VALLEY VIEW UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF INFORMATION TECHNOLOGY

A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN

INFORMATION TECHNOLOGY DEGREE.

TOPIC:

AN ANDROID APP TO PASSIVELY DETECT DEPRESSION AND ANXIETY

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DECLARATION

This is to declare that, the research work underlying this thesis has been carried out by the under mentioned student under the supervisor. Both student and the supervisor certify that the work documented in this thesis is the output of the research conducted by the student as part of her final year project work in partial fulfillment of the requirement of the Bachelor of Science degree in Information Technology.

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CHAPTER ONE

GENERAL INTRODUCTION

1.0 INTRODUCTION

Depression is a mental disorder affecting lot of people worldwide, and it is hard to notice. The term “depression” is often characterized by feelings of being sad, discouraged, hopeless, unmotivated, as well as a general lack of interest or pleasure in life. When these feelings last for a short period of time, it may be called a passing case of “the blues.” But when they last for more than two weeks and interfere with regular daily activities, it’s likely you have a depressive disorder. Research suggests that depression and anxiety are risk factors for people committing suicide: More than 90 percent of people who commit suicide have a diagnosable mental disorder (ADAA, 2015). Early diagnosis and intervention with appropriate treatment are critical steps to feeling better. Mood disorders or depressive disorders include three main types: major depression, dysthymia, and bipolar disorder, and they can occur with any anxiety disorder.

Depression is a significant contributor to the global burden of disease and affects people in all communities across the world. Today, depression is estimated to affect 350 million people. The World Mental Health Survey conducted in 17 countries found that on average about 1 in 20 people reported having an episode of depression in the previous year. Depressive disorders often start at a young age; they reduce people's functioning and often are recurring. For these reasons, depression is the leading cause of disability worldwide in terms of total years lost due to disability. The demand for curbing depression and other mental health conditions is on the rise globally. A recent World Health Assembly called on the World Health Organization and its member states to take action in this direction (WHO, 2012).

In fact, "the pain of severe depression is quite unimaginable to those who have not suffered it, and it kills in many instances because its anguish can no longer be borne. The prevention of many suicides will continue to be hindered until there is a general awareness of the nature of the pain" (Styron, 1990).

1.1 SUBJECT AREA AND FIELD OF STUDY

The subject of this project is developing an android mobile application to passively detect depression and anxiety. The

field of study is in Information Technology, specifically, Android mobile application development, Software Engineering, and Database Management.

1.2 STUDY OBJECTIVES

The study objectives of this research can be categorized into global and specific objectives.

1.2.1 GLOBAL OBJECTIVE

The aim of this project is to improve the mental health by using a mobile application to fight depression and anxiety after detection or prediction.

1.2.2 SPECIFIC OBJECTIVES

The specific objectives of this proposal will base on fulfilling the objectives below:

- To get heart rate (monitor) with pulse from user's finger (camera's flash light) for signs of anxiety.
- To track users mobility for signs of depression.
- To collect voice data from calls through voice recognition for verbal communication of emotions.
- To use PHQ-9 (Patient Health Questionnaire) and GAD 7 (General Anxiety Disorder) to determine severity.

- To take the depression away by using motivational quotes to boost confidence and humor such as funny clips.
- To use of pictures or photos, and music that triggers positive feelings to improve mood.
- To encourage the use of breathing techniques and meditation to take away depression and anxiety.

1.3 BACKGROUND OF THE STUDY

Depression and anxiety are invincible mood disorders and hard for one to notice especially if they do not know anything about the illness. People with depression and anxiety are not opened or clear about how they feel because they are seen as weak in society. When these mood disorders last for weeks one can't function properly like they did before and are likely to be of harm to themselves with thoughts of suicide as the extreme and others as well.

Depression is estimated to affect 350 million people and is the leading cause of disability worldwide in terms of total years lost to disability (WHO, 2012).

People must know about the signs of depression and anxiety and how they can self-manage it by changing their way of thinking and acting positively. This cannot be done if there are no mental health information to create that awareness.

There should be an application that has a combined effect of passively and actively detecting or predicting depression and anxiety and improving the mood or mental health of users so they can function properly.

Depression has the power to affect most areas of a person's life, even smartphone use, and researchers in the US have come up with an app that's able to recognize when someone's at risk. The underlying hypothesis is that the lower our mood, the more likely we are to spend time moping around on our phones (Nield, 2016). Additionally, the GPS tracker linked depression with people who spent most of their time in one location, typically their homes (Saeb, 2016).

To get a better idea of the effectiveness of Purple Robot, the researchers are going to do a study involving more participants over a longer period to see if the app can detect changes in behavior over time, Saeb said. In addition, the group will see if they can improve Purple Robot's ability to spot depression by including additional data, such as how long people talk on the phone and who they talk to (Saeb, 2016).

There are probably hundreds of apps that promise to improve your mental health, from offering tests to gauge your depression risk to providing information about depression treatments. Others, like Purple Robot, are in the development stage. Being able to get people timely treatment for

depression is a critical failure point in public health right now (Mohr, 2016).

1.4 SCOPE OF THE STUDY

The scope of the study is focused on predicting how one is likely to be depressed by collecting data related to signs of depression and anxiety and fighting it with positive psychological interventions to trigger positive emotions.

The application also provides information on:

- The three main types of depression by detecting it that is
    - Major depression.
    - Persistent depression or dysthymia.
    - Bipolar disorder.

- Addressing the signs of depression according to DSM (Diagnostic and Statistical Manual of Mental Disorders) used across the world by health professionals.
    - Depressed mood or irritable most of the day, nearly every day, as indicated by either subjective report
      (e.g., feels sad or empty) or observation made by others (e.g., appears tearful).

- Decreased interest or pleasure in most activities, most of each day.
- Significant weight change (5%) or change in appetite.
- Change in sleep: Insomnia or hypersomnia.
- Change in activity: Psychomotor agitation or retardation.
- Fatigue or loss of energy.
- Guilt/worthlessness: Feelings of worthlessness or excessive or inappropriate guilt.
- Concentration: diminished ability to think or concentrate, or more indecisiveness.
- Suicidality: Thoughts of death or suicide, or has suicide plan.

However this project is not to represent a doctor's advice; people don't know when they are depressed, and the aim of this study is to let users of the app know they might be depressed and improve their mental health to function properly.

1.5 SIGNIFICANCE OF STUDY

This application of the project is important to the following users after its successful completion.

Students: This application also helps students of the university since it serves as a reference point any time a research is to be conducted in the mental health field.

Researcher: The researcher gains more knowledge since the application increases his understanding of the topic and also help him or her in their post graduate research project with more experience gained.

General Public: The general public will benefit from it by predicting the type of depression they are likely to be experiencing and triggering positive feelings and improving their mental health as well.

Government of Ghana: This application reduces the rate of suicide in the country due to lack of information or existence of mental disorders like depression and anxiety which can easily be treated by changing thoughts. People are more productive and will lead to development in the country.

1.6 METHODOLOGY

In this research, data collection was done through

1. The internet
    - Online journals and
    - Articles
2. Review papers
3. Observation

Technologies to be used:

- Android platform
- Android smartphone

The use of the spiral mode will be implemented as the software development cycle. This is to allow room for updates when they are needed.

1.7 EXPECTED RESULTS AND POSSIBLE USE OF THE STUDY

The expected results after this project is to present a detailed documentation of the design, building and implementation of a mobile based mental health application.

1.8 PRESENTATION OF THESIS

This study was made of eight chapters. They are as follows:

CHAPTER 1: Introduction to the study. This chapter contained the objectives, the significance of the study, the methodology used, expected results of the study, study work plan and presentation of the thesis.

CHAPTER 2: Literature review of the study and review of some related systems.

CHAPTER 3: Crystallization of the problem.

CHAPTER 4: The analysis of the proposed system. The functional and non-functional requirements of the proposed system are also stated here.

CHAPTER 5: This chapter includes use case modeling of the proposed system and data flow diagrams.

CHAPTER 6: System implementation and testing.

CHAPTER 7: System documentation.

CHAPTER 8: This chapter concludes the study and gives recommendations.

1.9 STUDY WORK PLAN

The proposed system would be delivered in two parts:

Part 1

This part would be the introductory analysis i.e. system analysis and design. The expected completion date is December, 2016.

Part 2

This includes the detailed design, and implementation of the proposed system including the final presentation. Part two is expected to be completed in May, 2016.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter presents a review of related literature and provides an in depth understanding in the area of this project.

2.1 DEPRESSION AND ANXIETY

According to (WHO 2012), "Depression is a common mental disorder that presents with depressive moods, loss of interest or pleasure or decreased energy, feelings of guilt or low self-worth, disturbed sleep or appetite and poor concentration Moreover depression often comes with symptoms of anxiety. These problems can become chronic or recurrent and leads to substantial impairments in an individual's ability to take care of his or her everyday responsibilities. At its worst depression can lead to suicide which translates to 300 suicides, 20 or more may attempt to end his or her life". Depression can be seen as a reaction to a significant life event (Munizza et al, 2013).

According to (Fussell, 1996),"verbal descriptions of emotional state can provide quite precise information about specific form of emotion, such as anger, depression, happiness that a person is experiencing." On the other hand non-verbal behaviors are signs rather than intentional signals of emotional state. By seeing that someone is crying, for

instance, we might assume that they are sad, but it gives no information as to why they sad.

Heart rate variability is how variable or changeable the heart rate is, and is a biomarker for physical and emotional wellbeing and cognitive performance. HRV is a biomarker for longevity, if one has a low HRV then the persons lifespan is expected to be low than if one had high rate variability. HRV is a biomarker for stress and emotional resilience and not only physical health. It's a desirable thing to have a high HRV. Low heart rate variability is linked with increased risk of all-cause mortality and has been suggested as a marker for disease (Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012).

Heart rate coherence is specific pattern of HRV. Negative emotions can block rhythm of HR coherence while positive emotions enhance coherence. It's useful to train HR coherence to positive influence physical health emotional wellbeing. Below is the resting heart rate for both men and women:

Resting Heart Rate for MEN

Age	18-25	26-35	36-45	46-55	56-65	65+
Athlete	49-55	49-54	50-56	50-57	51-56	50-55
Excellent	56-61	55-61	57-62	58-63	57-61	56-61
Good	62-65	62-65	63-66	64-67	62-67	62-65
Above Average	66-69	66-70	67-70	68-71	68-71	66-69
Average	70-73	71-74	71-75	72-76	72-75	70-73
Below Average	74-81	75-81	76-82	77-83	76-81	74-79
Poor	82+	82+	83+	84+	82+	80+

Resting Heart Rate for WOMEN

Age	18-25	26-35	36-45	46-55	56-65	65+
Athlete	54-60	54-59	54-59	54-60	54-59	54-59
Excellent	61-65	60-64	60-64	61-65	60-64	60-64

Good	66-69	65-68	65-69	66-69	65-68	65-68
Above Average	70-73	69-72	70-73	70-73	69-73	69-72
Average	74-78	73-76	74-78	74-77	74-77	73-76
Below Average	79-84	77-82	79-84	78-83	78-83	77-84
Poor	85+	83+	85+	84+	84+	84+

High blood pressure may be linked to symptoms of depression though lack of physical activities, smoking and alcohol abuse together with obesity. One could also say depression and hypertension are risk factors of each other (Meng, Chen, Yang, Zheng, & Hui, 2012).

Hypertensive patients tend to experience negative emotions which increases risk of mental disorders like depression and anxiety (Kretchy, Owusu-daaku, & Danquah, 2014).Many investigators have studied psychological factors that may lead to hypertension. Rutledge and Hogan found that the risk of developing hypertension was approximately 8% higher among

people who had psychological distress compared with those who had minimal distress. People suffering from either severe depression or anxiety were two to three times more likely to develop hypertension. (Cheung et al., 2005).

Being physically active is inversely assotiated with symptoms of depression and anxiety; less physical activities are some of the behaviours that can be seen in depresed people (Tulio et al., 2013).Ones mood and physical exercise have a relationship meaning depressed people exercise less (Blümel et al., 2015).The increase in sedentary behavior is known to be reducing physical health, but may also be having a negative impact on the mental health of the population (Harvey, Hotopf, Øverland, & Mykletun, 2010).The majority of studies that have examined the relationship between physical activity and common mental disorders have found lower rates of depression among those who are more active.

The current era can be known as a combination of information and communication. Today, in possession of advanced information and communication technology, we are able to establish connections and exchange information faster than before (Harvey, Hotopf, Øverland, & Mykletun, 2010).

The most dominant type of information and communication technology is the mobile phone, the use of which in the past

few years, due to social impact, has grown substantially. Mobile phone addiction, as a mental impairment resulting from modern technology, has come to the attention of psychologists, sociologists, and scholars of education. Troubled mobile phone use can be accounted a form of technological addiction (Harvey, Hotopf, Øverland, & Mykletun, 2010).

Many mobile phone addicts are people with low self-esteem and poor social relationships; thus, they think they should be in constant contact with others. Mobile phone silence can lead to anxiety, irritability, sleep disturbances, shaking, insomnia, and digestive problems.From the perspective of Thomee et al. problematic and overuse of mobile phones is associated with anxiety, insomnia, depression, psychological distress, and unhealthy lifestyle. The emotional attachment to mobile phones for their users is in a way that makes them believe they cannot live without a cell phone (Babadi-Akashe, Eshrat Zamani, Abedini, Akbari, & Hedayati, 2014).

Depression and anxiety are highly treatable. Psychotherapy and medications are used for the treatments of these mental disorders, and treatments are either combined or done separately. Depression and anxiety can be often treated the same way at the same time. Cognitive-behavioral therapy or CBT is a form of psychotherapy effective enough to teach skills to help one cope with anxiety and depression. It helps one feel more comfortable doing things that they have been afraid of or

lost interest in by teaching you to deal directly with the thoughts, feelings, and behaviors that are upsetting them and to change what keeps them going. CBT can also encourage a more balanced state in your body and better attendance with all aspects of your environment.

2.2 RESEARCH CONCERNING MENTAL HEALTH MOBILE APPLICATIONS

Below is a review of a research conducted in the area of mobile based mental health apps.

2.2.1 MENTAL HEALTH SMARTPHONE APPS

Mental health smartphone app is an article written by David Bakker et al (2016). They define smartphone as an advanced mobile phone that functions as a handheld computer capable of running software apps. Smartphones have been joined into personal, occupational, social routines in the last decade. More than half the population in US alone use smartphone and 83% take their smartphone when they get out. Averagely users check their phones 150 times a day which makes it clear how smartphone apps can reward, generate, and maintain strong habits involving its use. Apps have the ability of influencing behavior change interventions, which can improve physical health of users, such as through promotion of physical exercise.

Mental health smartphone app have been created and made available to users of the smartphone apps over recent years.

The aim of these apps is to improve mental health and well-being improving mental health. Mental health smartphone apps are in demand; from a public survey 76% of 525 respondents would be interested using smartphone for self-management and self-monitoring of mental health on condition that it was free.

Also mental health a have the capabilities of playing an important role in mental health care future. Innovative solutions they think will be more beneficial in terms of self-management because only a small fraction are opened about their problem (mood and anxiety). Support is not always available financially, socially, geographically even when people are opened about their problems.

Smartphones are the best tools for users who prefer self-help materials since they are usually accessible to users and can be used in any context and almost in any environment. With mental health smartphone apps users can be reminded about ongoing goals and motivations.

2.2.2 MOTIVATIONAL QUOTES, FUNNY CLIPS, MUSIC LINK TO POSITIVE EMOTIONS

People engage in musical activities because of the emotional effects it has to offer as it is often suggested. Diverse

areas like gaming industry, film industry, marketing, and music therapy use music for the reason of its emotional power (Vuoskoski, 2014).

2.3 DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (METRICES)

The American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) is a classification of mental disorders designed to enable a more reliable diagnoses of these disorders. Over the past 60 years with successive editions, it has become a standard reference for clinical practice in mental health field. DSM is intended to serve as a practical, functional, and flexible guide for organizing information that can help in the accurate diagnosis and treatment of mental disorders. It is a tool for clinicians, an essential educational resource for students and practitioners, and a reference for researchers in the field (5th ed.; *DSM-5*; American Psychiatric Association, 2013).

2.3.1 DIAGNOSTIC CRITERIA FOR MAJOR DEPRESSION AND DEPRESSIVE EPISODES

DSM-IV Criteria for Major Depressive Disorder (MDD)

- Depressed mood or a loss of interest or pleasure in daily activities for more than two weeks.
- Mood represents a change from the person's baseline.
- Impaired function: social, occupational, educational.
- Specific symptoms, at least 5 of these 9, present nearly every day:
    1. **Depressed mood or irritable** most of the day, nearly every day, as indicated by either subjective report (e.g., feels sad or empty) or observation made by others (e.g., appears tearful).
    2. **Decreased interest or pleasure** in most activities, most of each day
    3. **Significant weight change (5%) or change in appetite**
    4. **Change in sleep**: Insomnia or hypersomnia
    5. **Change in activity**: Psychomotor agitation or retardation
    6. **Fatigue or loss of energy**
    7. **Guilt/worthlessness**: Feelings of worthlessness or excessive or inappropriate guilt
    8. **Concentration**: diminished ability to think or concentrate, or more indecisiveness
    9. **Suicidality**: Thoughts of death or suicide, or has suicide plan

DSM – V proposed (not yet adopted) anxiety symptoms that may indicate depression: irrational worry, preoccupation with unpleasant worries, trouble relaxing, feeling tense, fear that something awful might happen.

Screen for conditions that may mimic or co-exist with Major Depressive Disorder:

- **Substance abuse** causing depressed mood (eg. drugs, alcohol, medications)
- **Medical illness** causing depressed mood
- **Other psychiatric disorders:** mania, hypomania, bipolar, schizoaffective, schizophrenia, etc.
- **Bereavement** unless sx persist for > two months or show marked functional impairment, morbid preoccupation with worthlessness, suicidal ideation, psychotic symptoms, or psychomotor retardation.

Depressive Episode Criteria (may be part of Major Depressive Disorder OR an isolated episode)

A	**B**
Depressed Mood Loss of interest and enjoyment in usual activities Reduced energy and decreased activity	Reduced self-esteem and confidence Ideas of guilt and unworthiness

	Pessimistic thoughts Disturbed sleep Diminished appetite Ideas of self-harm

Severity of Depressive Episode:

Mild: > 1 from column A plus 1-2 from column B. Or 5-6 sx but mild in severity and functional impairment.

Moderate: > 1 from column A plus 2-3 from column B. Or 7 – 8 sx but moderate functional impairment.

Severe: All 3 from column A plus > 3 from column B. Or fewer sx but any of these: severe functional impairment, psychotic sx, recent suicide attempt, or has specific suicide plan or clear intent.

Functional Domain	**Moderately Impaired**	**Severely Impaired**
Family Relationships	Quiet, negative and oppositional	Withdrawn, won't talk, brusque, angry, aggressive
School & Academics / Work	Grades/work performance deteriorating, missing/cutting class or work, decreased effort,	Failing performance, missing school or work, doesn't care about work, oppositional,

	moderate academic or work stress	argumentative, high academic or work stress
Peer Relationships	Decreased socializing or extracurricular activities , more time on computer	Isolated, discontinued extracurricular activities, excessive computer time
Stress Level, Anxiety	Minimizes or denies issues, projects onto others or blames others	Withholds feelings, won't talk
Suicidal Ideation	Vague/occasional	Frequently considered, has a plan, or prior attempt
Other Self Harm	Occasional thoughts but no attempts	Cutting, other self-injury

2.3.2 ANXIETY DISORDER

Patient Health Questionnaire (GAD 7)

Name:_____

Date:_____

Over the last 2 weeks, have you felt bothered by any of these things?	**Not at all**	**Several Days**	**More than half the days**	**Nearly Every day**
1. Feeling nervous, anxious, or on edge?	0	1	2	3
2. Not being able to stop or control worrying?	0	1	2	3
3. Worrying too much about different things?	0	1	2	3
4. Trouble relaxing?	0	1	2	3
5. Being so restless that it is hard to sit still?	0	1	2	3
6. Becoming easily annoyed or irritable?	0	1	2	3
7. Feeling afraid as if something awful might happen?	0	1	2	3

Columns _____ Add + _____ + _____

Total

_____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of the things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

Quick Guide to the Generalized Anxiety Disorder-7 (GAD-7)

Description:	The GAD-7 contains 7 items which assess the frequency of anxiety related symptoms over the past 2 weeks. The GAD-7 can be used as a self-report tool or as an interview.
Purpose:	The GAD-7 is used to screen for anxiety and measure the severity of symptoms.
Target Population:	Adults
Languages:	The GAD-7 has been translated into over 30 languages and can be downloaded from the PHQ website: www.phqscreeners.com
Scoring and Interpreting:	Each question has a number value (0-3). The total score is computed by adding the values endorsed for each item. Total Scores range from 0 to 21, and indicate the following levels of anxiety severity: **Total Score — Anxiety Severity** 0-5 — None or mild 6-10 — Moderate anxiety 11-15 — Moderately severe anxiety 16-21 — Severe anxiety A recommended cut-point for further evaluation is a score of 10 or greater.

When to use:	As indicated to screen for anxiety
Recommended Interventions:	Use this screener to help patients assess skill development in relaxation classes and workshops. It is also sometimes helpful in individual PCBH visits when patients are working on anxiety management skills.

2.3.3 THE PATIENT HEALTH QUEATIONANAIRE (PHQ-9)

Patient Health Questionnaire (PHQ-9)

Name:_____

Date:_____

Over the last 2 weeks, how often have you been bothered by any of the following problems?	**Not at all**	**Several Days**	**More than half the days**	**Nearly Every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling asleep or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself- or that you are a failure or have let yourself or family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite-	0	1	2	3

being so fidgety or restless that you have been moving around a lot more than usual				
9. Thoughts that you would be better off dead, or of hurting yourself in some way	0	1	2	3

Columns _____ Add + _____ + _____

Total

_____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of the things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

Quick Guide to the Patient Health Questionnaire - 9 (PHQ-9)

Description:	The items on the PHQ-9 follow the criteria for a Major Depressive Episode listed in the DSM-IV. Symptom severity is rated by indicating the frequency that depressive symptoms have been experienced during the last 2 weeks on a scale of 0 "*Not at all*" to 3 "*Nearly every day*". An additional single item is rated to determine the impact of depressive symptoms on psycho, social, and occupational functioning.
Purpose:	The PHQ-9 is used to screen for depression, aid in diagnosis[1], and monitor change in symptoms over time.

_____

Target Population:	Adolescents, adults, older adults
Languages:	The PHQ-9 has been translated into over 30 languages and can be downloaded from the PHQ website: www.phqscreeners.com
Scoring and Interpreting:	The total score is computed by first producing a sum for each column (e.g. each item chosen in column "*More than half the days*" = 2), then summing the column totals. Total Scores range from 0 to 27, and indicate the following levels of depression severity: **Total Score — Depression Severity** 0-4 None 5-9 Mild depression 10-14 Moderate depression 15-19 Moderately severe depression 20-27 Severe depression In addition to the patient's Total Score, the responses to Question #9 (suicidality) and Question #10 (the impact of symptoms on the patient's daily functioning) should be reviewed to determine appropriate treatment interventions.
When to use:	As indicated to screen for depression
Recommended Interventions:	Ask patient about preferences for addressing troubling symptoms. Offer behavioral strategies (for example, planning and engaging in more pleasurable, social, and mastery activities as well as exercise) and cognitive behavioral strategies (for example, taking a systematic approach to solving life problems). For patients with higher levels of severity and/ or with greater negative impact on ability to function, explore patient interest in combined treatment.

Panic Disorder

Diagnostic Criteria 300.01 (F41.0)

A. Recurrent unexpected panic attacks. A panic attack is an abrupt surge of intense fear or intense discomfort that reaches a peak within minutes, and during which time four (or more) of the following symptoms occur;

Note: The abrupt surge can occur from a calm state or anxious state.

1. Palpitations, pounding heart, or accelerated heart rate.

2. Sweating.

3. Trembling or shaking.

4. Sensations of shortness of breath or smothering.

5. Feelings of choking.

6. Chest pain or discomfort.

7. Nausea or abdominal distress.

8. Feeling dizzy, unsteady, light-headed, or faint.

9. Chills or heat sensations.

10. Paresthesias (numbness or tingling sensations).

11. Derealization (feelings of unreality) or depersonalization (being detached from one-self).

12. Fear of losing control or "going crazy."

13. Fear of dying.

Note: Culture-specific symptoms (e.g., tinnitus, neck soreness, headache, uncontrollable screaming or crying) may be seen. Such symptoms should not count as one of the four required symptoms.

B. At least one of the attacks has been followed by 1 month (or more) of one or both of the following:

1. Persistent concern or worry about additional panic attacks or their consequences

(e.g., losing control, having a heart attack, "going crazy").

2. A significant maladaptive change in behavior related to the attacks (e.g., behaviors designed to avoid having panic attacks, such as avoidance of exercise or unfamiliar situations).

C. The disturbance is not attributable to the physiological effects of a substance (e.g., a drug of abuse, a medication) or another medical condition (e.g. hyperthyroidism, car-diopulmonary disorders).

D. The disturbance is not better explained by another mental disorder (e.g., the panic at-tacks do not occur only in response to feared social situations, as in social anxiety

dis-order: in response to circumscribed phobic objects or situations, as in specific phobia: in response to obsessions, as in obsessive-compulsive disorder: in response to re-minders of traumatic events, as in posttraumatic stress disorder: or in response to sep-aration from attachment figures, as in separation anxiety disorder).

2.4 REVIEW OF EXISTING SYSTEM

Below is a review of six existing system.

2.4.1 PURPLE ROBOT

The purple robot is a location and usage monitoring software developed by the Northwestern University that collects data from users' phones to detect depression. The underlying hypothesis is that the lower our mood, the more likely we are to spend time moping around on our phones (Nield, 2015). Additionally, the GPS tracker
linked depression with people who spent most of their time in one location, typically their homes (Saeb, 2015).

Studies conducted by the university using purple robot proved 87 percent accurate. 28 adults participated in the study half of claimed they were depressed responding to pop-up messages on their moods.

Features & Processes Involved

The app provides the following major features for constructing context-aware interventions and experience:

- A full real-time sensor data acquisition platform for collecting information about the user and their immediate surroundings. Purple Robot provides
- Full access to the android sensor framework, including the accelerometer, gyroscope, pressure, and more.
- Access to the other device information such as battery level, running software & apps, and hardware information.
- Option to scan for external devices such as wireless access points and visible Bluetooth devices.
- Location sensors that use the built-in GPS and cellar triangulation option to map the user's location.
- Local environmental data sources such as solar event timing (sunrise & sunset) and weather conditions.
- Statistical summaries of the user's communication patterns including phone logs and text-message transcripts.
- Cryptographic anonymization of personally-identifiable information before it leaves the device
- Robust java script $ scheme scripting engines
- An embedded web server that exposes the scripting engine to put web-based applications on an equal footing with native applications.
- A complete programming framework that allows other applications (native & web-based) to store data, launch applications, update home screen widgets, and create customized native prompts and dialogs.

- The ability to define new sensors & features using standard Java Script.
- Network configuration options built around the scripting engine that allow for remote configuration (with proper authorization).

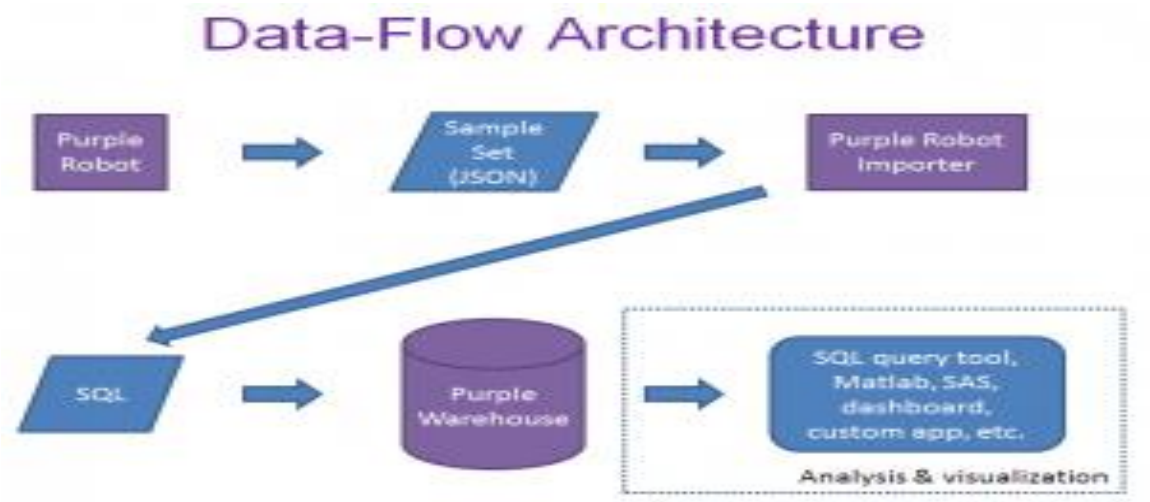


Figure 2.1: Data flow architecture.

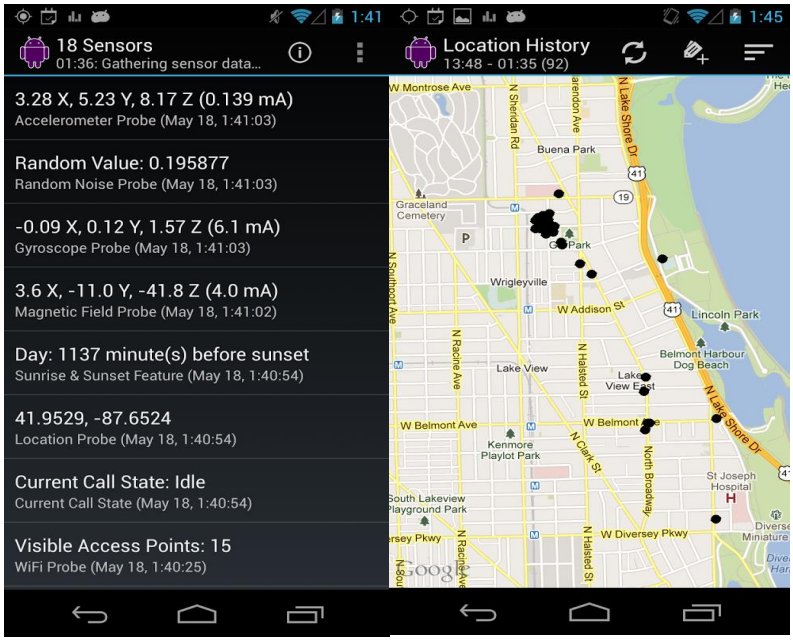


Figure 2.2: Purple robot's interface.

Strength

- This app collects data from user's phone that is their location history and how often users use their phones (call logs and message transcripts).
- It collects data passively to detect depression based on users' behavior.
- Helps with doing surveys.

Weakness

- It does not take the depression away or improve mood of the users'.
- It focuses on only behaviors leaving emotions.

Most of the data collected does not relate to depression.

Recommendation

This app will be more useful if it can at least notify users' of their current behavior for example "hey we noticed you have not been moving, what could be the problem?" some form of interaction will help in knowing if the sedentary behaviors are linked to depression and anxiety.

2.4.2 SECRETE OF HAPPINESS

The secret of happiness is an android app that trains one's mind to think positively .Users are challenged to input positive experiences morning and evening for 30 days to train

the brain to think positively. All one need to do is think positive and enter it into the app right after you get up in the morning and just before you hit the bed in the night. Repeating it for 30 days will train your brain to think positively and your subconscious mind will remain happy.

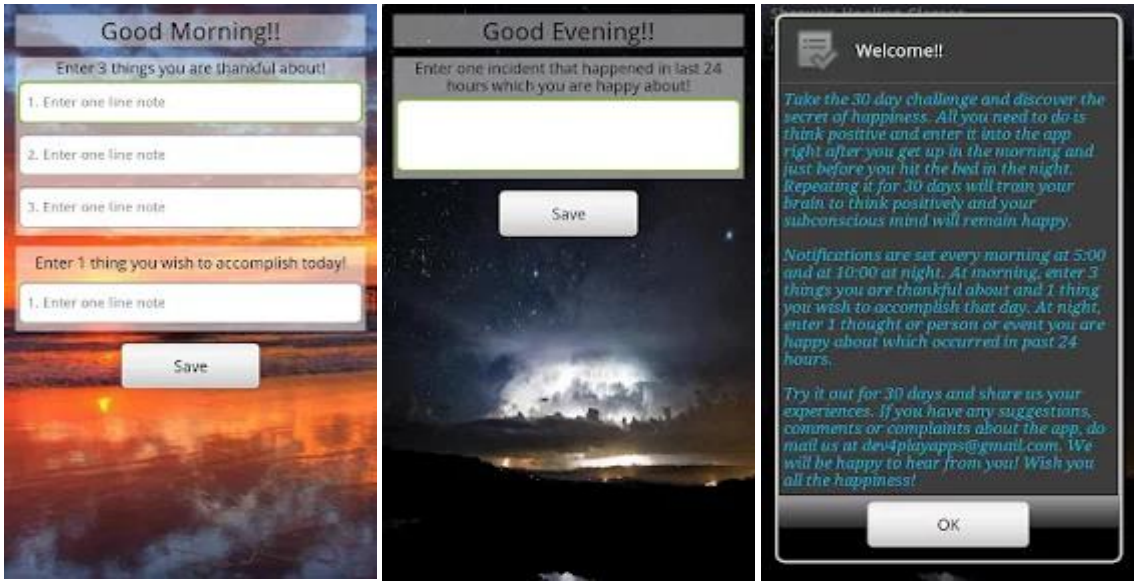


Figure 2.3: Secrete of happiness.

Strength

- It encourages positive thinking
- It is easy to use.

Weakness

- It takes 30 days to train the mind to think positively.
- It does not detect depression.

Recommendation

Training the mind to think positively for 30 days is too long for a depressed or anxious person. The app can be more effective if it is able to collect motivational quotes that is specific enough from severs that the users can select and read to change their way of thinking.

2.4.3 7 CUPS- ANXIETY & DEPRESSION

This app creates a platform for people to communicate anonymously and share their problems for emotional support with active listeners. The conversation between both parties is confidential.

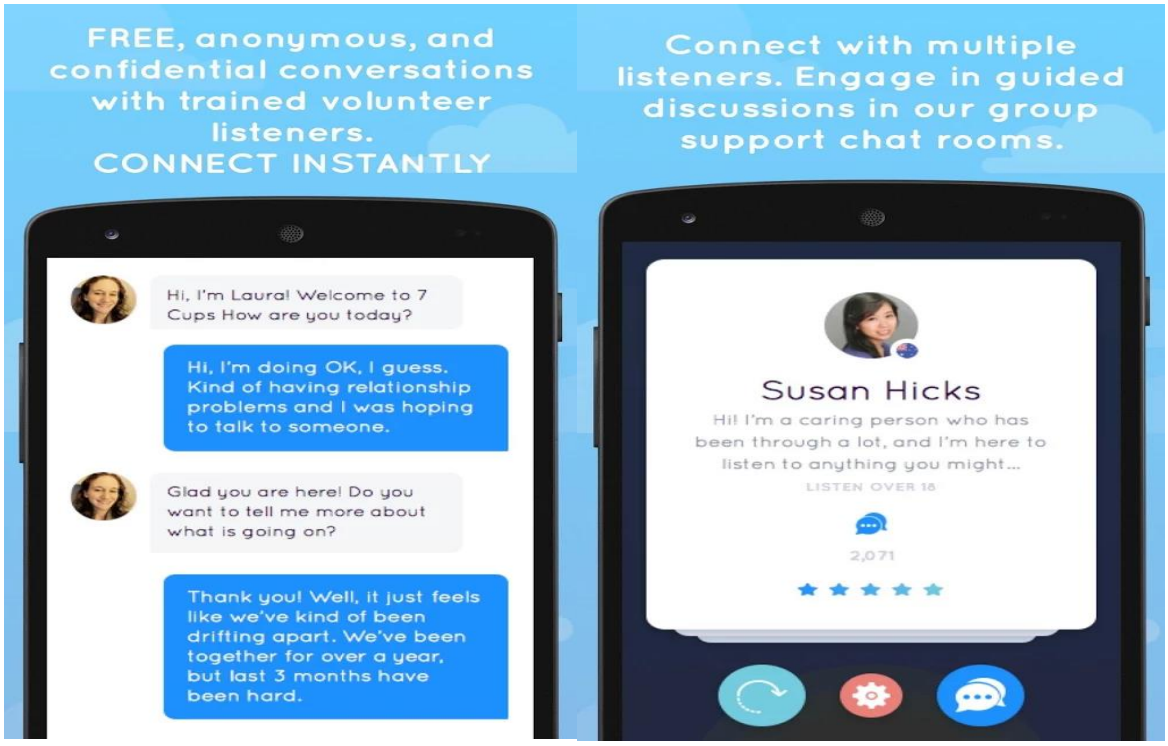


Figure 2.4: 7 cups- Anxiety & depression.

Strength

Provide access to dedicated listeners who listen to thinks bothering the user and advise the user.

Communication is done anonymously.

Weakness

- Requires connection to the internet.
- Requires an active listener.

Recommendation

7 cups – anxiety and depression requires an active listener. It will help the user if there is no one to listen to have a platform where depressed and anxious people can share experiences among themselves to be motivated and know what they are going through someone has been there before. An example could be how someone was diagnosed with HIV and was afraid of dying and that their life was coming to an end but with a doctor's advice they have learnt that exercising and eating a balance diet can slow the virus.

2.4.4 STRESS CHECK BY AZUMIO

Stress check analyzes heart rate to calculate stress levels. Using phones camera and light it reads the pulse from users' finger to get stress levels.

Figure 2.5: Stress check by Azumio.

Strength

- Can estimate your level of stress in real time

Weakness

- This app is focused only on heart rate to detect one's stress levels.

Recommendation

A resting heart rate pumps the lowest amount of blood one needs if they are not exercising. If one is sitting or lying and you are calm, relaxed and aren't ill, their heart rate is normally between 60 (beats per minute) to 100 (beats per minute). The app can help users with anxiety problems if they

are thought how to relax and breathe rather than just giving heart rate information or values.

2.4.5 FIGHT DEPRESSION – YOGA GURU

Yoga Guru trains the user how to do Yoga .Yoga can fight depression through bringing fresh oxygen into the body through abdominal breathing. Meditation in yoga workout helps enhance self-awareness and conduct emotion control with the support of some calming music. The app reminds you to focus on yourself and start meditation and mind on your breath when practicing.

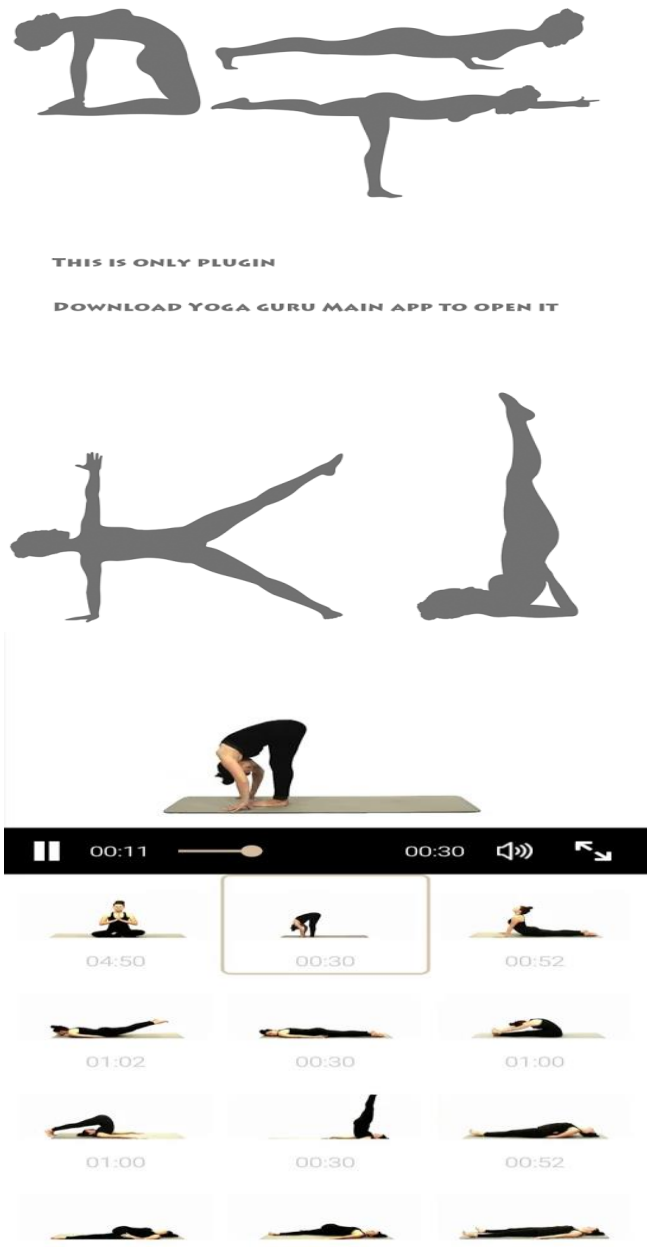


Figure 2.6: Fight depression- Yoga Guru.

Strength

- Teaches users how to do yoga and stay fit.
- It improves the mood of the users.

Weakness

- It takes time to take depression away since users will have to practice yoga for some time.

Recommendation

One needs to psych themselves up to do yoga which is not easy doing and will require lots of practice making people give up. The app should be able to have access to other contents like funny clips, music to improve mood immediately.

2.4.6 PRIORI

The PRIORI application developed by the University of Michigan team is a smartphone app that monitors subtle qualities of a person's voice during everyday phone conversation to detect early signs of mood changes in people with bipolar disorder. While the app still needs much testing before widespread use, early results from a small group of patients show it's potential to monitor moods while protecting privacy. The team is led by computer scientists Zahi Karam, PH.D., and Emily Mower Provost, Ph.D., and psychiatrist Melvin Mclnnis, M.D. Bipolar disorder affects tens of millions of people worldwide, and can have devastating effects including suicide.
The app runs in the background on an ordinary smartphone, and automatically monitors the patients' voice patterns during any

calls made as well as during conversations with a member of the patient's care team.

Only the patient's side of everyday phone calls is recorded- and the recordings themselves are encrypted and kept-off limits to the research team. They can see only the results of computer analysis of the recordings, which are stored in secure servers that comply with patient privacy laws.

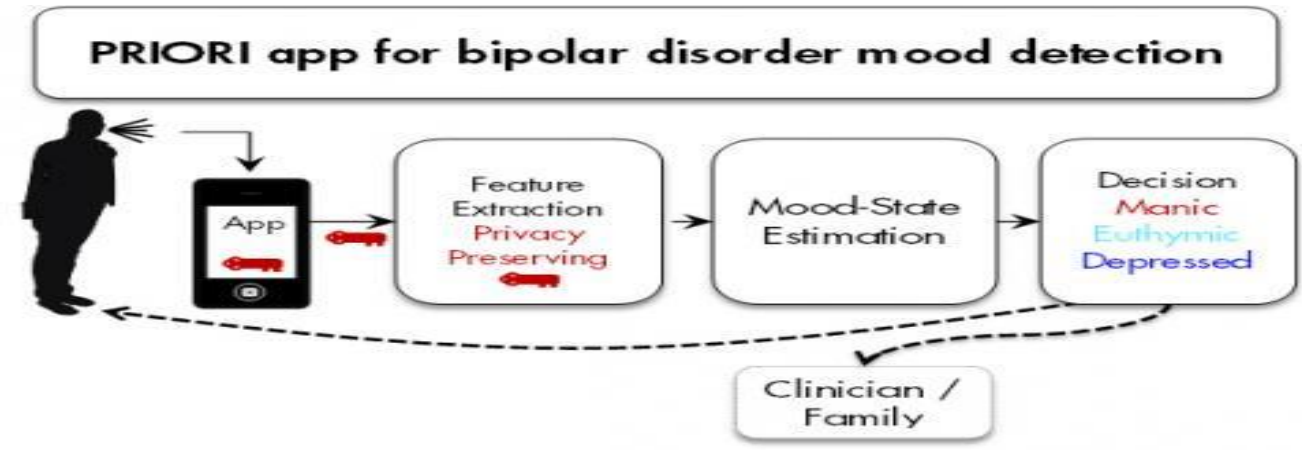


Figure 2.7: Priori mood detection.

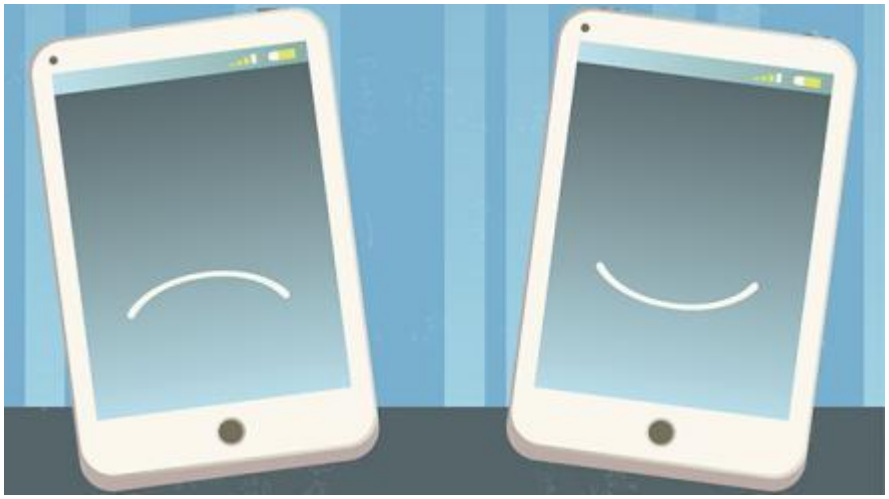


Figure 2.8: PRIORI

Strength

- Works in the background meaning it collects voice data to predict, which is more accurate than interacting with users.
- It is simple.

Weakness

- All it does is listen to sounds and silences it does not capture negative phrases.
- Does not improve the mood the user.

Recommendation

Instead of focusing how people communicate like listening to sounds and silence and pauses in speech, it will be better if

they could consider negative contents what people say like "I'm tired of living."

2.5 JUSTIFICATION AND THE PROPOSED SYSTEM

The various applications above used different approaches to either detect depression and anxiety or try to improve the depression and anxiety to achieve the same goal by fighting it which takes time to improve it.

To justify this work it is observed from the six systems reviewed above, methods used were helpful in predicting depression and anxiety and trying to take it away, however they had gaps which the proposed system seeks to fill as seen in the recommendation of each system.

The proposed system takes three different kinds of inputs, that is speech, GPS location, and heart rate or for prediction or detection of depression and anxiety. It notifies the users what it has found based on negative phrases used for the speech input, sedentary behavior using GPS location input, stress level by reading pulses from users finger to check heart rate. Using multimedia to improve or trigger positive emotions it displays motivational quotes to motivate, display funny clips for humor or laughter, music and photos to trigger positive emotions. The system will not require additional hardware or be paired with other external software.

CHAPTER THREE
CRYSTALLIZATION OF THE PROBLEM

This chapter presents an analyses and discussion of existing systems. The strengths and weaknesses of the systems will also be identified.

3.0 BRIEF HISTORY OF ACCRA PSYCHIATRIC HOSPITAL (PANTANG)

During the period of colonization and before the introduction of scientific medicine, mental illness was treated with medicine and spiritual rites. In the very early days of colonial rule, mental ill patients were left alone to their own fate.

However, on 4th February 1888, by a Legislative Instrument (LI) under the signature of the then governor, Sir Edward Griffiths, the old High Court of Victoria Borg was converted into Lunatic Asylum.

The Wardens then looked after the patients. No medical treatment was giving and no real distinction made between the requirements of the mentally ill and those of the criminal. Overcrowding in the prison promoted the building of a new hospital at Adadraka 1904, and was called Lunatic Asylum; the present Accra Psychiatric Hospital. It was commissioned in 1906 to accommodate 200 patients.

About 110 patients were initially admitted into the new hospital under the charge of 16 untrained attendants. The

hospital consisted of four wards; Female, Male, General and Criminal wards. The Lunatic Asylum later underwent modifications and extension into the Psychiatric Hospital with a bed capacity of 600.

Pantang hospital is the second born child of Accra Psychiatric Hospital. It was opened by General I.K. Acheampong in 1975 and was headed by Dr. Sika Nartey a psychiatrist. The hospital is situated near a village called Pantang about 1.6 kilometers off the Accra Central. The hospital was originally planned to be a Pan-African Mental Health Village (Accra Psychiatric Hospital, 2016).

3.1 MODE OF OPERATION

Clinical psychology is the branch of psychology (regulated mental health profession) concerned with assessment and treatment of mental illness, abnormal behavior and psychiatric problems. This field integrates the scientist practioner model of psychology with the treatment of complex human problem. Clinical psychology aims to reduce psychological distress and enhance and promote psychological well-being. Clinical psychologist work with clients of all ages on a variety of different mental or physical health problems including:

I. Stress
II. Depression and anxiety

III. Schizophrenia and other psychotic disorders

IV. Adjustment to physical illness, trauma or injuries

V. Neurological disorders

VI. Addictive behaviors

VII. Challenging behaviors

VIII. Eating disorders

IX. Personal and family relationship problems

X. Learning disabilities

XI. Sexual disorders

XII. Personal disorders

XIII. Crises such as divorce or loss of a loved one

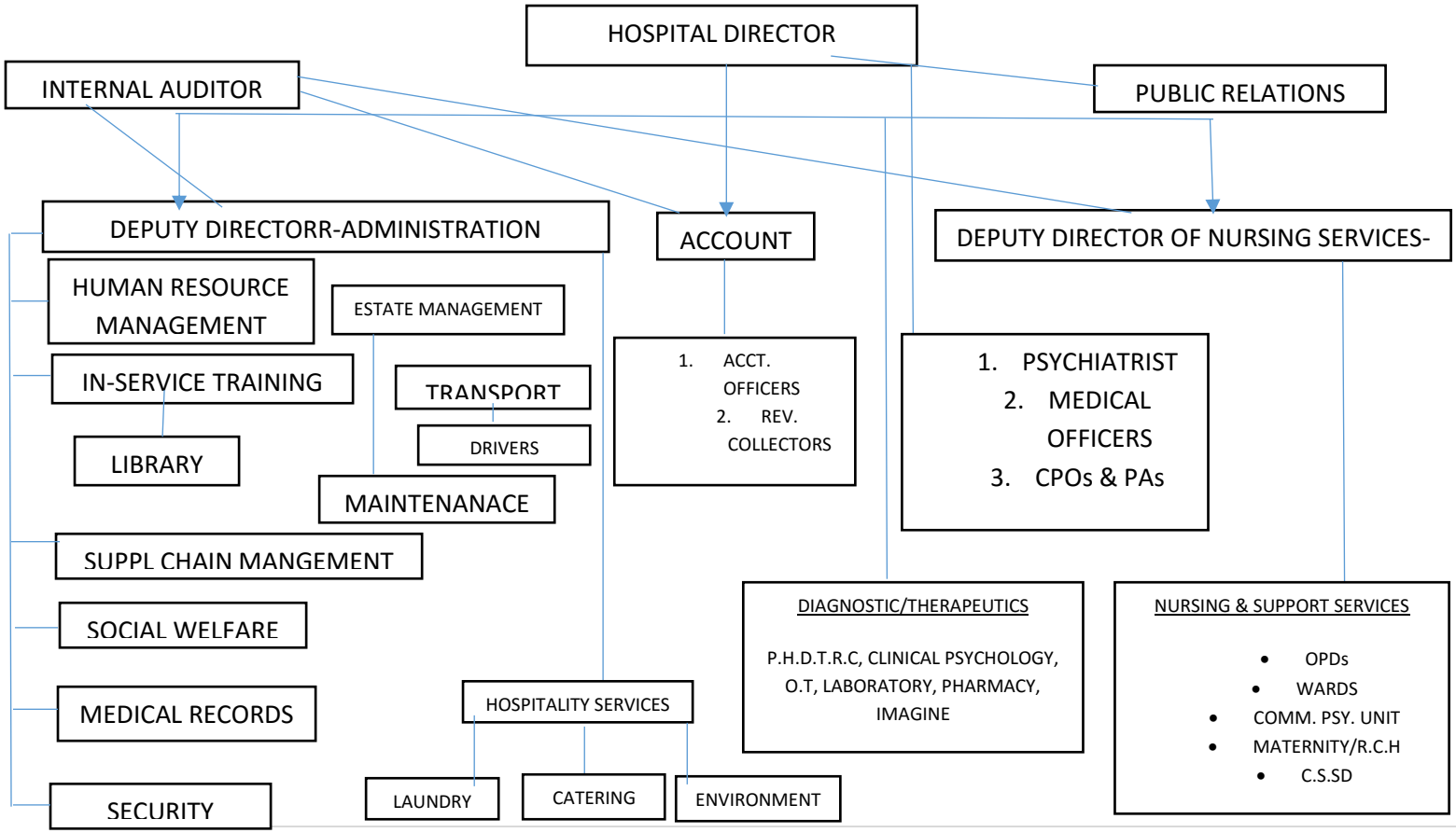
Some of the job roles performed by the clinical psychologist include:

- Assessing a client's needs, abilities or behavior using a variety of methods, including psychological and neuropsychological test, interviews and direct observation of behavior
- Writing assessment report on clients for job or school placement
- Devising and monitoring appropriate programs of treatment, including therapy, counselling or advice, in collaboration with colleagues

- Offering therapy and treatments for difficulties relating to mental health problems such as anxiety, depression, stress, drug, and alcohol addiction, social and interpersonal problems and challenging behavior
- Developing and evaluating service provision for clients
- Providing consultation to other professions, encouraging a psychological approach in their work
- Counselling and supporting careers
- Provide occupational, educational, and other information to individuals so that they can make educational and vocational plans
- Carrying out applied research, adding to the evidence base of practice in a variety of healthcare settings
- Teaching
- Creating and administering program to treat and prevent social problems
- Working as part of a multidisciplinary team alongside doctors, nurses, social workers, education professionals, health visitors, psychiatrists and occupational therapists
- Refer clients to other specialists, institutions , or support services as necessary

3.2 FLOW OF ACCRA PSYCHIATRIC HOSPITAL (PANTANG) OPERATIONS

Fig 3.1 Organizational chart of Accra Psychiatric hospital Pantang Operations



3.3 STRENGTHS OF THEIR SYSTEM

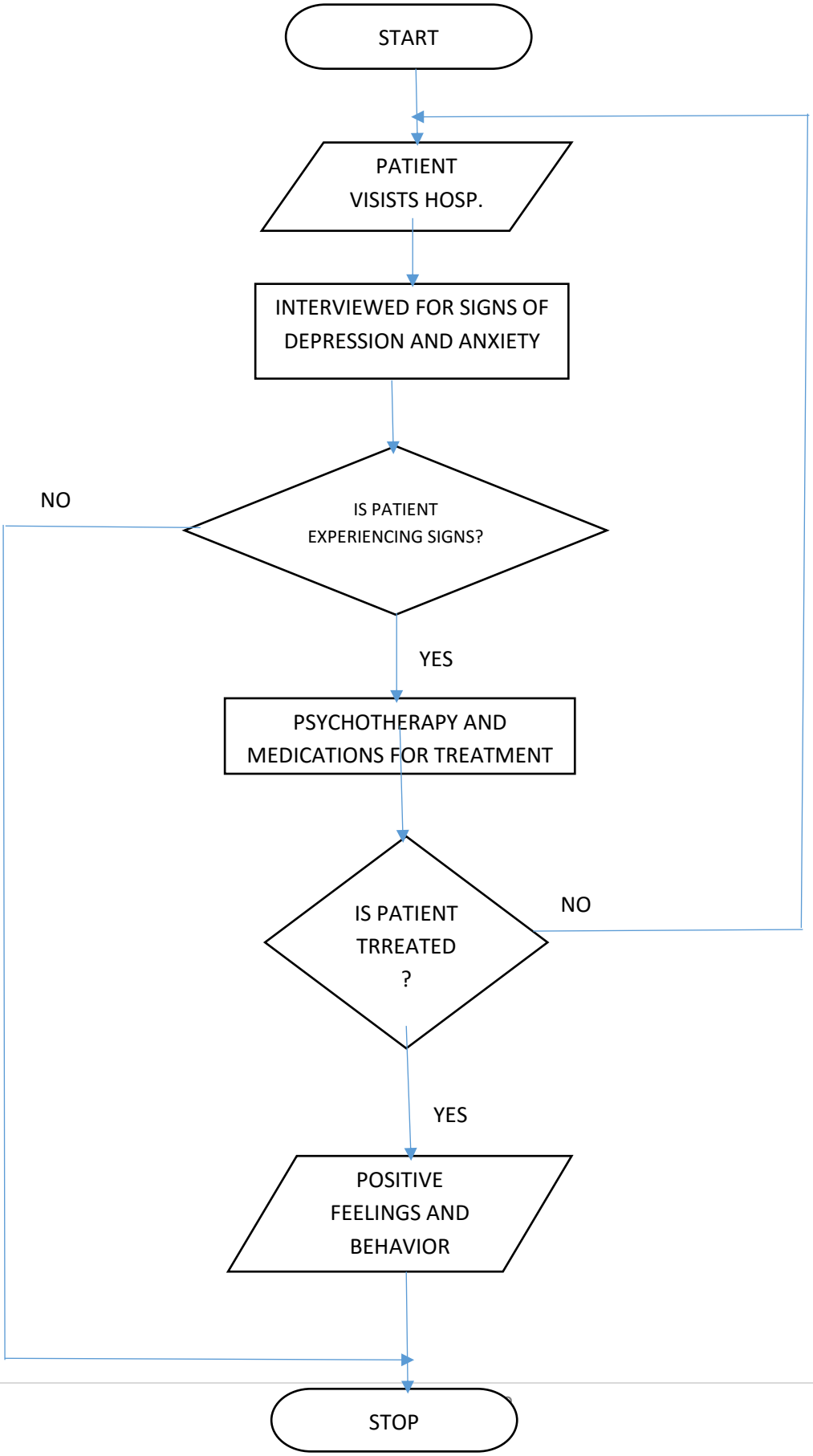
- Depression and anxiety is treated easily if patients are opened about their problems; patients can function properly, and be of use to society after treatment.
- Patients get help from clinical psychologist on how to manage mood disorders on their own.

3.4 WEAKNESSES OF THEIR SYSTEM

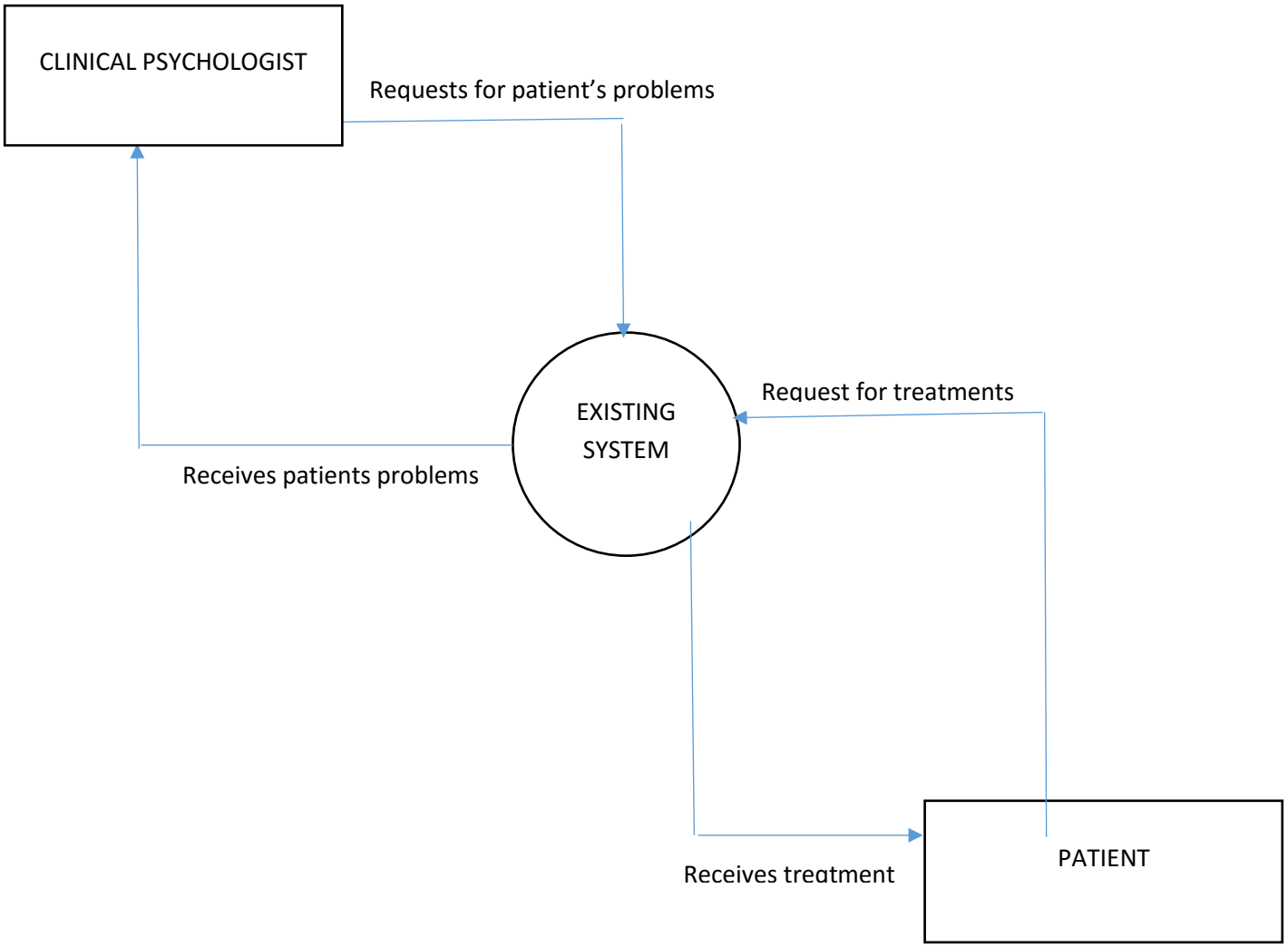
- Depression cannot not be treated if patients are not opened about their experiences or problems.
- Cost for treating depression and anxiety can be high since patients will have to buy drugs (medications) depending on severity.
- May require weeks or even months to treat it with therapy (psychotherapy).
- There is much focus on treatment done prevention.
- There is not enough awareness on depression and anxiety until one experiences it. An example could be suicidal thought by one who made an attempt and survived. They get educated when they are taking to hospital.

3.5 FLOW OF HOW DEPRESSION AND ANXIETY IS TREATED

Fig 4.2 Flow



3.6 CONTEXT DIAGRAM OF EXISTING SYSTEM



3.7 STATISTICAL REPORTS ON DEPRESSION AND ANXIETY (PROBLEMS)

PANTANG PSYCHIATRIC HOSPITAL OUTPATIENT DEPRESSION AND ANXIETY CASES FOR 2014 AND 2015

CONDITION	FIGURES PER YEAR	
	2014	2015
DEPRESSION	1,461	1,945
ANXIETY DISORDER	128	179

3.8 CONCLUSION

Considering the disadvantages or weaknesses identified, it will be important to have the proposed system for the prediction of signs and symptoms of depression and anxiety early enough and also taking it away as soon as possible which the proposed system will seek to address; prevention than treatment it will encourage.

It can be observed from the statistical reports above the rise in depression and anxiety from 2014 to 2015 alone and knowing the how it affects one's life. People with desire to cause harm to themselves and others such as committing suicide

will be addressed by the proposed system through smartphone use. Smartphone addiction has been linked to mood disorders in the chapter 2. The proposed system also seeks to turn things the other way round where smartphone addicts can be monitored and improving their moods with the app installed on their phones; Smartphone addiction will not be linked mood disorders.

CHAPTER FOUR

ANALYSIS OF THE PROPOSED SYSTEM

This chapter gives an analysis of the proposed system with discussion of the major components of the system. In addition, the System Context Diagram will be considered and the benefits of the proposed system will also be outlined.

4.0 OVERVIEW OF THE PROPOSED SYSTEM

The proposed system take three different kinds of inputs. That is speech, GPS location, and heart rate for prediction or detection of depression and anxiety. It notifies the users what it has found based on negative phrases used for the speech input, sedentary behavior using GPS location input, stress level by reading pulses from users finger to check heart rate. Using multimedia to improve or trigger positive emotions it displays motivational quotes to motivate, display funny clips for humor or laughter, music and photos to trigger positive emotions. The system will not require additional hardware or be paired with other external software.

4.0.1 FUNCTIONAL REQUIREMENT(S)

Functional requirements are detailed statements of the project's desired capabilities, including the things that may be not seen by the users, and what the system should do. This include:

GPS LOCATION MODULE

Ability to collect data or track user's movement. If users are found to be at one location for a long time it notifies them. This is to monitor behavior.

PHRASE LISTENER MODULE

Involves capturing of negative words and phrases from users calls using speech recognition technology. This will predict if they are likely to cause harm to themselves E.g. "I will kill myself ","I can't take it anymore" , "I lost".

The system uses CMU sphinx speech recognition engine to convert voice data from calls from **speech to text**. The text is analyzed for negative phrase by comparing it to a database of negative phrases. The analyzed text will be encrypted to address privacy problems.

HEART RATE MONITOR MODULE

Provides information on the user's heart rate and the intervals between every heartbeat for anxiety. This is to ensure their hearts are in a resting state if they are not engaged in any activity that can induce anxiety. A normal resting heart is between 60 to 100 bpm (beat per minute).

In the android application the phone's camera will be used to capture the heart rate. When the user places a

finger the camera, an image processing algorithm detects the red component on the finger image to sense the blood flow and calculate a reading. The heart rate is determined after one minute.

ALERT

Users get alerts on their mobility. They also get alerts on negative phrases they use related to signs of depression.

DEPRESSION AND ANXIETY SOLUTION MODULE

This part seeks to take the depression and anxiety away by making available motivational quotes, funny clips, songs, pictures from servers. All these will be collected from servers or links.

4.0.2 NON-FUNCTIONAL REQUIREMENTS

The non-functional requirements of the proposed system places constraints on how the system will execute its processes (such as performance requirements, security, or reliability). They are as follows:

- The proposed system executes only on Android platforms.
- The app will secure data collected (voice data) by encrypting it.
- Interface will be easy to navigate.
- A login functionality will be provided for security and privacy.

4.1 MAJOR FEATURES OF PROPOSED SYSTEM

This section presents details of the major features of the proposed system.

4.1.1 MOBILITY-SIGNS OF DEPRESSION AND ANXIETY DETECTOR

This module monitors how often users move about for signs of these mood disorders since depressed people are not physically active. No input from the user is required and it works in the background. If users are at one location for a long time they are notified about it. The accelerometer will be used to sense movement.

4.1.2 VOICE-SIGNS OF DEPRESSION AND ANXIETY DETECTOR

This module plays part of the role of detecting or predicting it by listening to what users say when they make calls. Their calls are recorded and converted to text and analyzed for negative words and phrases before the data is encrypted. The system performs this by:

1 Recording voice data (audio).
2 CMU sphinx or google speech recognition converts from speech to text.
3 Text is compared with a negative database phrase.
4 Alerts the user on the phrase used.
5 Encrypts data.

4.1.3 HEART RATE-SIGNS OF DEPRESSION AND ANXIETY DETECTOR

This module seeks to also detect or predict to mood disorder by getting heart rate of the users through camera and light features on their android phones for the disorders. The system performs this by:

1 Reading the user's pulse through finger.
2 An image sensing algorithm senses the blood flow and calculate reading.

4.1.4 DEPRESSION AND ANXIETY SOLUTION MODULE

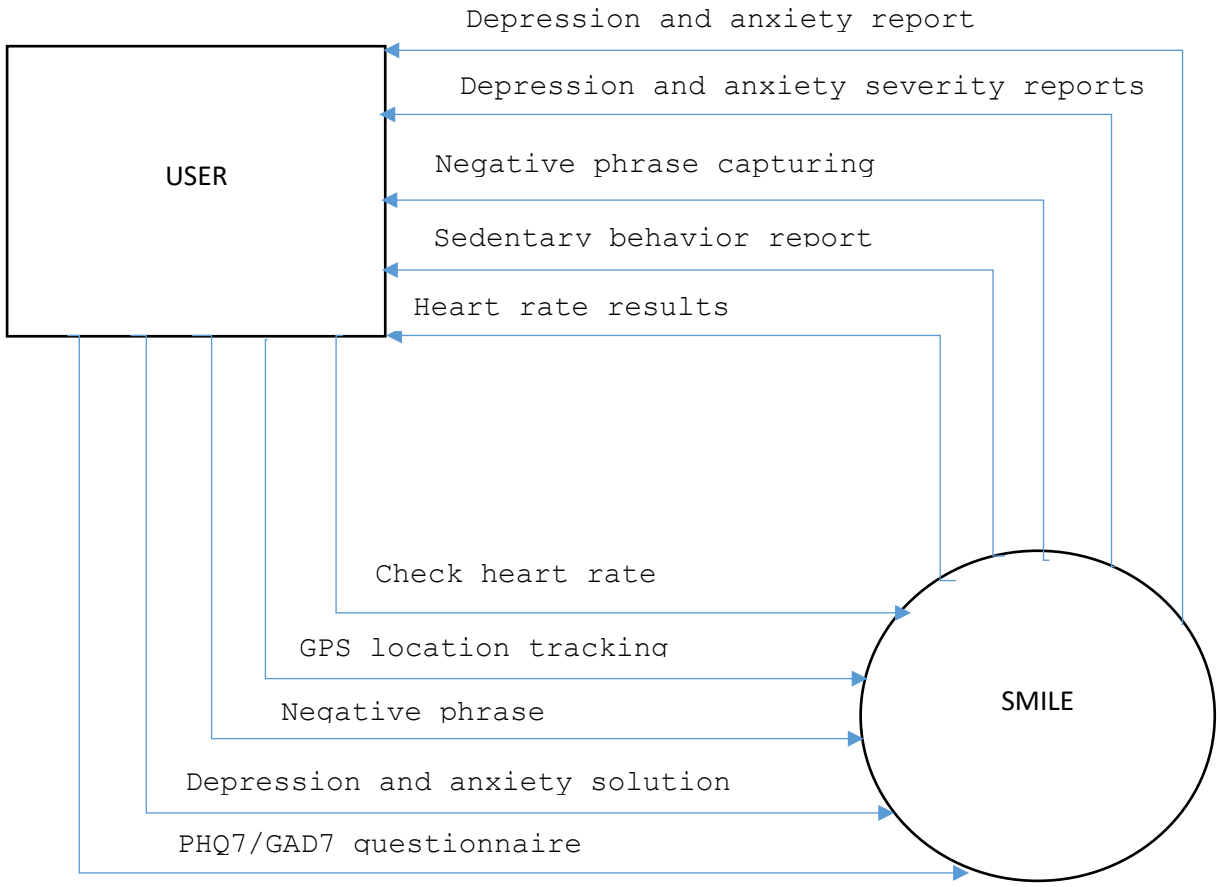
This module collects data from servers to improve the mood of the user. It gets motivational quotes, funny clips, songs, and pictures of the user to improve mood.

4.2 BENEFITS OF THE PROPOSED SYSTEM

- The proposed detects or predicts depression and anxiety for early signs or symptoms of the user.
- The proposed system improves the mood of the user using motivational quotes, funny clips, songs.
- The proposed system encrypts voice data after analyzing it to address privacy issues.
- Users don't have to worry about who has access since there will be a login functionality for that.

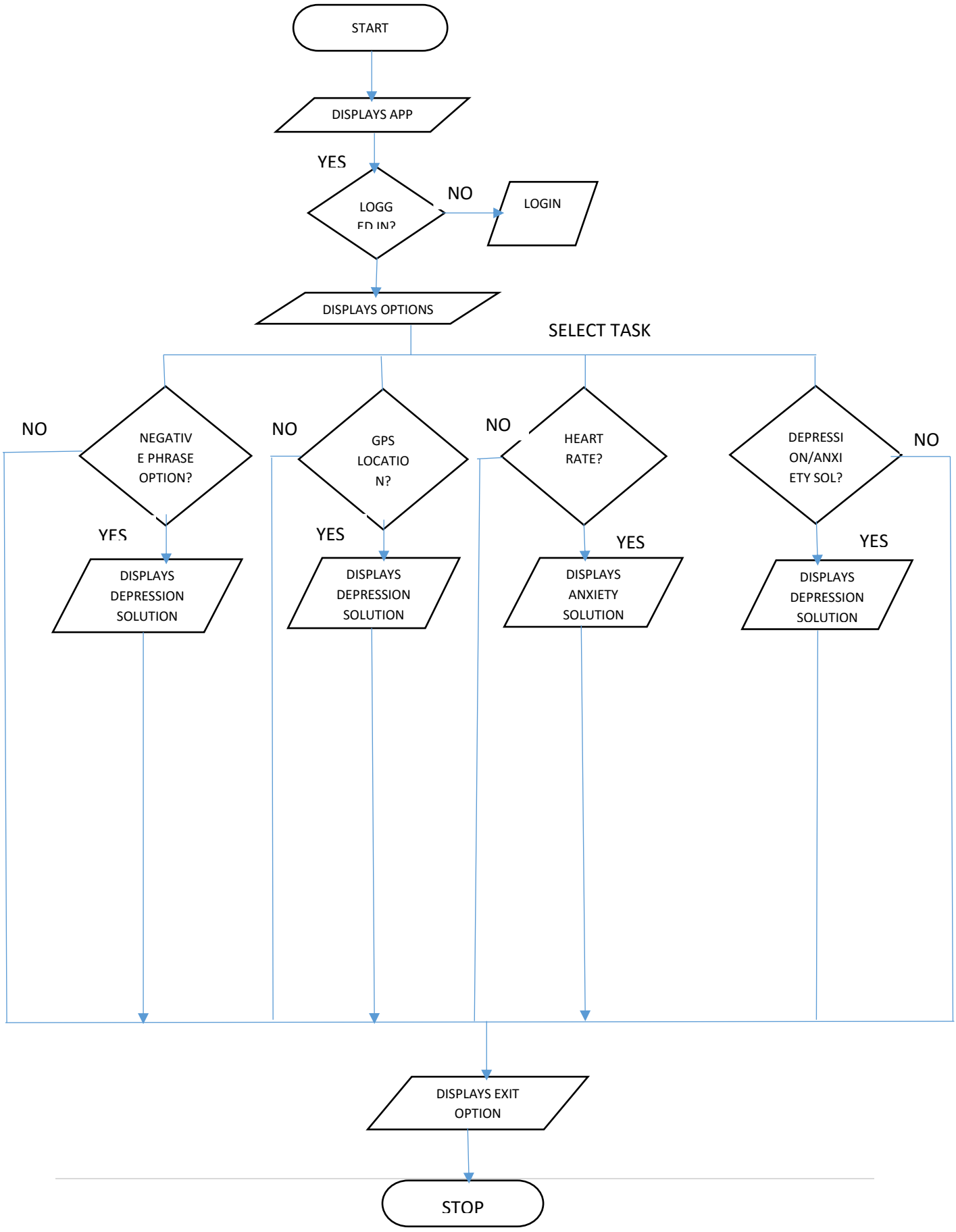
4.3 CONTEXT DIAGRAM (PROPOSED SYSTEM)

Fig 4.1 context diagram for proposed system



4.4 FLOW CHART (PROPOSED SYSTEM)

Fig 4.1 flow chart for proposed system



CHAPTER FIVE

DETAILED ANAYSIS OF THE PROPOSED SYSTEM

5.0 FUNCTIONAL PROCESS

This mood predictor application has certain key modules which are outlined in this chapter, with a breakdown into the various functional processes. This involves the functional process diagrams of the GPS location module, Emotion prediction module, heart monitor module, depression and anxiety solution module.

The GPS location module serves the purpose of keeping track of the user movement and their location.

The heart rate monitor module performs the task of monitoring the heart rate of the user by reading pulse from the user's finger.

The phrase listener module serves the purpose of listening and looking out for negative phrases the user say when they are making calls .It works in the background.

The depression and anxiety module performs the task of trying to improve the mood the user if users are experiencing the blues.

5.2. AGORITHM AND FLOW CHART OF THE SYSTEM PRCCESS

1. START
2. SELECT Option
3. IF 'Heart rate monitor'
    4. DISPLAY Heart rate Actions
    5. SPECIFY Heart rate Actions
    6. PERFORM Heart rate Actions
    7. COMMIT Heart rate Actions
    8. GO TO STEP: 20

ELSE IF 'GPS location Service'

    9. Display GPS location services
    10. SPECIFY GPS location Service
    11. DISPLAY GPS location Service Information
    12. GO TO STEP: 20

ELSE IF 'Phrase listener'

    13. DISPLAY Emotion detection' Action
    14. GO TO STEP:20

ELSE IF 'Depression and anxiety solution'

15. Display 'Depression and anxiety solution' Action
16. DISPLAY Depression and anxiety solution Information
17. GO TO STEP: 20

ELSE 'Exit'

    Exit Application
    18. GO TO STEP: 20
19. STOP

5.2.1 AGORITHM AND FLOW CHART OF HEART RATE MONITOR

a. Algorithm

Step 1: Start

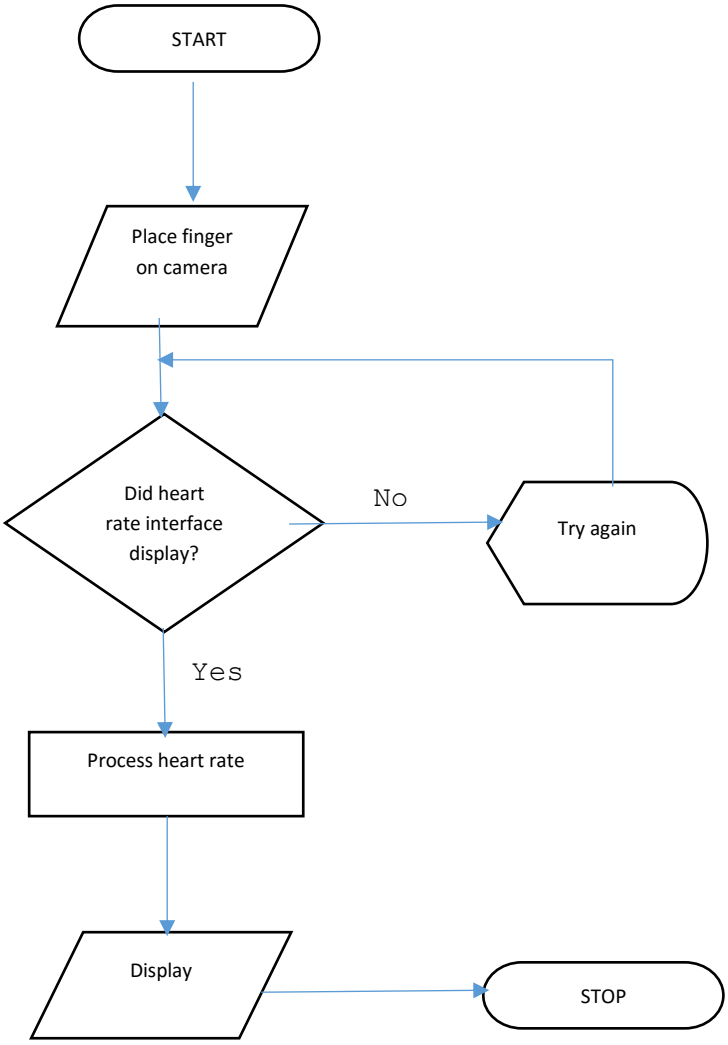
Step 2: Place finger (camera) on camera

Step 3: If heart rate not displayed, prompt user to try again

Step 4: Else display heart rate

Step 5: Stop/End

Fig 5.3 FLOW CHART OF HEART RATE MONITOR



5.2.2 AGORITHM AND FLOW CHART OF GPS LOCATION TRACKING

a. Algorithm

Step 1: Start

Step 2: Mark user's current location

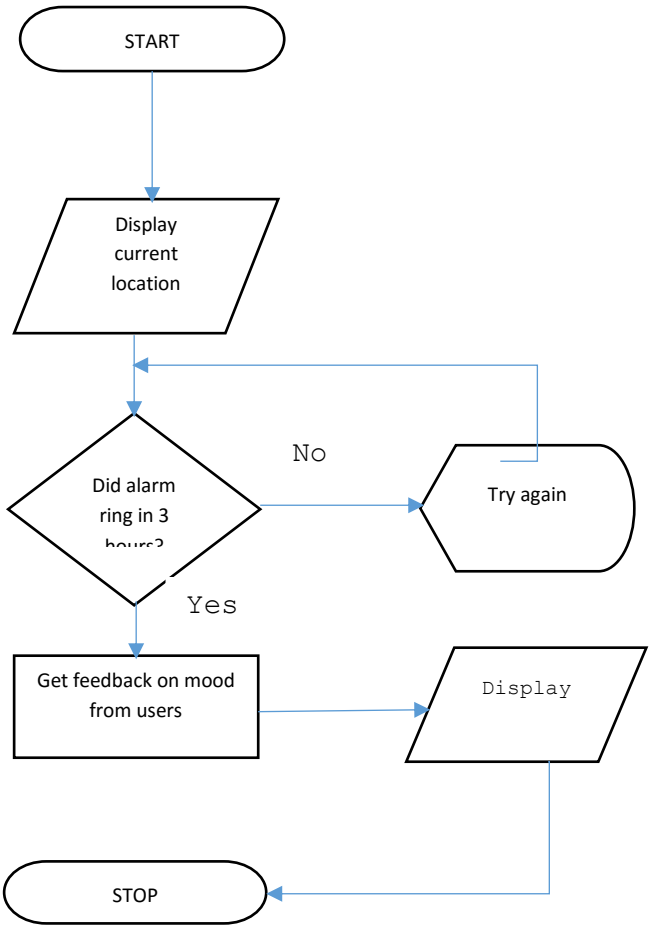
Step 3: If current location is displayed, alarm user after 3 hours on mood "Are you moody?"

Step 4: Else display current location not retrieved

Step 5: Display depression and anxiety location

Step 6: Stop/End

Fig 5.4 FLOW CHART OF GPS LOCATION TRACKING



5.2.3 AGORITHM AND FLOW CHART FOR PHRASE LISTENER

a. Algorithm

Step 1: Start

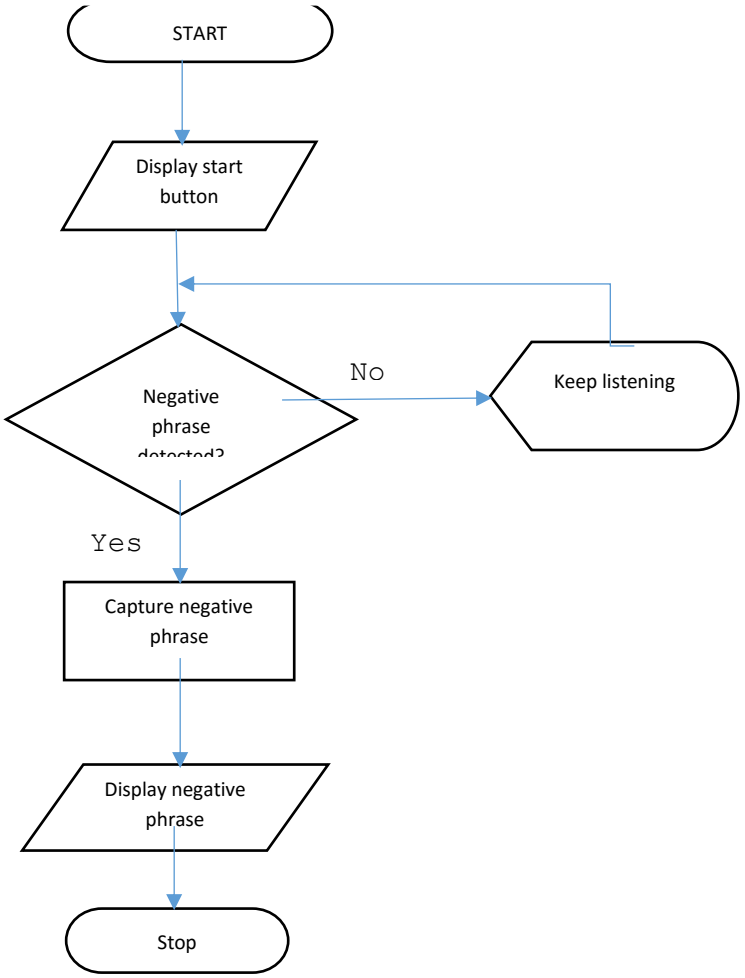
Step 2: Listen for negative phrase in the background

Step 3: If negative phrase detected, display depression and anxiety module

Step 4: Else keep listening

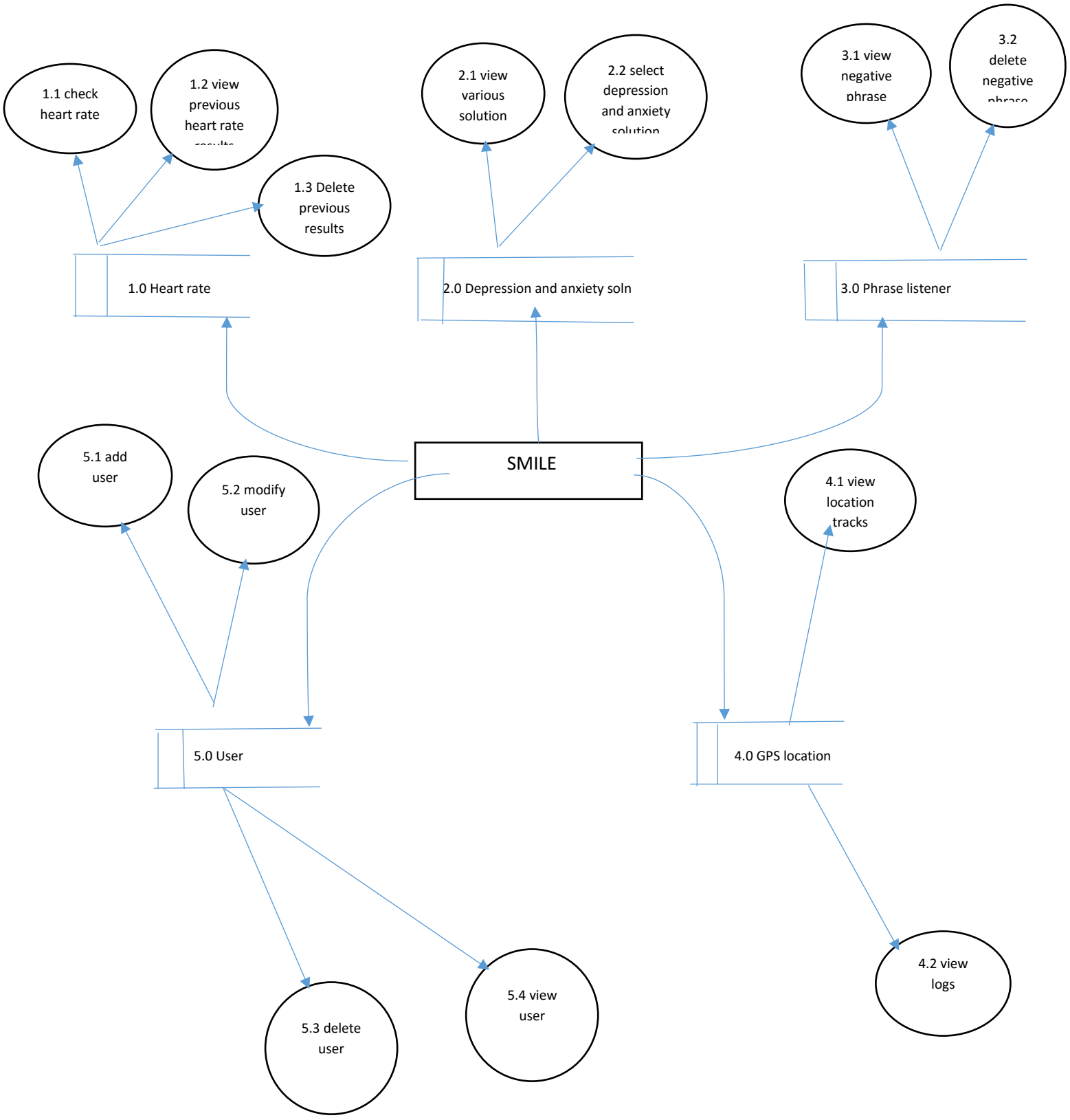
Step 5: Stop/End

Fig 5.5 FLOW CHART OF THE PHRASE LISTENER



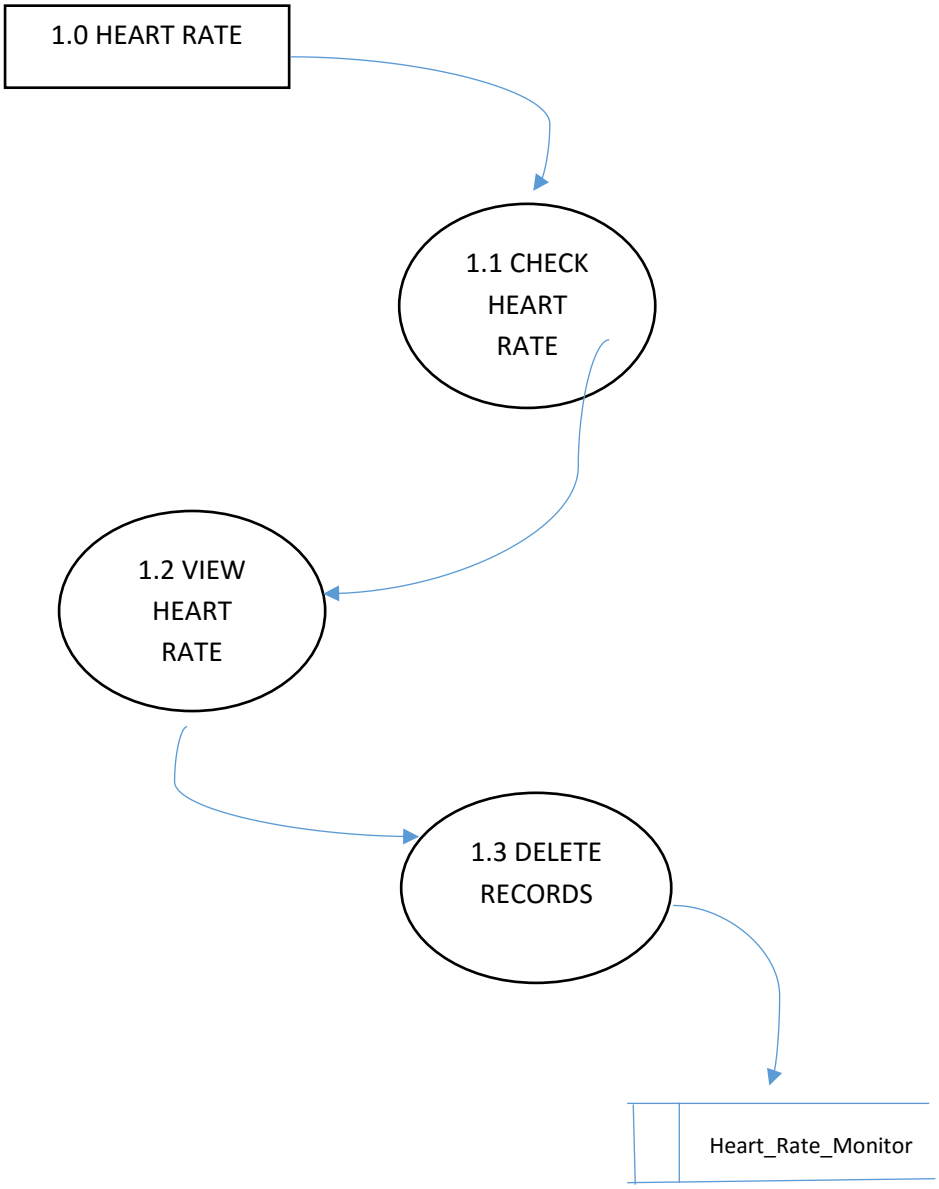
5.3 FUNCTIONAL PROCESS DIAGRAM OF THE PROPOSED SYSTEM

Fig 5.6 Functional process diagram of the proposed system



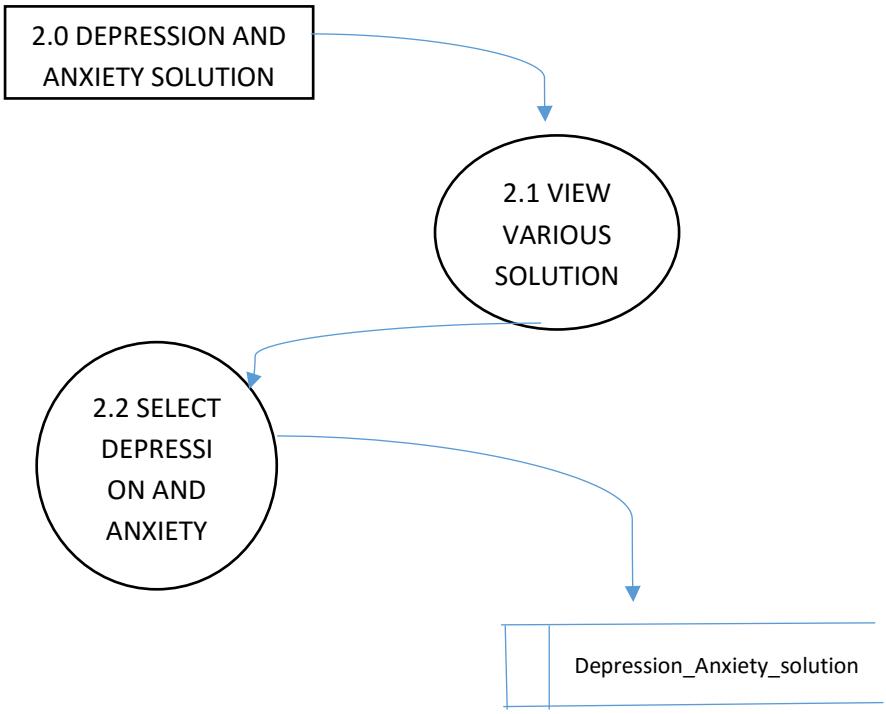
5.3.1 PROCESS DIAGRAM FOR THE HEART RATE MODULE

Fig 5.7 Process diagram of the heart rate module



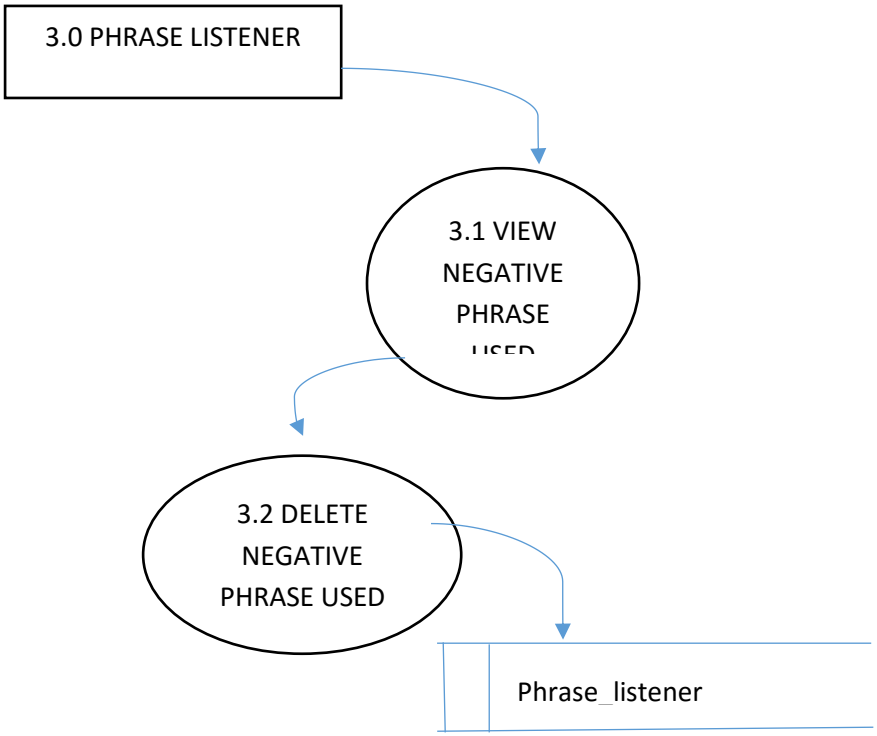
5.3.2 PROCESS DIAGRAM FOR DEPRESSION AND ANXIETY SOLUTION MODULE

Fig 5.8 Process diagram for depression and anxiety solution module



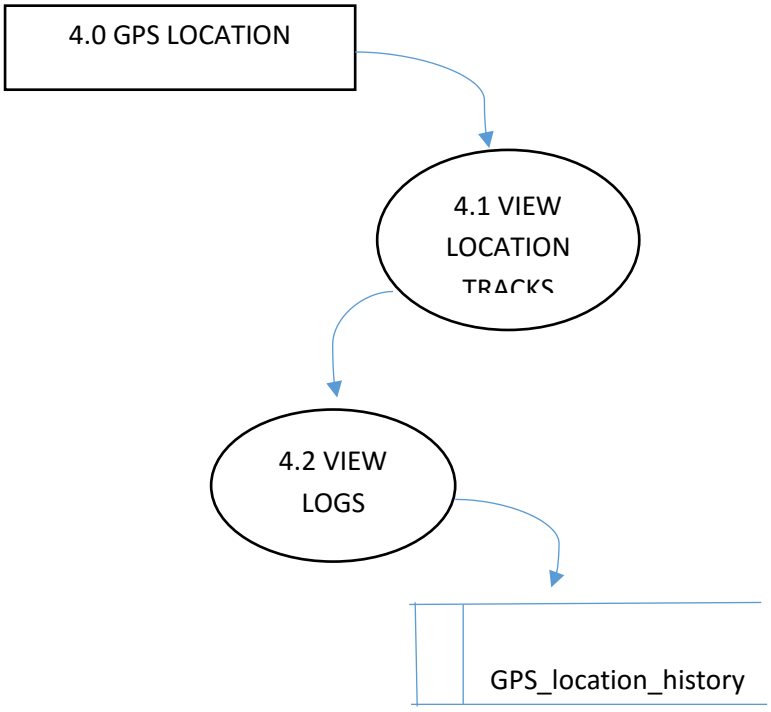
5.3.3 PROCESS DIAGRAM FOR PHRASE LISTENER MODULE

Fig 5.9 Functional process for emotion detector module



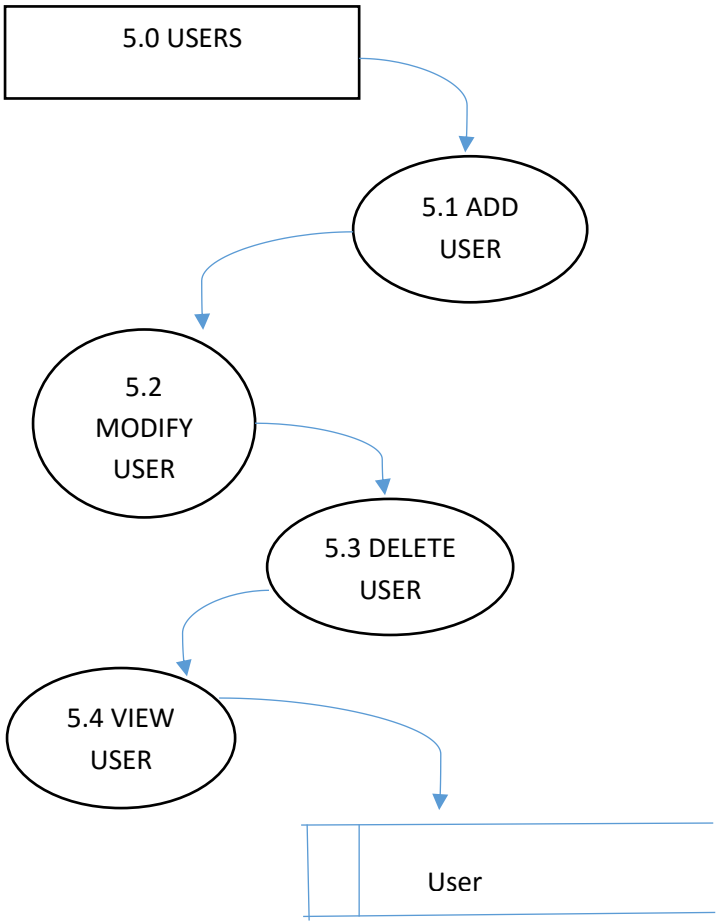
5.3.4 PROCESS DIAGRAM FOR GPS LOCATION MODULE

Fig 5.10 Process diagram of the GPS location module



5.3.5 PROCESS DIAGRAM FOR USER MODULE

Fig 5.11 Process diagram for user module



5.4. DATA DICTIONARY

Table: User

Field	Type	Null	Default	Comments
UserId	int(15)	No		Primary key
Username	varchar(50)	Yes	NULL	
Password	varchar(50)	No		
E-mail		no		

Table: Heart_rate_monitor

Field	Type	Null	Default	Comments
Id	int(11)	No		Primary key
Heart_rate	varchar(50)	No		
Date	varchar(50)	Yes	NULL	

Table: Phrase_listener

Field	Type	Null	Default	Comments
Id	int(11)	No		Primary key
Negative_phrase	varchar(50)	No		
Positive_phrase	varchar(50)	No		

Table: GPS_location_history

Field	Type	Null	Default	Comments
Id	int(11)	No		Primary key
Locations	varchar(50)	No		

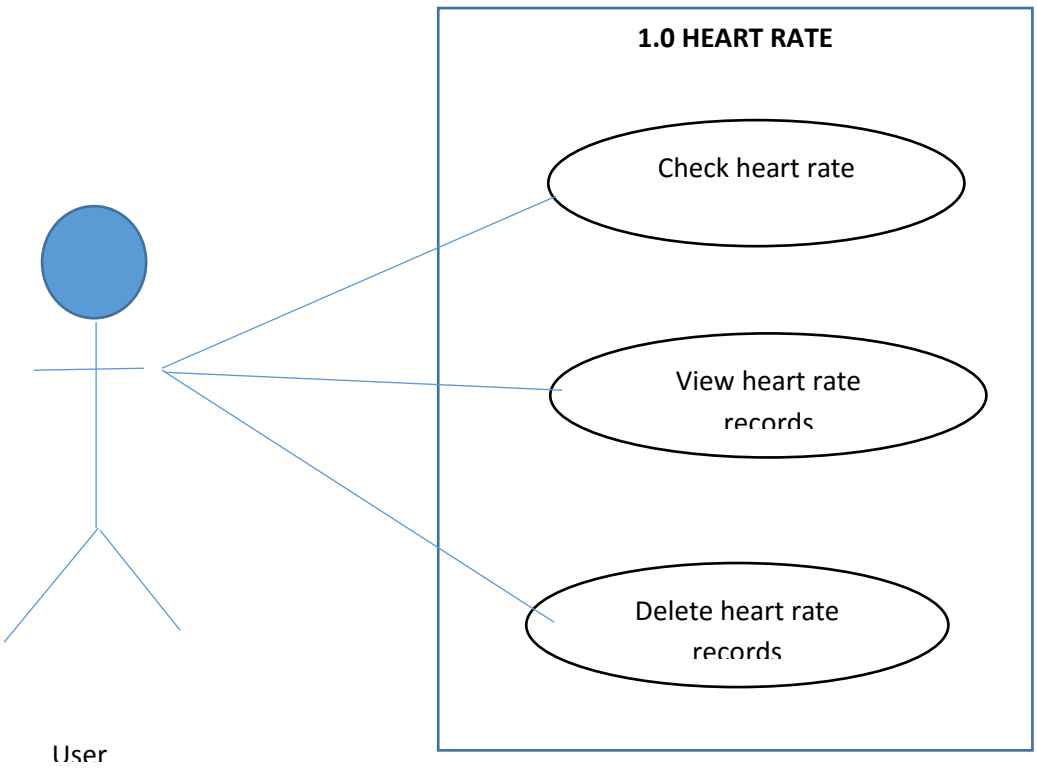
Table: Depression_Anxiety_Solution

Field	Type	Null	Default	Comments
Id	int(11)	No		Primary key
Quotes	Varchar(1000)	No		
Songs	BLOB	No		
Funny_clips	BLOB	No		
Breathing_techniques	BLOB	No		

5.5 MODELLING THE PROPOSED SYSTEM WITH USE CASES

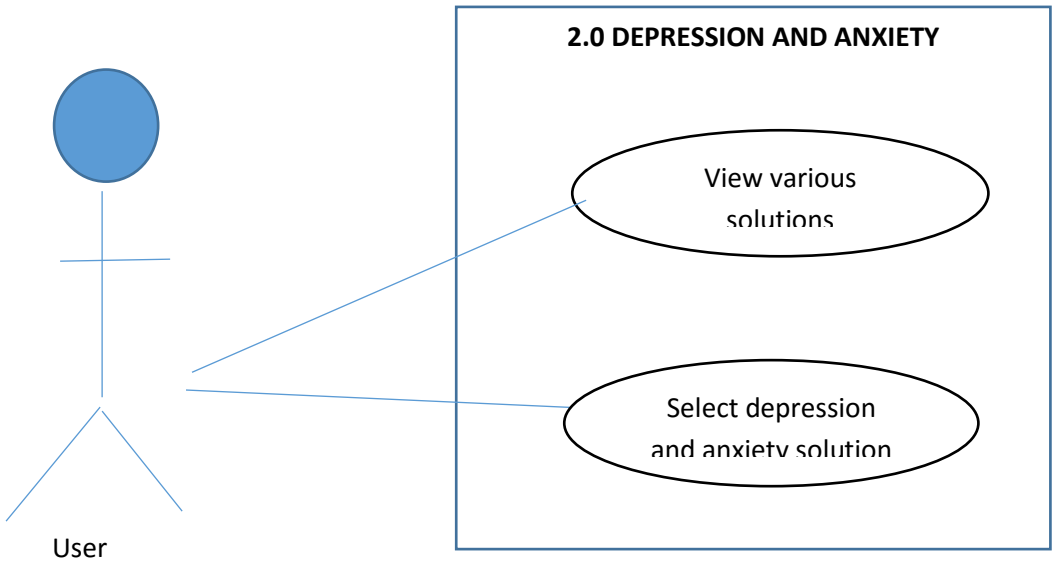
5.5.1 USE CASE DIAGRAM FOR HEART RATE MODULE

Fig 5.12 Showing Use Case diagram for heart rate module



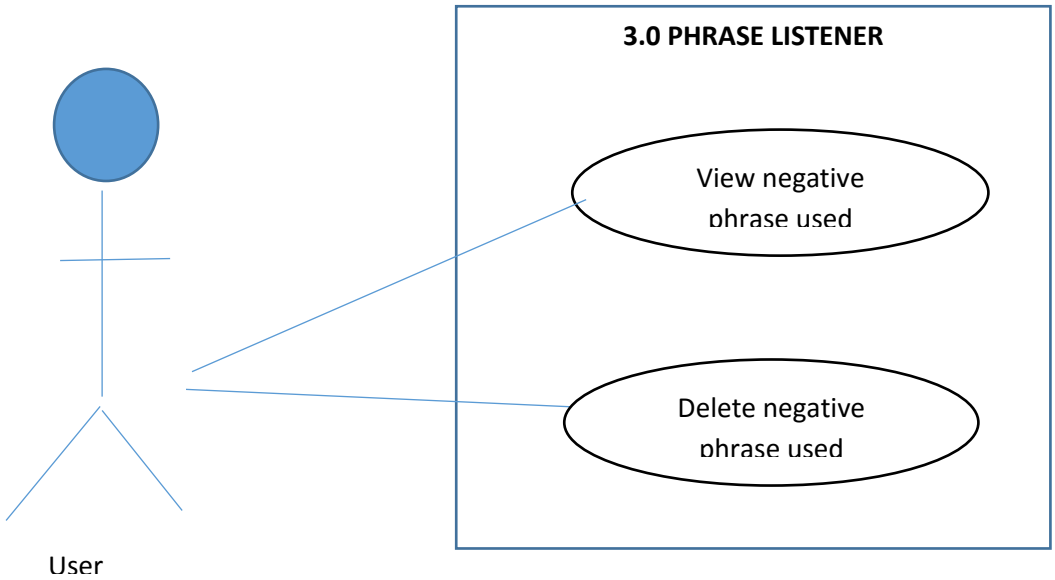
5.5.2 USE CASE DIAGRAM FOR DEPRESSION AND ANXIETY MODULE

Fig 5.13 Showing Use Case diagram for depression and anxiety module



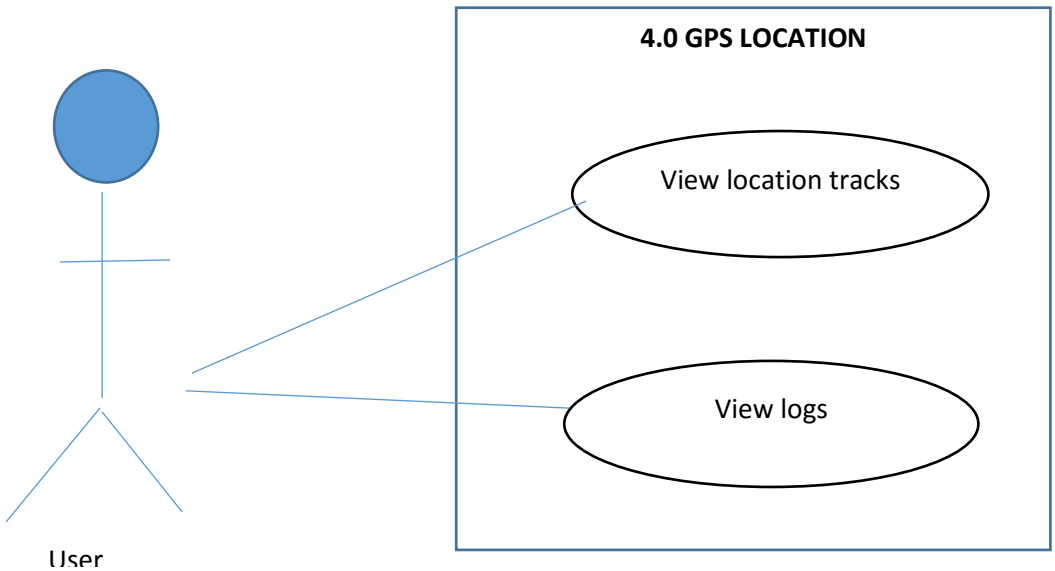
5.5.3 USE CASE DIAGRAM FOR PHRASE LISTENER MODULE

Fig 5.14 Showing Use Case diagram for emotion detector module



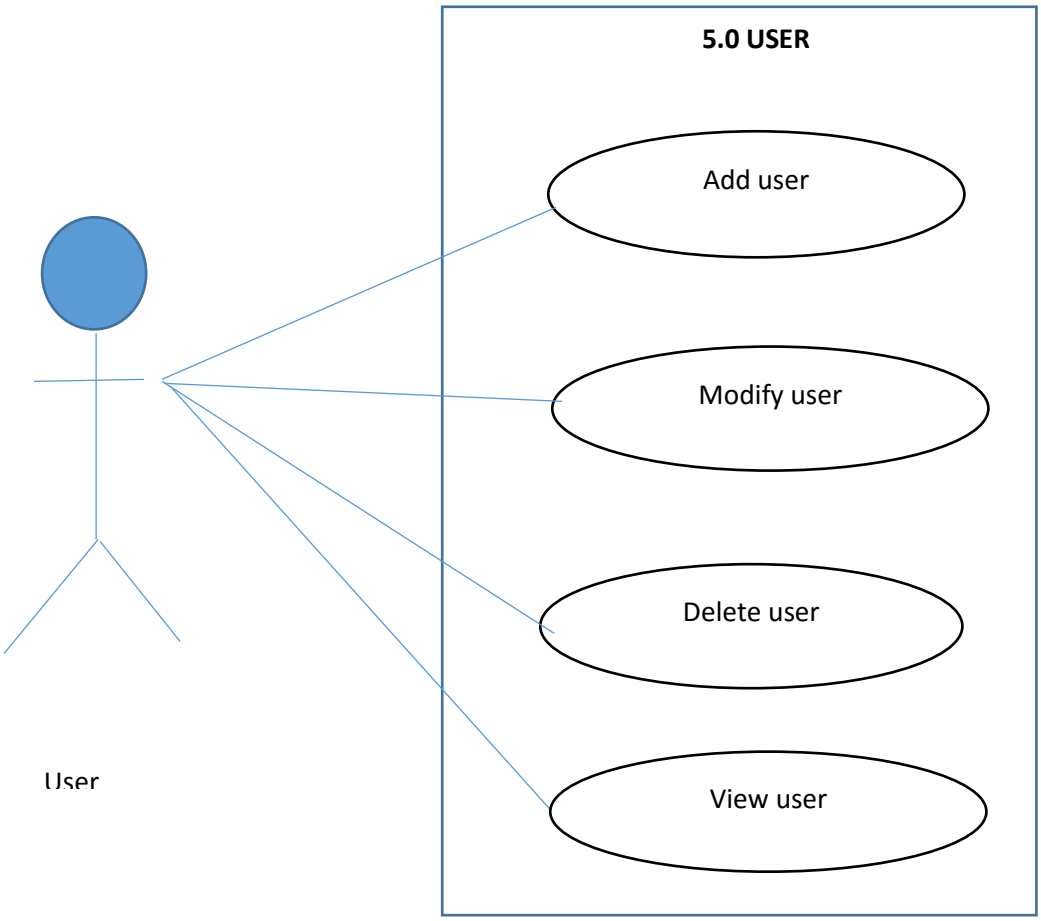
5.5.4 USE CASE DIAGRAM FOR GPS LOCATION MODULE

Fig 5.15 Showing Use Case diagram for GPS location module



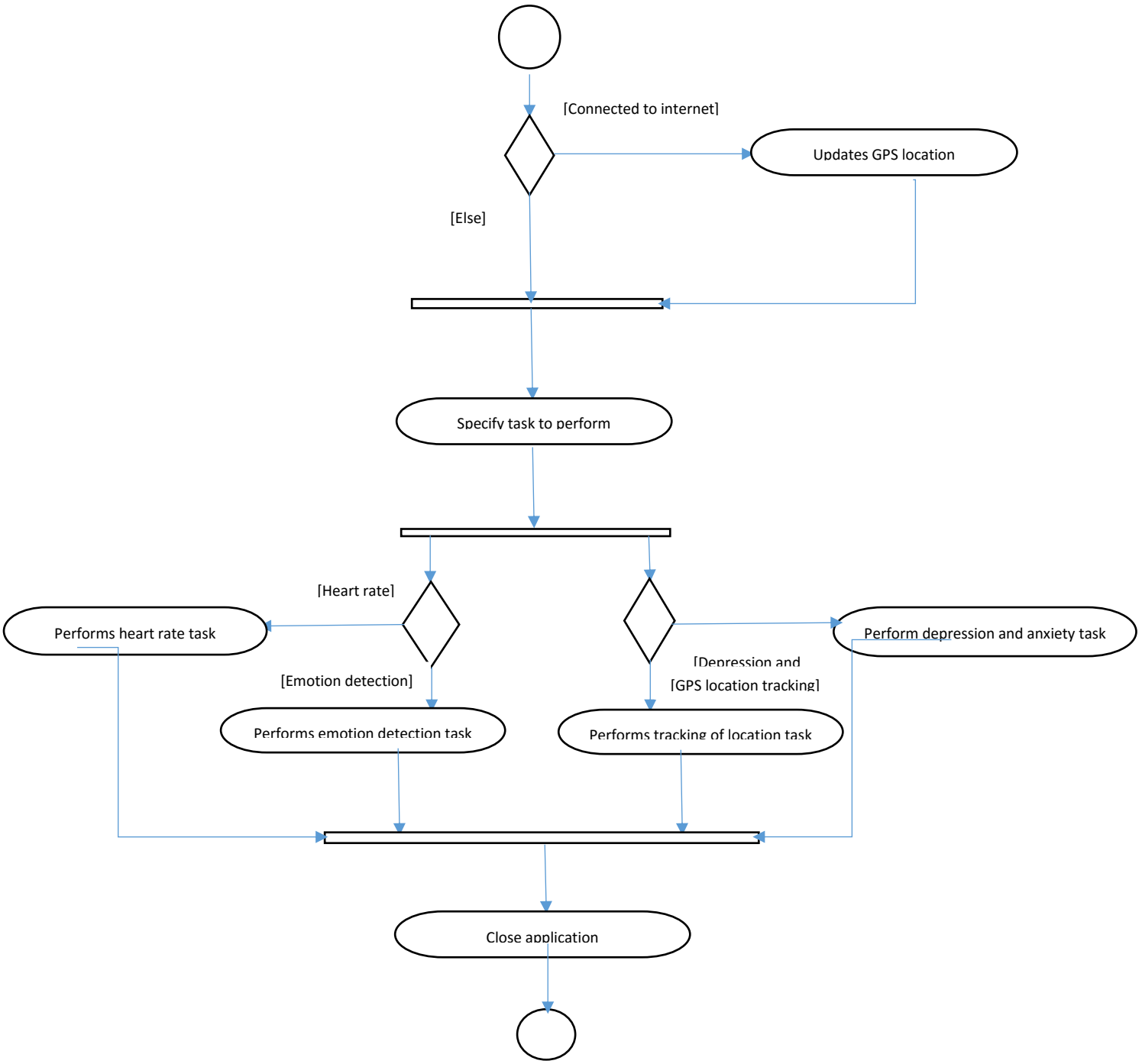
5.5.5 USE CASE DIAGRAM FOR USER MODULE

Fig 5.16 Showing Use Case diagram for user module



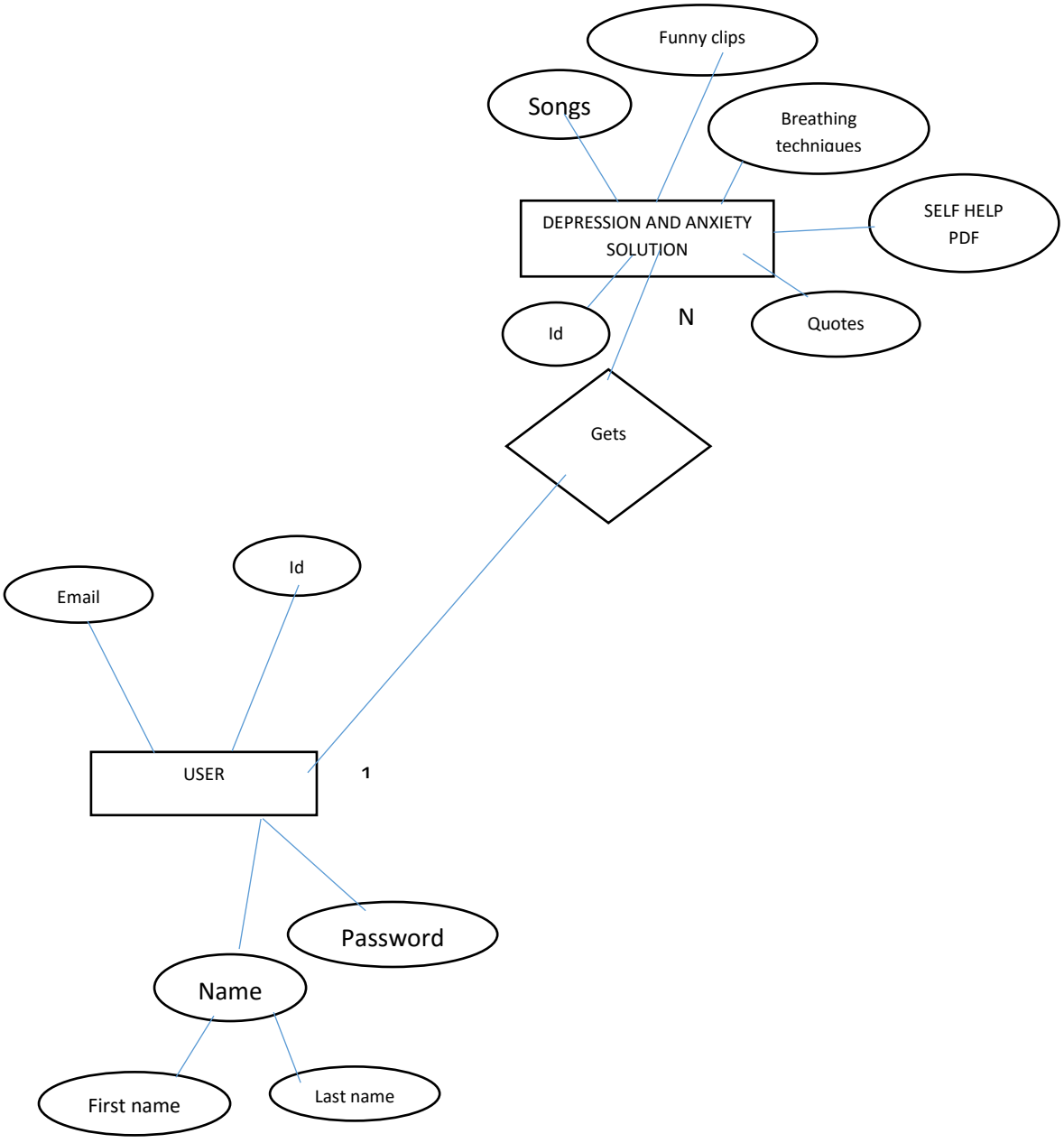
5.6 ACTIVITY DIAGRAM OF THE PROPOSED SYSTEM

Fig 5.17 Showing Activity diagram for the proposed system



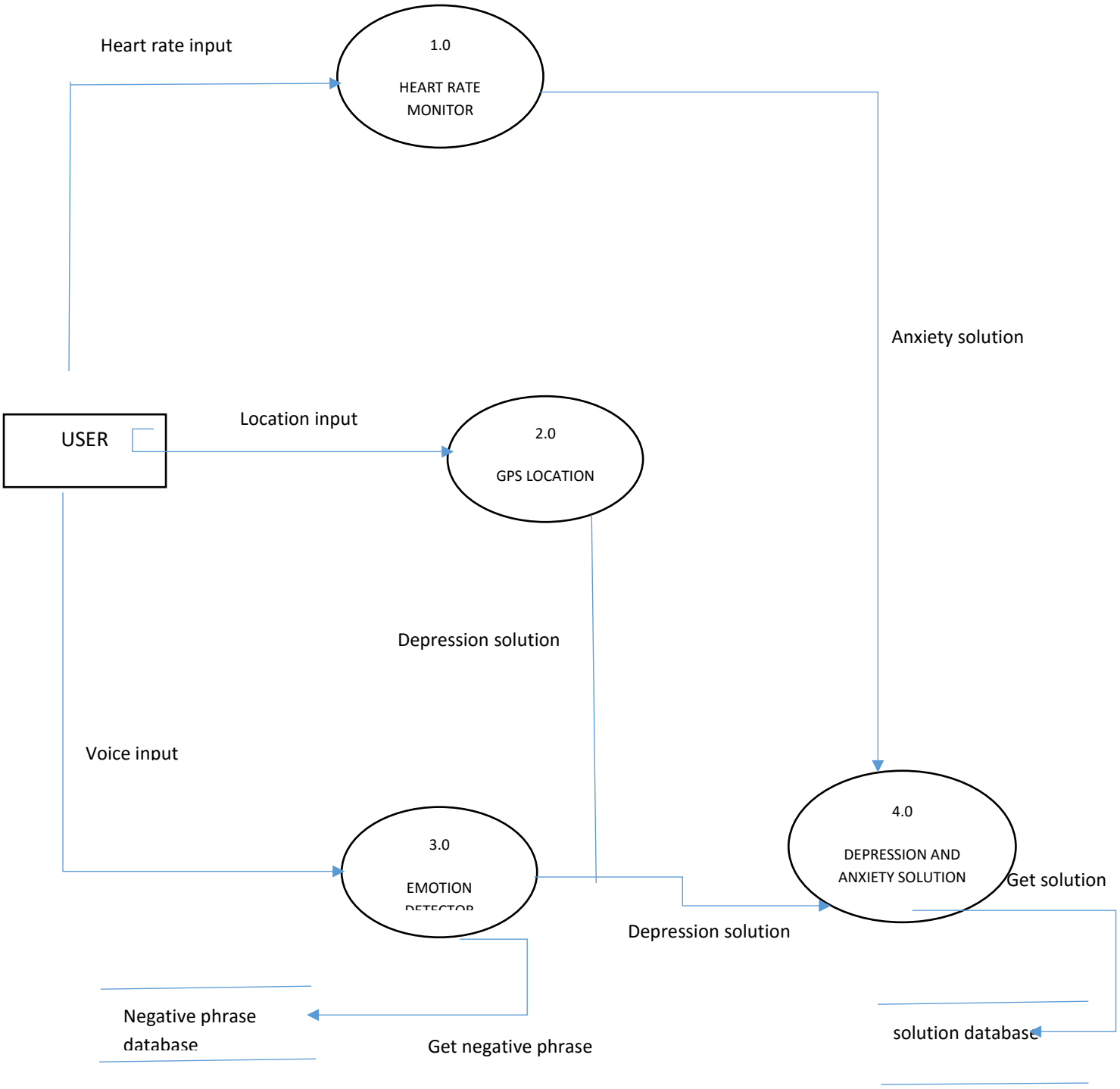
5.7 ENTITY RELATIONSHIP DIAGRAM

Fig 5.18 Showing ER diagram for the proposed system



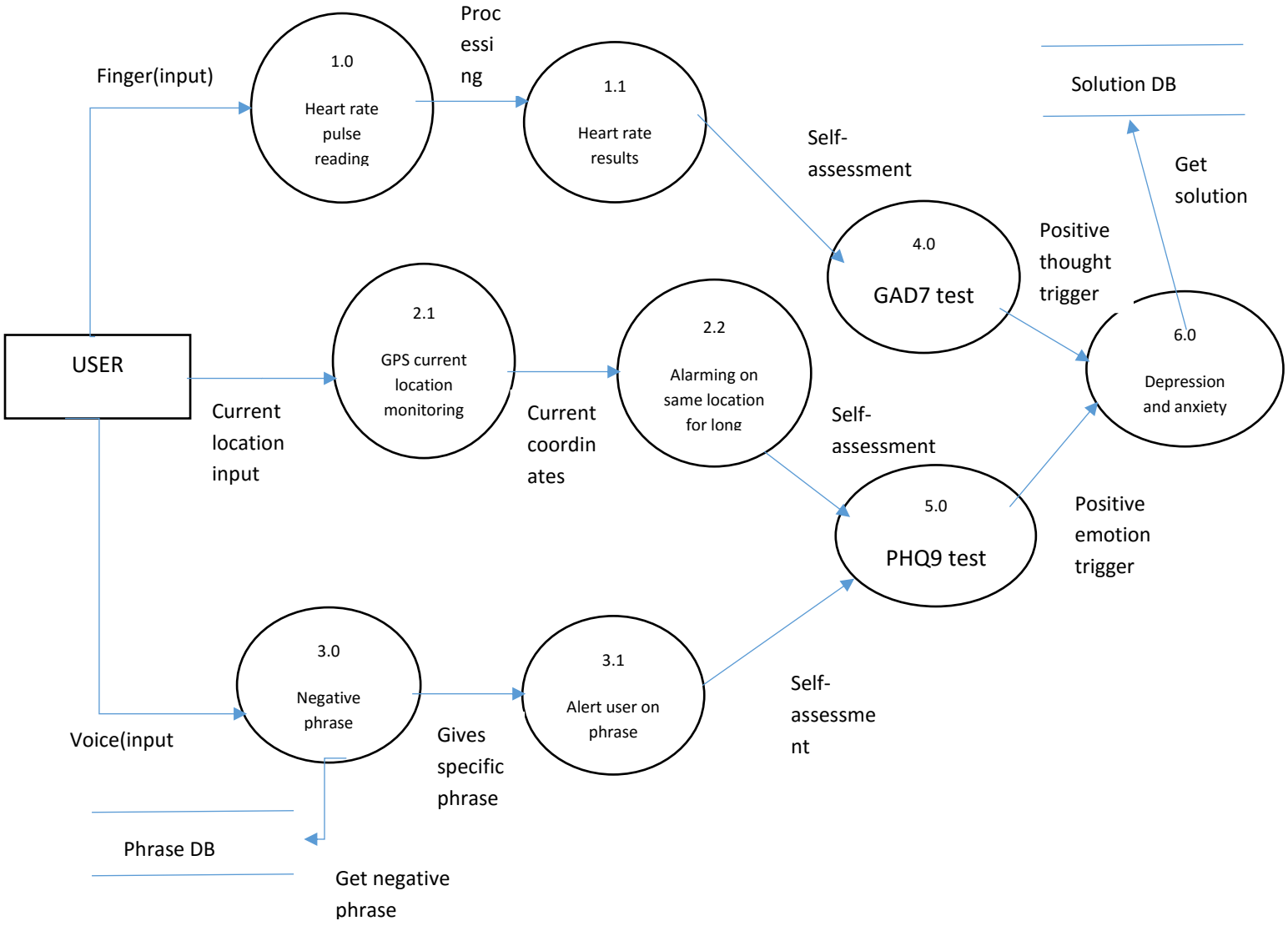
5.8 DFD LEVEL 1 DIAGRAM

Fig 5.19 Dfd level 1 diagram of the proposed system



5.9 DFD LEVEL 2 DIAGRAM

Fig 5.20 Dfd level 2 diagram of the proposed system



5.10 CASE TOOLS

Computer-Aided Software Engineering (CASE) is a technology that provides automated assistance for software development. The CASE tools used for the development of the proposed system are:

Microsoft Visio

This case tool was used for drawing all the diagrams used for the system development

Android studio

This case tool was used to develop the entire modules of the system

5.11 CONCLUSION

This chapter focused on the detailed design of the proposed system.

CHAPTER SIX

SYSTEM IMPLEMENTATION AND TESTING

This chapter describes the system itself in general and the end-user of the system. It also describes the installation process, software and the hardware requirements of the software.

6.0. SYSTEM IMPLEMENTATION

Smile was designed using Android studio, Php, MySQL, Bootstrap.

6.0.1. HARDWARE AND SOFTWARE SPECIFICATIONS

The Minimum Requirements for this System to run smoothly are as follows:

Mobile Version

OPERATING SYSTEM: Android (version 4.4.2 or higher)

RAM: 1024 MB RAM

CPU Android: Processor - Dual core, 1200 MHz

INTERNAL STORAGE: 200MB

Device: Smart Phone

SUPPORT INTERNET: Yes

6.1 TESTING

The system was tested using an "experiment-and-report" approach. Individuals were allowed to use the application and then report their experience.

The following Test Cases were considered:

- CASE 1 - To capture heart rate of users using phone's camera flash for signs of anxiety.
- CASE 2 - To track user's mobility for signs of depression.
- CASE 3 - To collect voice data from calls through voice recognition for verbal communication of emotions.
- CASE 4 - To use PHQ-9 (Patient Health Questionnaire) and GAD 7 (General Anxiety Disorder) to determine severity.
- CASE 5 - To take the depression away by using motivational quotes to boost confidence and humor such as funny clips.
- CASE 6 - To use of pictures or photos, and music that triggers positive feelings to improve mood.

Smile heart rate monitor and a blood pressure monitor (OMRON) results was compared using the same user. The results were accurate .The user recorded 73 bpm using smile app and also 73 bpm for the blood pressure cuff which was exact. Results can also vary depending on how the hand is placed on the camera's lens (if not done properly).

2 persons were used for the experiment. All were allowed to use the application and later interviewed to know their experience with application. They all had their heart rate captured using phone’s camera flash, recording 100% success for CASE 1, they had to also place their hands on the camera over and over again to determine the average for accuracy.

For the rest of the cases all the participants had confirmed that their mood will improve after reading motivational quotes, watching funny clips and pictures, breathing techniques,.

CHAPTER SEVEN

SYSTEM DOCUMENTATION

7.1 INSTALLATION AND USER MANUAL

For a user to make use of Smile, he or she will need to have and android smartphone. An internet connection will be needed to run some parts of the application.

To install Smile, users must go to Google Play Store and enter a search – "Smile". There, they can install the application or to install the application, you need to have the Android Application Package File (APK) of the application. Then run the APK to install the application unto the device. Finally tab the app icon to open the application. You will then see this,

Fig 7.1 (This screen display before the system open)

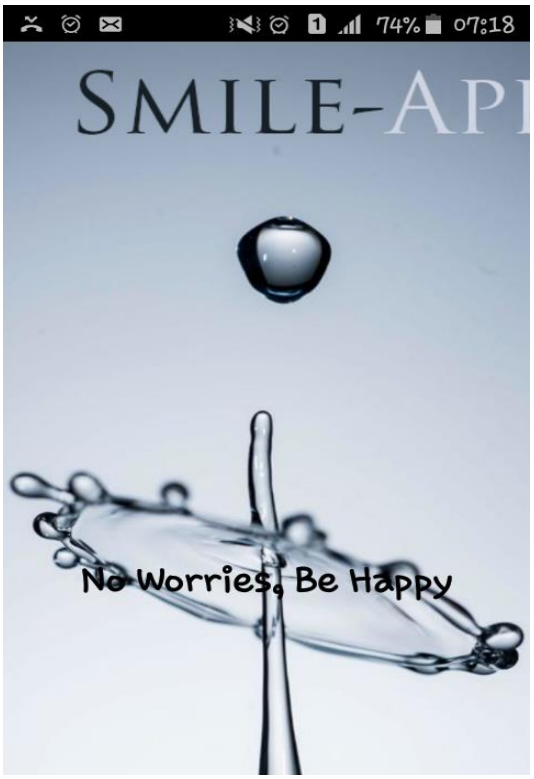


Fig 7.2 (Display of login interface)

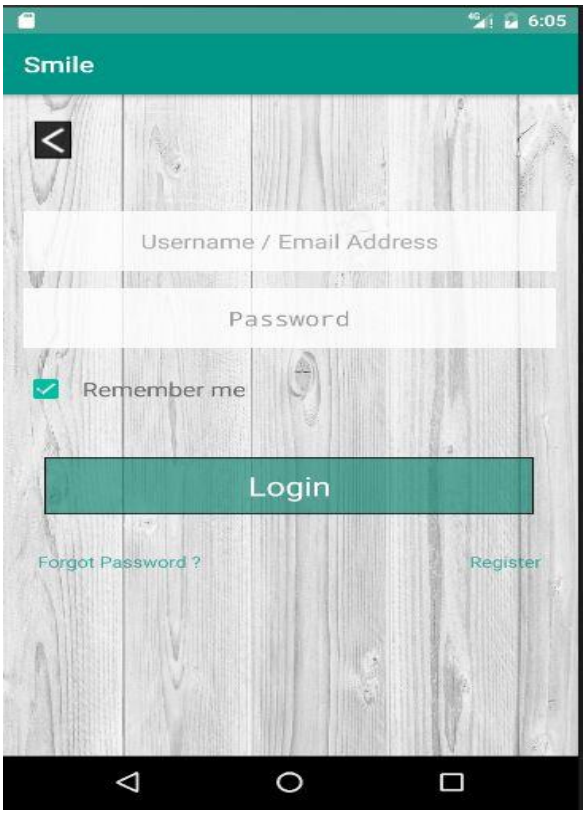


Fig 7.3 (Heart rate monitor interface)

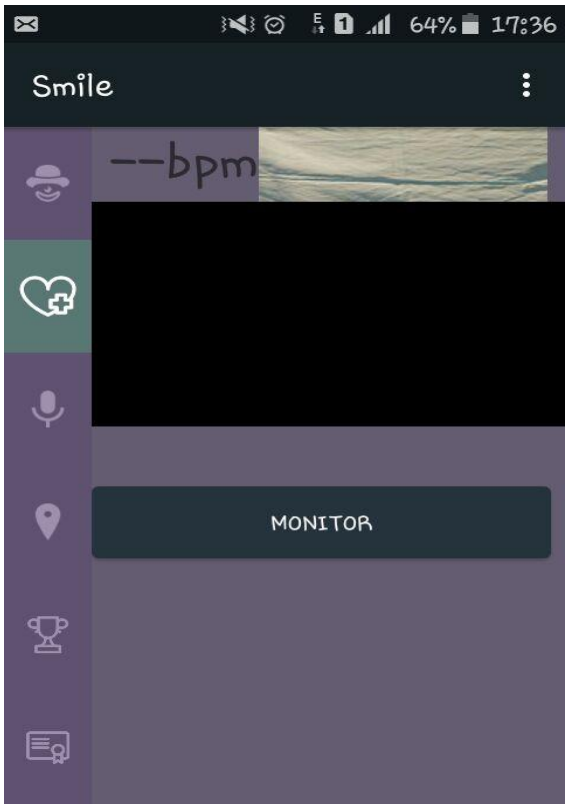


Fig 7.4 (Phrase listener interface)

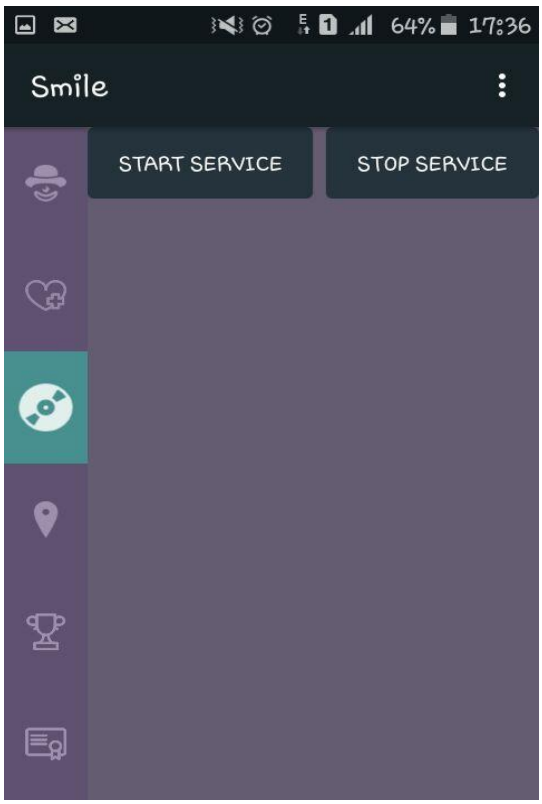


Fig 7.4 (Anxiety questionnaire-GAD7)

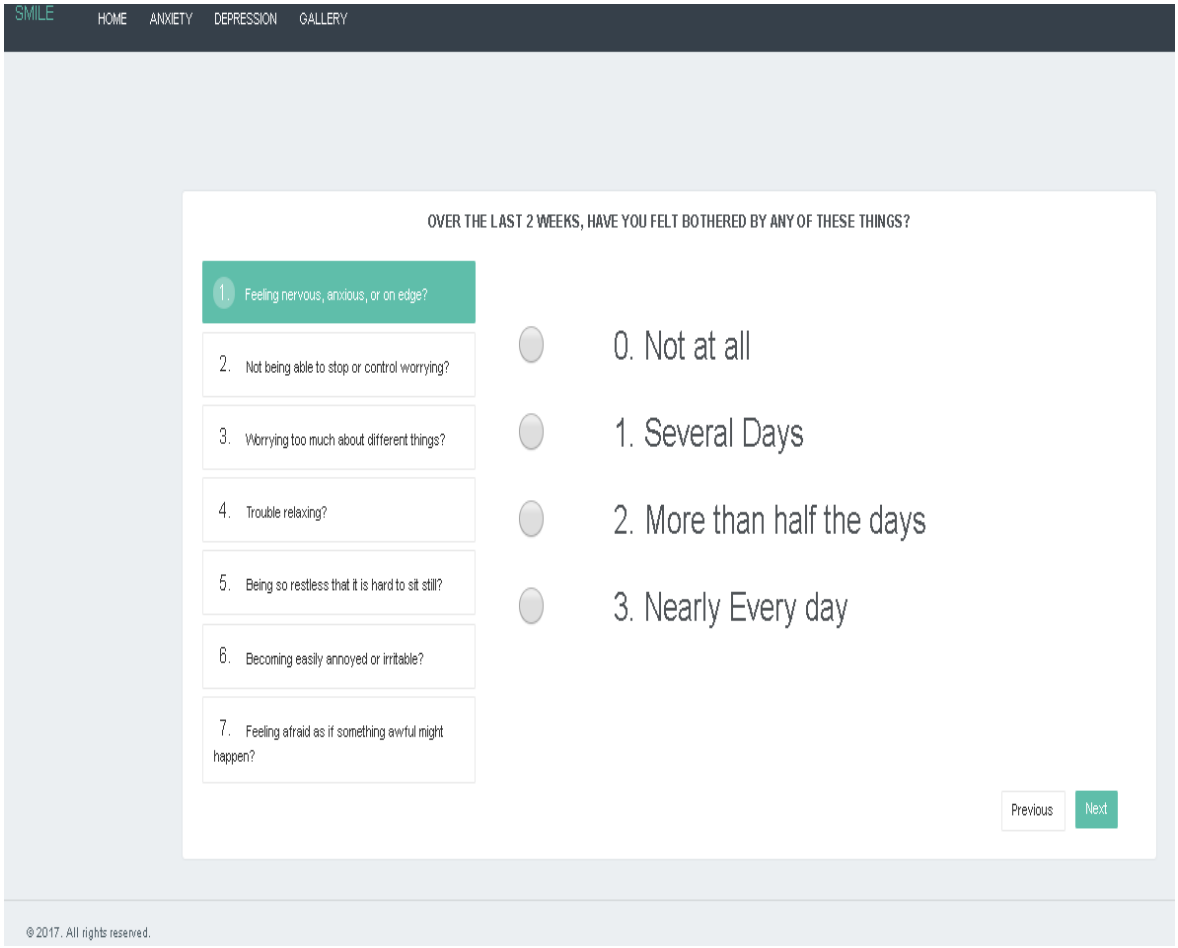


Fig 7.5 (Depression questionnaire-PHQ9)

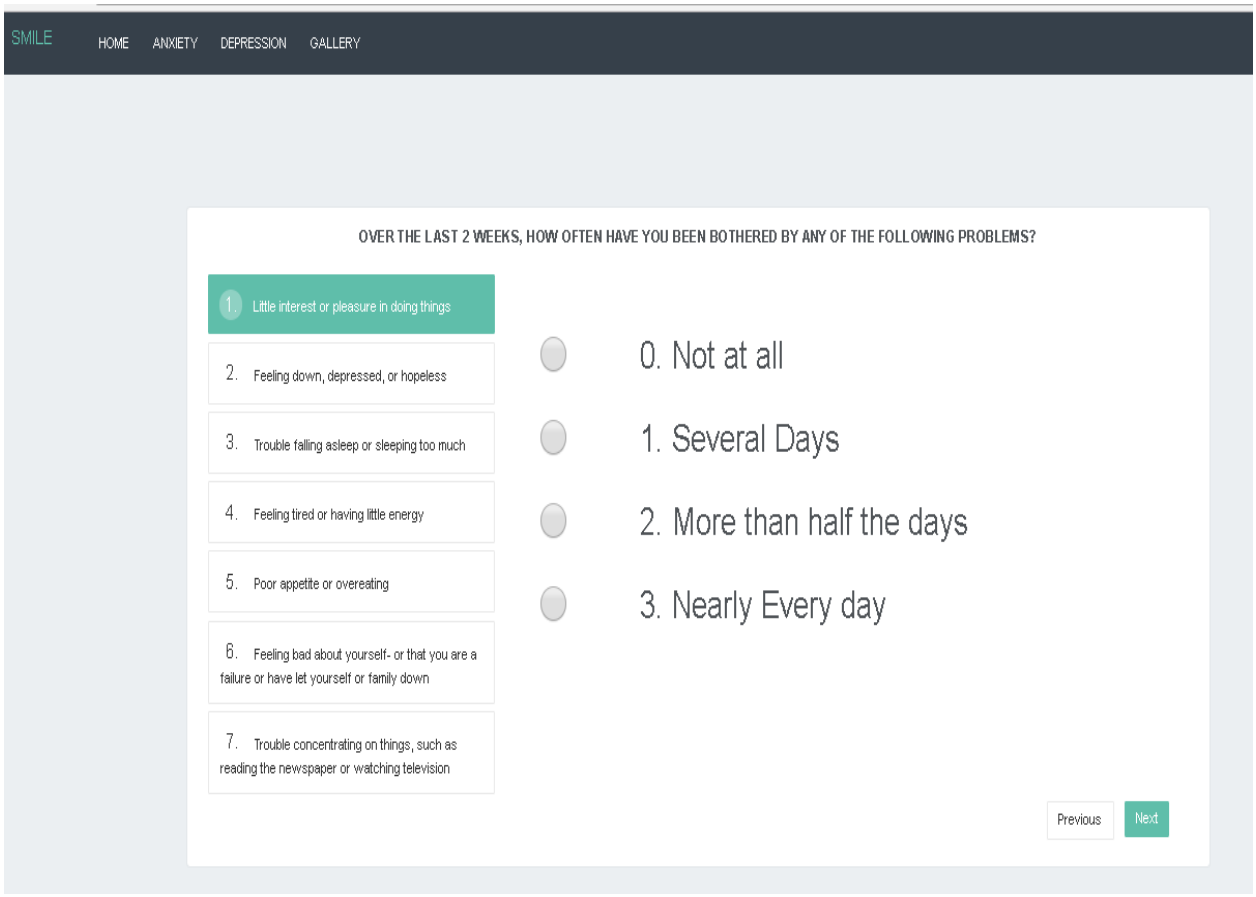
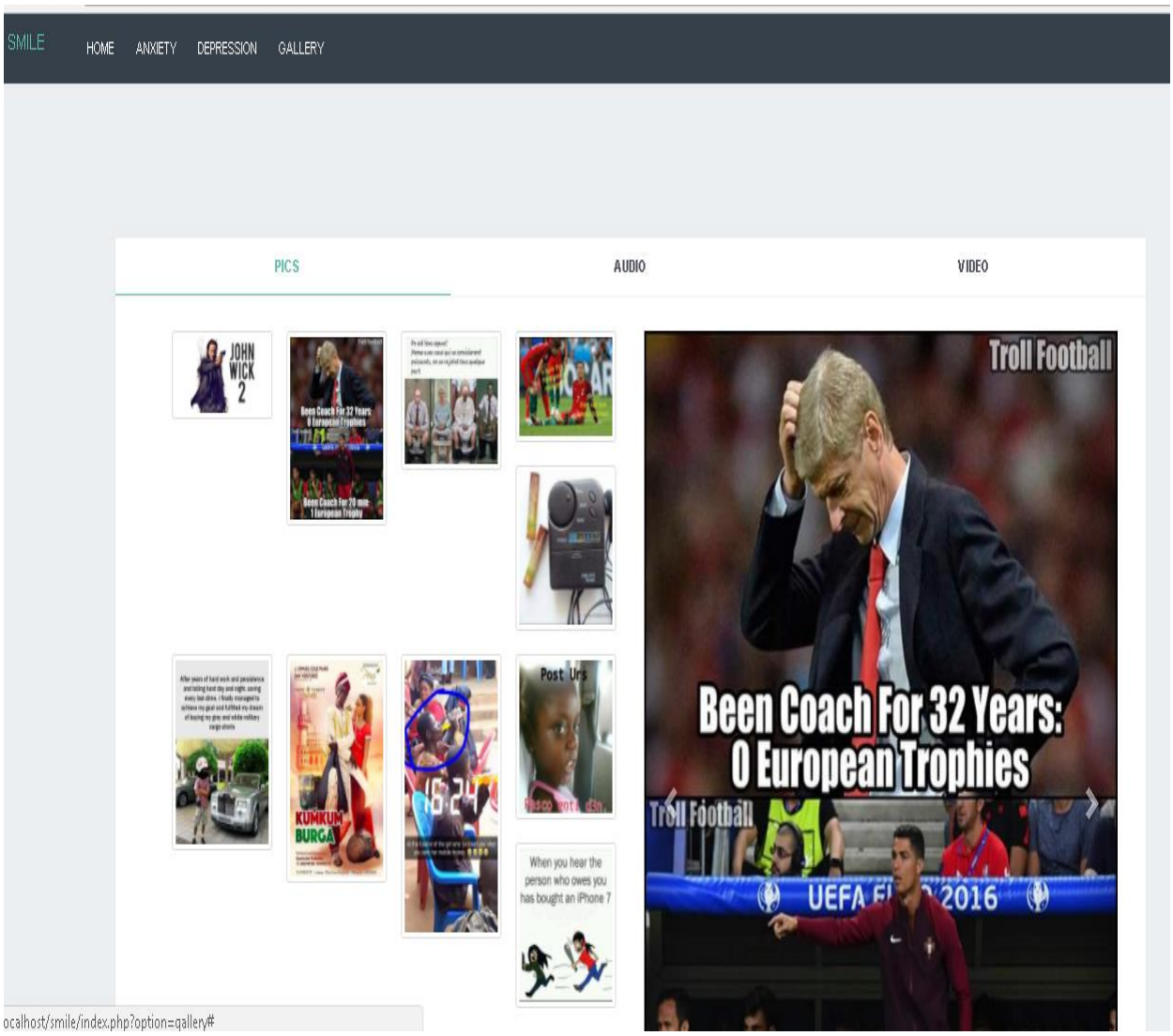


Fig 7.6 (Pictures)



CHAPTER EIGHT

RECOMMENDATIONS AND CONCLUSION

8.1 FUTURE WORK/RECOMMENDATIONS

The researcher recommends that in the future, SMILE will be developed to work on other mobile OS platforms like iOS and Symbian. Smile was able to meet most of the objectives, it has:

- The heart rate monitor that uses the camera's flash for capturing the user's heart rate.
- The phrase listener that works in the background to capture negative phrases.
- The PHQ9 and GAD7 questionnaire to measure severity of user's depression and anxiety.
- An interface of motivational quotes, funny pictures, music, funny clips, breathing techniques to improve mood of the user.
- A GPS location and a timer but not properly linked to alert user for being in one location for too long (at least 3 hours).

The heart rate monitor using the phones camera's flash was achieved using light intensities the LED light emitted from the camera. The brightness and darkness of these light or colour determines a beat. For this project red was used meaning dark red and light red was used to determine when a beat occurred and after 10 seconds the average beat was derived.

The phrase listener was achieved using CMU sphinx a speech recognition engine that works in the background and listen for some key negative words or phrases a depressed or anxious person will say.

The PHQ9 and GAD7 questionnaire psychologists' use for diagnosing depression and anxiety was programmed as web application using bootstrap where the user could select the option provided for severity of their depression or anxiety to be measured.

Funny pictures, videos with contents of proper breathing techniques was used to improve the mood which was effective. Motivational quotes for depression and anxiety was added to the web part of the smile application.

GPS services was obtained by subscribing to google for a token key which allowed for the services to be used so that users see marks of places they have been.

Other recommendations for this project is to add more functionalities like collecting information passively from texting (SMS, WhatsApp), facial expression for more accuracy in the prediction of negative emotions, creating a platform for

psychologists to interact with the user of Smile and also user to user interaction.

8.2 CONCLUSION

Developing this project has been very interesting but challenging. The researcher has enjoyed every bit of developing the mental health application.

It is the researcher's wish that more mental health related problems will be solved using the mobile technology because of the growing demand for mobile devices.

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