cases and a variety of questions be displayed according to their previous answers. That will enable the doctor to probe deeper and provide a more accurate diagnosis.

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APPENDIX I

PTSD CheckList – Civilian Version (PCL-C)

Client's Name: _____

Instruction to patient: Below is a list of problems and complaints that veterans sometimes have in response to stressful life experiences. Please read each one carefully, put an "X" in the box to indicate how much you have been bothered by that problem *in the last month.*

No.	Response	Not at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
1.	Repeated, disturbing *memories, thoughts, or images* of a stressful experience from the past?					
2.	Repeated, disturbing *dreams* of a stressful experience from the past?					
3.	Suddenly *acting* or *feeling* as if a stressful experience *were happening* again (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful experience from the past?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful experience from the past?					
6.	Avoid *thinking about* or *talking about* a stressful experience from the past or avoid *having feelings* related to it?					
7.	Avoid *activities* or *situations* because they *remind you* of a stressful experience from the past?					
8.	Trouble *remembering important parts* of a stressful experience from the past?					
9.	Loss of *interest in things that you used to enjoy?*					
10.	Feeling *distant* or *cut* off from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short?*					
13.	Trouble *falling* or *staying asleep?*					
14.	Feeling *irritable* or having *angry outbursts?*					
15.	Having *difficulty concentrating?*					
16.	Being *"super alert"* or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

PTSD CheckList – Civilian Version (PCL-C)

The PCL is a standardized self-report rating scale for PTSD comprising 17 items that correspond to the key symptoms of PTSD. Two versions of the PCL exist: 1) PCL-M is specific to PTSD caused by military experiences and 2) PCL-C is applied generally to any traumatic event.

The PCL can be easily modified to fit specific time frames or events. For example, instead of asking about "the past month," questions may ask about "the past week" or be modified to focus on events specific to a deployment.

How is the PCL completed?

⊔ The PCL is self-administered

⊔ Respondents indicate how much they have been bothered by a symptom over the past month using a 5-point (1–5) scale, circling their responses. Responses range from **1** *Not at All* – **5** *Extremely*

How is the PCL Scored?

1) Add up all items for a total severity score

or

2) Treat response categories **3–5** (*Moderately* or above) as symptomatic and responses **1–2** (below *Moderately*) as non-symptomatic, then use the following DSM criteria for a diagnosis:

- Symptomatic response to at least 1 "B" item (Questions 1–5),
- Symptomatic response to at least 3 "C" items (Questions 6–12), and
- Symptomatic response to at least 2 "D" items (Questions 13–17)

Are Results Valid and Reliable?

⊔ Two studies of both Vietnam and Persian Gulf theater veterans show that the PCL is both valid and reliable (Additional references are available from the DHCC)

What Additional Follow-up is Available?

⊔ All military health system beneficiaries with health concerns they believe are deployment-related are encouraged to seek medical care

⊔ Patients should be asked, **"Is your health concern today related to a deployment?"** during all primary care visits.

• If the patient replies "**yes**," the provider should follow the Post-Deployment Health Clinical Practice Guideline (PDH-CPG) and supporting guidelines available through the DHCC and www.PDHealth.mil

PTSD Checklist – Military Version (PCL-M)

Name: _____ Unit: _____
Best contact number and/or email: _____
Deployed location: _____

Instructions: Below is a list of problems and complaints that veterans sometimes have in response to a stressful military experience. Please read each one carefully, put an "X" in the box.

		Not at all	A little bit	Moderately	Quite a bit	Extremely
1.	Repeated, disturbing *memories, thoughts, or images* of a stressful military experience?					
2.	Repeated, disturbing *dreams* of a stressful military experience?					
3.	Suddenly *acting* or *feeling* as if a stressful military experience *were happening again* (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful military experience?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful military experience?					
6.	Avoid *thinking about* or *talking about* a stressful military experience or avoid *having feelings* related to it?					
7.	Avoid *activities* or *talking about* a stressful military experience or avoid *having feelings* related to it?					
8.	Trouble *remembering important parts* of a stressful military experience?					
9.	Loss of *interest* in things that you used to enjoy?					
10.	Feeling *distant* or *cut off* from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short?*					
13.	Trouble *falling* or *staying* asleep?					
14.	Feeling *irritable* or having *angry outbursts?*					
15.	Having *difficulty* concentrating?					
16.	Being "*super alert*" or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

Has anyone indicated that you've changed since the stressful military experience? Yes ___ No___

APPENDIX II

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	Selection of topic	▓	▓																										
2	Phase 1 : Project Planning		▓	▓																									
3	Phase 2: Research and Review			▓	▓	▓	▓	▓	▓	▓																			
4	Phase 3: System Development																												
	System Planning									▓	▓																		
	Feasibility Study										▓	▓																	
	Analysis											▓	▓																
	Design												▓	▓	▓	▓	▓	▓	▓	▓									
5	Phase 4:																												
	Implementation																				▓	▓							
	Testing									▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓				
	Evaluation																									▓			