JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

FACULTY OF ELECTRICAL AND COMPUTER ENGINEERING

COMPUTER STREAM

MINI PROJECT

Title: - IoT Based Coma Patient Monitoring System

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ABSTRACT

A coma is a state of senseless in which the person is not aware of their surroundings to give a response. It is caused by different problems such as traumatic head injury, stroke, brain tumor, drug or alcohol intoxication, or even an underlying illness, like diabetes or an infection. In the present health care centers like hospital and, clinic coma patient is one of the tasks that need continuous supervision. Such task may have a greater threat due to errors that can be formed by human beings if it doesn't be monitored via technology. The problem can be surpassed or solved by the IoT-based coma patients monitoring system. This project is developed and implemented to monitor the coma patient in a simple way at any time. The system collects coma patient's status like heartbeat, body temperature, blood pressure, eyeblink and body movement using relative biometric sensors and sends to website. And also, if eyeblink and body movement happened the system alerts whether the doctor or the nurse by sending an SMS via GSM module. Both doctor and nurse can login the website and can get patient's status from it. And also, they can monitor the patient by seeing all the information about the patient from the LCD being in their respective office room. The system is beneficial in reducing the burden of a manual requirement to continuously monitor the coma along with assistance to the doctor about the health and consciousness status of the coma remotely through the website.

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ACRONOMY

IoT BCPM	**I**nternet of **T**hings **B**ased **C**ome **P**atients **M**onitoring **S**ystem
VS	**V**egetative **S**tate
MCS	**M**inimally **C**onscious **S**tate
EMA	**E**thiopian **M**edical **A**ssociation
IoT	**I**nternet of **T**hings
GSM	**G**lobal **S**ystem for **M**obile Communications
LCD	**L**iquid **C**rystal **D**isplay
CSS	**C**ascading **S**tyle **S**heets
HTML	**H**yper **T**ext **M**ark Up **L**anguage
CGI	**C**ommon **G**ateway **I**nterface
PIR	**P**assive **I**nfrared
PID	**P**assive **I**nfrared **D**etector
RAD	**R**apid **A**pplication **D**evelopment
UML	**U**nified **M**odeling **L**anguage

CHAPTER 1: INTRODUCTION

1.1 Background of the Project

"Imagine your life hangs by thread, imagine your body hangs by a wire, imagine you are not imagining", Michael Crichton "1978"

Almost every country in the world is now implementing a technologically-based health-care monitoring system. One of the technology solutions is an IoT-based health care monitoring system, which has gotten a lot of attention because it solves a lot of health-care concerns.

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy, and economic benefit.

Things, in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist fire-fighters in search and rescue operations. These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. There is a lot of application of IoT systems to simplify, automate and control different processes. Some sectors are smart home applications, health care, smart cities, agriculture, industrial Automation, etc.

Health care monitoring is one of the applications of IoT used to manage the health status of any person if he/she is exposed to some hazards by capturing a sequence of patient data from monitors and medical devices. A Health monitoring system is carried out in hospitals by doctors and nurses to monitor a patient. Different hard scenarios of health problems need special attention on IoT-based system development.

One of the major health issues to be monitored is coma. Coma is a deep state of persistent sleep in which a person cannot be awakened; he fails to respond normally too painful stimuli, light, or sound lacks a normal wake-sleep cycle, and does not initiate voluntary actions. Coma can be caused by various things such as a severe injury to the head that hurts the brain, infections in the brain, brain damage due to lack of oxygen for too long, taking too much medicine (overdose) or other drugs, maybe due to chemical imbalances in the body from other illnesses. Sometimes the person in a coma state can respond to the external environment by voluntary movement such as he may open his eyes in response to the external impulse. Even though an individual in a coma state appears normal but they could not respond to the external commands. They need continuous care from doctors and other health cares. So, lots of health care's service sectors are needed. Especially developing country gate lots of challenge on this behind. Ethiopia is one of the developing countries. It has many problems in its health care sector. The problem in this sector is due to many reasons and some of these are like that of there is a low number of doctors (health care specialists), to treat the patients, and also there is lack of technology.

The number of doctors to patient ratio in Ethiopia has always been a topic of debate and differs from one source to the other. The annual report provided to Addis Standard by the Ministry of Health reveals that currently there are just 411 government health care centers with only 5,540 doctors who are thinly spread throughout the country. The doctor to patient ratio stands at one to 17,000 people, a slight improvement from the 2014 ratio of one to 20,000. A statistical analysis published on World Atlas on 25 Jan 2016 also shows that Ethiopia ranks 4th among the 25 countries with very limited access to health care. According to this report, on EMA(Ethiopian Medical Association) Ethiopia has only 22 doctors for a million people, a big difference even by the standards of other African countries. And there is a shortage of health workers in Ethiopia [1].

With the help of technology, we can improve this problem by different mechanisms like IoT. This project attempts to solve such types of the scenario by delivering a health status assisting system that identifies human body parameters such as blood pressure, body temperature, eye blink, body movement on the IoT server. And this IoT server helps the doctors (the health care specialists) to collect patient's information and for taking the right measurements of patient's health parameters and also to give proper treatment at the appropriate time.

1.2 Statements of the Problem

This project is done depending/omit on the lack of supervising a patient who is in coma regularly. Ethiopia is one of the countries with a low number of health care workers and also with a low health worker to population ratio. This influences that one doctor may be given for many patients. Due to this, the doctors or caregivers are not able to check quickly the patients' results. But a person who is in coma can be affected while his/her status changed from the vegetative state (VS) to a minimally conscious state (MCS) unless they get quick help. Maybe their heartbeat can be raised over the normal condition, they can be made a sudden movement and can affect themselves by any health equipment found on their body. Another problem is that a doctor or a nurse can go away far from the patient for some cases. COVD-19 is the current time big problem which make all over the world's doctors and nurses so very busy. Especially this pandemic disease can result farther more lack of doctors or nurses in Ethiopia.

1.3 Objectives

1.3.1 General Objective

The general objective of this project is to design, develop and implement an IoT-based coma patient monitor system.

1.3.2 Specific Objectives

- To design a website that stores and displays full information of coma patient to a doctor or nurse
- To design a system with a different sensor, LCD, LED, Wi-Fi module and GSM module that collects, transfers and displays information about a person in coma state to website.
- To develop the website which stores and display full information of coma patient to the doctor or nurse.
- To develop a system designed to collects and transfers information about a person in coma state to the website.
- To implement overall the system

1.4 Significance of the Project

The significance of this project is that the doctors or any health caregivers can access the current information about the coma patients from both near and remote. Because the patient's information is checked continuously, the doctor or any health caregiver doesn't worry about that patient while they are away from him/her for any issue. Rather than they can be busy to keep and check frequently the patients' condition manually, they can do other jobs as an additional while they are keeping them. Not only these also the system notifies the workers if the patients' condition is changed suddenly.

Any health care center that can access the internet can use this system without any confusion since the system is used by educated workers whether doctors or other health caregivers. The system is not complex to use because it shows or informs any information related to the patients clearly to the users or the workers who use it.

Additionally, the system is cost-effective when compared with other IoT-based coma patient monitoring systems. So, concerning the economy of our country Ethiopia, any health care center can buy and use with a balanced cost.

1.4 Scope and Limitation of the Project

1.4.1 Scope of the Project

The scope of this project is that it checks the patient's condition by using different sensors attached to a person who is in coma state. The data fetched by the sensors sent to the website and a doctor or a nurse can be checking the patient's status remotely. And also, if any exceptional case like eyeblink and body movement is happened to the patients the system notifies them via sending a SMS.

Since the system checks patient's condition with five sensors if any one of component of the system are failed, other components can work properly and gives information about the patient. In this system, a health observing system comprises a variety of sensors connected to the patient and

they transfer the data of the patient to the website via an IoT system. This IOT is acting as a data junction node, which means all the patients' data are stored in the database.

1.4.2 Limitation of the Project

The limitation of this project is that if the Arduino microcontroller is failed, the system is totally stop working. Because all the information about the patient are sent and received via the microcontroller. If the microcontroller is failed the website cannot display any the information. This is because of the microcontroller is the brain of the system that receives and send the information interchangeably.

1.5 Outlines of the Project

This project outlined an introduction containing a statement of the problem, the background of the project, objectives, significance, and scope of the study in chapter one, whereas chapter two deals with the literature review. Subsequently, chapter three contains methodology then again chapter four contains designing of the overall system. Following this, chapter five deals with results and discussion. Finally, chapter six allocates the conclusion and recommendations. At last some appendixes are inserted.

CHAPTER 2: LITERATURE REVIEW

To do this project, we have reviewed different literatures that related to this project topic. There are some existing systems and we have seen their work dealing with analysis and monitoring of health parameters of coma patients. In case we try to identify the limitations of these literature reviews to improve them in this project.

2.1 Existing Systems

Coma patient monitoring system using image processing: this project which is advanced related to a physical change in body movement of the coma patient. And this system is used to monitor the change in the body (body movement) of coma patients. And if there is a physical change (body movement) it gives a warning in the form of the alarm around there. And also, it displays on the LCD in less than one second time.it also passes an SMS to a person sitting at a distant place if there exists any movement in any body part of the patient. And the drawback of this project is it gives an alarm or it will notify only if there is body movement. And also making an alarm in the hospital is not preferable because it may disturb the patients furtherly this system is not work for us monitoring other essential parameters like heartbeat, blood pressure and temperature [2].

Analysis and monitoring of coma patients using wearable motion sensor system: in this system, they proposed to accomplish two tasks which are monitoring and alerting the medical person (doctors or the health care worker). And in this project, they also use the sensor. The wearable motion sensor system is used to monitor the body movements such as eye blink movement and hand movement to detect the conscious state of an individual. And for as Pulse rate and temperature alert the doctor whenever attention is needed. The drawback of this system is again cost-ineffective it uses an LPC2148 ARM controller which needs extra hardware for connection to the internet, while this facility is inbuilt available in the raspberry-pi [3].

A Model-Driven Methodology for The Design of Autonomic and Cognitive IoT- Based System: and this project describes model-driven technology for automatic and cognitive IoT-based systems in the field of healthcare. In this system it is combined and instantiated a set of patterns for developing a flexible cognitive monitoring system to manage patient's health based on heterogeneous wearable devices. And by using these wearable device sensors it collects

information from the patient then by using IoT it sent to the data base to accesses it the doctor or the health care specialist to give the appropriate decision. The drawback of this technique is the insufficient analysis and is that it is expensive due to prototype implementation [4].

Monitoring of health parameters by using raspberry pi: This project proposes a health monitoring system that monitors the vital parameters of the patient. such as temperature and heart rate by using sensors as well as a Fitbit which are connected to a raspberry pi board. The raspberry pi acts as a personal server that logs the details of the patient's medication. And it involves alerting the doctor through SMS if any vital parameter of the patient deviates from the normal value. And the drawback of this system is that its cost is high when compared to the system we are going to do in this project [5].

Health monitoring for coma patients: in this system it detects(monitor) different parameters of coma patient by using PIC microcontroller 8051. A ZigBee (RF4C4) has been proposed and implemented to support remote patient monitoring. The different sensors collect the medical data of the patient and give feedback to doctors. ZigBee module is connected to the microcontroller. ZigBee is used for transfer values to the receiver side. The drawback of this project is that it was developed only for heart bit and blood pressure sensors which means the sensor with some fault lost its status the patient health gets to question [6].

IoT-based healthcare system for coma patients: this system is also like that of the other coma patient monitoring system it proposed a health observing system comprise of variety of sensor connected to patient and it will collect the information of the coma patients through o these sensors. And these sensors use WIFI to communicate this information to the internet. The system uses the Raspberry-pi and it acts as a junction node. And the patient and doctor's smartphones or computers are used as monitoring devices. So, the information can be accessed by the doctor on his phone/computer and get the notification. The drawback of this project is required to reset the system when the treatment is done [7].

Generally**,** those systems which we express above have its good quality by its measurement We understand from those systems, some of them contain monitoring part not notifying which means the heartbeat, bp, temperature like vital sign are monitored, even if the system can monitor the

patient some exceptional cases like eye blinking boyloving are leads to unconditional wakeup, this vent it may not monitor because of its adaptability of doctor may not be sensed if the new change in those vital sign the notifying system is best in this vision. one the other side also unlike the monitoring they researcher choose on the alarming side when they patient is wakeup is also risky because the comma patient it may be heartbeat reality or other vital sign failure has occurred the alarming.

Hence, we have developed the system that containing both conditional and unconditional vital sign monitoring for coma patients. Here for his blood pressure, temperature and heart beat we considered this and monitored through continues data sharing using Wi-Fi module to the data base and the doctors can access the information see those events and can desire prescription with no need of and clinical staff like nurse and coming to the nurse they can see any prescription or comment by the doctors with its privilege in the website and on the other hand unconditionally events like eyeblink body movement are appeared they are monitored through the help of GSM module by sending message to the doctors . And additional feature if the healthcare may be not open the computer or its mobile phone different statues of the patient are monitored through the doctors and the nurse room using LCD display parallelly the LED is blink in both offices for giving message if sudden accident are appeared in the statue of the patient.

CHAPTER 3: METHODOLOGY

The overall system was well organized and coordinated for an efficient performance. There were several stages that we had gone in order to complete this project successfully. First, we studied about the literature review of IoT-based coma patient monitoring system. In this stage, we try to complete the project with good comfortable for user and also avoid some drawbacks from it. Then we choose compatible method and function for the project. Subsequently, we studied how the components are integrated. Then we constructed block diagram for IoT based coma patient monitoring system based on the integration of the components. After that we have prepared a questioner for seeking the problem to get a reliable solution. Then we design the system based on the requirement we have gained from the data. Finally, we implemented the system using the compatible environments for simulation and implementation purpose

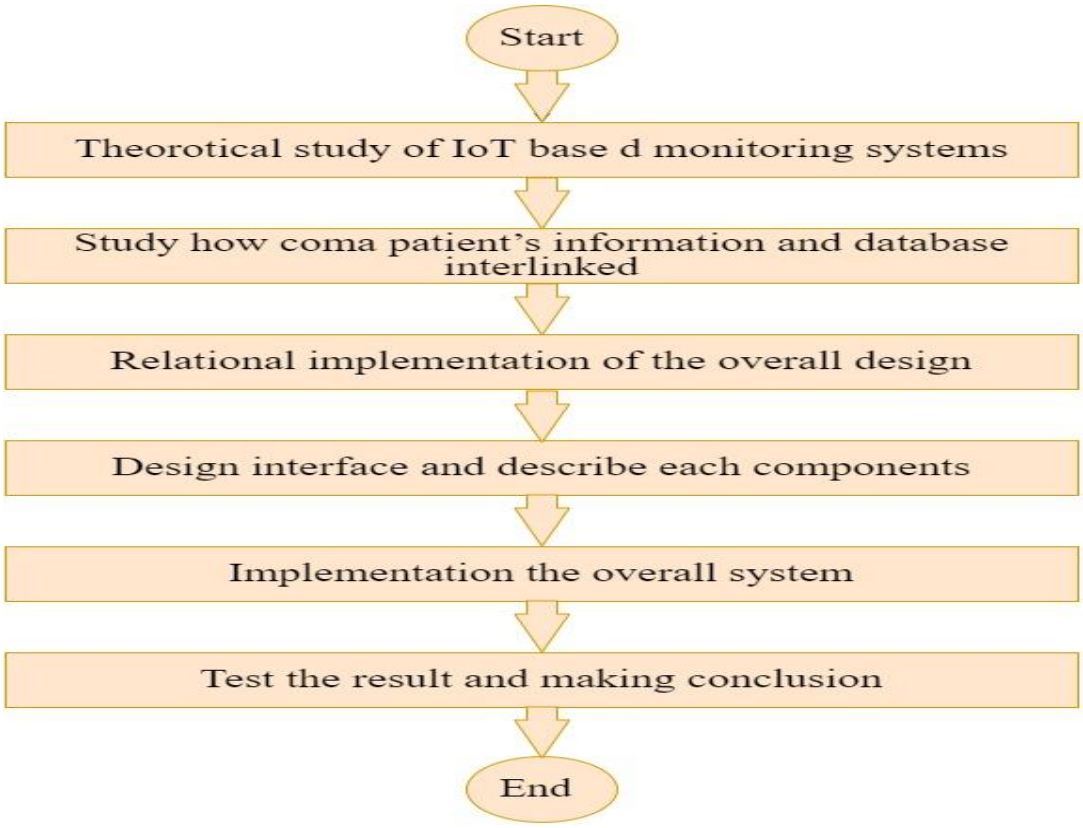


Figure 3-1:Procedure flow chart for the working system

3.1 RAD Software Model

For software development there are different models used such as waterfall, scrum, extreme programming, spiral, and rapid application development are techniques are models that can use in this software development. In this project, a rapid application development technique is used. RAD is a concept in software development that emphasizes speed. Working on software and being more adaptable than traditional development models, as well as RAD Model was created to make the most of the available resources. We have used RAD application development because of the following reasons:

- The RAD approach method is good for our group because of that they are applied contain as at most six members.
- Due to the time constrain for doing our project its iteration to gather requirement, to validate requirement and to design the overall system its approach is not takes long time.
- With its greatest efficiency, fast development environment and effective communication we choose this model for this project.

Depending on the model the four phases of the RAD we have done the followings. These are:

Planning for Requirements: - during this phase, we are defining the requirements that the IoT based coma patient monitoring system will be improved as the system based on identifying the problem by the investigation of the present issue and we planned to do this project depending of the requirement that we have gathered.

User Interface Design: after we scoped our project, we design iteratively across numerous development the users and our team members collaborate to turn the requirements into a usable design.

Construction: during this phase using the environment that is comfortable for our hardware and software design, we develop programs that improve the functionality of the system. For hardware part using Arduino IDE to we are communicate sensors with Arduino. For software part using PHP HTML and JAVA script we develop website that needs for our project. And using python we

communicate our hardware and software for transferring data to the website. Generally, in this stage we focused on

- Getting ready for a quick build
- Development of programs and applications
- Unit, integration, and system testing coding

Cutover: - this is the stage when we finished this project is ready to be released. Data conversion, testing of this project with its functional perspective with related to the real-world environment.

Generally, RAD works best for our projects with its well-defined goal and a well-defined scope. Not only this but also its time constrain to do one project and numbers of the team that is advisable in RAD. We have chosen this software model for our system.

3.2 Software Requirements

a) Functional Requirements

The functional requirement is the services that are provided by the system. It also describes the interactions between the system and the user and any other external system.

User: - a person who uses the system whether the doctor or any caregiver.

System Admin: - a person who registers the new patient, nurse, and doctor

Functional Requirements should include:

- The admin of the system should manage patients' data.
- The system should store all data related to all the tasks performed into a database.
- Produce a report for the doctor or another caregiver on the conditions of the patients.

b) Non-Functional Requirements

A non-functional requirement is quality attributes that describe ways that the product should behave. The list of basic non-functional requirements includes:

- Usability

- Legal requirements
- Reliability
- Performance
- Subjective nature
- Integrated nature
- User interface
- Security and access permission

c) Software Tools Required

There are different software requirements we have used in this project. Each of the software has its contribution. Each of the software requirements used in the project has its function The followings table shows the software tools required with their main function.

Table 3-1: Software tools required

Database	Backend development	Frontend/formatting	IDE
My SQL	Python Php JavaScript	CSS JavaScript HTML	Visual studio Arduino

MySQL-Database

MySQL is an open-source relational database management system. A team of volunteers that offer the technology free of charge develops it. It has been developed to handle large quantities of data that make it useful for the development of any project. MySQL was designed to handle a high volume of data. It can also save money because it is free to use with no licensing costs, which will

stay the same no matter how big a database becomes. MySQL doesn't differ much from other SQL technologies but it can handle large amounts of data[1].

In this project, we have used MySQL to store the data. These data are data of the doctors and nurse or other caregivers, data of patients, information fetched from the sensors, etc

HTML-Site Lay

HTML is an abbreviation of Hypertext Mark-up Language. It is used as the standard mark-up language for developing web technologies. HTML is used to build the structure of content and objects on all web pages. To display any Python, database, or JavaScript objects and data on a web browser it will have to be inserted and displayed in an HTML file. MYSQL may be storing the data and Python will be manipulating the data and giving it rules, but to display it on a web page in a table it will still need to use an HTML table tag with CSS styling to do so. For the software websites, we have used a base.html file that will be inserted into every HTML page on the web app. The base file contains the navigation menu, the page header, and the footer bar[2]. In this project, we used HTML to develop a web page that displays information about the coma patient to the doctors or any caregivers.

CSS-Front-End Development and Styling

CSS is an abbreviation of Cascading Style Sheets. CSS creates rules for how HTML elements are displayed and styled onto a screen, paper, or other media. CSS3 is the backbone of all styling done on the websites. It directly tells HTML content how to display and act. CSS tells objects how to act in the front-end only and doesn't add many functions to the site apart from styling. In the website application, we use different CSS pages to give different styling for different sized screens; this is to ensure maximum optimization between device platforms. The CSS page being used will be changed depending on the size of the device's screen size. The website is optimized to use a

[1] MySQL, https://www.edureka.co/blog/what-is-mysql/, July 13, 2021, 2:15:56 AM

[2] HTML, https://www.javatpoint.com/html-layout, July 13, 2021, 2:18:48 AM

different CSS file for Desktop computers, tablet devices, and smartphone devices. So, in the web page development, we used CSS to style the web[3].

JavaScript Front-End Development

JavaScript is an agile, interpreted, an object-oriented programming language that uses first-class functions. It usually is used to run on the client-side of the web and is used to design how web pages should behave after user events. JavaScript is only used partially in the front-end of web apps. It's prepared for a developer that provides an opportunity to give animation to web pages. It is fundamental to give a page the most up-to-date styling techniques on the web. It is a great tool for manipulating objects on the front end of web pages. If used effectively it can make the web page more interactive for the user and grab their attention[4].

Python

Python is a dynamically typed programming language designed by Guido Van Rossum. Much like the programming language Ruby, Python was designed to be easily read by programmers. Because of its large following and many libraries, Python can be implemented and used to do anything from Webpages to scientific research. Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programming, and procedural styles. It has a large and comprehensive standard library. Python is an object-oriented, high-level coding language, which uses dynamic semantics. It is particularly useful for speedy application development because of its high-level data structures and dynamic typing and binding. Python also has a simple syntax, which emphasizes readability, which reduces cost in the development and maintenance process[5].

[3] CSS, https://en.wikipedia.org/wiki/CSS, July 13, 2021, 2:21:09 AM

[4] Javascipt, https://en.wikipedia.org/wiki/JavaScript, July 15, 2021, 2:23:23 AM

[5] Python, https://www.python.org/about/, July 13, 2021, 2:25:21 AM

Php uses Python as its main coding language; this is why it has to be used in the website application. Python is the backbone of the whole application. It connects the database to the front-end. It also tells the database and the front-end which way it is supposed to function. Python is used to manipulate the data in the database to produce the ranked and trending tables. It is the communicator between the front and back ends. Python is somewhat simpler than other languages because the code its self is lighter than some of its counterparts like Java and C++.

Visual Studio Code

Visual Studio Code is an efficient, agile source code editor developed by Microsoft. It is free to download and is open source. It is a useful tool that keeps development environments clean and efficient. All web source code is edited using Visual Studio Code. The tool is free and very straightforward to use. It can handle a wide variety of programming languages that makes it the perfect tool for developers. The text editor is Considered lightweight and compared to other source code editors on the market.it gets straight to the point and lets you start working on your code with no confusion or unnecessary features. Others source code editors may have some beneficial features like they might suggest code to the developer as they type. But if you feel comfortable with working with a language it isn't needed[6].

Php-Web Framework

This is a general-purpose scripting language especially suited to web development It was created by Danish-Canadian programmer Rasmus Leadoff in 1994. PHP code is usually processed on a web server by a PHP interpreter implemented as a module, a daemon, or as a Common Gateway Interface (CGI) executable. On a web server, the result of the interpreted and executed PHP code – which may be any type of data, such as generated HTML or binary image data – would form the whole or part of an HTTP response. Various web template systems, web content management systems, and web frameworks exist which can be employed to orchestrate or facilitate the generation of that response. Additionally, PHP can be used for many programming tasks outside

[6] Vitual studio, https://code.visualstudio.com/, July 13, 2021, 2:28:20 AM

of the web context, such as standalone graphical applications and robotic drone control. PHP code can also be directly executed from the command line. In an IoT-based coma patient monitoring system, we use PHP as its main web framework[7].

3.2.2 Hardware Tools

This project requires not only software tools also need hardware tools. These hardware tools are tools that are needed to implement the system hardware part. For this project, we have used different hardware tools. The same to the software tools these hardware tools have their functional contributions. The hardware parts of tools that have been used in this project are listed in the following table with their categories.

Table 3-2: Hardware tools required

Controller	Sensors	Modules	Display
Arduino Uno	Heartbeat sensors Temperature Body movement Eyeblink Blood pressure	WIFI GSM	20x4 LCD LED

Arduino Uno

Arduino Uno is a microcontroller board based on an 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists of other components such as crystal oscillator, serial communication, voltage regulator, etc. To support the microcontroller.

[7] Php, https://en.wikipedia.org/wiki/PHP, July 13, 2021, 2:31:48 AM

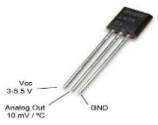
Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header, and a reset button[8]. In this project, we use Arduino Uno for controlling the processes or information of the patients extracted from the sensors and sent to the database

Heart Beat Sensor

The heartbeat sensor is designed to give a digital output of heat beat when a finger is placed on it. When the heartbeat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to the microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through the finger at each pulse an optical heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occurs when the heart pumps blood. Pulse waves are detected by measuring the change in volume using an optical sensor and LED. Adopting an optical filter optimized for pulse wave detection in the sensor block minimizes the effects of ambient light such as red and infrared rays[9].

In these projects, we use the heartbeat sensor to measure the heartbeat of the patients. This sensor is measure while the finger is placed on it. So, by placing the sensor on any part of the patient's and the measured value will be store in the database. And the doctors (the health care) will see it and if there is any chance they will check the patients.

Temperature sensor



Temperature Sensors are a simple instrument that measures the degree of hotness or coolness and converts it into a readable unit. Temperature sensor is essentially an electronic device used to take accurate temperature measurement readings.

[8] Arduino Uno, https://en.wikipedia.org/wiki/, July 13, 2021, 2:38:09 AM

[9] Heartbeat, https://www.rohm.com/sensors, July 13, 2021, 2:50:06 AM

Temperature sensors are available in different "types". We have a wide selection in our product portfolio. Each type uses a different measurement technique to give its result[10].

In this project, we have used temperature sensors to measure the body temperature of coma patients. And it stores the results (the measured value of the body temperature of the patient) in the database and the doctors or the health care can access the result of the value remotely using the website. Then if there is a difference in increasing or decreasing the body temperature the doctors (health care specialists) will check the patients.

Body movement sensor

Motion sensing is a critical sensing modality that plays an important role in medical practice. The current clinical solution for motion sensing, where the body motion is derived from the movement of multiple feature points attached to the body. The motion detector detects moving objects, particularly people. A patient movement & monitoring system is a system that is used to detect movement changes in a coma patient[11].

In this project, the body movement sensor is used to keep the change of the body or body movement of a patient. And this change will be notified to the doctor (health care specialists). This body movement is maybe either abnormal behavior or unusual changes made by the patient in the absence of the doctor. So, this change maybe it hurts the patient while he/she is moving so the doctor has to check them.

16x2 LCD (Liquid Crystal Display)

It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even

[10] Temperature, https://www.fierceelectronics.com/sensors/, July 14, 2021, 11:55:29 AM

[11] Body movement sensor, https://www.ncbi.nlm.nih.gov/, July 19, 2021, 07:33:14 AM

animations, etc.[12] In this project the LCD is used to display the vital signs detected to the patient being both in the doctor's room and the nurse room.

PIR Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications. PIR sensors are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". The term passive refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects[13].

Eye Blink Sensor

The Eye Blink sensor is IR-based. The Variation Across the eye will vary as per eye blink. If the eye is closed means the output is high otherwise output is low. This is to know the eye is in a closing or opening position. This output is given to the logic circuit to indicate the alarm. For this project, we have used the eyeblink sensor to detect while the patient's eye is g open

GSM-Module

A GSM modem or GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially dentical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network. GSM modems typically

[12] LCD, https://www.thingbits.in/products/, July 19, 2021, 12:37:06 PM

[13] PIR Sensor, https://en.wikipedia.org/wiki/, July 14, 2021, 12:49:07 PM

provide TTL-level serial interfaces to their host. They are usually used as part of an embedded system[14]. This GSM module has been used in this project to send an SMS for both special cases that happened to the patient. These two cases are eyeblink and body movement. While these two cases have happened the GSM, module sends both doctor and nurse an SMS to notify them of the condition.

Wi-Fi-Module

The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability, produced by Expressive Systems in Shanghai, China. The chip first came to the attention of Western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first, there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, the chip, and the software on it, as well as to translate the Chinese documentation[15].

This Wi-Fi module is used to connect both Arduino and the server for data transferring. The data or information related to the patient are sent to the server via the help of this Wi-Fi module.

Blood Pressure Sensor

Blood Pressure Sensor is a non-invasive sensor designed to measure human blood pressure. It measures systolic, diastolic, and mean arterial pressure utilizing the

[14] GSM-module, https://en.wikipedia.org/wiki/, July 14, 2021, 1:22:57 PM

[15] Wife-Module, https://en.wikipedia.org/wiki/, July 21, 2021, 1:31:02 PM

sociometric method. Pulse rate is also reported[16]. The blood pressure sensor is used to measure the blood pressure level of the patient.

LED

An LED lamp or LED light bulb is an electric light that produces light using light-emitting diodes (LEDs). In this project we have used to indicate when sudden case has been happened.

[16] Blood pressure sensor, https://www.vernier.com/product/, July 21, 2021, 2:45:54 AM

CHAPTER 4: SYSTEM DESIGN

This project has both hardware and software parts of design. The software part design shows that the development of both the database and the website. And the hardware part design is about the designing of the overall of the components interfacing of with the Arduino controller. Both each part is discussed one by one as following.

4.3 Software Design

The software part system design of this project contains two parts. These are the frontend part and the backend part.

3.3.1 Frontend Design

The front-end of a website is the part that users interact with. Everything that you see when you're navigating around the Internet, from fonts and colors to dropdown menus and sliders, is a combo of HTML, CSS, and JavaScript being controlled by your computer's browser. These frontend design includes:

Flow chart: - A flowchart is a type of diagram that represents an algorithm, workflow or process. This illustrates a solution model to a given problem and are used in analyzing, designing, documenting or managing a process or program in various fields, they also help visualize what is going on and thereby help understand a process. For this project overall system flow chart that the system doing with is drawn. It represents from the starting to the end of the system follow up *(See figures).*

Another flow chart shown is that the individual for the actors of the system. These are administrator, doctor and a nurse. It illustrates all the step by step what each individual actor does while they are using the system, even when the use the website. The admin of the system does register the new patient, creating the account both for nurse and doctor. And also post the status of the patient. The doctor can login the website, and check the patient's status. And also, if there is any case he/she can give prescription for the patient

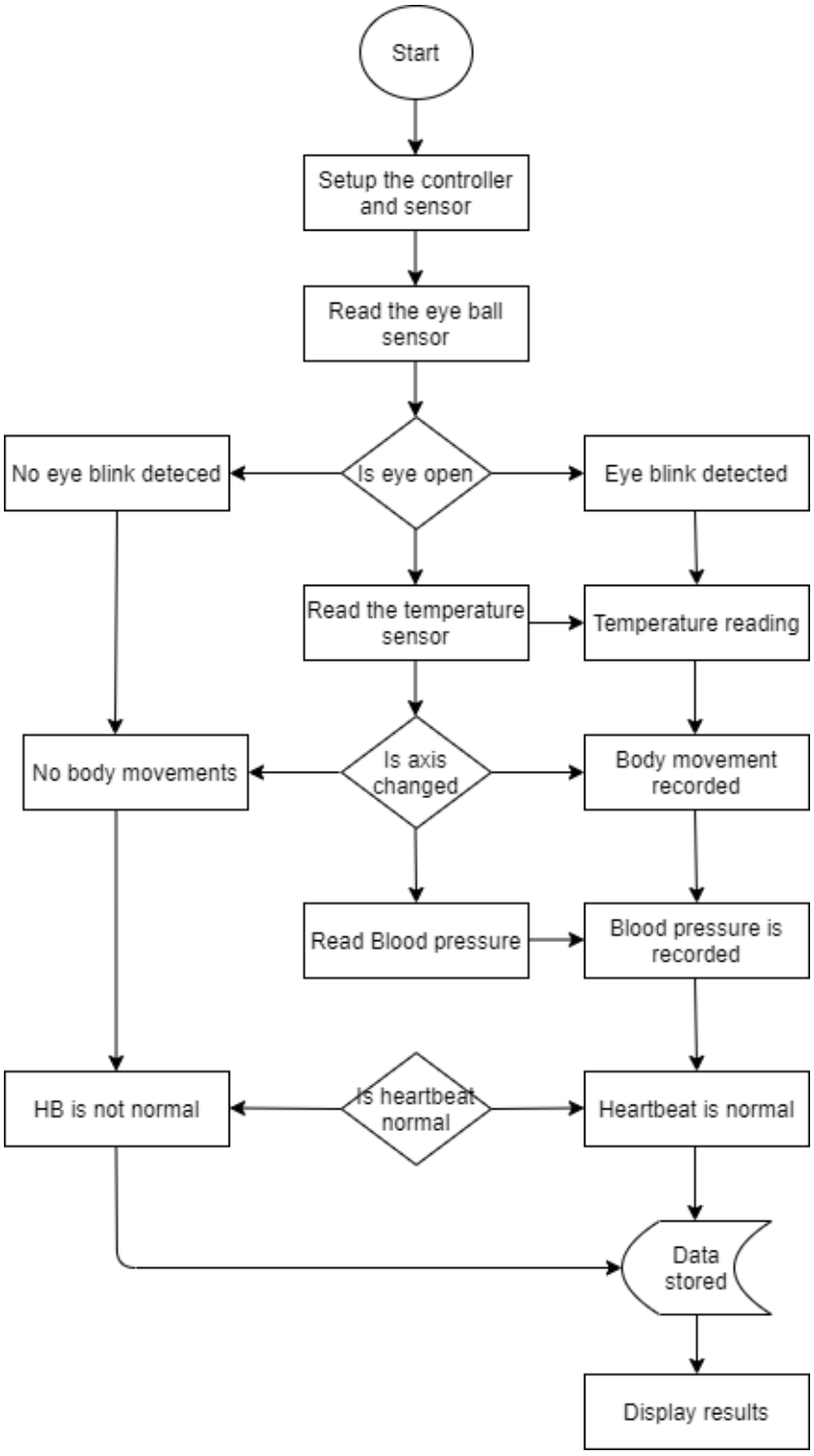


Figure 4-1: Overall system diagram

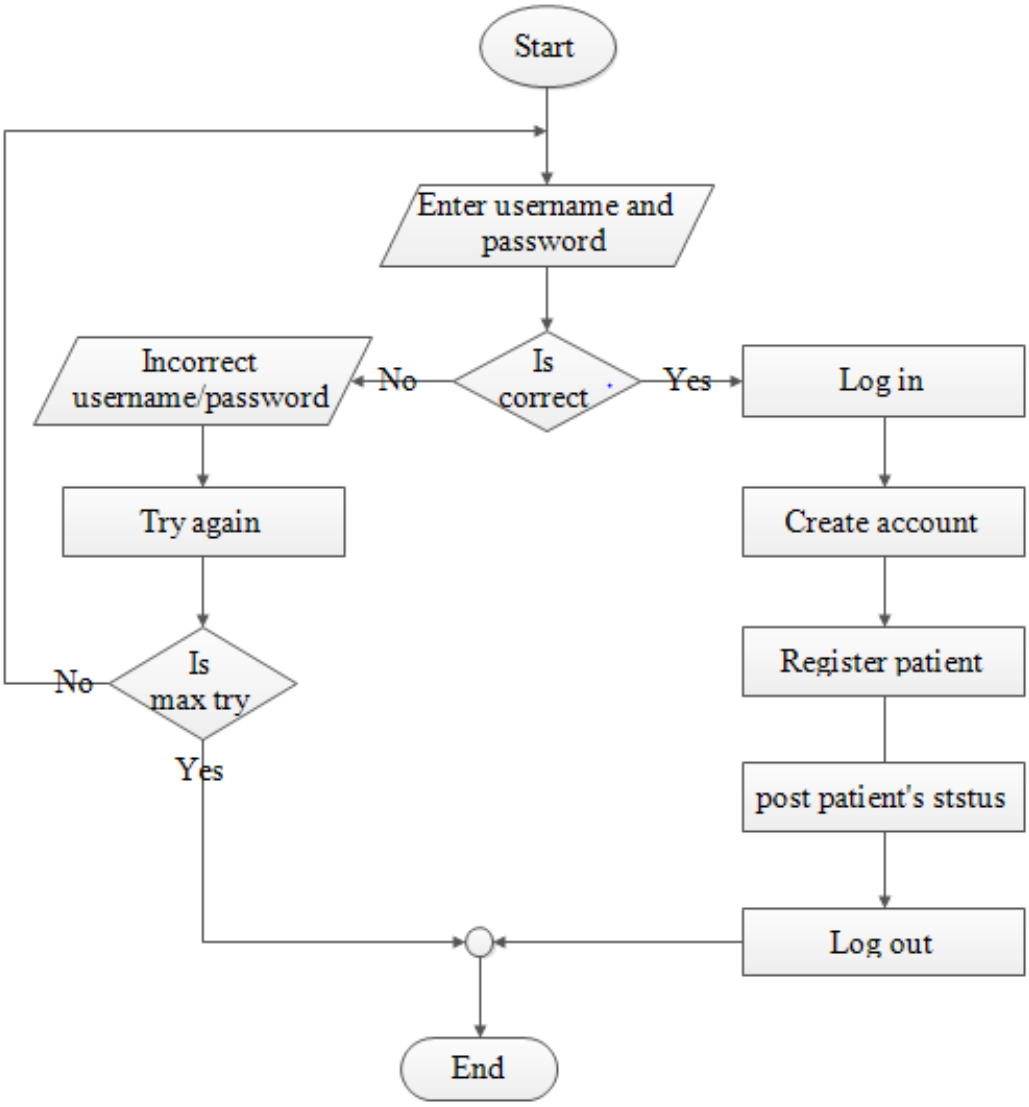


Figure 4-2: Admin flow chart

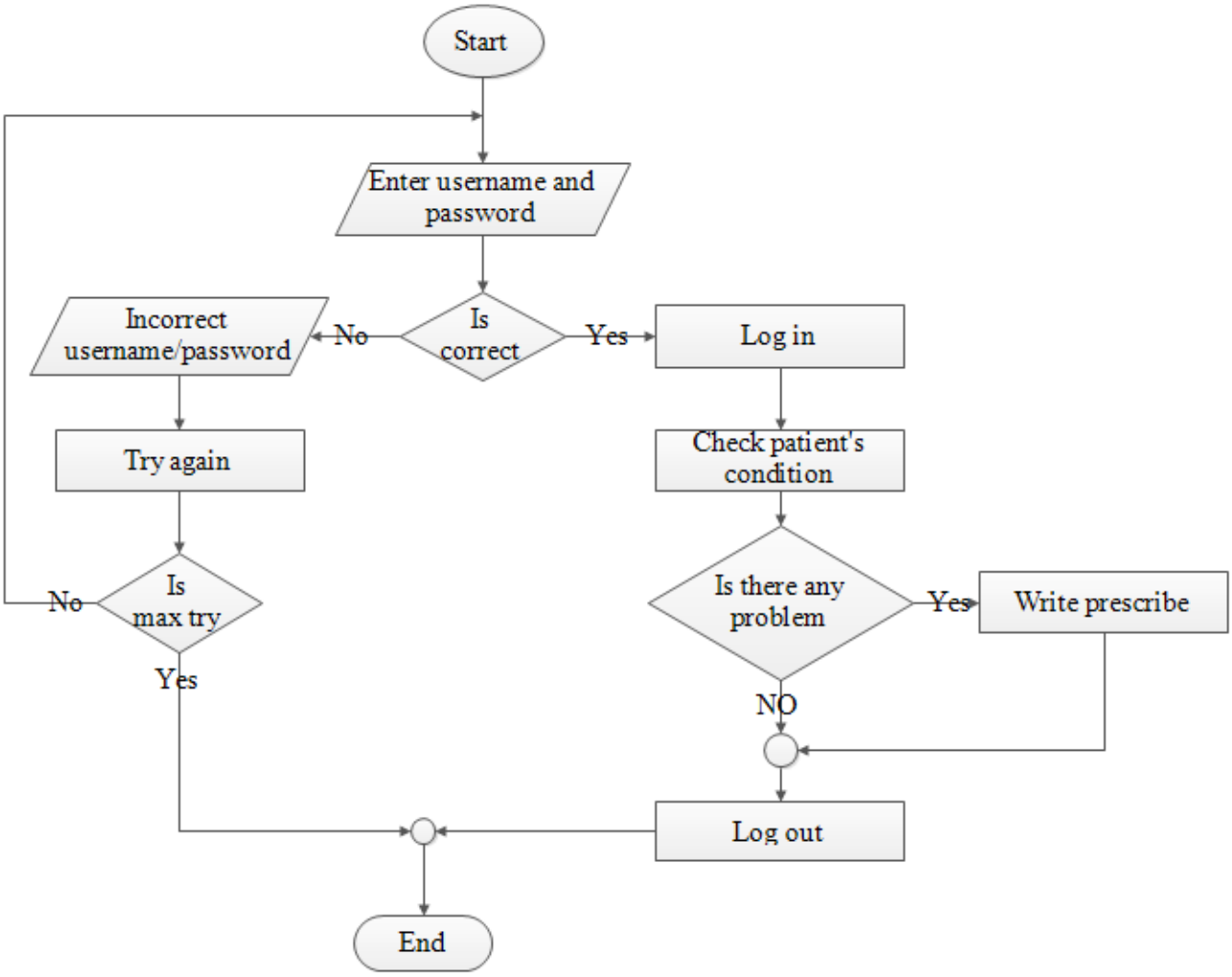


Figure 4-3: Doctor flow chart

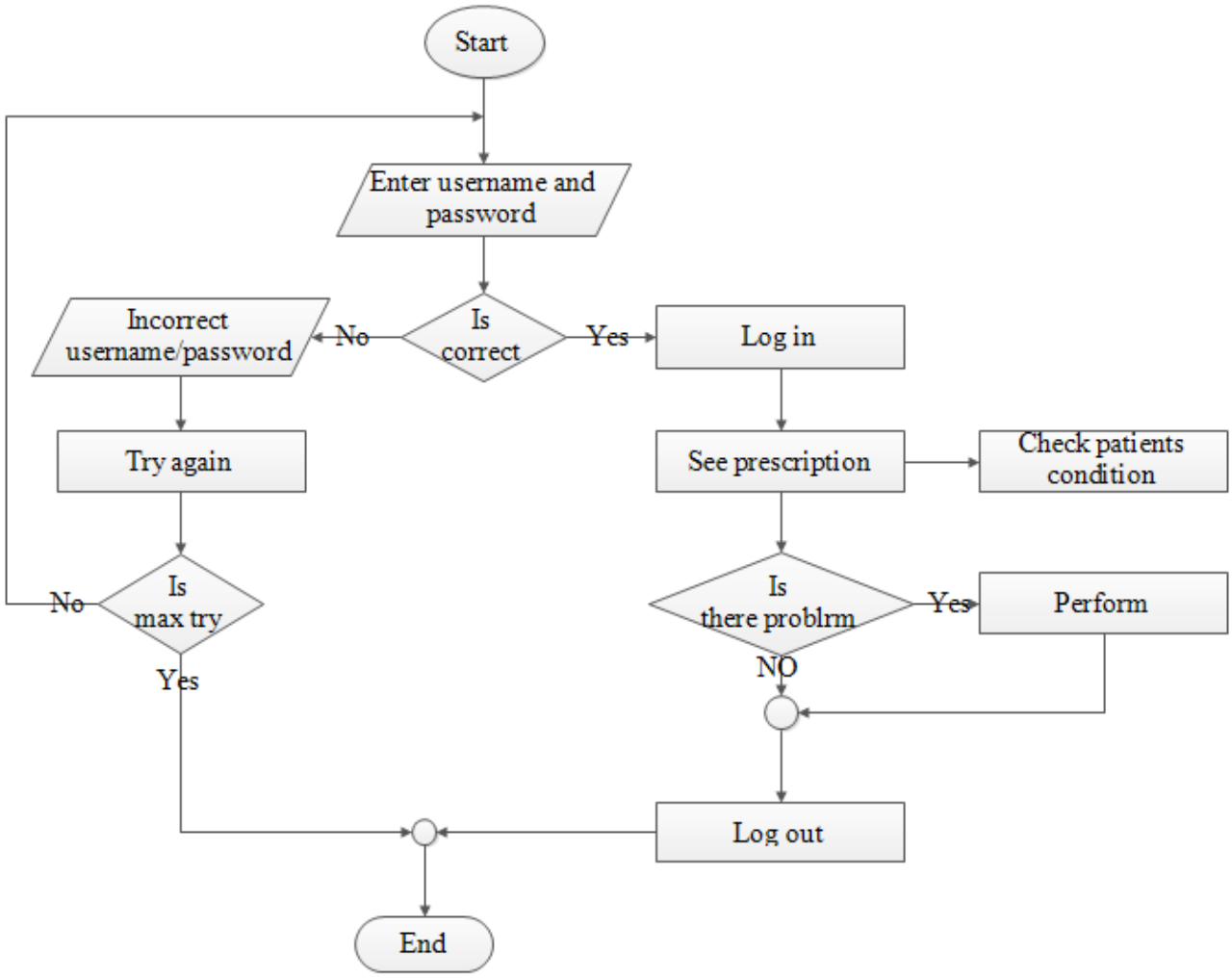


Figure 4-4: Nurse flow chart

ER Diagram: - These illustrate the logical structure of databases, that is, they indicate how information in the databases is created, stored, retrieved and used by a business system to support the activities performed. The ERD enables users to identify individual pieces of information in the system and how they are related to each other. They will be used because they are relatively simple, user friendly and can provide a unified view of data, which is independent of any data model.

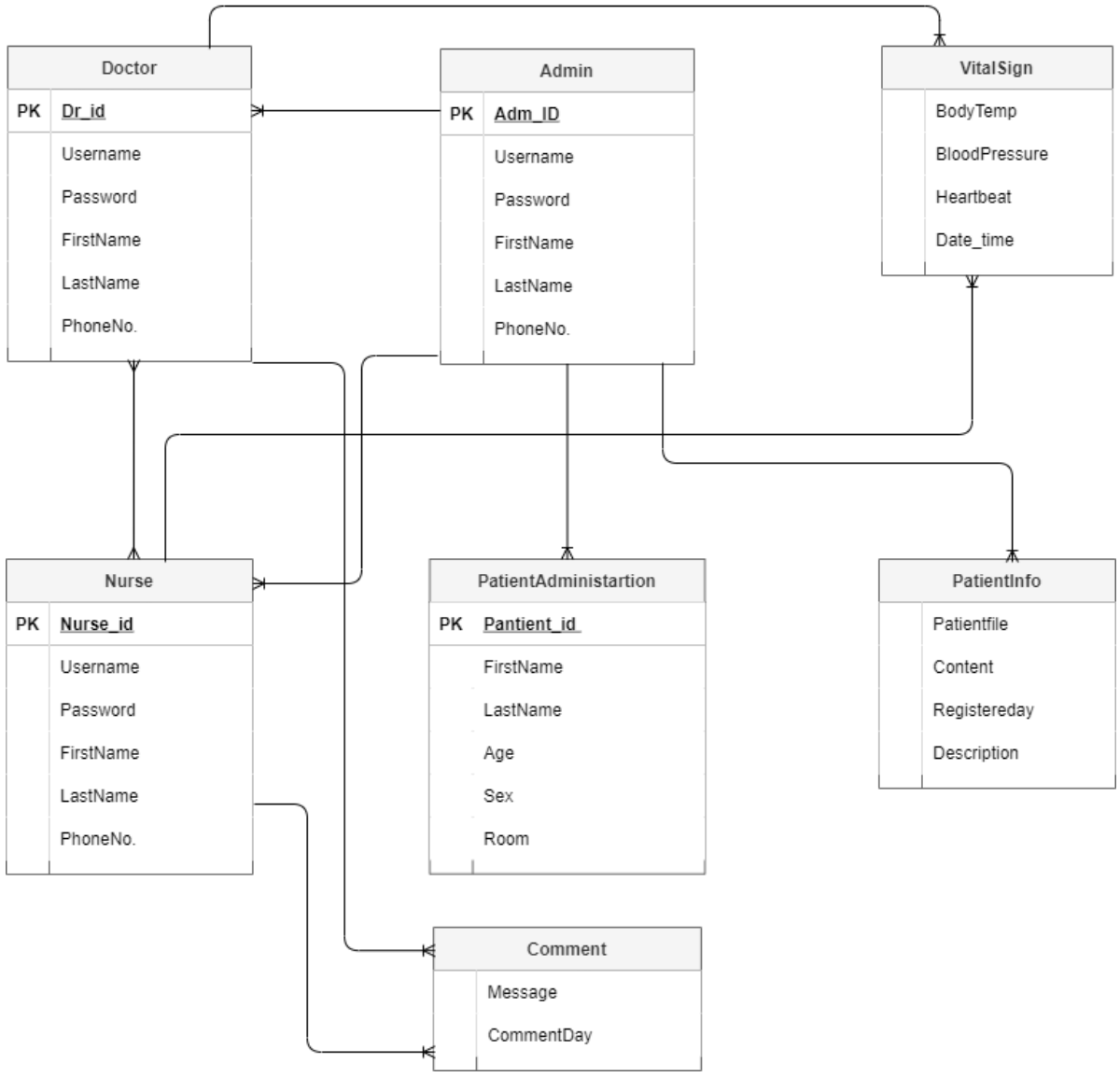


Figure 4-5:ER Diagram

3.3.2 Backend Design

The back-end of a website consists of a server, an application, and a database. A back-end developer builds and maintains the technology that powers those components which, together, enable the user-facing side of the website to even exist in the first place.

Use Case Diagram: - A use case diagram includes a set of use cases (including cases, actors and their relationships) where each use case is a description of the functionality of the system from the user's perspective. Use case diagrams are used to show the functionality that the system will provide and to show which users will communicate with the system in some ways to use that functionality. Use case diagrams are a set of use cases, actors and their relationships. They represent the use case view of a system. The following figure shows the use case diagram.

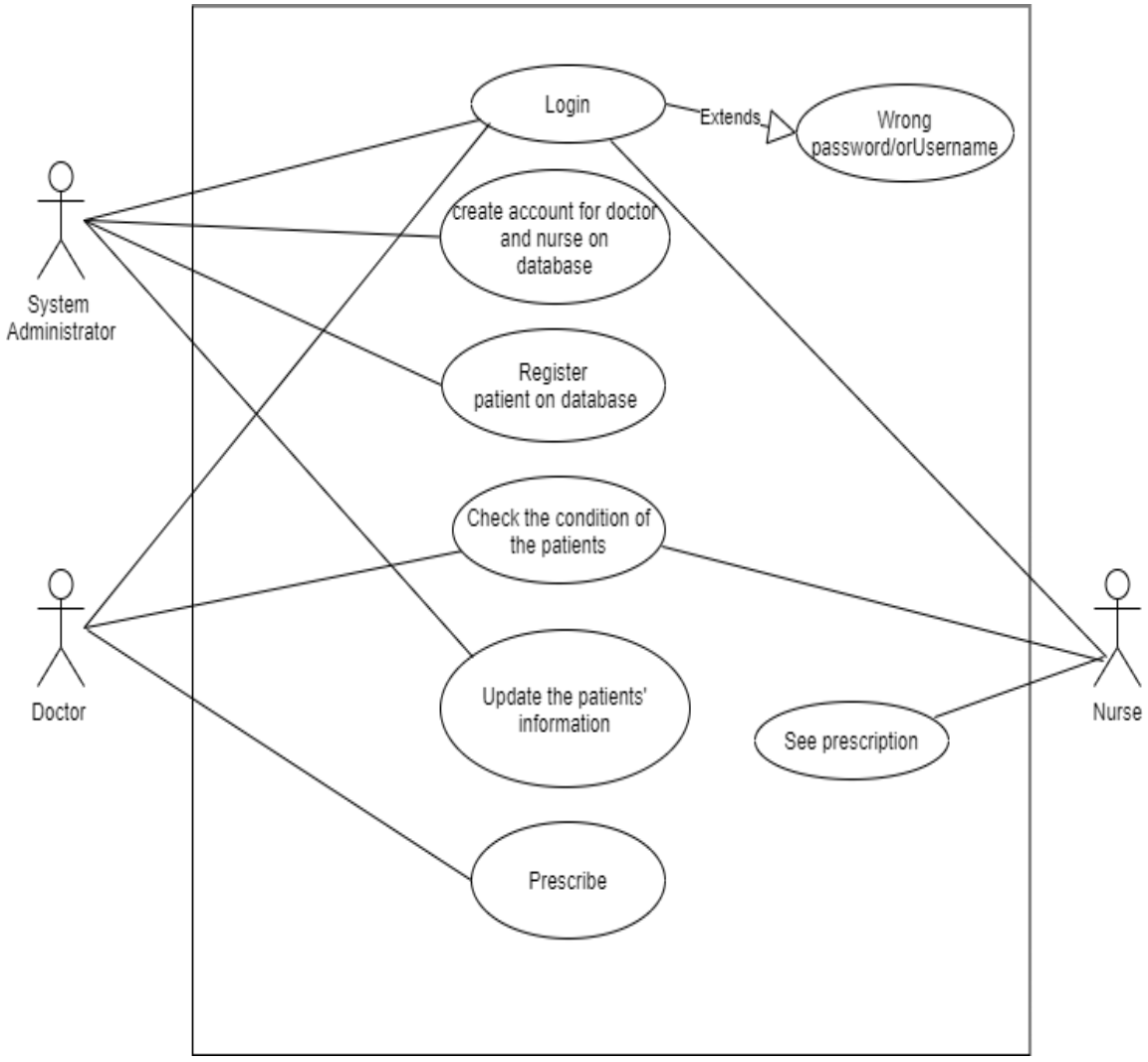


Figure 4-6: Use case diagram

Sequence Diagram: - A sequence diagram in a Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged

in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams typically are associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

For this project the sequence diagram is shown for individual actors of the system. These are administrator, doctor and a nurse. It illustrates all the sequence what each individual actor does while they are using the system, even when the use the website. The admin of the system does register the new patient, creating the account both for nurse and doctor. And also post the status of the patient. The doctor can login the website, and check the patient's status. And also, if there is any case he/she can give prescription for the patient. The following are the sequence diagram of the actor of the system. The sequence diagrams listed below illustrates all the follow up

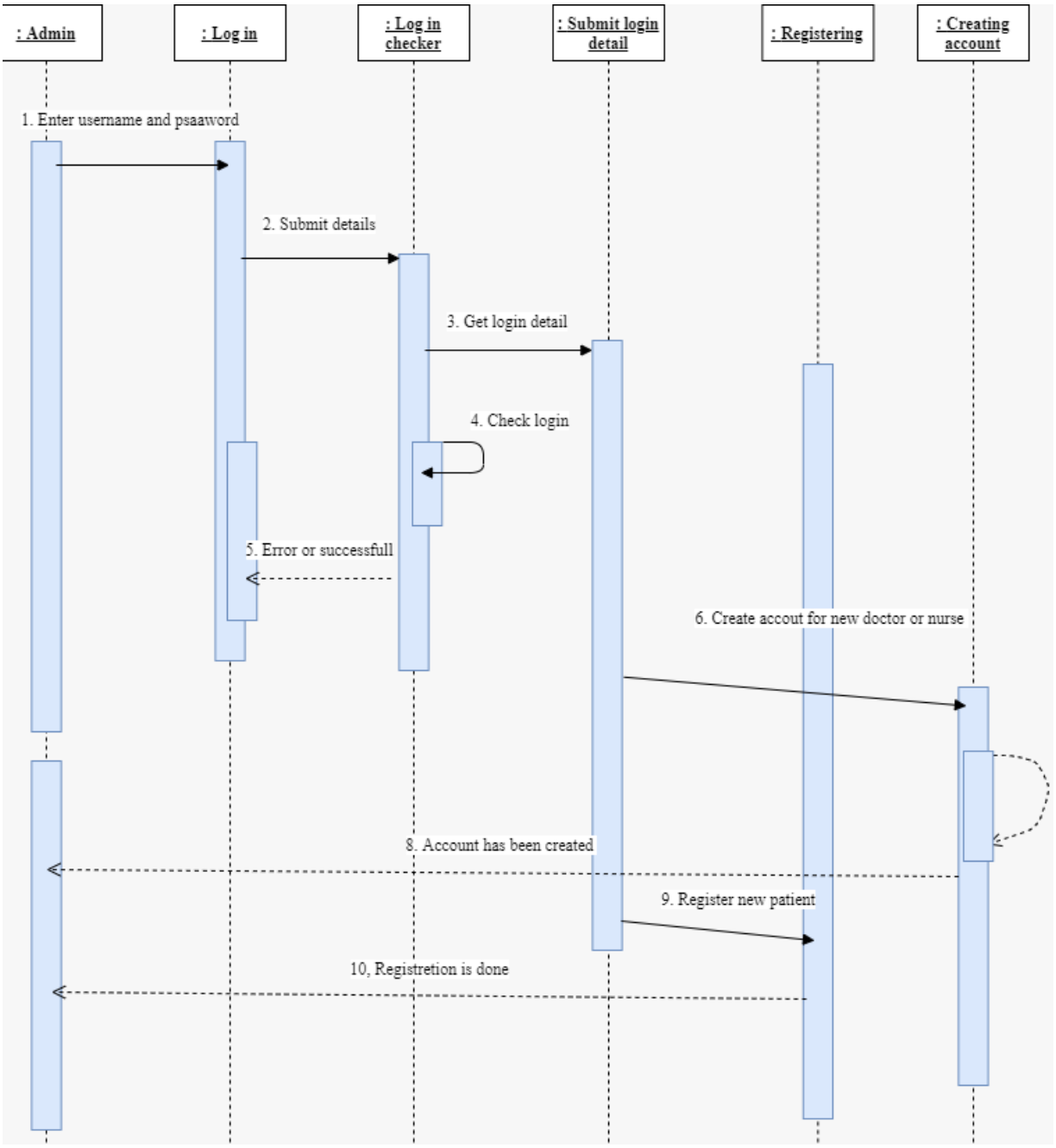


Figure 4-8: Admin's Sequence diagram

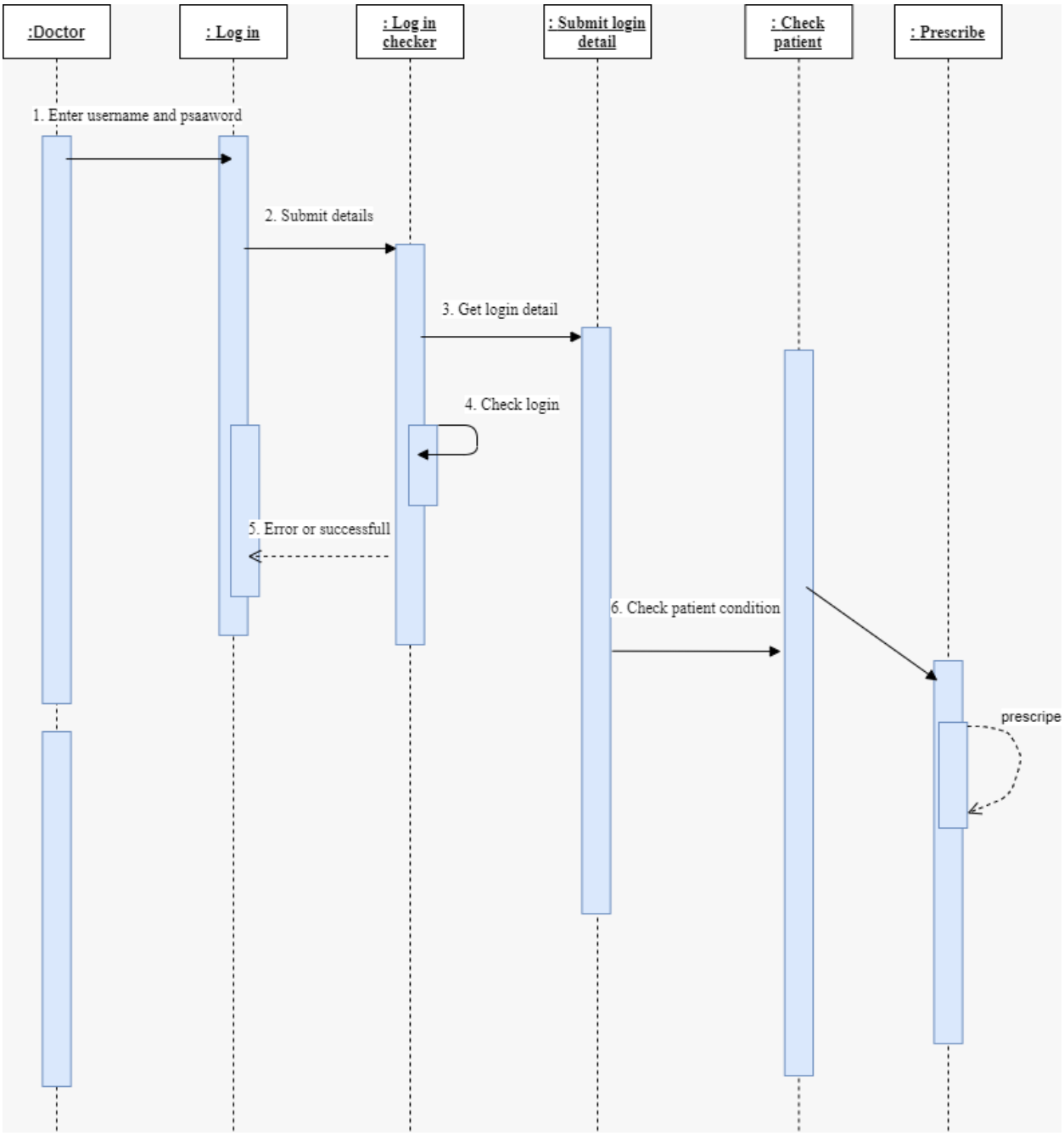


Figure 4-9: Sequence diagram for doctor

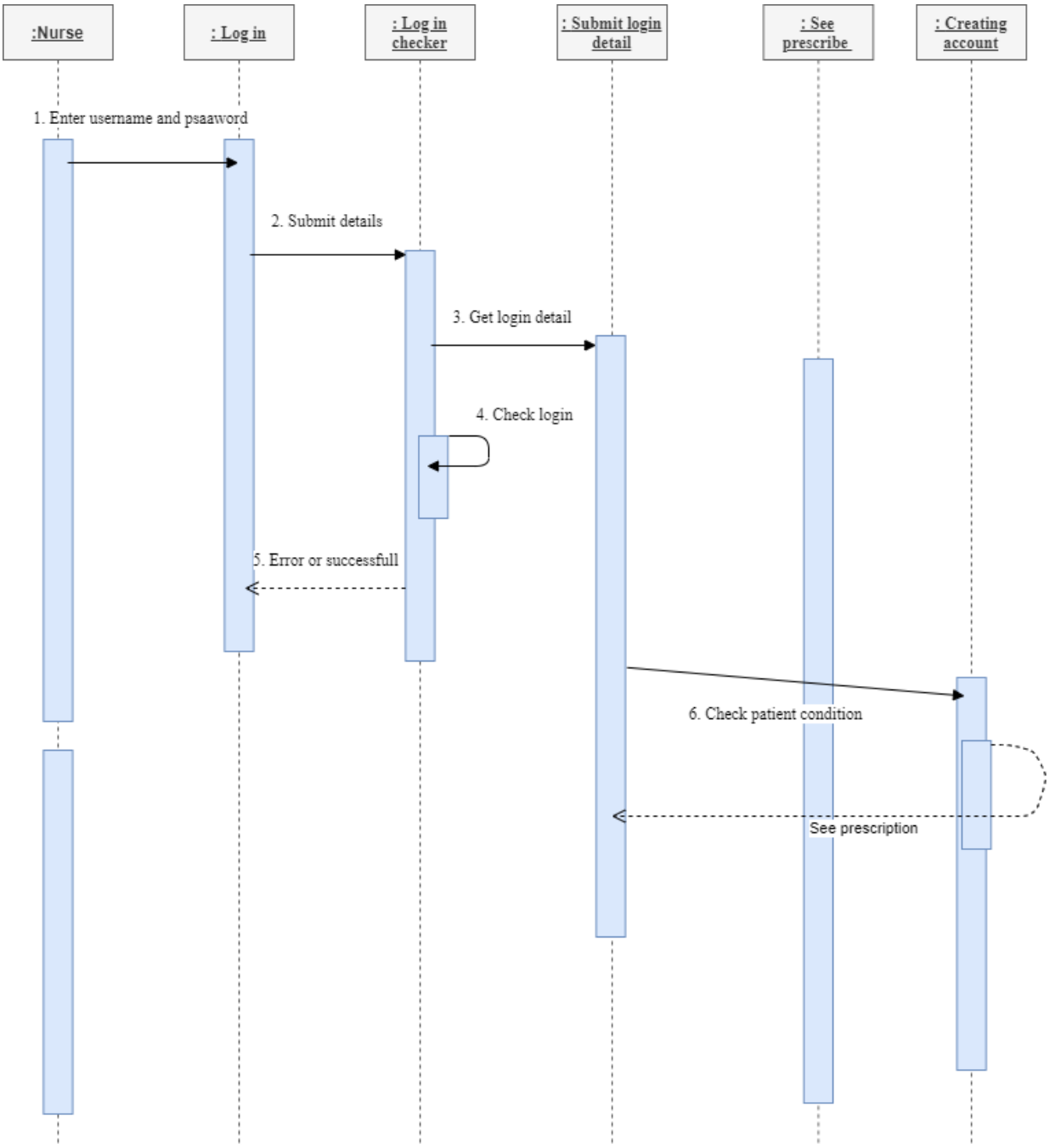


Figure 4-10: Sequence diagram for nurse

Class Diagram: - A design class diagram shows a collection of classes, attributes with their detail description, method, association and collaboration. It is directly converted to physical data modeling. The following class diagram is for this project's website part. It includes all about the necessary things that needed in the system. So, it has been directly converted to the physical data modeling.

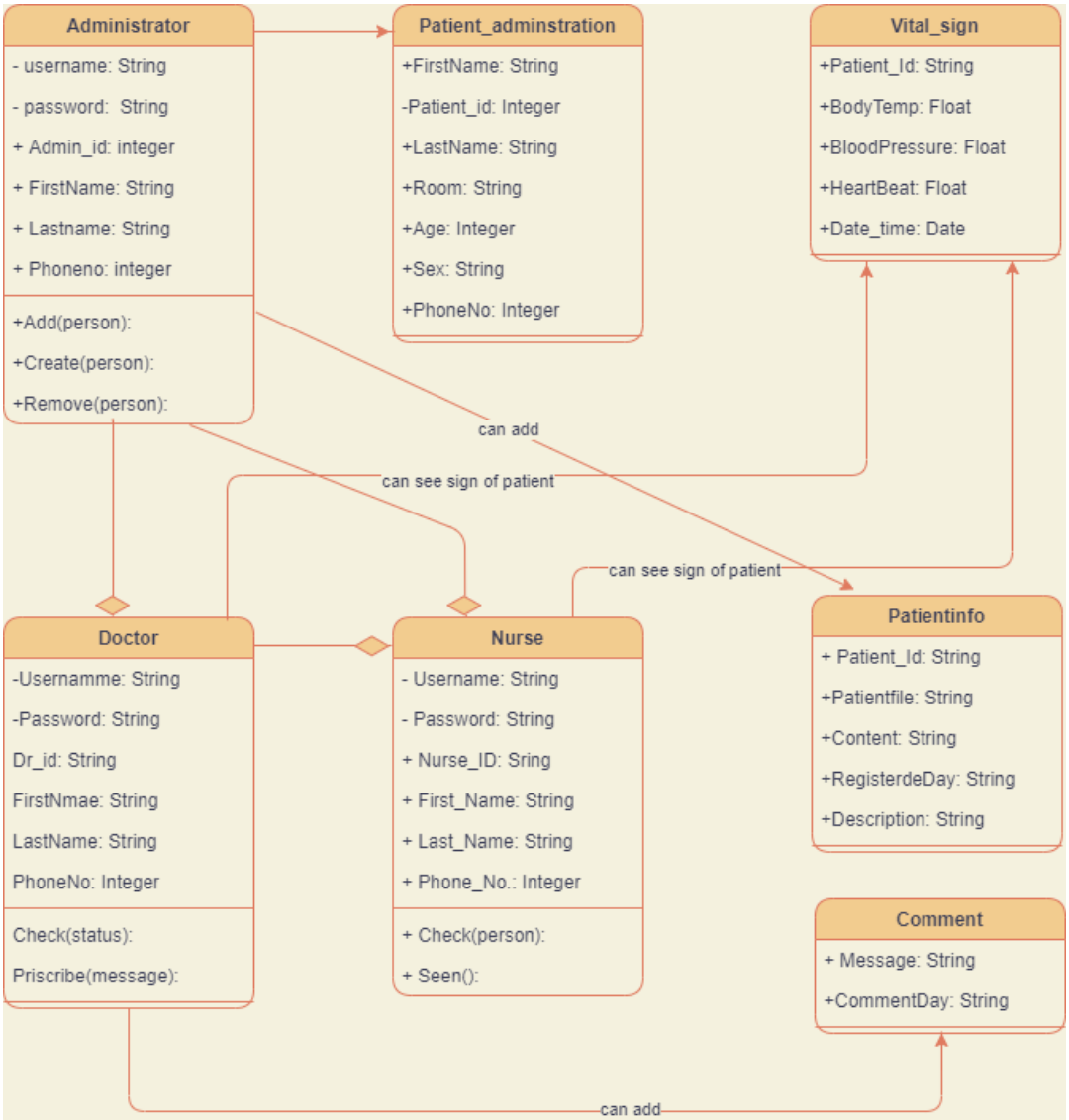


Figure 4-11: Class diagram

4.3.2 Hardware Part System Design

This is hardware part of the system which includes all about the interfacing of the hardware components required in the system with the Arduino microcontroller. These components are the sensors which are used for the extract the condition of the patient. These components must be interface with the microcontroller to work properly. Other components are the interfacing of the LCD, LED Wi-Fi module, and GSM module. The interfacing components is designed and simulated properly as shown on below figure.

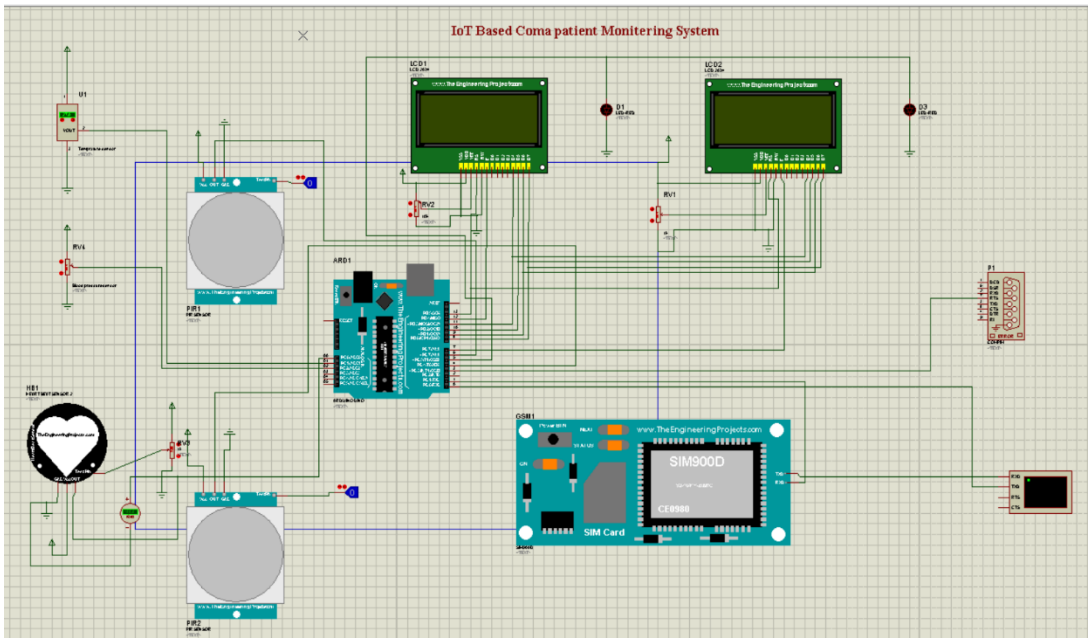


Figure 4-12: Hardware design

4.3 Overall System Design Block Diagram

The overall block diagram of the system of IoT-based coma patient monitoring system is as the following. First, the information is collected by using different sensors such as heartbeat, blood pressure, body movement, eye blink, and body temperature sensors. And all these measured or recorded data are sent to Arduino from the sensors. Depending on the codes written for each sensor for the Arduino the information about the patient or information measured from all sensors are displayed on the LCD. And also, by using the Wi-Fi module connector, this information is saved on the cloud database server. Then whether the doctor or nurse can access the updated information about the coma patients from the cloud database server.

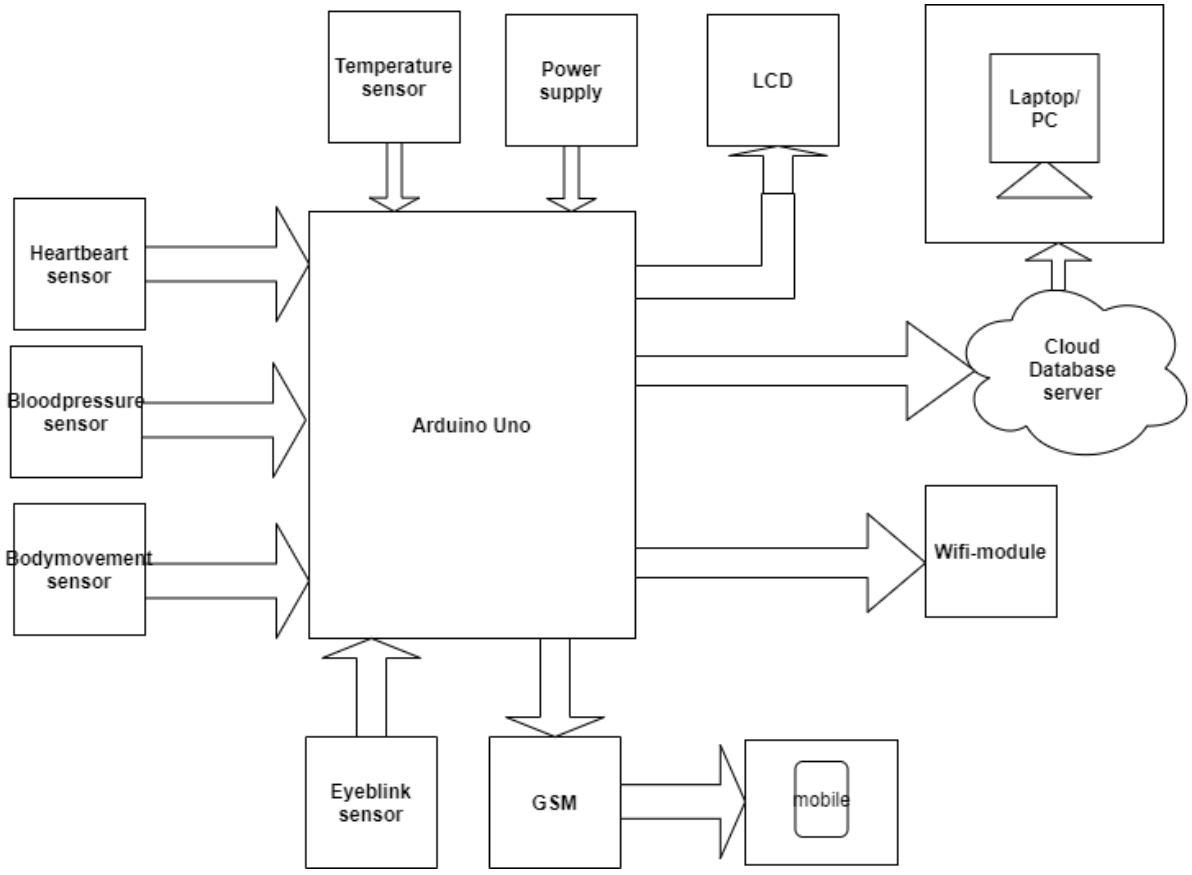


Figure 4-13: Overall system design block diagram

CHAPTER 5: RESULT AND DISCUSSION

5.1 Results

The following are the results we have observed from the simulation and implementation

5.1.1 Hardware part

Heartbeat Sensor: - is simulated and able to produce bit per minute value of the heart bit whenever the patient is used. And create Awareness of vital sign information to the doctors and nurses

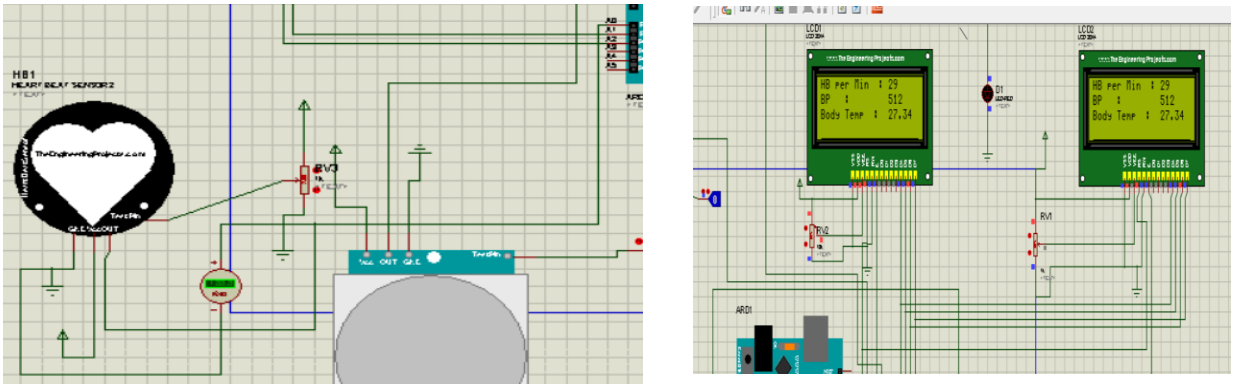


Figure 5-1: Heartbeat sensor result

Body Temperature sensor: - the temperature sensor detects value of the body whenever the patient is used. And has been created awareness of vital sign information to the doctors and nurses

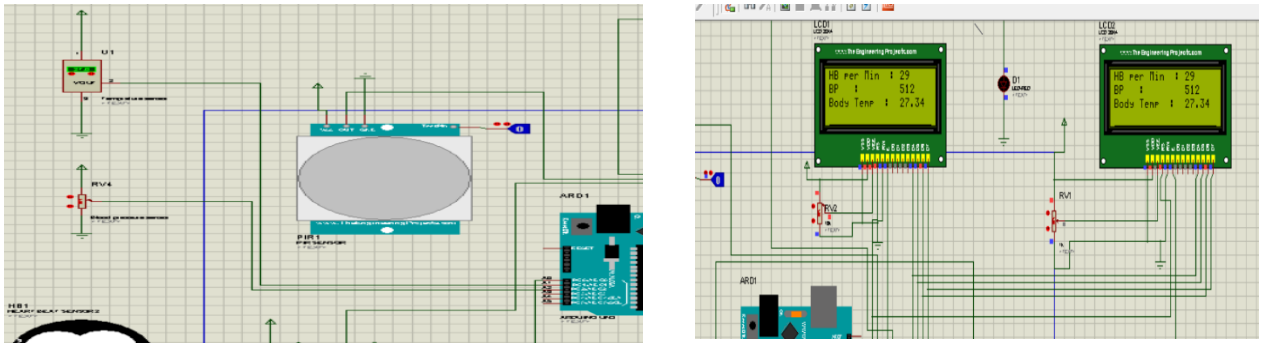


Figure 5-2: Blood temperature sensor result

Blood Pressure Sensor: - the blood pressure senses the value of the blood pressure whenever the patient is used. And create awareness of vital sign information to the doctors and nurses

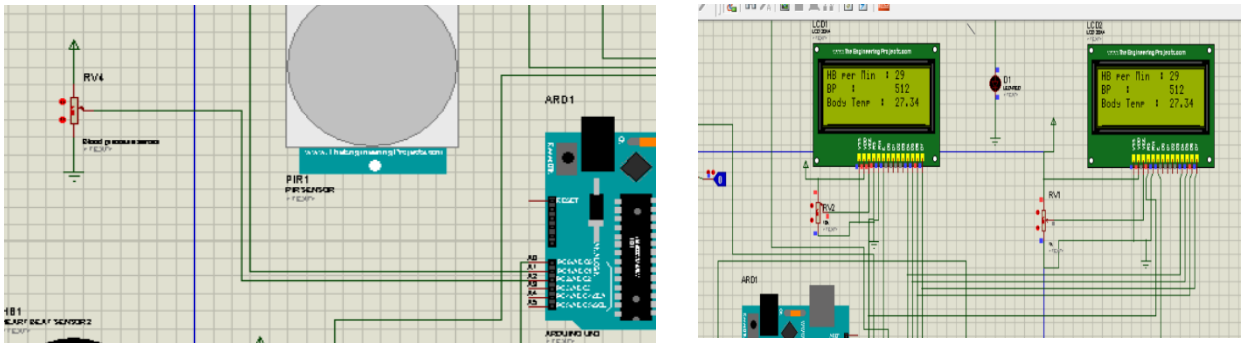


Figure 5-3: Blood pressure

Eyeblink And Body Movement Sensor: -are correctly designed and simulated. From the simulation when the logic terminal of both sensors be at high value the virtual terminal shows as the GSM is sending the message whether to the doctor or to the nurse. In both cases it shows that the detection of the motion whether eyeblink or other body parts of the patient. And create Awareness of vital sign information to the doctors and nurses using GSM

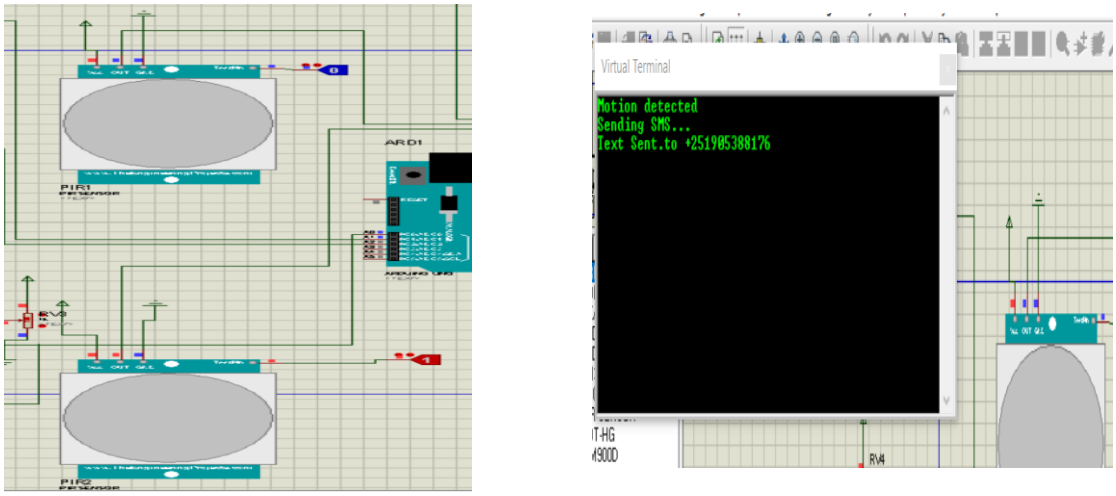


Figure 5-4 Eyeblink and body movement result

LCD 20x4 Sensor: - The LCD correctly interfaced to the Arduino and displays the information needed from the system. As shown on the figure below the blood pressure, temperature and the heartbeat information are displayed on the LCD depending on the information of the patient's

condition. This implies that it is giving awareness to Doctor and nurse continuously vital sign detected.

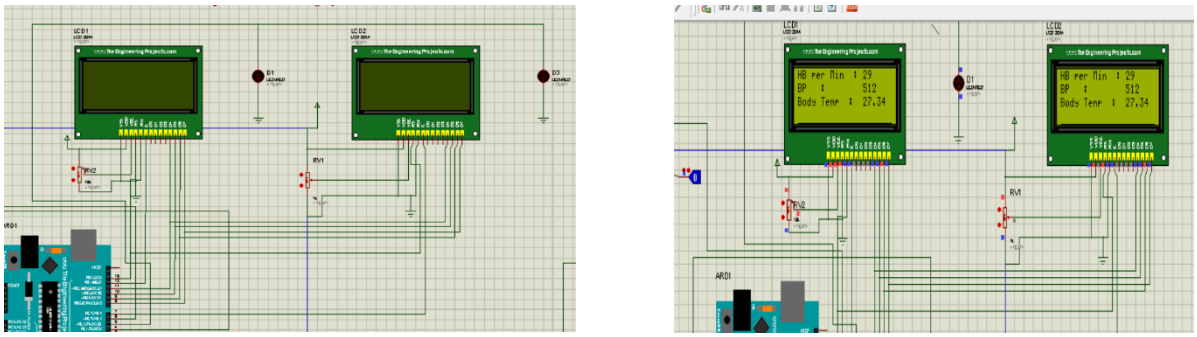


Figure 5-5: While LCD displaying the results sensor

GSM module: - the GSM module is also interfaced to the Arduino and works properly. While we run the simulation, we have seen that the GSM is sending SMS to the doctor or to the burse if one of the detections is happened whether eyeblink or body movement is detected. The following figure shows while the GSM is sending the SMS for the Motion detected.

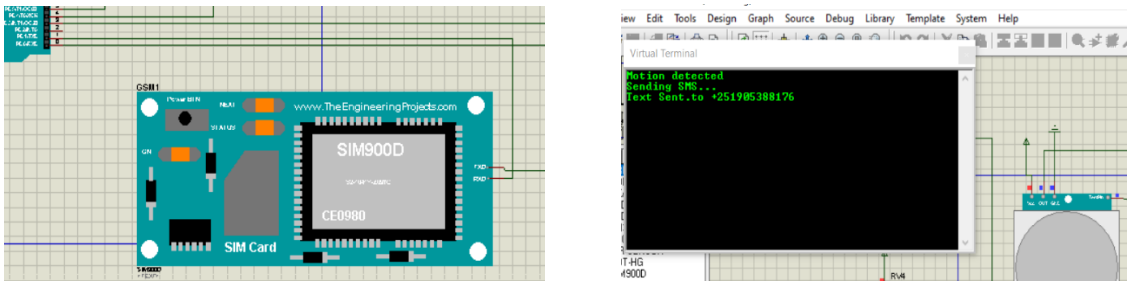


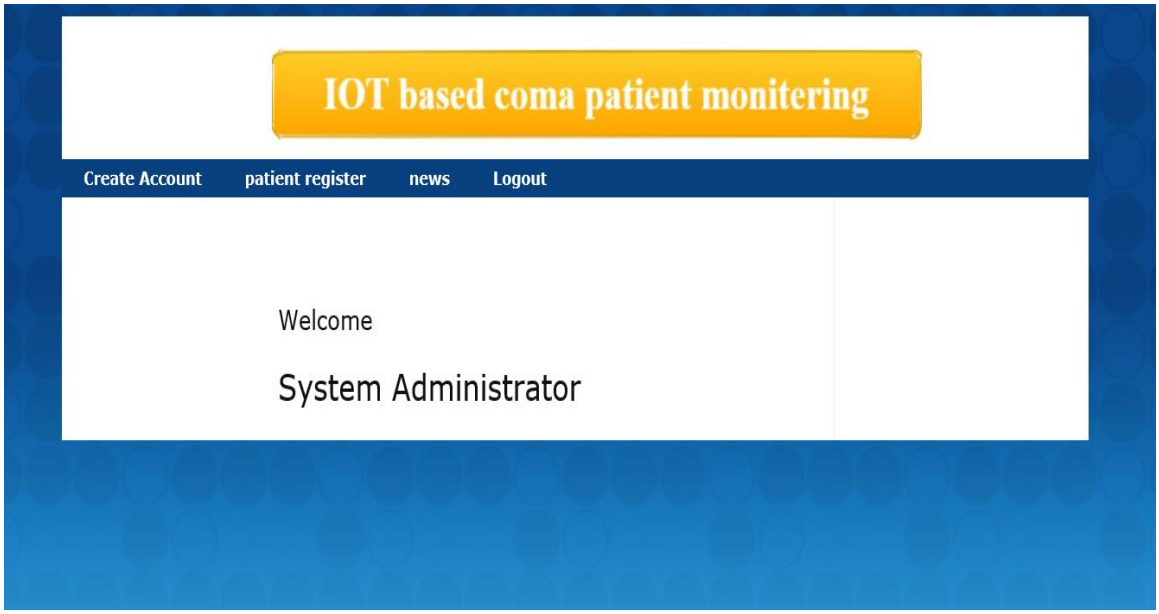
Figure 5-6: When GSM sending the message

Software part

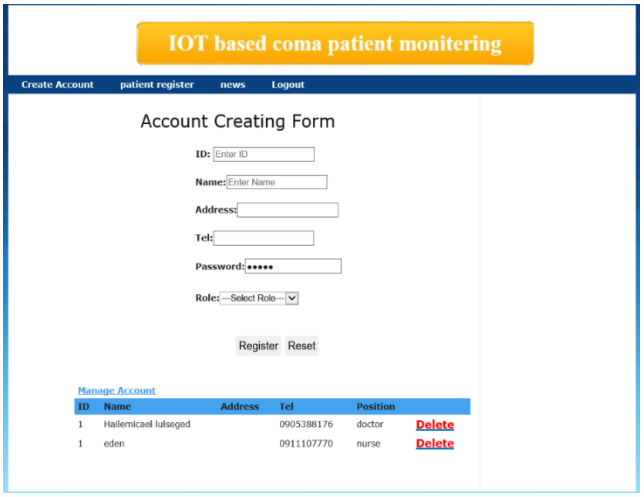
The software part of the system is developed properly and the users whether admin or doctor and also nurse can be login to the system. The following figure shows the graphical user interface of the website that can be seen at the first step when the users search the website. We checked this part by entering both as a doctor or as admin of the system and also as a nurse into the website and it allows us to login for both cases.

Figure 5-7: Login page

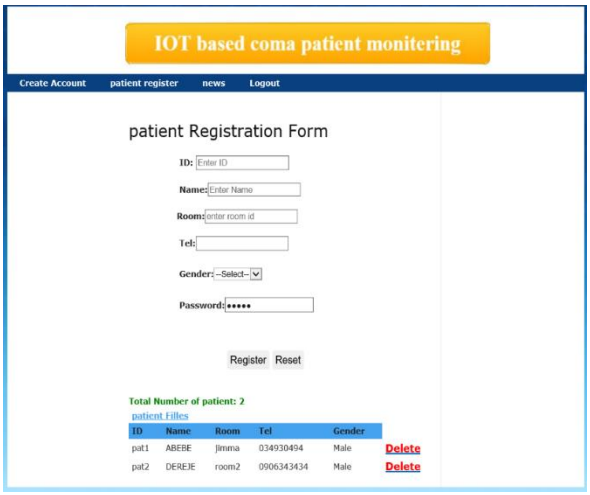
Admin privilege or authorization: - as an admin of the system we have login to the website and accessed successfully detail information for the administrator. The following is the result of we have got.



create account for doctors and patient



for patient registration



The patient to be monitored

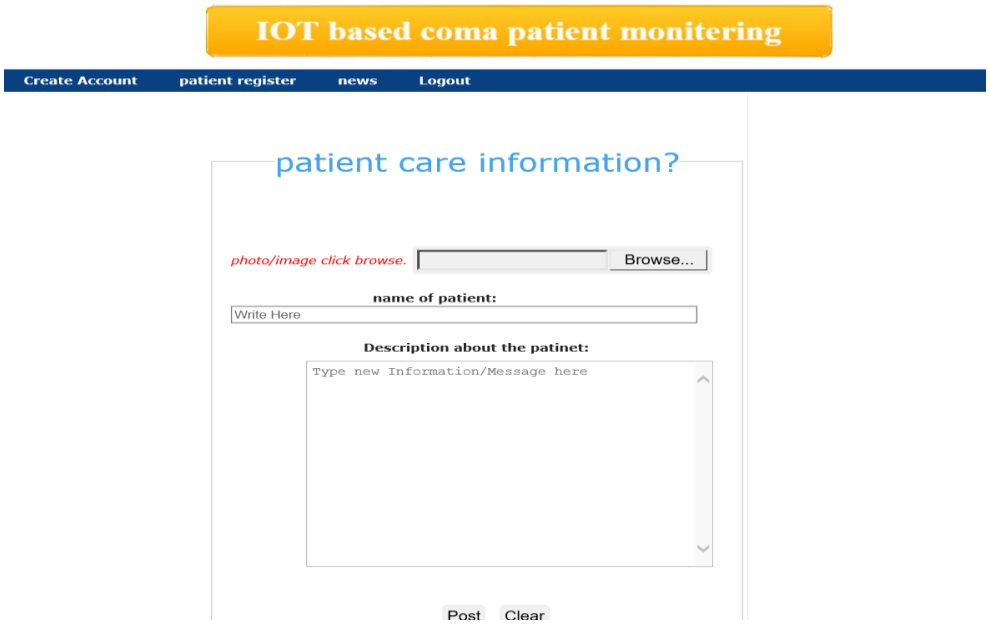
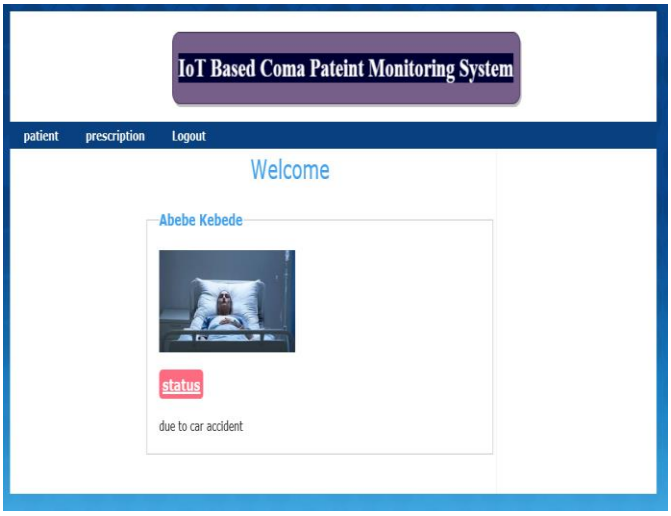


Figure 5-8: Admin privileges

Doctors privilege or authorization: -while we login as the doctor we have accessed all the information about the coma patient. The followings show as the patient's current information and status at that time. And also, it allows as to prescribe for the patient depending on the information and status of the patient.

patient information



patient status

Prescription page

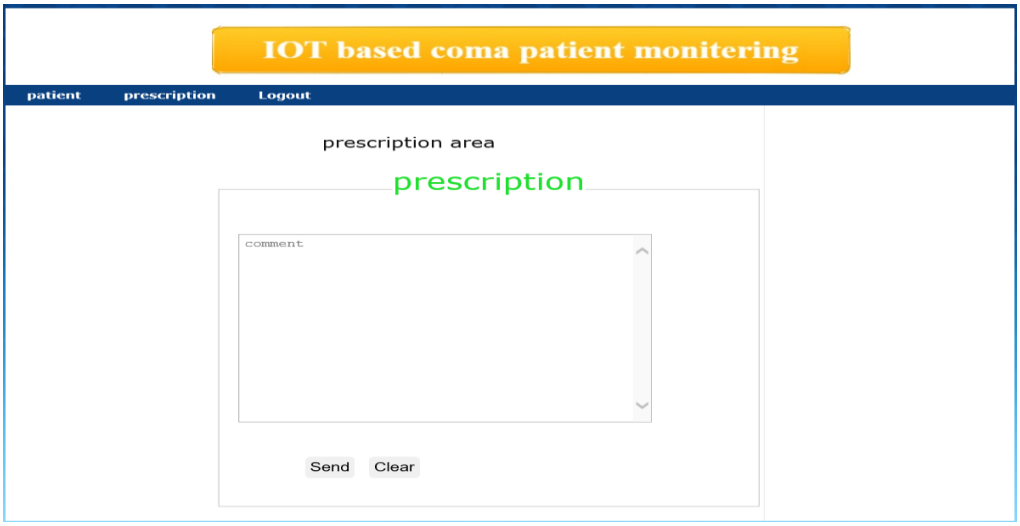
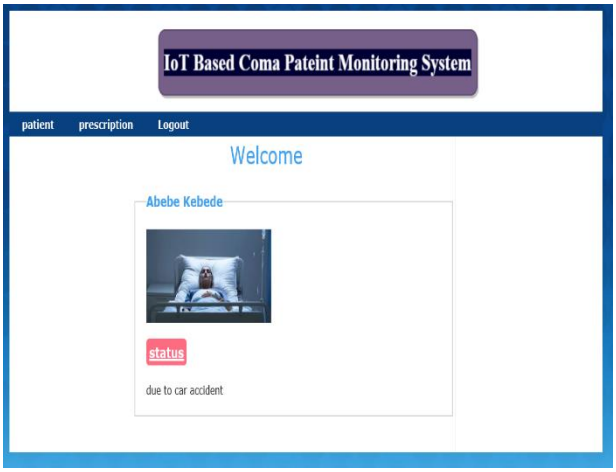


Figure 5-9: Doctor's privileges

Nurse privilege or authorization: - as a nurse also we have logged in and able to access the detailed information related to the patient.

patient information



patient status

Figure 5-10: Nurse's privileges

Doctor's Prescription

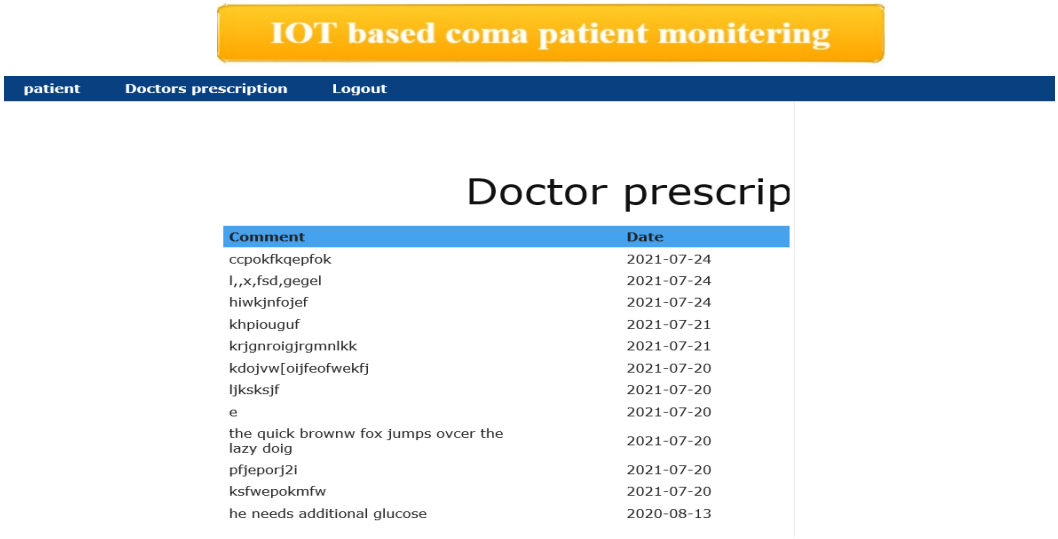


Figure 5-11: Nurse's Privileges

The hardware and the software parts of the system are integrated together and gave the result that the patient can be monitored. In this way on the patient side the sensors gave the information to the micro controller and by using serial communication they transfer data to the database using python pyserial communication.

Fetching body temperature data from the hardware

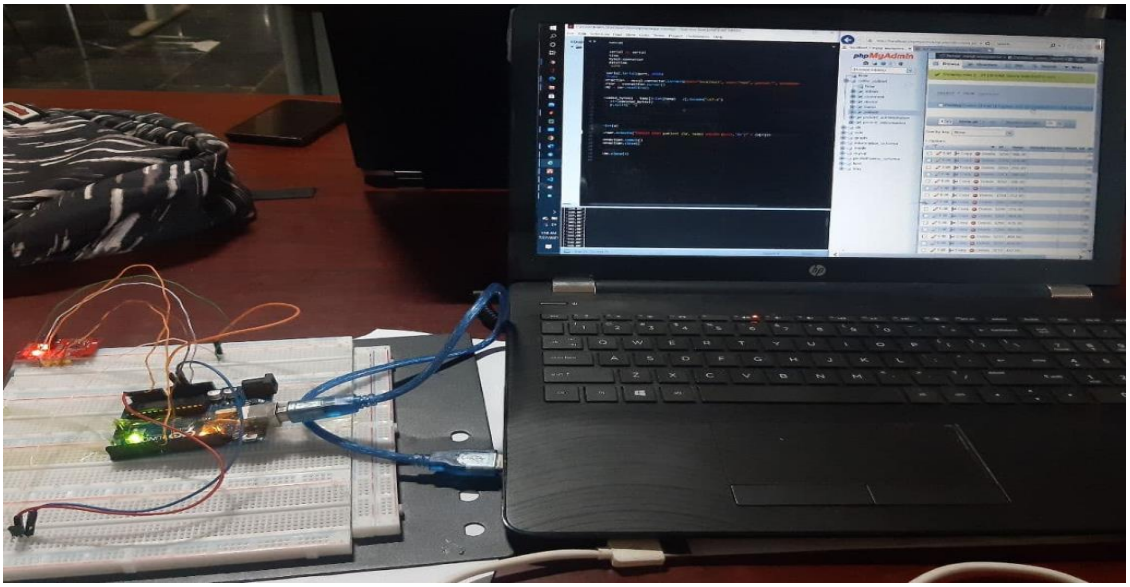


Figure 5-12: Hardware result

Here we have tested the system by using the temperature sensor. While we are touching the temperature sensor, the current body temperature is continuously recorded and on the database. And also, by login the website we can able to check the current body temperature being sent to the database.

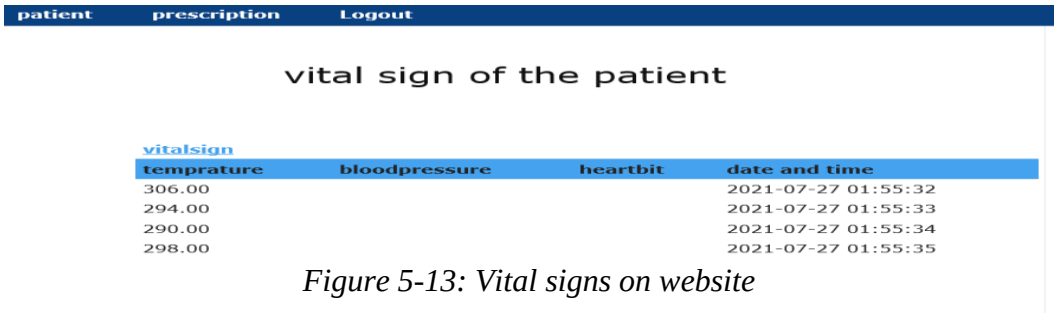


Figure 5-13: Vital signs on website

Like this the other are sending its data to the database, for condition of eyeblink and body movement as a sample someone teach the PIR sensor they display message

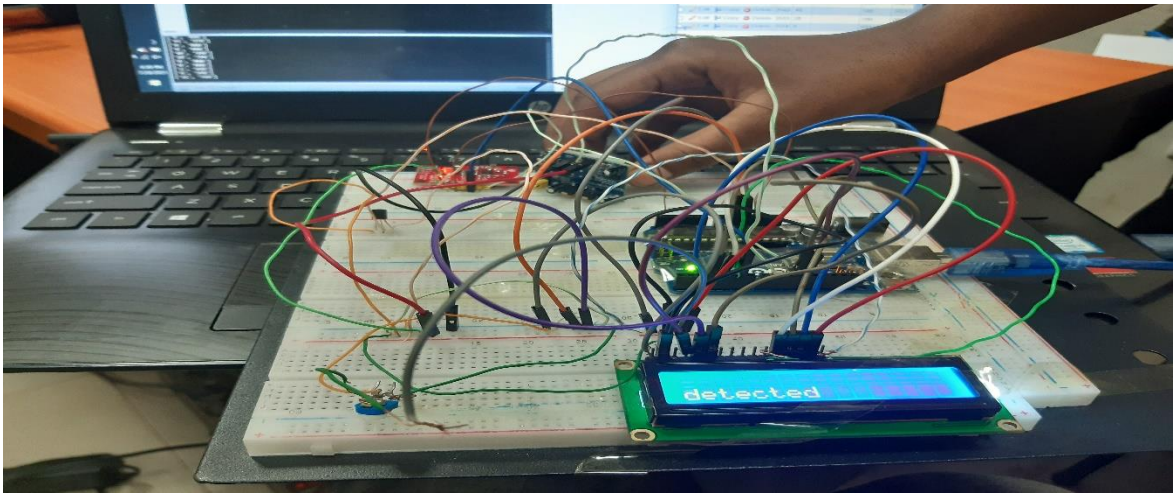


Figure 5-14: Detection of motion

The complete implementation of hardware part of the system is as shown below. The hardware part implementation part of the system includes temperature sensor, heartbeat sensor and PIR sensor are implemented and work properly.

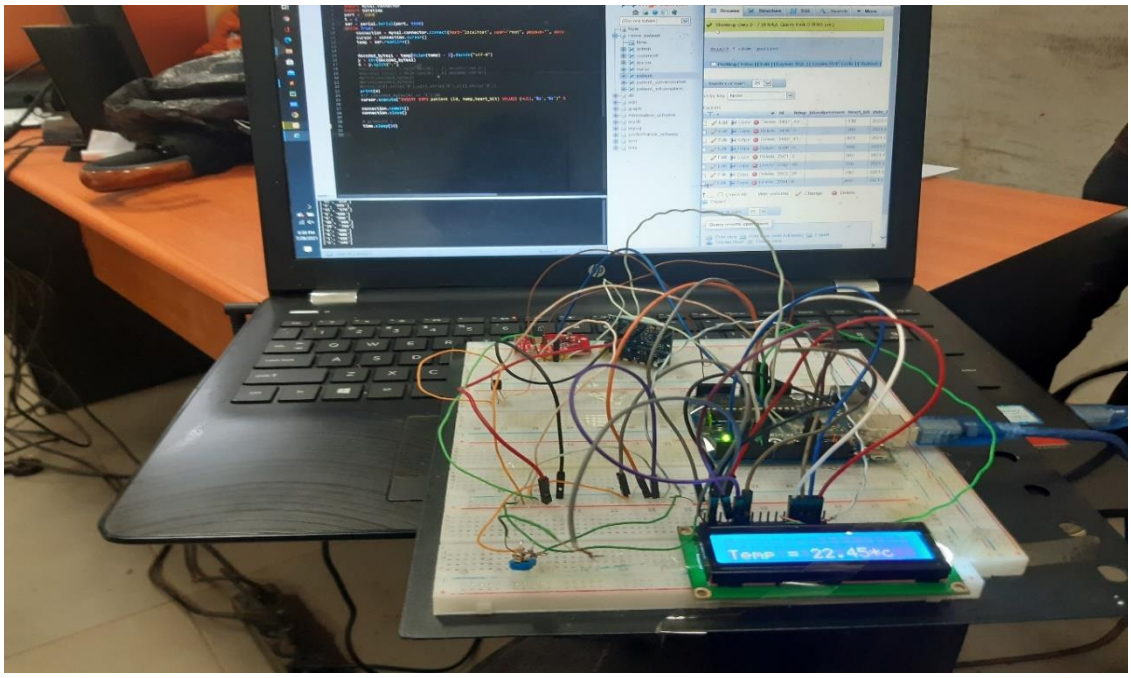


Figure 5-15:Complete implementation

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The project has been already designed, simulated and implemented successfully. When we have run the simulation of the system and it displayed the expected results. The integrated sensors work correctly and able to read a value which is measured. After we run the simulation, we have seen that as the system able to measure the patient vital sign as required and the LCD displays the vital signs in the doctor's and nurse's room. And also, for some immediate conditions that happened to the patient, the system able to send and shows message on the LCD and with the LED blink. They will also notify the health care after that serial send data to the database using python and we see the result in the database. And the health care by its privilege accessed the patient information. Using the GSM model also send unconditional movement events record using SMS to the doctor's phone. We also conclude that There are many IoT system developed on different platforms. These systems require either complex hardware or software applications to monitor the patients about the its vital sign. Many of them are costly and some drawback on its system. Moreover, these systems need adequate prior knowledge to operate those complex systems. So, in this work, an attempt has been made to implement a system that is economical, easily accessible, and improves coma patient health. The system can be updated by adding some additional features. Overall, this type of system is most important for all coma patient in different statuses specially on the developing countries.

6.2 Recommendation

Some further improvements can be made to this project is increase its reliability and effectiveness. The parts of improvement are on the hardware and software improvement. It is more advisable for future work on the hardware part, we recommend that addition of medical reminder of medicine for this and if they have further controlling the syringe infusion the system can be developed to be more advanced way to manage the coma patient. And also, it is advisable if the system is developed additional feature on the software part further android app is developed and QR code on the software part will add the effectiveness of the project. On the hardware implementation it is suggested that if it implemented with the standard sensors to give exact data that extracted from the coma patient when compared with for the educational purpose sensors we have implemented with.

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APPENDIXES

Appendix A: Python Code for Connection Purpose

```
serial as serial
import time
import mysql.connector
import datetime
port = 'COM5'
t = 1
ser = serial.Serial(port, 9600)
while True:
   connection = mysql.connector.connect(host="localhost", user="root", passwd="", database="coma_patient")
   cursor = connection.cursor()
   temp = ser.readline()
decoded_bytes1 = temp[0:len(temp) - 2].decode("utf-8")
   y = str(decoded_bytes1)
   x = y.split(" ")
cursor.execute("INSERT INTO patient (id, temp) VALUES (null,'%s')" % (x[0],x[1],x[2])))
    connection.commit()
   connection.close()
   time.sleep(10)
```

Appendix B: Some Html and JavaScript Code

```
<?php
error_reporting(E_ALL ^ E_NOTICE);
?>
<?php
session_start();
if(!isset($_SESSION['user'])){
   echo "<script>alert(\"Session has been expired\") </script>";
echo '<SCRIPT LANGUAGE="JavaScript">
document.location.href="login.php"
</SCRIPT>';
}
?>
<?php
include('library/connection.php');
?>
<html >
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>Iot Based comma patient monitoring system</title>

<link rel="stylesheet" href="css/screen.css" type="text/css" media="screen, projection">
```

```
<link rel="stylesheet" href="css/menu.css" type="text/css">

<link rel="stylesheet" href="css/print.css" type="text/css" media="print">
<script language="javascript" src="javascript/jquery.min.js"></script>
<script language="javascript" src="javascript/jquery.bxSlider.js"></script>
<script language="javascript" src="javascript/jcarousellite_1.0.1.js"></script>
<!--[if IE]>
<link rel="stylesheet" href="css/ie.css" type="text/css" media="screen, projection">
<![endif]-->
<style>
body{ margin-top:10px; background:#ffffff url(images/bg-body.jpg) repeat-x; }
</style>
<script type="text/javascript">
        $(document).ready(function(){
    $(".newsticker-jcarousellite").jCarouselLite({
            vertical: true,
            hoverPause:true,
            visible: 3,
            auto:500,
            speed:1000
        });
        $('div#listBox').hover(
            function(){

        $(this).addClass('mouseHover');
            },
            function(){

        $(this).removeClass('mouseHover');
            }
        );//hover
});
</script>
<style>
</style>
</head>

<body>

<div class="container">
        <div id="header" class="span-24">
            <center><img src="images/logo.jpg" /></center>
    </div>
 <?php include('admin/menu.php');?>

  <div id="sidebar-1" class="span-5 border">
```

```
</div>

<div id="content" class="span-13 border">

<br /><br />
<form action="" method="POST" name="stud" onsubmit="return errorins();" target="_self">
        <h2>patient Registration Form</h2>

        <p>
<b>                    ID: </b><input name="iid" type="text" placeholder="Enter ID" required="required" /><br /><br />
<b>                    Name:</b><input name="iname" type="text" placeholder="Enter Name" pattern="[a-zA-Z ]+" title="please enter only characters" required="required"/><br /><br />
<b>                   Room:</b><input name="address" type="text" placeholder="enter room id" required="required"/><br /><br />
<b>                    Tel:</b><input name="tel" pattern="[0-9+]+" title="please enter only characters" type="tel" /><br /><br />
<b>                    Gender:</b><select name="sex" required="true">
        <option value="">--Select--</option>
        <option value="Male">Male</option>
        <option value="Female">Female</option>
</select><br /><br />
<b>                    Password:</b><input name="password" required="required" type="password" value="12345" />
 <br /><br />
</p>
```

```
<input type="submit" value="Register" name="reg" class="btn"/>
<input type="reset" value="Reset" class="btn"/><br /><br /></p>
  </form>
 <?php
if(isset($_POST['reg']))
{

$iid=$_POST['iid'];
$address=$_POST['address'];
$tel=$_POST['tel'];
$sex=$_POST['sex'];
$password=$_POST['password'];
$iname=strtoupper($_POST['iname']);
 $dept=$_SESSION['dept'];
$query=mysql_query("insert into patient_adminstration values('$iid','$iname','$address','$tel','$password','$sex')");
if($query==1)
{
echo "<script>alert(\"Successfully Regestered\") </script>";
echo '<SCRIPT LANGUAGE="JavaScript">
document.location.href="register.php"
</SCRIPT>';
}
else
{
echo "<script>alert(\"Error: ID is duplicatied\") </script>";
echo '<SCRIPT LANGUAGE="JavaScript">
document.location.href="register.php"
</SCRIPT>';
}
}
?>
<?php
$data = mysql_query("SELECT * FROM patient_adminstration ") or die(mysql_error());
echo "<b style='color: green'>Total Number of patient: ".mysql_num_rows($data);
 Print "<table border=1 cellpadding=3>";
 Print "<tr>";
 print "<th colspan='7'><span style='color: #44a2ee;' /><u> patient Filles </u></span></th>";

print "</tr>";

 print "<tr style='background-color: #44a2ee'>";

 Print "<th>ID</th>";

 Print "<th>Name</th>";

Print "<th>Room </th>";

Print "<th>Tel </th>";
```

```
Print "<th>Gender </th>";
 Print "</tr>";
 $data = mysql_query("SELECT * FROM patient_adminstration ") or die(mysql_error());
 while($info = mysql_fetch_array( $data ))
 {
Print "<tr>";
 print "<td>".$info['id'];
 print "<td>".$info['name'];
 print "<td>".$info['address'];
 print "<td>".$info['mobile'];
 print "<td>".$info['sex'];
 //echo '<td><a href="delete.php?id=' . $info['course_code'] . '">Delete</a></td>';
 echo "<td><a onClick=\"javascript: return confirm('Are you sure you want to Delete: ". $info['id']." ?');\" href='del_reg.php?id=".$info['id']."' class=btn><span style='color: red;' />Delete</span></a></td><tr>";
  Print "</tr>";
 }
 Print "</table>";
 ?>
</div></div>
</body>
</html>
```

Appendix C: Some Arduino code to communicate Arduino to sensors

```
#define USE_ARDUINO_INTERRUPTS true    // Set-up low-level interrupts for most acurate BPM math.
#include <PulseSensorPlayground.h>     // Includes the PulseSensorPlayground Library.
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
LiquidCrystal lcd1(13, 12, 11, 10, 9, 8);
LiquidCrystal lcd2(13, 7, 11, 10, 9, 8);
SoftwareSerial sim800l(0, 1); // RX,TX for Arduino and for the module it's TXD RXD, they should be inverted
SoftwareSerial wifimodule(2, 3);
PulseSensorPlayground pulseSensor;  // Creates an instance of the PulseSensorPlayground object called "pulseSensor"
const int PulseWire = 0;

int tempPin = A1;

int temprature;

int Threshold = 550;

int led = 5;                // the pin that the LED is atteched to
int sensor = 6;
```

```
int sensor2 = 4;// the pin that the sensor is atteched to
int state = LOW;             // by default, no motion detected
int eyeblink = 0;
int bodymovement = 0;
int blood=A2;
int bloodpressure = 0;
void setup()
{
  Serial.begin(9600);
  sim800l.begin(9600);   //Module baude rate, this is on max, it depends on the version
  wifimodule.begin(9600);
  lcd1.begin(20, 4);
  lcd2.begin(20, 4);
   lcd1.clear();
  lcd2.clear();
  lcd1.setCursor(0,0);
  lcd2.setCursor(0,0);
   lcd1.print("  IOT  BASE  COMA PATIENT MONITORING ");
   lcd2.print("  IOT  BASE  COMA PATIENT MONITORING ");
   delay(1000);
  lcd1.clear();
  lcd2.clear();
  lcd1.setCursor(0,0);
  lcd2.setCursor(0,0);
   lcd1.print("HB per Min  : ");
   lcd2.print("HB per Min  : ");
  lcd1.setCursor(0,1);
  lcd1.print("BP   : ");
  lcd2.setCursor(0,1);
  lcd2.print("BP   : ");
  lcd1.setCursor(0,2);
  lcd1.print("Body Temp  : ");
  lcd2.setCursor(0,2);
  lcd2.print("Body Temp  : ");
  delay(200);
   pinMode(led, OUTPUT);        // initalize LED as an output
  pinMode(sensor, INPUT);
   // Configure the PulseSensor object, by assigning our variables to it.
  pulseSensor.analogInput(PulseWire);
  pulseSensor.setThreshold(Threshold);
  pulseSensor.begin();
}
void loop()
{
 int                myBPM                =
pulseSensor.getBeatsPerMinute();
if (pulseSensor.sawStartOfBeat()) {          // Constantly test to see if "a beat happened".
// Print phrase "BPM: "
 wifimodule.println(myBPM);
 lcd1.setCursor(14,0);
 lcd1.print(myBPM);
 lcd2.setCursor(14,0);
```

```
 lcd2.print(myBPM);// Print the value inside of myBPM.
}
delay(20);                    // considered best practice in a simple sketch.
 temprature = analogRead(tempPin);
  float mv = (temprature/1024.0)*5000;
  float temp = mv/10;
  wifimodule.println(temp);
  lcd1.setCursor(14,2);
  lcd1.print(temp);
  lcd2.setCursor(14,2);
  lcd2.print(temp);
  delay(100);
  bloodpressure = analogRead(blood);
    wifimodule.println(bloodpressure);
    lcd1.setCursor(14,1);
    lcd1.print(bloodpressure);
    lcd2.setCursor(14,1);
    lcd2.print(bloodpressure);
  delay(100);
eyeblink = digitalRead(sensor);
bodymovement = digitalRead(sensor2);
  if (eyeblink == HIGH || bodymovement == HIGH) {          // check if the sensor is HIGH
    digitalWrite(led, HIGH);   // turn LED ON
    delay(100);
  if (state == LOW) {
    lcd1.clear();
    lcd2.clear();
    lcd1.setCursor(0,0);
    lcd2.setCursor(0,0);
    Serial.println("Motion detected");
    lcd1.println("Motion detected");
    lcd2.println("Motion detected");
    delay(200);
     lcd1.clear();
    lcd2.clear();

    //Small delay to avoid detecting the button press many times
    SendSMS();
    state = HIGH;}
    //And this function is called
  if (sim800l.available()){          //Displays on the serial monitor if there's a communication from the module
    Serial.write(sim800l.read());
  }

}

}
void SendSMS()
{
  Serial.println("Sending SMS...");
//Show this message on serial monitor
  sim800l.print("AT+CMGF=1\r");
//Set the module to SMS mode
  delay(100);
```

```
sim800l.print("AT+CMGS=\"+251905388176\"\r");  //Your phone number don't forget to include your country code, example +212123456789"
  delay(500);
  sim800l.print("SIM800l is working"); //This is the text to send to the phone number, don't make it too long or you have to modify the SoftwareSerial buffer
  delay(500);
  sim800l.print((char)26);// (required according to the datasheet)
  delay(500);
  sim800l.println();
  Serial.println("Text Sent.to +251905388176");
  delay(500);

}
```