Elderly Patient Monitoring System

Project ID: 17-105

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ELDERLY PATIENT MONITORING SYSTEM

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Software Requirement Specification

(Software Requirement Specification Documentation submitted in partial fulfilment of the requirement for the Degree of Science Special (honors) In Information Technology)

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Declaration

I declare that this is my own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date:

……. 02/05/2017

Mr. Yashas Mallawarachchi

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1 Introduction

1.1 Purpose

This document intended to illustrate the requirements of the Project ‘Elderly Patient Monitoring System’. The document gives the detailed description of the both functional and non-functional requirements proposed for the system. This explains the high-level architecture of the system, purpose and features of the system, the interfaces of the system, user requirements, what the system will do, the constraints under which it must operate in order to obtain optimal results and how the system will react to external factors.

This document is developed after a background study conducted by the project group regarding the requirements of the specified project. The final product of this system will meet requirements specified in this document. This document is intended for software engineers, quality assurance engineers for building and maintaining the system and for the end users of this system.

1.2 Scope

This document covers the requirements for developing a system that is able to help elderly patients who are having respiratory problems. This describes the functionalities, software requirements, hardware requirements, related research findings and the technological challenges that the system must overcome. And also the overview of the project, along with its goals, tasks, users and research areas. It provides the clear overall design of the system which will provide the basis for developing the final product.

Functional requirements will convey specific functionalities, tasks or behaviors of the system and non-functional requirements will be the constraints, performance factors, etc.

The requirements mentioned in this document may change as the project team go through the development process.

Patient Monitoring System consists of four major components such as Respiratory Sound Analysis

And drug reminder, sensor configuration and anomaly detection via sensor inputs, abnormality detection of behaviors and abnormality detection in emotions. System will be having a mobile application for the drug reminder component and to inform the caregiver regarding abnormalities of the patient.

This proposed system can be effectively used to monitor multiple necessary facts about the patient's health. There are several computerized monitoring systems available to date, but which are lack of many mandatory features worth to their extreme cost. Therefore proposed system will be ideal solution to monitor the elderly patient who are suffering from respiratory issues. Heart rate or the pulse is a parameter to check the health of a person regardless of age or gender. Monitoring such thing in patients who are having respiratory issues is as much as important due to frequent changes in heart rate. Very low heart rates, frequent fast heart rates or irregularity in heart rate are mostly due to abnormality of the patient's body and caregiver should inform the doctor in case of such incident. Blood oxygen saturation level (Sp02) or the percentage of the oxygen amount in the blood is another health parameter which can be advantageous in monitoring the patients with respiratory issues. It is a must to identify the normal SpO2 level of such patient with the help of a doctor and keep monitoring it to avoid adverse events. Patients with respiratory problems are lacking the ability to take oxygen in to their bodies easily and they are putting extra effort in breathing to gain more oxygen. Therefore component of sensor configuration and anomaly detection via sensor inputs can be used to identify abnormalities in heart rate and the SpO2 level of the patient. Patients with respiratory issues are having restlessness in case of a situation where they need more oxygen. Restless patients tent to change their position in the bed to gain more oxygen in to the body. Even

the pose can be changed with amount of the oxygen that the patient require at the given time. Component abnormality detection of behaviors and abnormality can be used to clarify the normal behaviors and the abnormal behaviors of the patient respective to the time. Unknown observations should be identified as an abnormal behavior. Emotions can state the stress level, anger, sadness and many other feelings which should be classified as normal and abnormal. Therefore caregiver should have the responsibility of focusing on the emotions of the patients in every possible second. With the help of component abnormality detection in emotions, it will be easier to identify any anomalies in the emotions of the patients. Auscultation or the listening to the internal sounds using a stethoscope is an effective way of diagnosing the respiratory sounds and identify related diseases in the respiratory system. But identification of respiratory sounds and separate them as normal and abnormal is not an easy task to perform and it requires a skill level of a well-trained physician. Respiratory Sound Analysis component will be implemented to listen and understand the nature of the respiratory sounds with relevant classification mechanisms. Elderly patients should not be treated with the wrong drugs irrespective of any disease. It will affects the health level of the elderly patient immensely. Therefore drug reminder component will notify the caregiver in order to give the right dose of right drug at the right time.

1.3 Definitions, Acronyms, and Abbreviations

Table 1.1 List of Abbreviations

ELPS	Elderly Patient Monitoring System
SRS	Software Requirement Specification
OS	Operating System

PC	Personal Computer
FFT	Fast Fourier Transformation
RAM	Random Access Memory
SVM	Server Vector Machines
IT	Information Technology
QA	Quality Assurance
SpO2	Percentage of oxygenate hemoglobin

1.4 Overview

This document is designed to characterize about the development of the Elderly Patient Monitoring System who are having troubles in respiration.

Main Objectives of the proposed system are given below.

- To implement an inexpensive, efficient and a reliable system which can effectively monitor elderly patients who are having respiratory problems and detect anomalies in order to minimize adverse events.

- To eases up the duties of the family caregiver where he/she can manage the day to day work while taking care of the patient and can save the amount of cost which is needed for a separate caregiver or a nurse.

1.4.1 Product overview

One of a main component of this proposed Elderly Patient Monitoring System is the Abnormality detection in Emotions. A data set with facial emotions will be used for this purpose. Analyzing of facial emotion is done by several steps. Facial emotions will be captured by a high resolution video camera. Should detect the face of the patient correctly while capturing the video, and send it to a personal computer. If noises have in the capturing video clips, it should be filtered. An average filtration method will be used for this purpose. If the facial expressions cannot be detect due to not correctly focusing face to the camera, it should be re-oriented. Here, first have to detect the land marks of the face. Then if there is an orientation deviation, detect the locations of the land marks, re-calculate and should make the correct orientation for the emotion detection. Then extract the features of the video to be given as input to the data model. Non- linear classification method like artificial neural network method will be used for the classification purposes. If any abnormality is detected in the patient's face, it will be informed the caregiver by generating a status message.

1.4.2 Document overview

This document consists with 4 different sections.

Section 01:

This section describes the purpose of the preparation of the document. In this section it was mentioned that the scope of the project while stating what the researchers

what will do and what will not do. This also illustrates the benefits of the proposed system, main goals and also the product overview.

Section 02:

This section will discuss the overall description about the proposed project in non-technical form which will understandable by the end users. Product perspective will describe how the proposed system will compared with the systems which are already in the market. This will shows why the product is needed for the market compared to the existing products. Product functions; which will give a summary of all for functions of the proposed system, User characteristics; which describes targeted end users, Constraints; describing all conditions that may limit developers' options, Apportioning of requirements and finally the assumptions and dependencies; describing the assumptions that has been made while designing and implementing the proposed system, also will be a discussed under this section.

Section 03:

This section uses the technical words or phrases that can be clearly understood by the software engineers, quality engineers, developers and maintainers about the specific requirements. External interfaces, classes/objects, performance requirements, design constrains, software system attributes and other requirements were explained in detail within this section.

Section 04:

This section provides the information such as appendices and references which will be useful for readers.

2 Overall Descriptions

Considering the outcome of the literature survey, it is possible to decide the most suitable for the implementation phase. In some cases of design decisions, consider more than one possible technology and take performance and dependencies into consideration. The proposed solution can be divided in to following major parts.

1. Respiratory Sound Analysis and Drug Reminder
2. Sensor configuration and anomaly detection via sensor inputs
3. Abnormality detection of behaviors
4. Abnormality detection in emotions

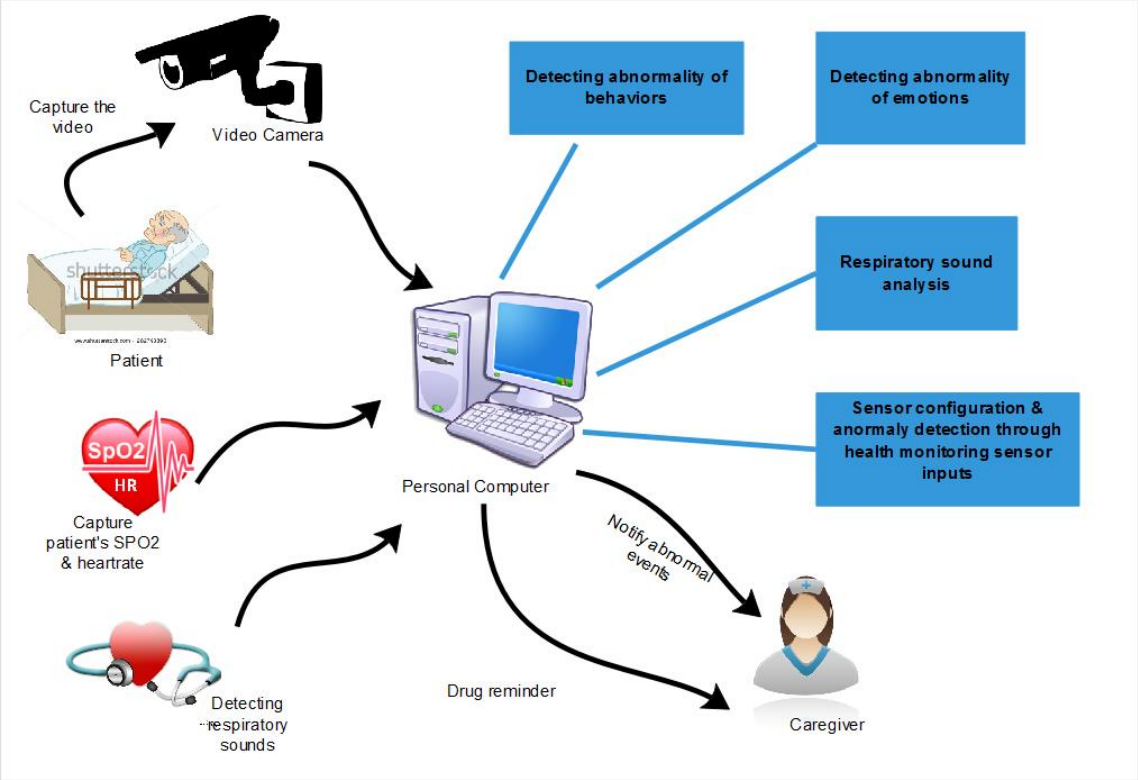

Figure 2.1 High level Architecture of the system

Respiratory Sound Analysis and Drug Reminder

Machine Learning allows computers to learn in order to achieve specific tasks without being programmed and it is evolving day by day. More information is fed in to existing algorithms to gain more accurate and the maximum outputs. There are so many applications of the Machine leaning techniques in various kinds of fields and the results are proven to be good. Many researches have been successfully implemented using machine learning in past few years and more researches are currently happening over the world. The development of computerized respiratory sound analysis has attracted many researchers in past years which has led to implementation of machine learning algorithms. Therefore respiratory sound analysis component of the proposed system will be implemented using machine learning.

Data set of patients who are having respiratory problems are required to have prior to analysis. Analysis of the respiratory sounds will be achieved step by step with different processes. After the capturing of the respiratory sound, normalization process should be performed in order to remove differences among signals acquired from different subjects at different time points from the same location. Filtration is necessary to cut-off unwanted frequencies such as frequencies coming from heart sounds which are not required. Feature extraction is there to perform the task of converting the signal waveform to reduced number of parameters for further analysis and processing. Correlation will be used to identify how similar two signals are for how long they remain similar when one is shifted with respect to the other. The performance of the respiratory sound analysis is mainly based on the classification method and finding out the best method is very advantageous for better accuracy rate. Artificial Neural Networks (ANN), SVM classifier and K-NN (nearest neighbor) can be used to classify the extracted features.

Sensor configuration and anomaly detection via sensor inputs

Therefore proposed system will be ideal solution to monitor the elderly patient who are suffering from respiratory issues. Heart rate or the pulse is a parameter to check the health of a person regardless of age or gender. Monitoring such thing in patients who are having respiratory issues is as much as important due to frequent changes in heart rate. Very low heart rates, frequent fast heart rates or irregularity in heart rate are mostly due to abnormality of the patient's body and caregiver should inform the doctor in case of such incident. Blood oxygen saturation level (Sp02) or the percentage of the oxygen amount in the blood is another health parameter which can be advantageous in monitoring the patients with respiratory issues and those parameters will be captured using pulse rate and SpO2 sensors. It is a must to identify the normal SpO2 level of such patient with the help of a doctor and keep monitoring it to avoid adverse events.

Abnormality detection of behaviors

A behavioral disorder should be included in the differential diagnosis of any patient who presents with repeated complaints, especially fatigue, insomnia, pain or just feeling overwhelmed. For a variety of reasons, this demands that the primary care physician or the caregiver maintain a high index of suspicion for behavioral disturbance in their patients. In here mainly focusing on bedridden patients. The bedridden patients are naturally obstinate in behavior and the face may negatively impact to their health condition due to various kind of accidents. Sleeping sessions, sudden wakeups and falling down will get in to major consideration. Main task of this function is to identify the abnormality of behaviors of their patient. A High resolution camera will be in use to capture the behaviors of the patient.

Abnormality detection in emotions

It is so much tough to find a disease for which emotions are not playing any significant role in identifying abnormalities of the patient. Emotions have a huge impact on understanding the mental status of the patient in order to give more attention and special care. Emotions can state the stress level, anger, sadness and many other feelings which should be classified as normal and abnormal.

Facial emotions will be captured by a high resolution video camera.

2.1 Product perspective

Conducting a Literature Survey prior to the design phase of the system is essential to identify existing systems and analyze them for further development. Regardless of respiratory patients, majority of the of the solution in this domain are mainly focused on monitoring major health parameters of the patients such as heart rate, respiratory rate, SpO2 etc. Proposed system justifies the importance of monitoring behaviors of the patient, emotions of the patients and the respiratory sounds of the patients. But those requirements have hardly been met by existing systems and even a proper implementation for patients with respiratory issues have not been addressed.

Jawbone is a health and fitness tracker, available to individual consumers, combines a wristband monitor that tracks movement and sleep details with a user-friendly mobile app that enables logging of exercise, food and hydrations.

Alarm.com is another patient monitoring system which can find nowadays. This system is using discreet wireless sensors throughout the client's living area, wellness tracks activity and wellness indicators, giving caregivers real-time insight into each client's current condition as well as potential emergent problems.

Like discussed above there are number of patient monitoring systems. But they all are not satisfying all functions in our proposed system. The below mentioned instances clearly portray the features provided by existing and EPMS.

Table 2.1 EPMS vs Existing Systems

SYSTEM	**RESPIRATORY SOUND ANALYSIS**	**SENSOR CONFIGURATION & ANOMALY DETECTION VIA SENSOR INPUTS**	**ABNORMALITY DETECTION OF BEHAVIOURS**	**ABNORMALITY DETECTION IN EMOTIONS**	**ALERTING CAREGIVER**
PROPOSED SYSTEM	✓	✓	✓	✓	✓
JAWBONE	✗	✗	✓	✗	✗
PREVENTICE SOLUTIONS	✓	✓	✗	✗	✓
GREATCALL	✗	✓	✗	✗	✓
ALARM.COM	✗	✓	✓	✗	✓

There was a research done by Fadzilah Siraj and others from the faculty Information Technology, University of Utara Malaysia to classify emotion using neural network. Nowadays emotion is a major network for the communication between human and

machines. By detecting the emotion of the human machines can make decisions, learning and do various cognitive tasks [1]. In this study they classified six major human emotions using neural network.

Group of researchers Patrick Lucy (Member, IEEE), Jrffrey F.Cohn(Associate member, IEEE) and some other researches described a research about Automatically Detecting Pain in video through facial Action Units. Here they use videos of patients with shoulder injuries. They proposed an Active Appearance Model (AAM) which can automatically detect the patients' pain in a video at a frame-by-frame level based on Action units. In here, they used UNBC-McMaster Shoulder Pain Archive (which contains data on patients moving both their injured and uninjured shoulders) database which can detect the spontaneous emotions with respect to reaction of the patient's pain. By using this system they were able to find whether a patient is currently suffering from a pain or not [2].

A research, "Automated coding software outperforms people in recognizing neutral from neutral faces as neutral from standardized datasets" was done by Peter Lewinski in the Amsterdam School of Communication Research, Department of communication Science, University of Amsterdam, Amsterdam, Netherland. Automated Facial Coding Software (AFC software) is a software which can detect human's neutral faces via a computer. Here he had used two data sets Karolinska Directed Emotional Faces and Warsaw set of emotional express pictures to analyze neutral faces using his AFC software. Following figure shows how the face reader of the AFC is analyzing a neutral face [3].

A group of researches in department of Computer Science And Engineering, Nagoya Institute of Technology, Japan done a research to detect facial emotion by considering partial Occlusion of face using Bayesian Network. In real world it is possible that the face can be partially covered by some ornamentation materials such as caps, scarfs glasses and many more materials. In this type of a situation detecting facial emotions is difficult. Here in this research they proposed an emotion detection system taking into consideration partial occlusion of face using casual relations between facial features. They used Bayesian network to detect emotions without filling in the gaps of occluded features.

Because this Bayesian network classifiers figure out from the dependencies among the target attribute and explanatory variables. The figure following shows how Bayesian network detect human facial features and their descriptions [4].

In the above literature reviews which was under emotion detection, all those researches were under normal patients, but here, the proposed system will manage a special patient profile (bedridden patients). The proposed system will mainly focus on the abnormality detection on bedridden patients having breathing difficulties. It is very important to have a proposed system like this, because if any patient is having any breathing difficulty, it will be shown in his/her facial emotions. Here the changing of those type of emotions will be detected I this proposed system. And if any abnormality is detected it will be informed to the care giver immediately.

2.1.1 System interfaces

In the proposed system there is no requirement for specific system interfaces.

2.1.2 User interfaces

User Registration

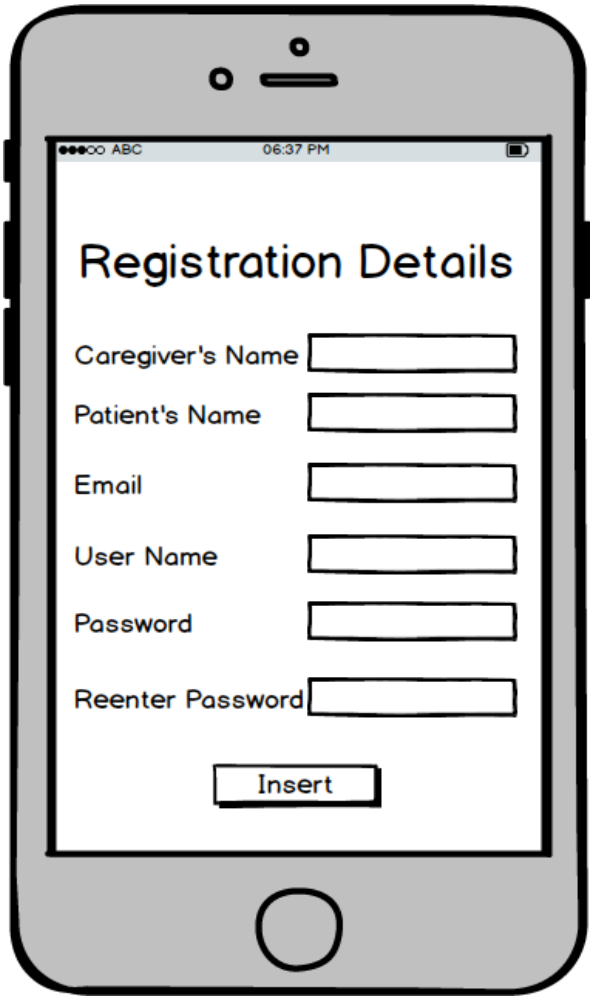

Figure 2.2User Registration Interface

Once the User Clicks on Sign Up button, it will display above interface for registration of the caregiver. User will have to fill all the fields above and click the insert button.

Login

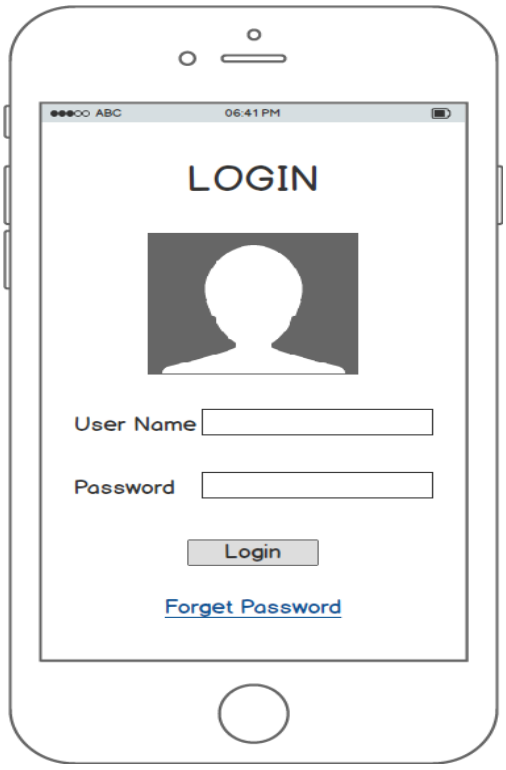

Figure 2.3 User Login Interface

User has to give username and the password in order to log into the system. Validation process will be done once user clicks the Login Button. If the user forget his/her password user can select forget password option appeared on the interface where user can reset the password via an email received.

Main Interface

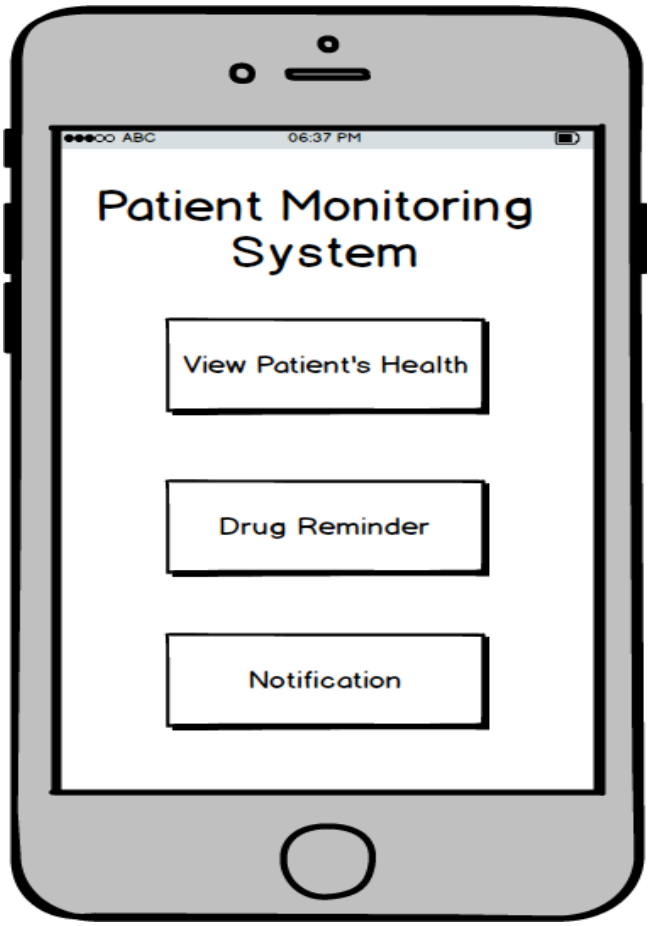

Figure 2.4 Main Interface

When the user login to the system successfully above interface will be appeared. User can select any options according to his need. Then the relevant interface will be displayed according to the selection of the user.

User Interface of adding drug details

Figure 2.5 Add Drug Details Interface

User can add patient's drug details to the system so that user will be notified by the system that particular drug should be given in particular time.

User Interface of Updating Drug Details

Figure 2.6 Update Drug Details Interface

User can change the drug taking details of the patient, if the doctor make any changes to the drugs of the patient.

2.1.3 Hardware interfaces

In the proposed system there is a requirement of product specific hardware along with specific hardware interfaces for the user.

Mobile Phone

Mobile Application will be developed to notify the caregiver regarding the abnormalities of the patient. Therefore it is a major hardware requirement to have a mobile phone with installation of the mobile application related to proposed system.

Figure 2.7 Mobile Phone

Personal Computer / Laptop

All the necessary processing related to proposed system will be done in the personal computer and it is mandatory to have a PC or a Laptop with specified requirements.

2.1.4 Software interfaces

Mobile Application

Mobile Application should be installed on the caregiver's mobile phone in order to get necessary notifications and the alarms related to drug reminder. Mobile is required to fulfill mandatory specifications.

2.1.5 Communication interfaces

GSM - 3G or 4G LTE connection of the mobile phone will be used for data transmission between the mobile app and the web server.

Wi-Fi - If the mobile data is not available, user can connect to an available Wi-Fi router to get the internet connection in order to use the application. And this will also be used for data transmission between the mobile app and the web server. Required Connection bandwidth might differ time to time. Since large data load is travelling through the network, having a high bandwidth internet connection will help a lot for the users to use the application with ease.

2.1.6 Memory constraints

For the mobile application to run a minimum 1024 MB of memory will be required and a 100 MB of secondary memory as well.

All the processing will be done in the PC and it requires minimum of 2GB of RAM and free space of at least 10 GB.

2.1.7 Operations

This section describes what operations should be or can be performed by user in order to use the services of the system.

- Create profile - User should provide related details with unique username and password when registering with the mobile application.
- Log in to profile - User should provide user name and password in order to login to the application.
- View and edit profile - User can view the profile and update necessary information.
- Add drug details – User should add drug taking details of the patients.
- Upload images of the drugs - User should upload valid images of the drugs to the system in order to maximize the identification purpose of the relevant drug.

System Administrator is capable of following operations.

- Login - Admin can provide user name and password in order to login to the application.
- Manage the user details- Has the privilege to manage user details.

2.1.8 Site adaptation requirements

There are no such site adaptation requirements at the implementation of the ELPS. But necessary adaptation requirements are needed to mount the camera in the room of the patient. Mounting of the camera has to be done in a way that bed area of the patient will be covered and the more focus will be on the face of the patient.

2.2 Product functions

Here below is a detailed description of the Patient Monitoring System and UML designs has been used in order to give a clearer idea on what happens and how it happens in the system.

Patient Monitoring System, as stated above is mainly focused on elderly patient who are suffering from respiratory issues. System will analyze the captured video and detect the patient's face and recognize his/her emotions. If any abnormality detected system will notify the caregiver via a notification to the mobile phone.

2.2.1 Use case Diagram

The following us case diagram describes the Abnormality detection in emotions of the Elderly Patient Monitoring System (EPMS)

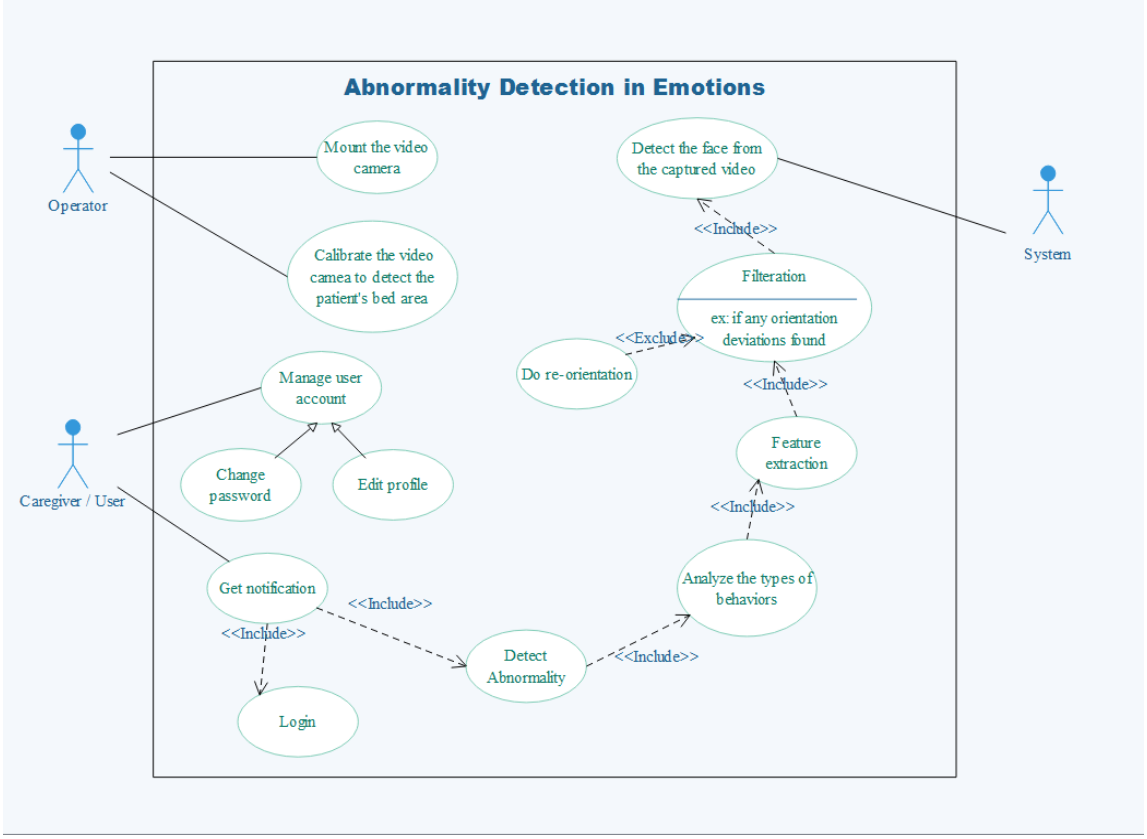

Figure 2.8 Use case Diagram for Abnormality detection in Emotions

2.2.2 Use case Scenarios

Table 2.2 Use case 01: Login to the System

Use case 01	Mobile Application Login
Description	Login to the mobile application by providing the user name and password
Primary Actors	Caregiver
Pre-conditions	1. The mobile application is up and running. 2. Mobile data is turned on. 3. User has already registered.
Main Success Scenarios	1. User enters the user name and password. 2. User select the login button 3. System validates the user name and password. 4. The main window is displayed to the patient.
Extensions	1a. If the username or/and password is invalid, display an error message and prompt the patient to enter the user name and password again.

Table 2.3 use case 02: Get Notifications on abnormality of the patient

Use case 02	Get Notifications
Description	Get Notifications on abnormal situations of the patient.
Primary Actors	Caregiver
Pre-conditions	1. The mobile application is up and running. 2. Mobile data is turned on. 3. User has already registered. 4. User has already logged in to the mobile application.
Main Success Scenarios	1. User taps on the notifications.

Table 2.4 Use case 03: Abnormality Detection in Emotions

Use case 03	Abnormality Detection in Emotions
Description	Analysis of emotions in order to detect the anomalies of the patient.
Primary Actors	System
Pre-conditions	1. Inputs the captured video from the video camera in to the PC.
Main Success Scenarios	1. Detect the face from the captured video 2. Analyze the video

	3. Filtration. 4. Feature extraction. 5. Classification. 6. Normal or abnormal event detects.
Extensions	4a. if there are any orientation deviations in the face, t should be re-oriented.

2.2.3 Activity Diagram for the Abnormality Detection in Emotions

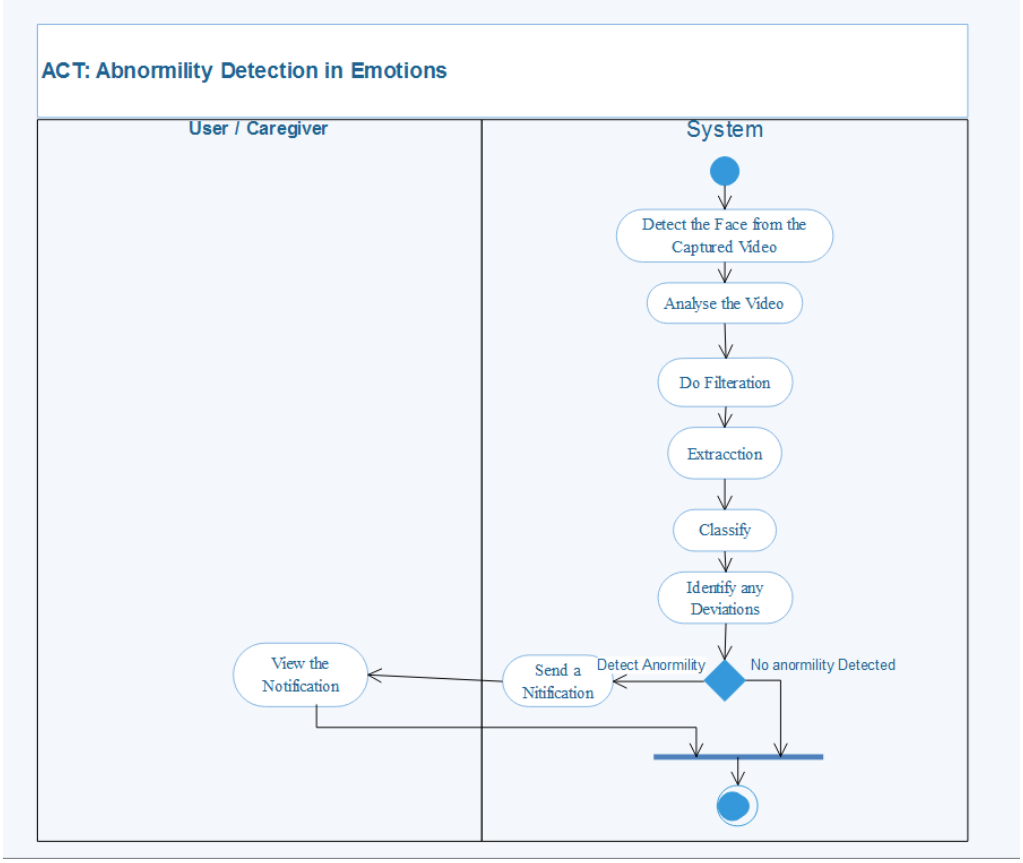

Figure 2.9 Activity Diagram: Abnormality Detection in Emotions

2.3 User characteristics

The software is intended for use by the caregiver or the parties who are having elderly patients with respiratory issues in their domestic arena. Elder's homes and Elder care agencies can be effectively assisted by this system, if there are patients who are suffering from respiratory problems and responsible persons of those places will eventually become users of the system.

The other category of user is the Administrator who is responsible for configuring the system.

2.4 Constraints

- Mobile application consumes the battery power for internet connectivity and for the processing in the mobile application. So the operation time of the mobile application has limited to several hours.
- PC is compulsory for the system.
- Necessary sensors and the stethoscope have to be equipped to the patient.
- High resolution web camera should be set on top of patient's bed covering the bed area while more focusing on the face.

2.5 Assumptions and dependencies

2.5.1 Assumptions

- Patient is equipped with the necessary sensors and the stethoscope.
- Patient is living under normal environmental conditions.
- Most users have Smart mobile phones.
- Users who interact with the system have at least a slight knowledge about handling smart phones.
- The OS runs in the mobile devices are android version 2.3 or above.
- The mobile devices have mobile data turned on when running the application.

2.5.2 Dependencies

- The system is immensely depend on the hardware, because data transmitted from the sensors and the stethoscope are essential for the analysis process.

2.6 Apportioning of requirements

In the section 1.5, it describes the overview of the proposed system and the section 2 provides the overall detailed description about the system and its requirements. The section 3 contains the requirements in detail that should be followed while designing the above mentioned requirements. The methodology of the implementation of the system might have slight differences from the contents described in this document. During the system designing, the requirements specified will not change and the system that is to be released will contain its purposes and the objectives as mentioned in the document.

3 Specific requirements

3.1 External interface requirements

3.1.1 User interfaces

Section 2 describes the user interfaces from the front end for any kind of stakeholder who is interested in understanding the functionalities of the system. In this section we will describe the backend of the system in order of clear clarification of the requirements for the related professionals with IT knowledge like developers, QA engineers and etc.

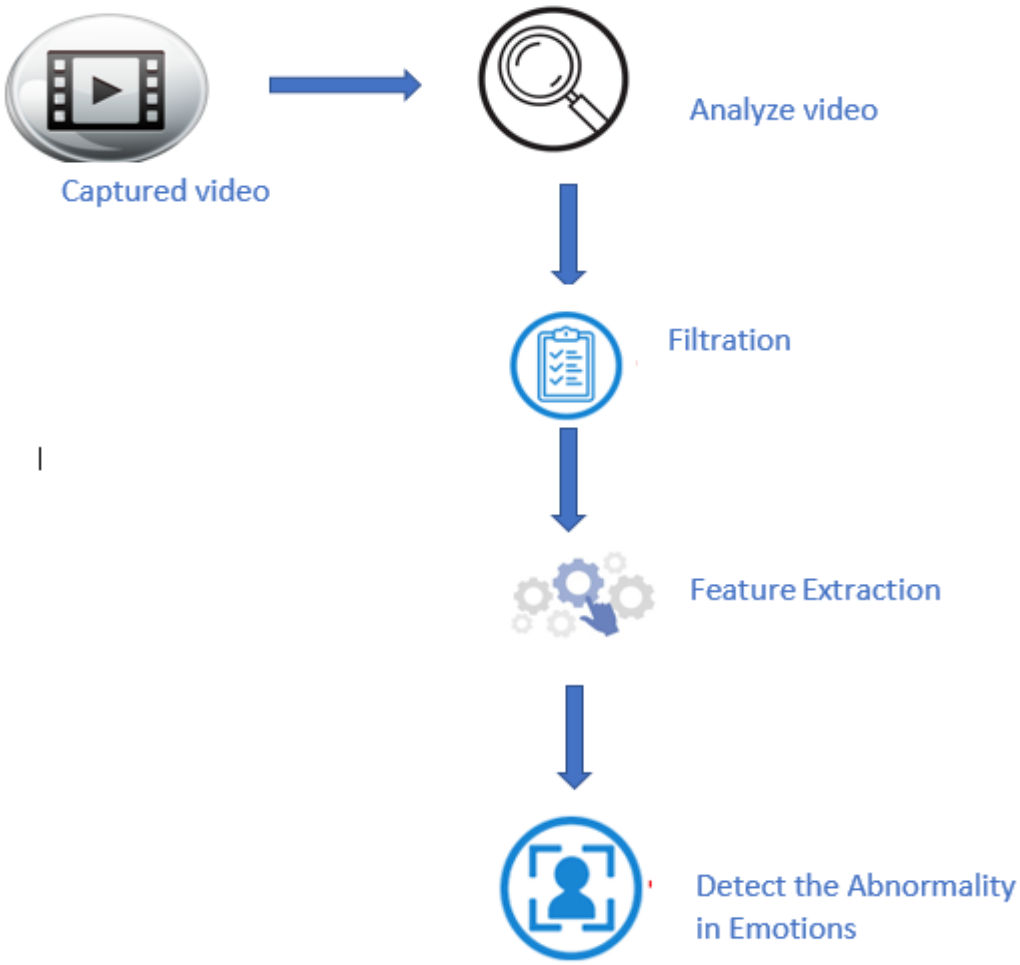

Figure 3.1 User Interface: Abnormality detection in Emotions

3.1.2 Hardware interfaces

This section shows the necessary hardware interfaces which will be used by the developer in order to produce the proposed system.

Arduino Uno 3

Since it is not possible to send serial inputs straight away in to the PC, Arduino Board will be used as controller.

Figure 3.2 Arduino Uno 3

Pulse SpO2 Sensor

Pulse SpO2 Sensor will be used to detect heart rate and the oxygen percentage of the blood.

Figure 3.3 Pulse SpO2 Sensor

Web Camera

Web Camera will be in use to detect the emotions and the behaviors of the patient.

Figure 3.4 Web Camera

Bluetooth Module

Bluetooth Module will be used to transfer the data to the PC which will be captured by the Arduino Board.

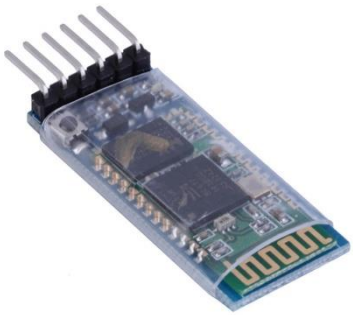

Figure 3.5 Bluetooth Module

Stethoscope

Stethoscope will be in use to capture the respiratory sounds.

Figure 3.6 Stethoscope

Microphone

Microphone will be used to record the captured signal in order to send to the PC.

Figure 3.7 Microphone

3.1.3 Software interfaces

For the implementation of the EPMS, developer will have to utilize different software interfaces.

- OpenCV library – For behavior recognition and emotion recognition purposes.
- Dlib library – For face detection.
- MATLAB – For signal processing.
- Apache HTTP Server – As the web server of the system.
- MYSQL – As the Database Management System of the EPMS.

3.1.4 Communication interfaces

To communicate between knowledge base and mobile application and also to communicate between web application and mobile application HTTP protocol will be used.

Once the necessary values from the sensors are obtained by the main board they had to be transmitted to the PC for the necessary processing to take place. Therefore Bluetooth will be one of the major communication interface.

3.2 Classes/Objects

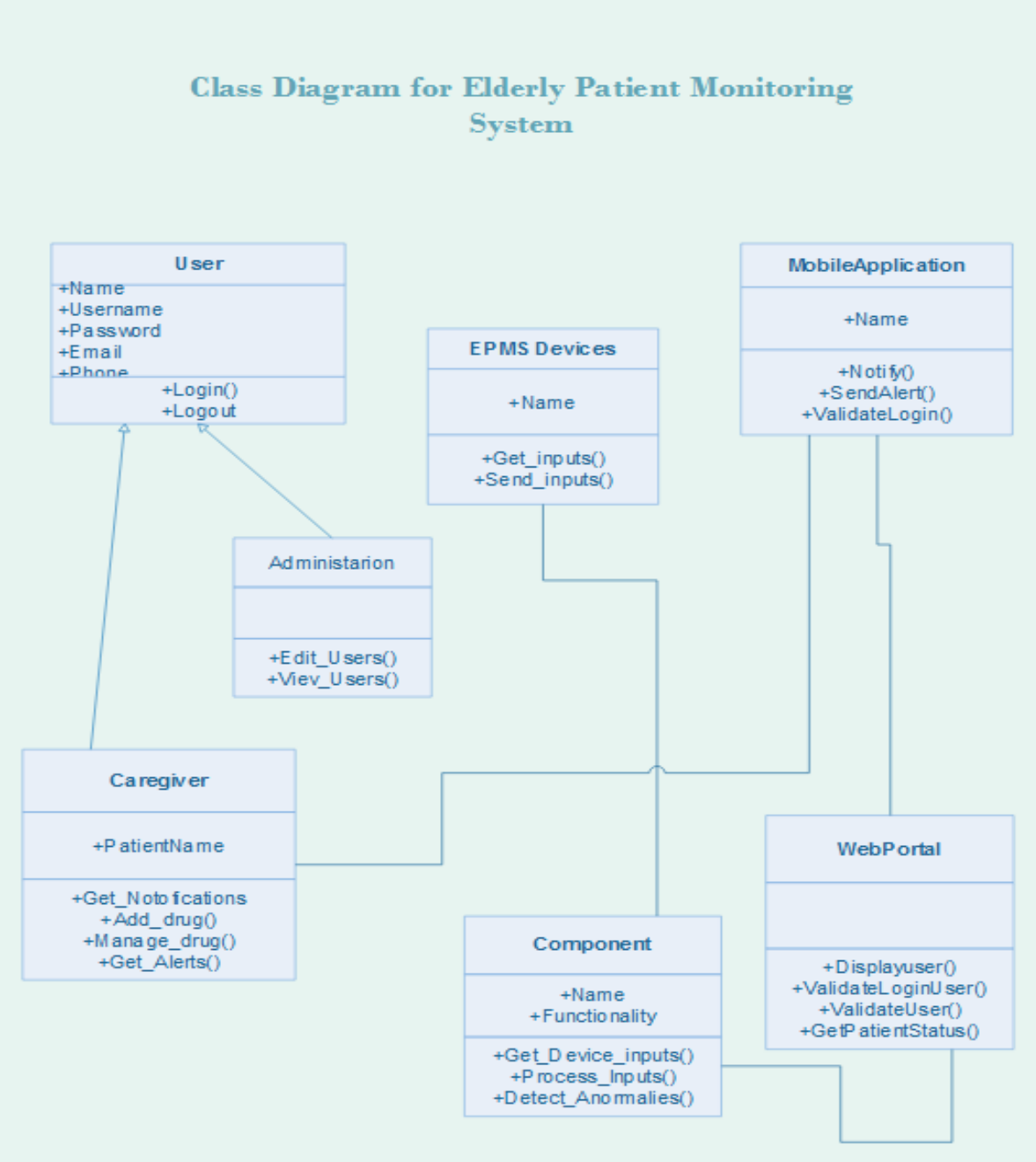

Figure 3.8 Class Diagram for the EPMS

3.3 Performance requirements

An internet connection with an average downlink speed of 400 kbps will allow an uninterrupted service. The product will be based on web and has to be run from a web server. The system will take initial load time depending on internet connection strength which also depends on the media from which the product is run. And 95% of the detected abnormalities are processed in less than one second. Data should be secured and backed up every quarter hour.

And in this system Power supply have a backup and a disaster recovery plan. System will be operable 24 hours a day and accessible in real-time.

3.4 Design constraints

Since the mobile application is used by caregivers who are fairly computer illiterate, the GUIs will be designed as very simple and self-evident interfaces.

3.5 Software system attributes

3.5.1 Reliability

The reliability is an attribute of any computer-related component that consistently performs according to its specifications. This is the most important attribute of a software since the entire system process depends on that.

At a time of a failure in the proposed system have a proper mechanism to notify the parents about the failure and if there is a certain sensor failure or any other failure in ICMS hardware device, the system is able to work with sensors and hardware parts without leading the whole system crash.

3.5.2 Availability

The system could be accessed whenever in in need and availability is the ratio of time a system or component is functional to the total time it is required or expected to function. Ratio should be a higher value to achieve high availability of the system. Elderly Patient Monitoring System will be implemented with high availability and necessary testing will be done to check whether high availability has maintained or not.

3.5.3 Security

Security is the protection of the data against unauthorized access. Elderly Patient Monitoring will be and exposing health values of the patient and those are confidential information, the security of those data has to be considered. Those data have only to be visible for the intended parties. Ethical issues which might arise from this kind of system have to be considered. To achieve those goals password usage is more important.

3.5.4 Maintainability

Maintainability is defined as the probability of performing a successful repair action within a given time. In other words, maintainability measures the ease and speed with which a system can be restored to operational status after a failure occurs. The system should be modularized in order to achieve good maintainability. The sensors should be able to replace individually without replacing the whole system. The application design also needs to facilitate maintainability.

4 Supporting information

4.1 Appendices

Appendix A – Use Case Diagrams

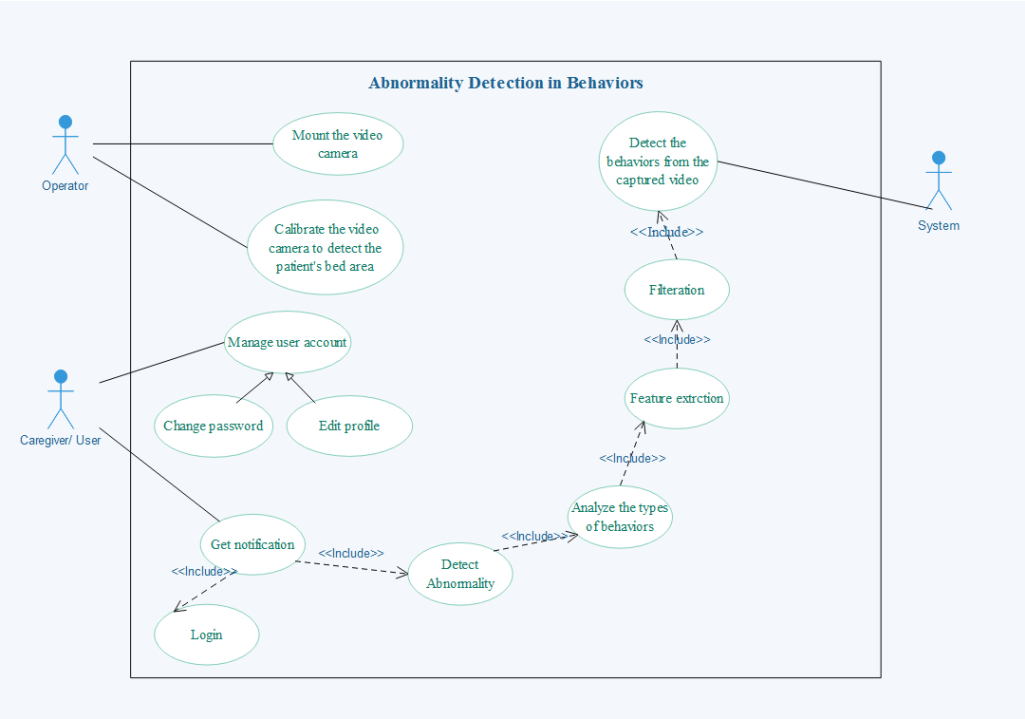

Figure A.1 : Abnormality Detection in Behaviors

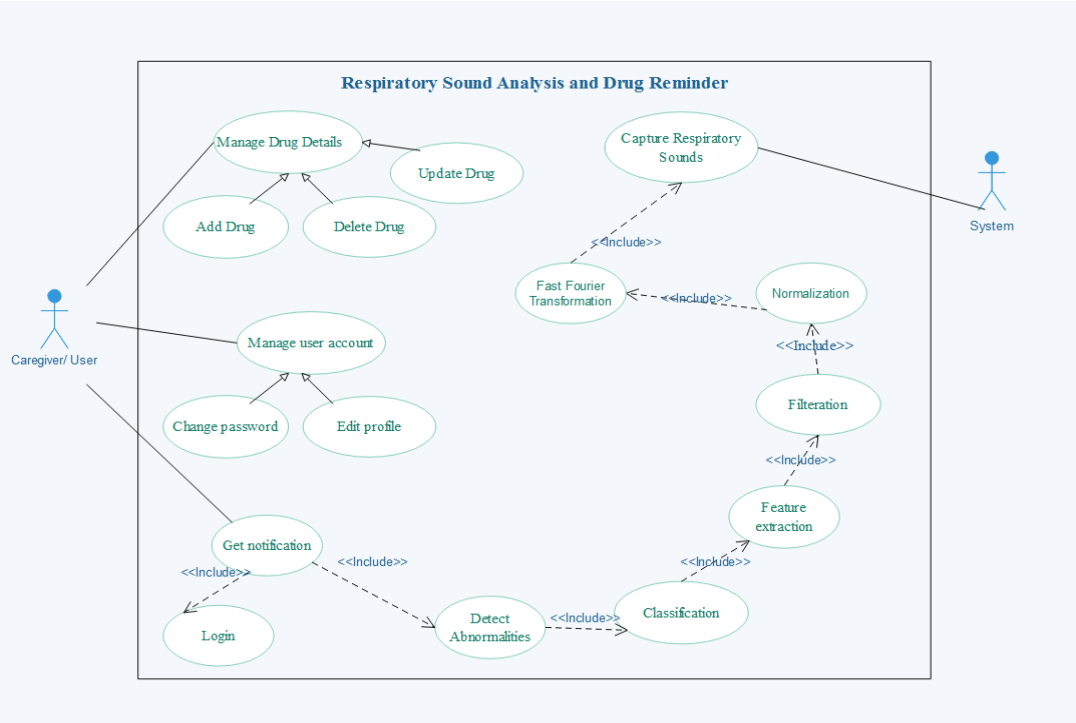

Figure A.2 : Respiratory Sound Analysis And Drug Reminder

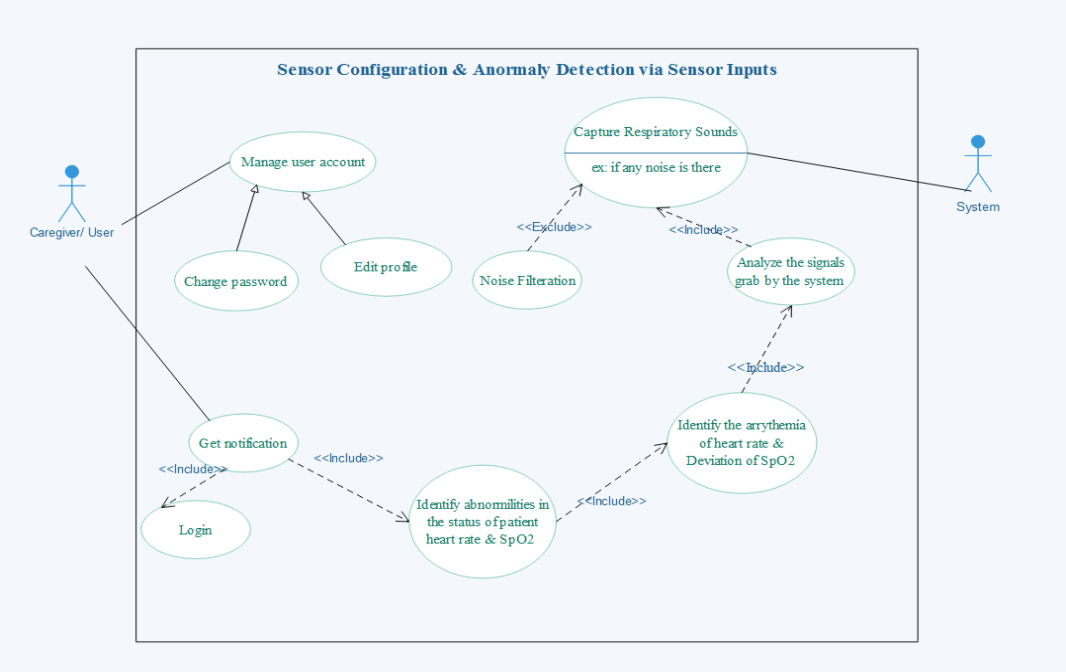

Figure A.3 : Sensor Configuration &Abnormality Detection via Sensor Inputs

Appendix B – Activity Diagrams

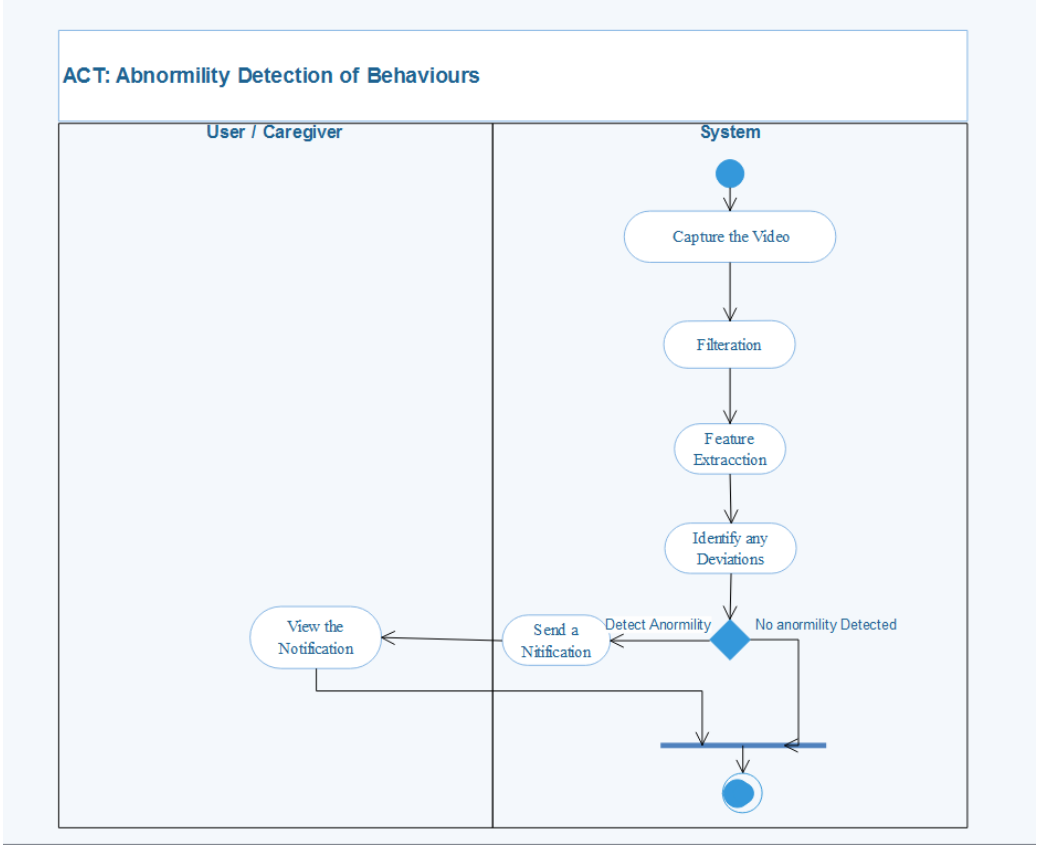

Figure B.1 : Abnormality Detection in Behaviors

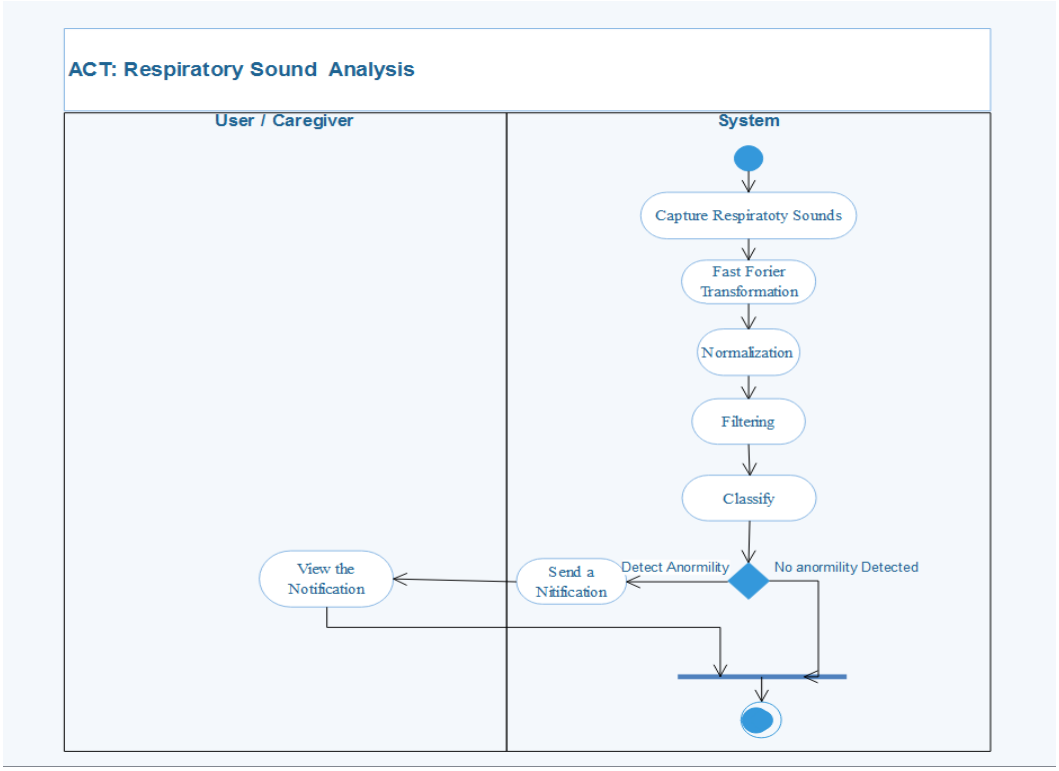

Figure B.2 : Respiratory Sound Analysis And Drug Reminder

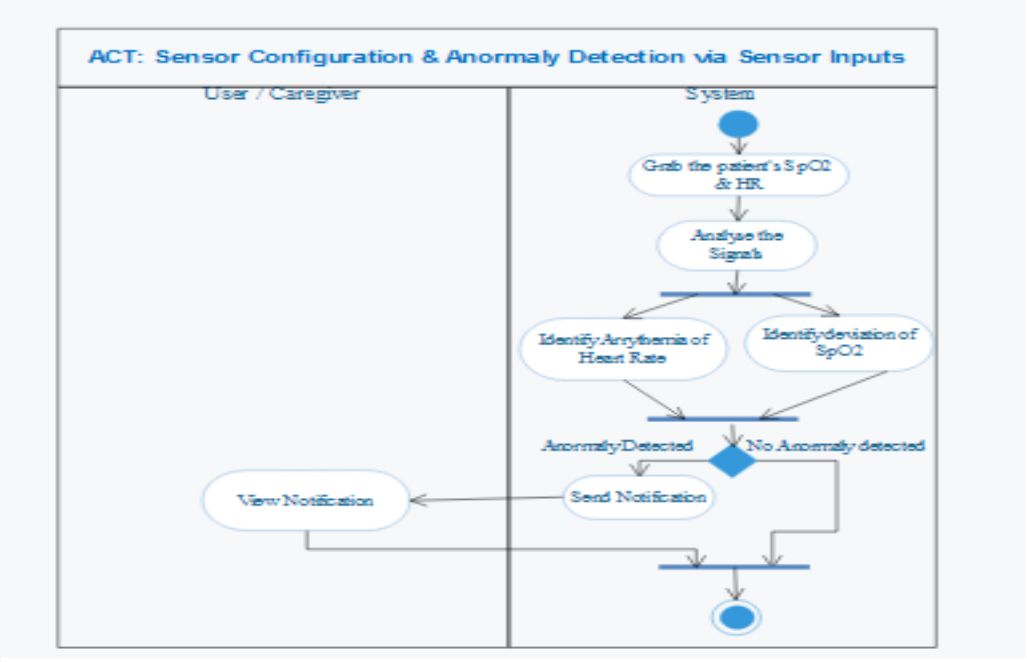

Figure B.3 : Sensor Configuration &Abnormality Detection via Sensor

Appendix C - External Interface Requirements- User Interfaces

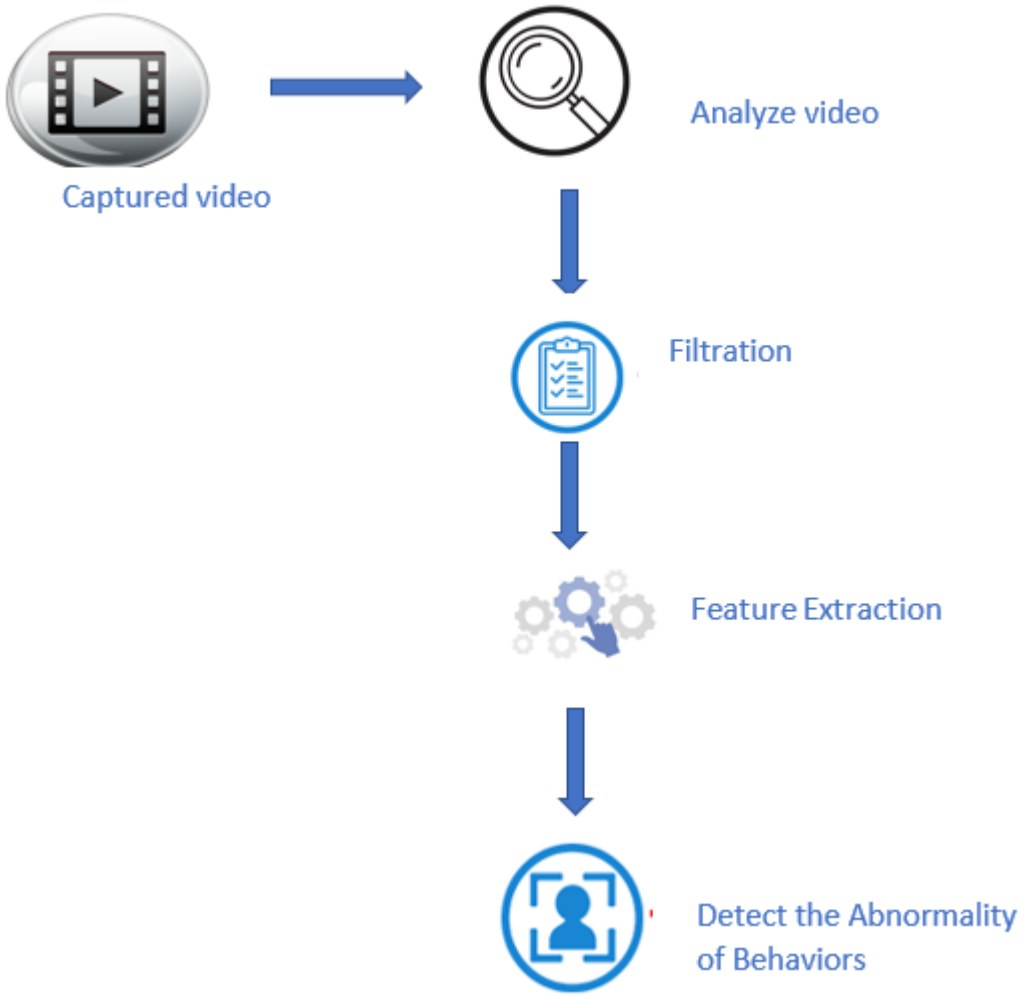

Figure C.1 : Abnormality Detection in Behaviors

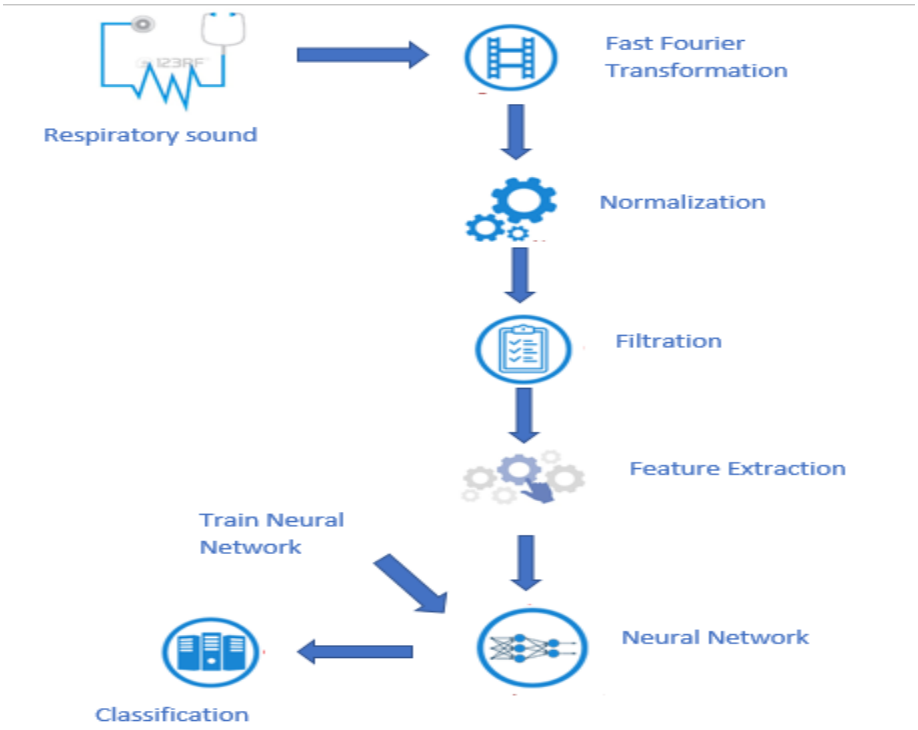

Figure C.3 : Respiratory Sound Analysis And Drug Reminder Inputs

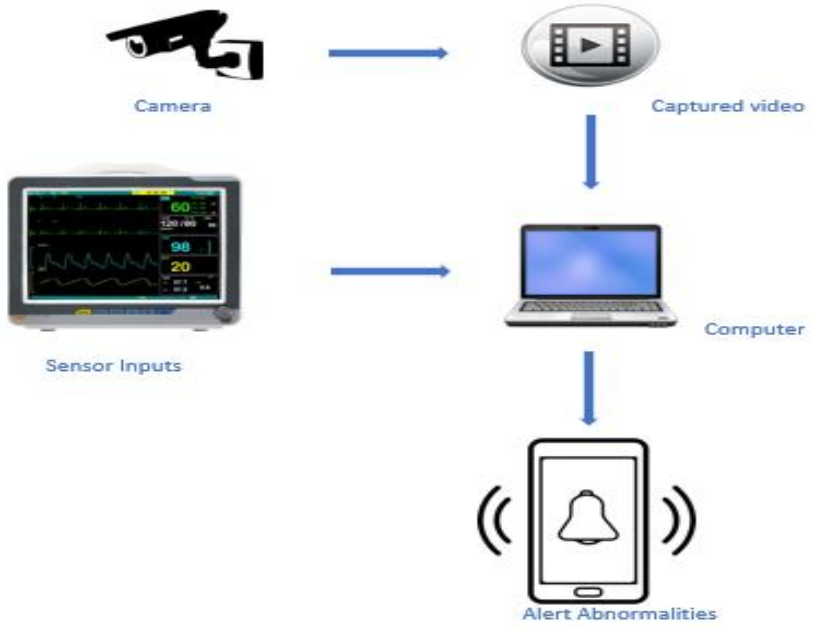

Figure C.3 : Sensor Configuration &Abnormality Detection via Sensor

4.2 References

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[2] Lucey, Patrick, et al. "Automatically detecting pain in video through facial action units." *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)* 41.3 (2011): 664-674.

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