An Undergraduate Internship on Project Pashei

by

Farhan Ahmed

ID: 1611078

Spring,2021

Supervisor:

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Department of Computer Science and Engineering
Independent University, Bangladesh.

June 17th, 2021

Dissertation submitted in Partial fulfillment for the degree of
Bachelors of Engineering in Computer Science
Department of Computer Science and Engineering
Independent University, Bangladesh.

Attestation

M-WORLD
CONNECTING GLOBALLY

Date: 14th June, 2021

TO WHOM IT MAY CONCERN

This is to certify that **Mr. Farhan Ahmed,** student of **Computer Science and Engineering Department of Independent University, Bangladesh** has successfully completed an internship from **February 2, 2021- April 30, 2021.**

During the period of his internship program with us he had been exposed to different process was found sincere, hardworking, inquisitive and efficient.

We wish him every success in his life and career.

M-WORLD

Farhana Zannat
Admin Manager
M-World

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Acknowledgement

First and foremost, I must express my deepest sense of gratitude to Almighty Allah, it is because of His mercy and blessing that I have come this far with everything in life and I was wanting to thank my parents who supported me on everything that I chose to do in my life till now. It has been a great privilege to work for M-World BD. I have received a lot of support and encouragement from the individuals of M-World BD who have a tremendous and commendable passion for saving lives through improving the healthcare system of Bangladesh. I find myself extremely lucky that such experienced members have shared their time and knowledge with me and have guided me through this process. I would like to convey my special thanks to the founder of M-World BD, Dr. Faisal Mahmud for his continuous support and guidance.

I would like to express my gratitude to my internal supervisor, Ms. Romasa Qasim, Lecturer, Department of Computer Science and Engineering, Independent University, Bangladesh (IUB), for his invaluable instructions, continuous guidance, support and motivation during my internship period and preparation of this report.

I likewise, want to express my deepest gratitude to my external supervisor Md. Raiyan Mahmud and my team mate Md Tanim in this project for sharing their valuable knowledge. They were always there to help me out. And it is only for their help that I could have completed this smoothly.

My gratitude and Thanks extend to my team mate Tanim, who helped me learn so much in my own skill development process and assisted me in every step of the project and finally the project was a success.

Finally, I proudly acknowledge the great sacrifices, good wishes, moral support, fruitful advice, inspirations and encouragements from my family members, relatives and friends.

Farhan Ahmed
May, 2021

Letter of Transmittal

17th June 2021
Ms. Romasa Qasim
Lecturer,
Department of Computer Science and Engineering,
Independent University, Bangladesh

Subject: Letter of Transmittal for Internship Report, Spring 2021.

Dear Sir, this is to inform you that I, Farhan Ahmed (ID: 1611078) from Internship Course of Spring 2021 Semester, from Section 7 would like to submit my Internship report. This report is based on my internship program and the project I have worked on. My internship period started from the 2nd of February 2020 and it is expected to end on the 30th of April 2020 at M-World BD.

This report is based on my experience and the work I did at M-World during my internship program. The primary goal for my internship was to gain experience from working in the software engineering industry and familiarize myself with all the different technology related fields of the company, including research and development, documentation, software development and to get acquainted with software development processes and practices.

Over the period of my internship at M-World BD, I had to learn and adapt to the evolving technologies being used in the healthcare sector and requirements and to be able to apply them in real life projects. I hope the following report can achieve your approval and is adequate.

Sincerely yours,
Farhan Ahmed
1611078

Evaluation Committee

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Name

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Supervisor

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Internal Examiner

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Abstract

On 2nd February 2020, I have started Project Pashei which was assigned to me by M-World. The project's objective was to make an IoT based system which will improve healthcare in urban / remote areas. It will send live vital data to server using mobile GPRS data which can be viewed from anywhere in the world using web application. At first, I had to select the compatible microcontroller for this project which was ESP32. I had to figure out perfect sensors for different vital monitoring. After a lot of research, I have written the code for the microcontroller and other sensors. I had to watch various tutorials for the different libraries I used. I had to learn the REST Api during the deployment of the web application. I worked as a backend engineer during the deployment in Namecheap hosting service. I have faced various difficulties and challenges during in the project. After a lot of trials and errors, I have completed the project with firm's satisfaction. My team mate Md Tanim assisted me throughout the project duration. He worked as a frontend and QA engineer. Finally the whole system was completed on the last week of April 2020.

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Chapter 1: Introduction

1.1 Background of the Work

Project Pashei is basically a system that includes a portable hardware device and a web application. The hardware of this device is designed in such a way that, it will gather certain medical received signals from the human body and send it to a doctor using the web portal in Realtime. It is basically built for remote areas where there is no Wi-Fi or any advanced expensive connectivity. The device is built in such a way that it sends the value of patient's important physiological parameters through the GPRS connectivity of a sim card of any operator having a stable network connection. The data goes direct to the server of the web app after which it is viewed to front end of the website - Pashei - IoT Medic (mworldbd.com/pashei). This device can be called as a portable care unit as it will show the doctor the heart rate, oxygen rate, temperature, blood sugar and blood pressure all at a same time. That will allow the doctor to monitor the condition of the patient more effectively. It will help monitor to Covid-19 patient as it allows you to show the saturation of SpO2 in the blood cell.

Recent studies have shown that continuous monitoring in combination with other systems in case of deterioration improves patient outcomes. However, for continuous monitoring to be applicable for regular use, it should not lead to decreased mobility of the patient. Therefore, continuous monitoring devices should preferably be portable, wireless, and wearable on an easily accessible body part. In different parts of the world, wearable and wireless biosensors collecting continuous physiological data (CPD) in real time to generate information reflecting the patients' current state is being established. This has been proven to be highly effective both for the treatment of individual patients as well as for assessing the efficacy and safety of care given to these patients. In Bangladesh, it would severely decrease the risk of healthcare providers decreasing their exposure to coronavirus, help meet the supply of required workforce and improve healthcare delivery.

Scientists have perceived the importance of body vital signs monitoring as they have a significant influence on the body. One of the important vital signs is SpO2 which stands for peripheral capillary oxygen saturation, which estimates the amount of oxygen in the blood. It is the percentage of oxygenated hemoglobin compared to the total amount of oxygenated and deoxygenated hemoglobin in the blood. In the neonatal intensive care unit (NICU) oxygen saturation is continuously monitored in infants, while blood pressure is often monitored continuously immediately after birth, or during critical illness (Kumar et al., 2020). Vital sign monitoring system plays an important role in ameliorating the care of ill or premature newborn infants (Tarassenko, 2014). The body temperature is a vital sign which denotes the efficacy of any treatment applied by the physician. Both the hypothermia (104 F) are medical conditions concerning the body temperature. These aberrations of temperature can cause brain damage (Minamisawa et al., 1990) , cardiac arrest (Callaway et al., 2016), strokes (Doshi & Giudici, 2015). Vital sign monitoring helps in detecting these anomalies earlier which would help avoiding such hazardous circumstances. Tachycardia is a heart rate disease which occurs when the heart rate is above 100 beats. Most of the time the patient remains unknown of this deterioration. Vital sign monitoring systems

can help patients and relevant health care personnel be aware of this heart beat disease (Duus et al., 2018).

Current wearable sensors are capable of recording heart rate (HR), respiration rate, temperature, and movement. Although some wearable sensors have now obtained approval for medical use internationally, uptake within health care has been minimal in Bangladesh. One reason could be that there is little research and development of such products in our country. The validity and reliability have not been studied in a relevant environment like ours. Therefore, this will be a revolutionary step to be fully originated in Bangladesh, decreasing costs but ensuring full efficacy of the medical device.

Technology has come a long way. As it is device that will be used in remote urban areas and will mostly serve people of low income, it has to be built in the cheapest way possible. It provides the data from remote areas with the 2G/3G network of a sim since in remote areas it is impossible to have internet connection. So, this device has the potential to perform at any district and in any area of the country having a stable network as it is not depended on Wi-Fi or any advanced expensive connectivity. This project Pashei is the best step towards digitization for a country like Bangladesh in telemedicine field.

1.2 Objectives

- To enable treatment in remote zones from professional doctors without visiting the site.
- Cost effective treatment.
- Improved telemedicine.
- Send live health inspection data to doctor through servers from patients in remote areas.

1.3 Scope of the Project

- View the dashboard for the doctors for monitoring all the connected patient.
- Add, Remove, Update, Replace Patients to the corresponding Pashei devices.

Chapter 2: Literature Review

2.1 Project relation to Undergraduate Courses

Almost all CSE courses that are offered have provided knowledge that made this project sail smoothly. While some courses were implicitly helpful others provide knowledge that was directly incorporated in this project. In our undergraduate program of Computer Science & Engineering, we have learnt about building software for different applications. We learned about robotics and automations and done various projects. We also learned about electronics and web application development and their backend services. So, in this project of internship, we are implementing most of our knowledge from our undergrad courses that includes robotics and IoT programming. It also includes basic electronics and web developments. We will be building a web application and a hardware for it that will be providing live data to servers and stored in database. We will be preparing our servers accordingly. That's how this project relates with our undergraduate courses.

2.2 Related Work

The idea of Project Pashei came from Vital Sign monitors. Vital sign monitors began with Seymour B. London, an American physician and inventor from Florida who designed the first automatic blood pressure monitor. He created an automated blood pressure machine after finding constant manual blood pressure readings cumbersome. The physician designed his prototype using a blood pressure cuff, a column of mercury, a microphone and a fish tank pump. While his materials may have been unconventional, his research technique was anything but; he then tested the device on 400 doctors at a 1965 American Medical Association convention. He demonstrated there was no significant difference from vital sign monitoring versus hand-taken blood pressure readings. Today, vital sign monitors are used everywhere from hospital operating rooms to emergency situations. Vital sign monitors have continued to evolve through the development of technologies including digital signal processing, and new sensors that more accurately read the measurements, blood pressure, electric heart signals, blood oxygen, and temperature.

After the research we came to know that it is very costly and it also requires high internet speed or broadband speed to send the acquired details to the doctors. We have built this project mainly focusing on the improvement of the healthcare of people who live in remote zones and have low income. It is usable in town areas where there is no shortage of resources. But when it comes to remote urban areas, and if we want this thing to work properly throughout each and every corner of a developing country like Bangladesh, we came to realize that we can't rely on Wi-Fi or any advanced connectivity. So, Project Pashei was developed in such a way that it can communication with its server from anywhere in the world where there is a 2G/3G sim connectivity using GPRS technology. In this way the cost of the total project was reduced dramatically and it feasible to use anywhere in the world just with a sim card having internet package enabled in it. This device is having a Temperature sensor, a Heart Rate and Oxygen Rate sensor, a keypad and a display that will help the patient end support to input the value of blood sugar and blood pressure and an electronic stethoscope to examine the lung. The value of the blood sugar and blood pressure will

be automatically gathered using the automatic equipment's available in the market. So, the transfer of idea from VSM to a more efficient and feasible device for a country like Bangladesh is needed for monitoring patients in remote areas.

A new monitoring system designed to indicate patient vital signs was recently invented. The Remote Physiology Monitoring (RPM) is a portable device that is extraordinarily mobile and can be operated remotely. But these are very much costly. It costs around 300-600 per watch. Compared to heavy equipment used at home and hospitals in decades past, modern devices are much faster, primarily digital, non-invasive and often combine several analytic features into a single small device.

Samsung Galaxy Watch 3: Health and Activity Tracking

Figure 1: UI screenshots of Health app in in Samsung Galaxy watch 3

Chapter 3: Methodology

3.1 Software Development Life Cycle

In software engineering, a software development process is the process of dividing software development work into distinct phases to improve design, product management and project management. It is also known as a system development life cycle (SDLC). We can define SDLC as a framework that describes the activities performed at each stage of a System Development Project. So, it has some basic stages to be followed during the development phase. There many different SDLC to choose from like

- Waterfall Model Prototyping
- Agile
- Spiral Model
- Rapid Application Development
- V-Model
- Incremental
- Evolutionary Model

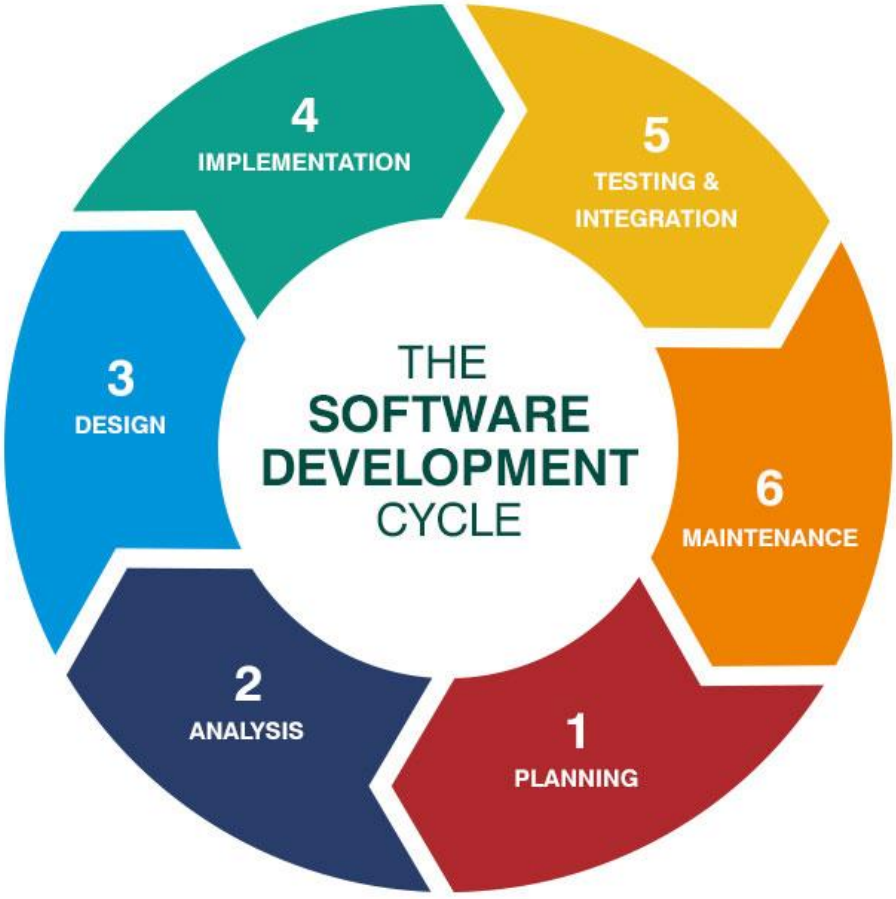

Figure 2: The software development life cycle

3.2 Model used in this project

All methodologies have their own advantages and disadvantages. However, the one that worked great for us was the waterfall method. Because we needed an easy to manage and a rigid model. More importantly, we wanted to divide our work into phases with specific deliverable and a review process. Moreover, the fact that the requirements were set by ourselves instead of having them defined by the client meant that we had very well-defined requirements which are not likely to change in the near future.

3.3 Waterfall Model

The waterfall model is a popular version of the systems development life cycle model for software engineering. Often considered the classic approach to the systems development life cycle, the waterfall model describes a development method that is linear and sequential. Waterfall development has distinct goals for each phase of development. Imagine a waterfall on the cliff of a steep mountain. Once the water has flowed over the edge of the cliff and has begun its journey down the side of the mountain, it cannot turn back. It is the same with waterfall development. Once a phase of development is completed, the development proceeds to the next phase and there is no turning back.

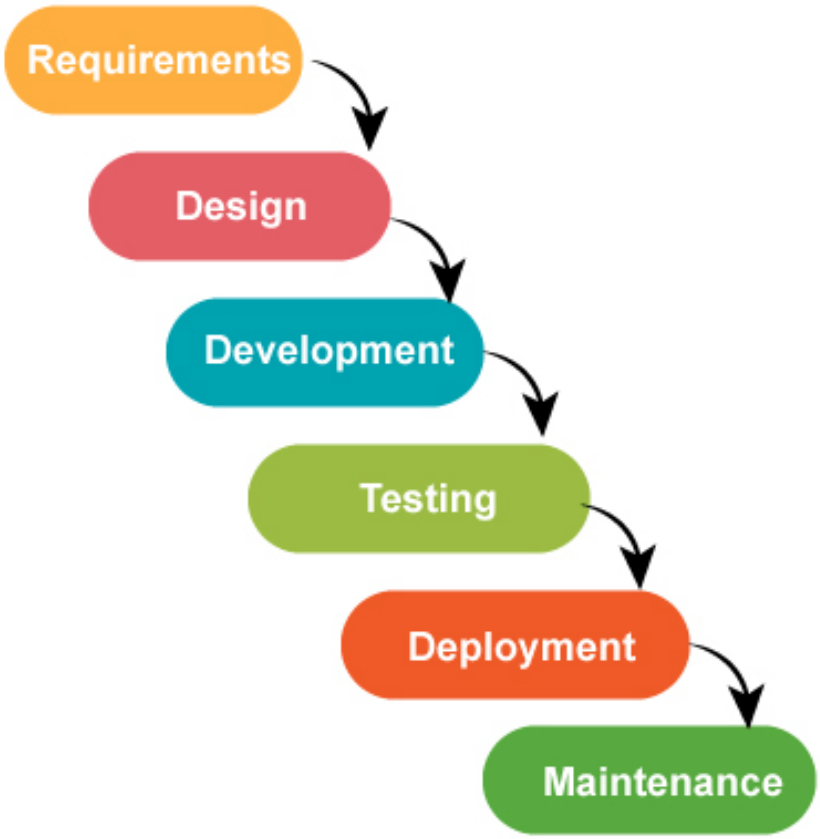

Figure 3: Waterfall Model

Chapter 4:
Project Management and Financing

4.1 Work Breakdown Structure

A work breakdown structure (WBS) is a visual, hierarchical and deliverable-oriented deconstruction of a project. It is a helpful diagram for project managers because it allows them to work backwards from the final deliverable of a project and identify all the activities needed to achieve a successful project. All the steps of a project are outlined in the organizational chart of a work breakdown structure, which makes it an essential project management tool for planning and scheduling. The final deliverable rests on top of the diagram, and the levels below subdivide the project scope to indicate the phases, deliverables and tasks that are needed to complete the project.

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Below is the WBS of the Pashei project.

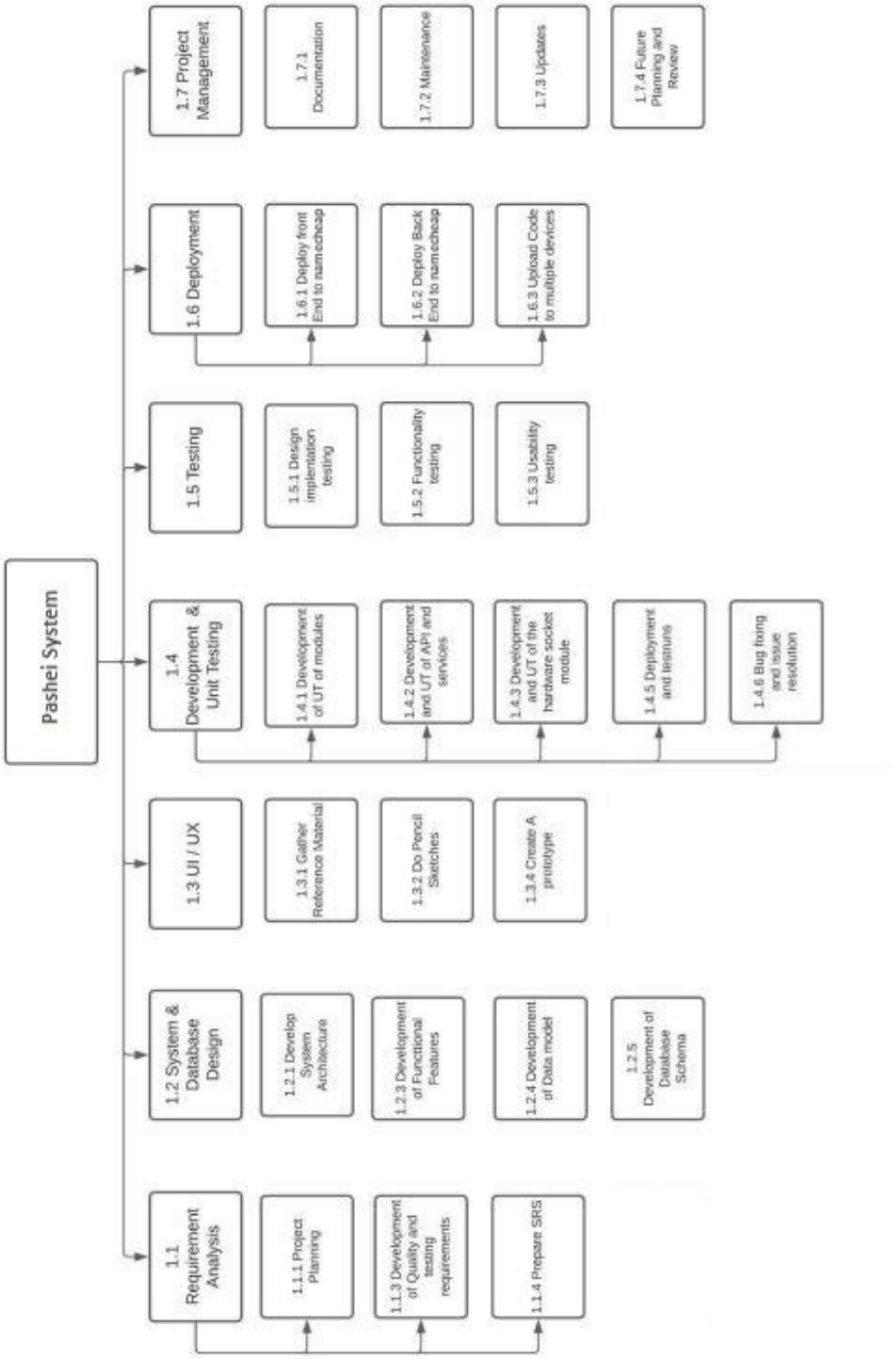

Figure 4: Work Breakdown Structure of Project Pashei

4.2 Gantt Chart

A Gantt chart has been produced to help plan and schedule project tasks. It helped assess how long the project should take, determine the resources needed and plan the order in which tasks will be completed. It also helped in managing the dependencies between tasks. The Gantt chart was also useful for monitoring the project's progress once it has started. It helped in having a clearer vision of what should have been achieved by a certain time frame and when the project fell behind schedule; appropriate actions were taken to bring it back to course.

The following Gantt chart was made for managing the Project Pashei.

Only the first nickname initials were used for decluttering the chart. The full names are as follows.

- Md. Tanim
- Farhan Ahmed

F = Farhan Ahmed T = Md. Tanim

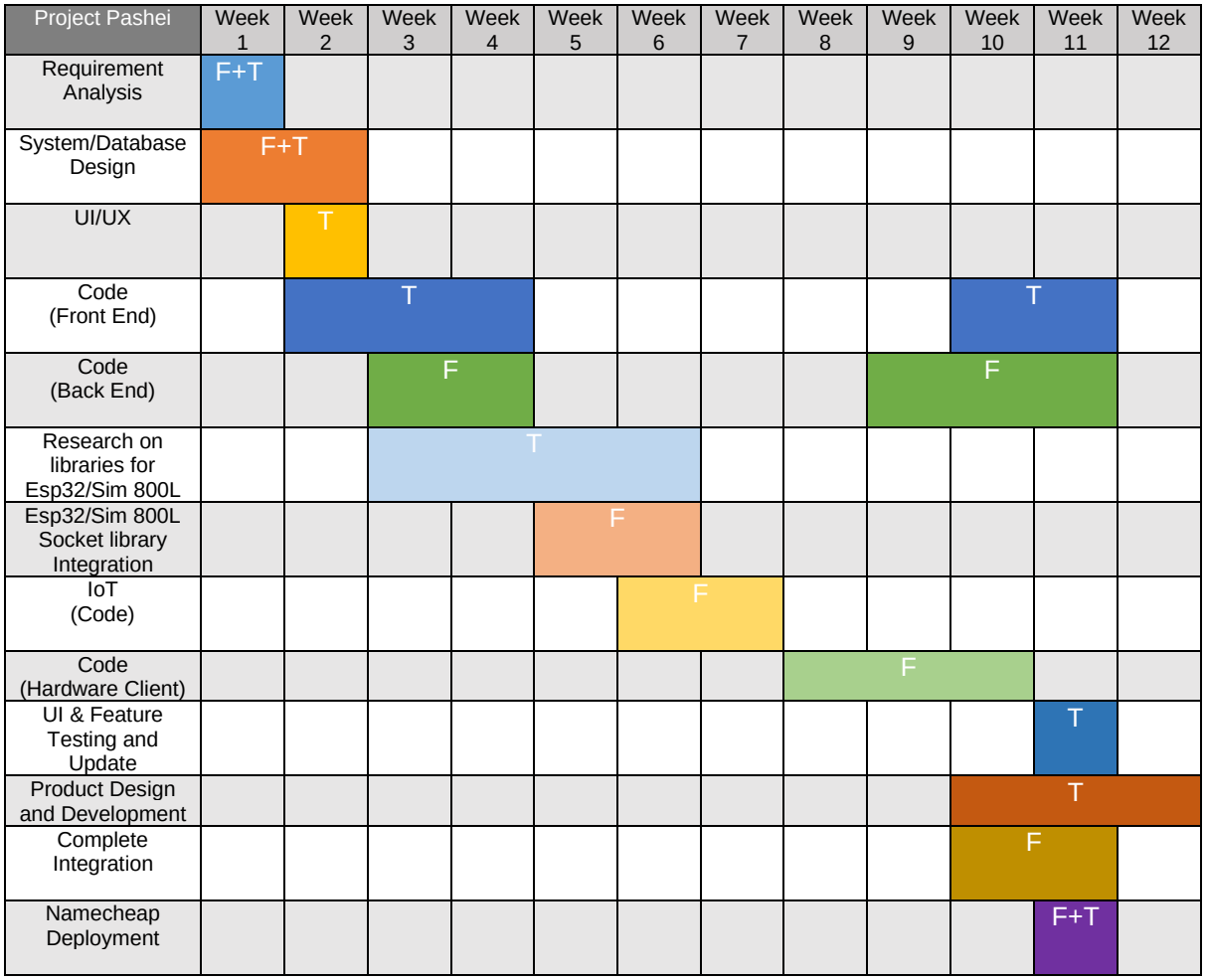

Figure 5: Project Pashei Management Gantt Chart

4.3 Estimated Costing

This IoT device was made of many sensors, microprocessors and other things. The estimated costing of these things is given below-

Table 1: Estimated costing of the complete project

Product	Price in BDT (Tk)
ESP32 with GPRS	1700
Arduino Mega	650
Heartrate Sensor	600
Temperature Sensor	950
Keypad	100
Display	150
Casing Materials	500
Stethoscope	400
Headphone	100
Cables and Mic	40
Power and Switch	110
Total	**5300/-**

For the backend of the web application, we have used the home server of our firm and users of the device can use the application paying a small fee.

So, the approximate cost is around 5,300/-. Which will be much less if the product is produced in mass.

Chapter 5:
Project Body

5.1 Description of the Project

For this Internship project we built a system that will be portable and carrying various digital medical equipment which will be connected with the servers. We assembled a digital stethoscope from scratch and other medical equipment will be programmed. All the equipment will be connected and controlled using various microcontrollers. There will be a blood oxygen count sensor, a heart rate sensor, a temperature sensor, a number pad for blood glucose and blood pressure data input and a lcd display to show the entered data. The microcontrollers are connected to the server using GPRS data of a 2G/3G sim as it will be going to remote urban areas. The microcontrollers will fetch data from various equipment and send it to server using http protocols. We programed the server and code its APIs accordingly so that it receives value from the protocols and save it to mySQL database. We built a web application which the doctor will use to communicate with the patient and get live data. The data will continuously get updated in Realtime. That's how the doctor will inspect the patients.

5.2 System Analysis

It is a method of collecting and interpreting facts, identifying the issues, and decomposition of a system into its elements. System Analysis is conducted for the aim of learning a system or its elements so as to spot its objectives. It is a problem-solving technique that improves the system and ensures that each one the elements of the system work with efficiency to accomplish their purpose. Analysis specifies what the system ought to do. This chapter contains elements of System Analysis that may facilitate perceive the project better.

5.2.1 Six Elements Analysis

Table 2: Six Elements Analysis of the Pashei software

Process	System Roles				
	Human	**Computing hardware**	**Software**	**Database**	**Comm. & Network**
Monitor all patient	Doctor	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS
Monitor specific patient	Doctor / The patient	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS
Reset patient data	Doctor	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS
Allow / Cancel Realtime data	Doctor	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS
Associate patient to a Pashei Device	Nurse	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS
Dissociate patient from a Pashei device	Nurse	Desktop Laptop	Web Browsers, Chrome, Edge, etc	mySQL	WAN GPRS

5.2.2 Feasibility Study

Feasibility Study is a study to evaluate feasibility of a proposed project or system. It is the feasibility analysis or a measure of the software product in terms of how beneficial product development will be for the organization from a practical point of view. Feasibility study is carried out based on many purposes to analyze whether software products will be right in terms of development, implantation, the contribution of the project to the organization, etc.

Main parts of Feasibility Study:

Technical Feasibility:

In Technical Feasibility, current resources, both hardware and software along with required technology are analyzed/assessed to develop the project. This technical feasibility study gives a report on whether there exists correct required resources and technologies which will be used for project development. Along with this, feasibility study also analyzes technical skills and capabilities of technical team, existing technology can be used or not, maintenance and up-gradation is easy or not for chosen technology, etc. The Pashei web application is built using JavaScript, PHP, HTML, CSS, Custom made RESTFUL APIs. These are the technologies that are very popular in the modern industry and one team mate was assigned for the front end of the app in which he was quite familiar with the technology and other team mate assigned for the backend of the app which includes the custom-made RESTFUL APIs. Hence, it can be concluded that the project is Technically Feasible.

Operational Feasibility:

Operational Feasibility: In Operational Feasibility degree of providing service to requirements is analyzed along with how easy the product will beto operate and maintain after deployment. Along with these, other operational scopes are determining usability of the product and determining whether a suggested solution by the software development team is acceptable or not etc.

The Pashe web portal is a web application made with complex logic and technology butfor any end user it is quite self-explanatory. The UI of the project was designed with usability in mind. A lot of difficult choices were made to make it user-friendly even though they made the development complicated. Moreover, a short training will alsobe provided even though everything is very self-explanatory. Therefore, the project can be determined as Operationally Feasible.

Economic Feasibility:

In Economic Feasibility study cost and benefit of the project is analyzed; a detailed analysis of what will be the cost of the project for development which includes all required cost for final development like hardware and software resource required, design and development cost, operational cost, etc. After that it isanalyzed whether the project will be beneficial in terms of finance for organization or not. We have made system keeping the economic factor in mind as this device is intended to improve the healthcare of people who live in rural urban areas and have low income. The system that this software along the Pashei device is designed to replace is very cumbersome and extremely expensive. The only cost in developing this software in terms of other services are the payment for the domain and small amount of GPRS data for the sim connectivity. Everything else is going to befree for the first iteration. Later on, the system will have to move towards a paid database service and maybe paid hosting service too. However, even when that happens the amount of money will be insignificant in front of the service it will be providing Thus, in conclusion, it can be said that the project is Economically Feasible.

5.2.3 Problem Solution Analysis

The existing system in hospitals today is very back-dated and extremely expensive to install.There has been advances in technology everywhere. However, for some reason hospitals are still holding on to their old ways. The problems that our system is solving are listed below:

- Patients in remote urban areas cannot be monitored.
- Equipment cannot be transferred all the time as they are bulky and very complicated.
- Large number of patients cannot be monitored as management and procedures becomes lengthy.
- Total system requires huge amount of hardware and human resource.
- The Current System is expensive to install.

5.3 System Design

5.3.1 Rich Picture

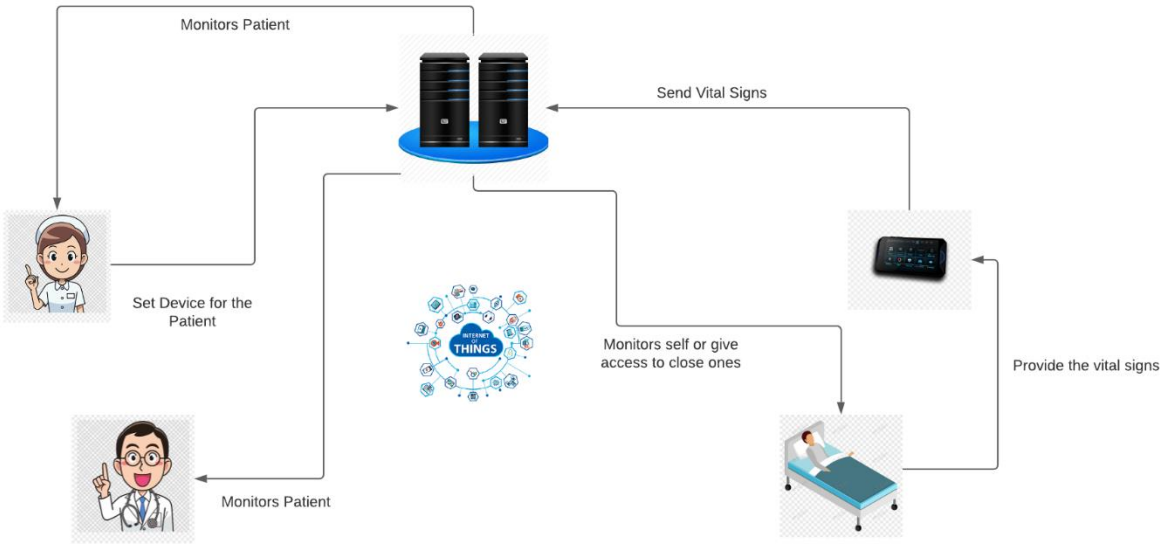

Figure 6: Rich picture of the Pashei project

The rich picture illustrates how the different stakeholders interact with the system. The Nurse will set device for the patients. They can then go on to associate/ disassociate a patient to/from the available devices. Moreover, the doctors and the nurses can monitor all the patient real time, as data is being collected from the patient real-time. The data will be stored in mySQL database.

5.3.2 Architecture of the System

The software architecture of a system depicts the system's organization or structure, and provides an explanation of how it behaves. A system represents the collection of components that accomplish a specific function or set of functions. Software architecture optimizes attributes involving a series of decisions, such as security, performance and manageability. It describes the organization and interaction of software components. There are many types of architectures that are used in different software. The Architecture that we went with comprises RESTFUL APIs and Sim GPRS connection that allows real-time bidirectional data flow between client and server.

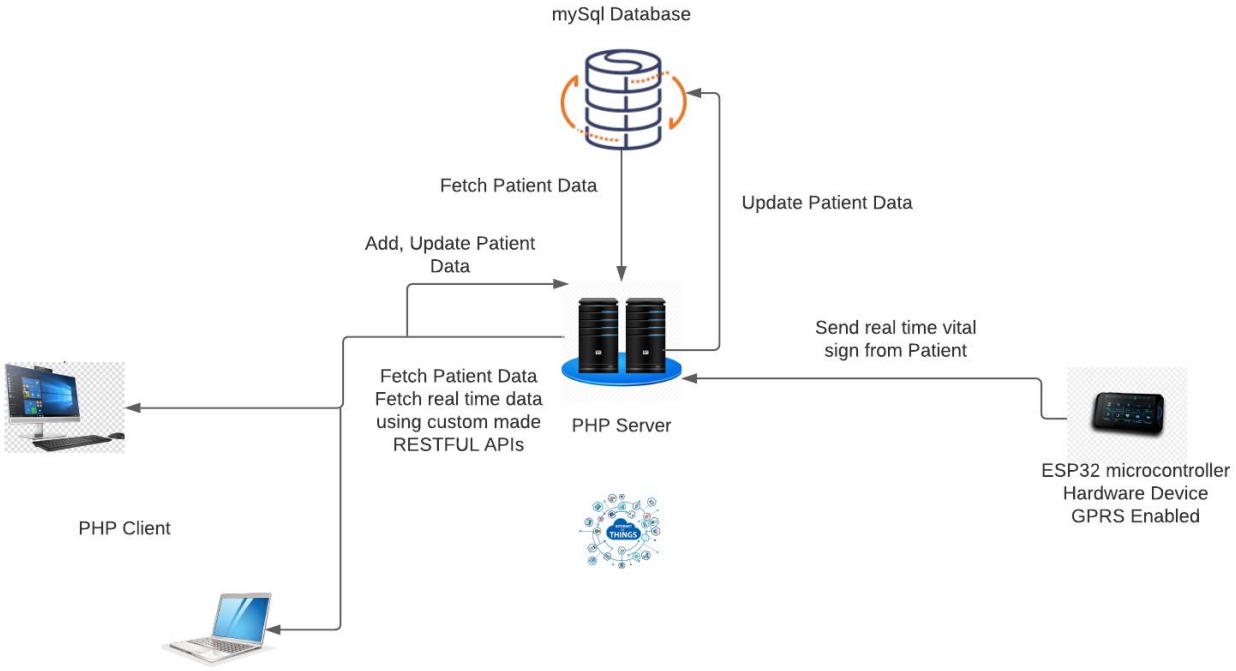

Fig 7: The architecture of Project Pashei

5.3.3 Process Flow Diagram

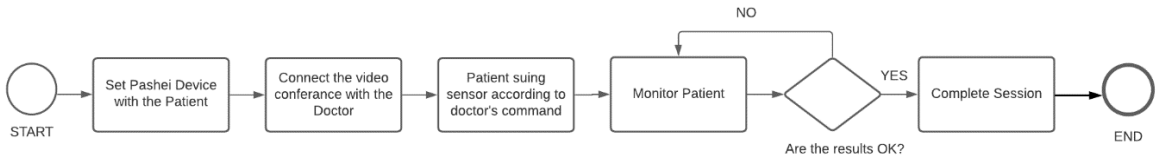

Fig 8: The Process flow diagram

5.3.4 Requirement

The software requirements are descriptions of features and functionalities of the target system. Requirements convey the expectations of users from the software product. The requirements can be obvious or hidden, known or unknown, expected or unexpected from the client's point of view. Requirements can be divided into two types; functional and non-functional requirements.

5.3.4.1 Functional Requirements

A functional requirement is a function or feature that must be included in an informationsystem in order to satisfy the business need and be acceptable to the users. A functional requirement defines what an application and its components are and what these components are supposed to accomplish. The following functional requirements were gathered with our decided requirements gathering methods. The inputs, processes and output are discussed below:

- **Realtime Data:** This requirement represents the need of the data that will be passed from the device to the server in real-time. This data will then be fetched and shown in the web portal spontaneously. Satisfying this requirement ensures that the doctor can monitor patient in real-time and the data maintain accuracy and immediate treatment can be offered.

- **Responsive Web Application:** This requirement represents the need of the portal that the doctor will use to inspect the patient. There will be a responsive web application that will be connected with the hardware device through the server. The application can communicate with the device and allows the doctor to take readings more precisely thus improving the consistency.

- **Save data in database:** This requirement represents the need of the data that has been fetched real-time by the device to be stored in a database for comparison and future usage purpose. Saving this data ensures the constant regulatory monitoring of a patient from time to time and improving the quality of the treatment.

5.3.4.2 Non-Functional Requirements

Another type of requirement is non-functional requirements. A nonfunctional requirement is a description of the features, characteristics, and attributes of the system as well as any constraints that may limit the boundaries of the proposed solution. Non-functional requirements are briefly described below:

- **Performance:** represents the performance of the system which is required to exhibit and to meet the needs of users. Performance describes the acceptable throughput rate and acceptable response time. This application should provide a smooth experience for the Doctors and the Nurses and also should have no lag in displaying the real-time as long as the devices are connected to a stable internet.

- **Information:** represents the information that is pertinent to the users in terms of content, timeliness, accuracy and format. Information is about the necessary inputs and outputs and how it will be managed, types of the required data to be stored, how currently the information will be saved into the system, how the interfaces of external systems will work, etc.

- **Efficiency:** represents the system's ability to produce outputs with minimal waste. We have tried to eliminate duplicate steps in the processes and to use the resources in an efficient way. Keeping our code non repetitive by using reusable code and components is how we achieved efficiency

- **Extensibility and Maintainability Requirements:** There is one standard User interface designed for the look and feel of the application. The application can be expanded to accommodate many further modules without making any changes to any existing modules. The application is created in such a way that the developers can easily maintain both the server and client sides.

5.4 The Pashei Device

This device is powered by USB power supply. Data collected from the device will be passed to the server and can be displayed on the web application real-time. Any device such as a laptop or desktop can access and view the data.

Figure 9: Pashei Device

The figure represents the Project Pashei prototype which will be used for the clinical trial and the vital signs like temperature, pulse rate, oxygen saturation, blood pressure and blood sugar (with keypad) will be recorded by the prototype.

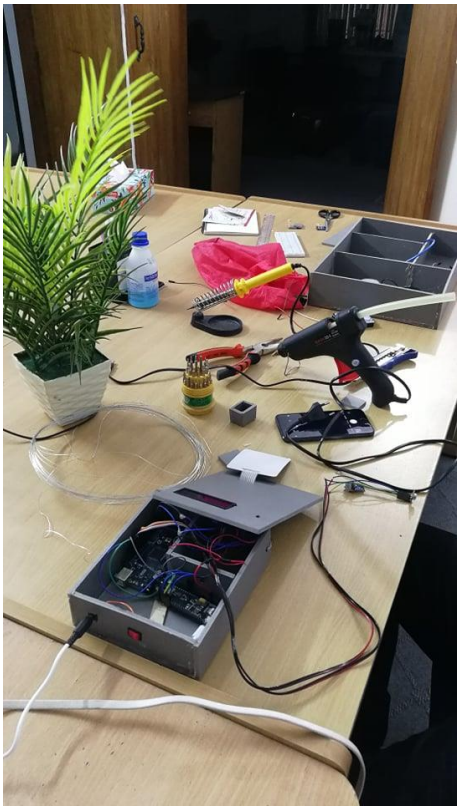

Figure 10: Work Station

The work table is shown here where all the discussions, decisions, changes, operations were done.

5.5 The parameters this prototype collects

5.5.1 Temperature

Body temperature is an age-old method of measuring the health status of a human body. It is a measure of the body's ability to generate and get rid of heat. The human body reacts instantly to changes in surrounding temperature to regulate the body temperature within a very narrow spectrum of optimum body operation. Using a temperature sensor, the body temperature is calculated. The collected signal is then modified appropriately for proper data reading. A real time display is expected to be shown to grasp the continuous changes in body temperature.

5.5.1.1 Mean Temperature

Despite different variations, the human body has a mean temperature. The mean human body temperature was first calculated in the middle of the 19th century. The temperature of twenty thousand people was measured and documented and the mean temperature was found to be around 98.6 o F or 37 o C with a variation of 1 o F or 0.6 o C. This value is still taken as the mean human body temperature and the set point to measure variations.

5.5.1.2 Temperature sensor model

The MLX90614 is an Infra-Red thermometer for non-contact temperature measurements. Both the IR sensitive thermopile detector chip and the signal conditioning ASSP are integrated in the same TO-39 can.

- Non-contact measurement perfect for measuring temperature of moving objects.
- Temperature measurement range: -70°C to +380°C
- I2C/SMBus interface
- Optional PWM and interrupt output
- 3.3V or 5V operation

The main difference between this and most other thermometers is that the temperature reading is taken without contacting the object whose temperature is being monitored. This can be very useful for monitoring the temperature of something moving like a spinning motor shaft or objects on a moving conveyor built for instance.

Because the sensor is not necessarily exposed to the same temperature that it is measuring, it can read a wide range of temperatures. It has measurement a range of -70°C (-94°F) to +380°C (+720°F) with an accuracy of 0.5°C around room temperature. The sensor itself is rated for -40°C to +125°C.

Figure 11: Temperature Sensor

5.5.2 Oxygen Saturation

Oximeter is based on the concept that arterial oxygen saturation determinations can be made using two wavelengths. The two wavelengths assume that only two absorbers are present, oxyhemoglobin and reduced hemoglobin. Light passing through the finger will be absorbed by skin pigments, tissue, cartilage, bone, arterial blood, venous blood but this absorption is indifferent to the wavelength of the light being passed through it. Therefore, the absorbance by all these helps us in the determination of oxygen saturation in the blood.

5.5.2.1 Oxygen Sensor Model

Pulse and SPO2 sensor (MAX30100): The MAX30100 is an integrated pulse oximetry and heart rate monitor sensor. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The MAX30100 operates from 3.3V and 5V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times. It follows the I2C protocol for communication.

Figure 12: Finger pointed on Pulse and SpO2 Sensor

5.5.3 Blood Sugar

The blood sugar level, blood sugar concentration, or blood glucose level is the measure of concentration of glucose present in the blood of humans or other animals. Approximately 4 grams of glucose, a simple sugar, is present in the blood of a 70 kg (154 lb) human at all times. The body tightly regulates blood glucose levels as a part of metabolic homeostasis. Glucose is stored in skeletal muscle and liver cells in the form of glycogen; in fasting individuals, blood glucose is maintained at a constant level at the expense of glycogen stores in the liver and skeletal muscle. Here, we gathered the value and sent the value using the keypad to the server.

5.5.4 Blood Pressure

Blood pressure (BP) is the pressure of circulating blood against the walls of blood vessels. Most of this pressure results from the heart pumping blood through the circulatory system. When used without qualification, the term "blood pressure" refers to the pressure in the large arteries. Blood pressure is usually expressed in terms of the systolic pressure (maximum pressure during one heartbeat) over diastolic pressure (minimum pressure between two heartbeats) in the cardiac cycle. It is measured in millimeters of mercury (mmHg) above the surrounding atmospheric pressure. Here, we gathered the value and sent the value using the keypad to the server.

5.5.5 Electronic Stethoscope

It’s an electronic stethoscope that will be connected to a video call such as WhatsApp, google meet and so on. And by the 3.5 mm port of the stethoscope will be connected with the communication device and the sound of the heart or breathing of lung will be transmitted for hearing. The doctor will be able to monitor the patient by hearing this sound.

Figure 13: Electronic Stethoscope

Chapter 6:
Results

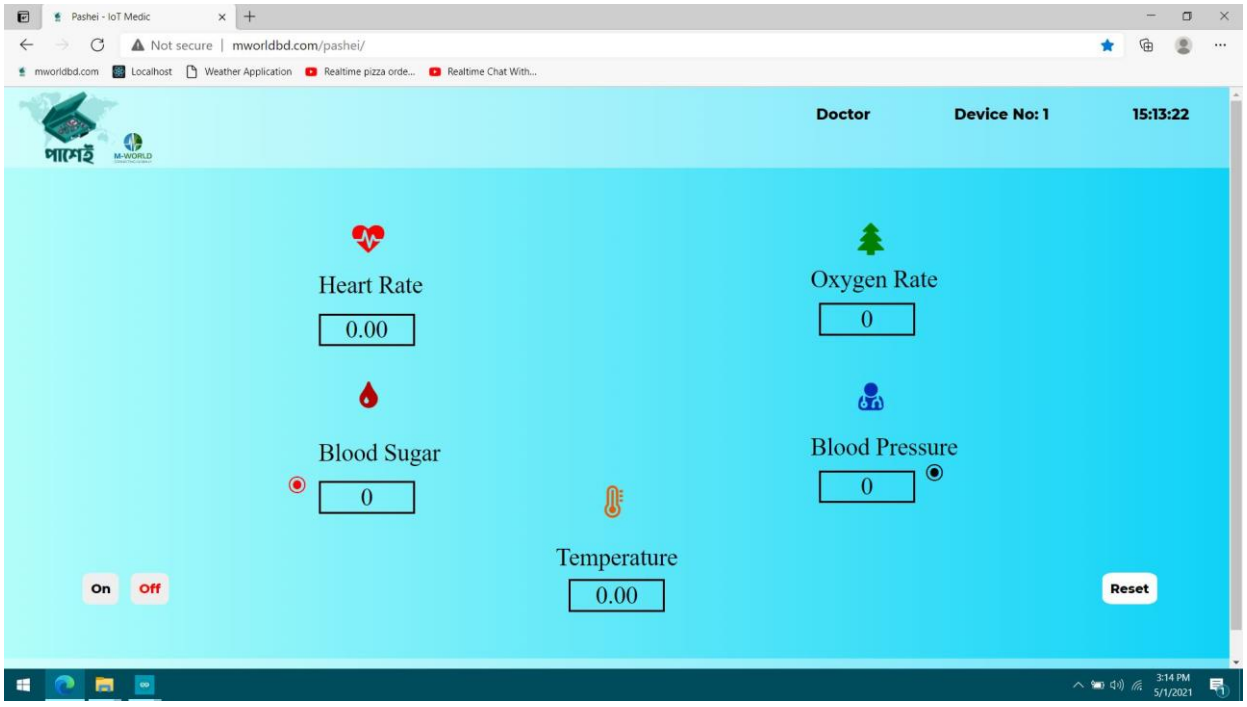

Figure 14: The Pashei Web application home page

This page will allow Doctors and Nurses to access and view all the features of the system. The data from the Pashei device will be transmitted and viewed in these respective fields in real-time. The user of the application can turn ON or OFF the data transmission to reduce the cost of the internet. The user can also reset the data transmission in-case of any glitch.

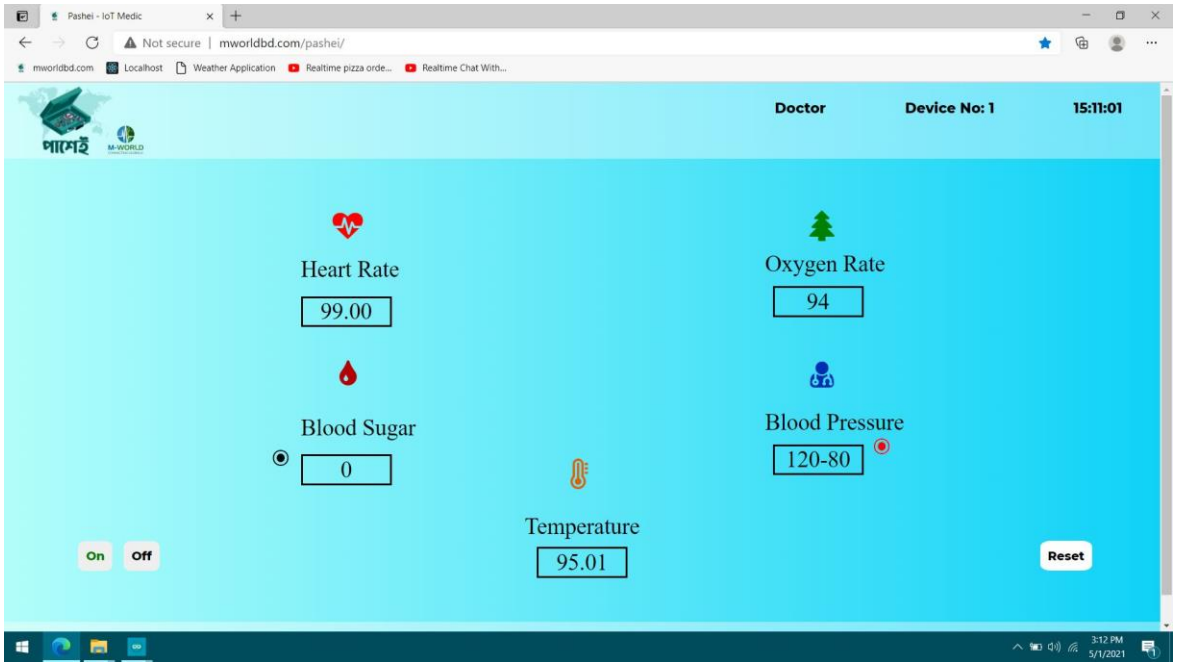

Figure 15: The Pashei Web application with Blood Pressure data transmission.

The Doctor can select which data he or she wants to see by clicking on the button of Blood Pressure or Blood Sugar.

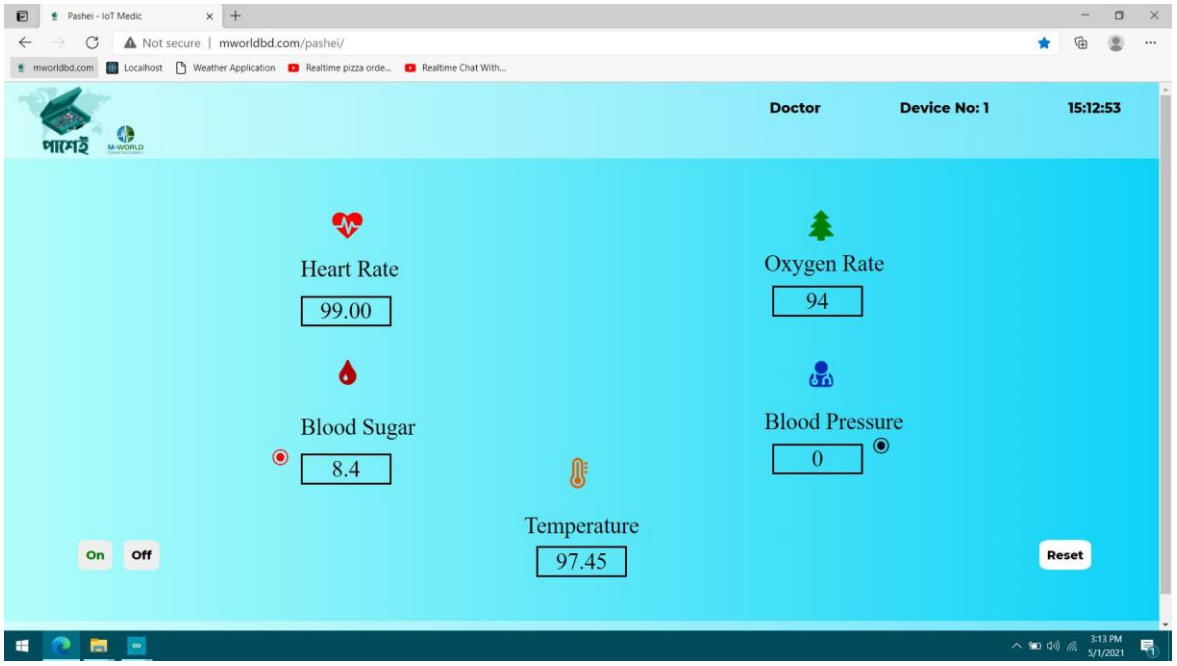

Figure 16: The Pashei Web application with Blood Sugar data transmission.

The Doctor can select which data he or she wants to see by clicking on the button of Blood Pressure or Blood Sugar.

Chapter 7:
Project as Engineering Problem Analysis

7.1 Sustainability of the product

Sustainability of the product refers to its ability to be maintained and updated. In the modern world, every application being released needs to be maintained and continuously updated for its user base. A product can be sustainable in three main categories:

- **Community Sustainability:** This type of support comes in many forms such as downloading and installing the application, using the application, subscribing to paid services, feedback and referring to other people etc. After the deployment and officialrelease of the Pashei platform, it is believed that it will have a strong user base since the target audience for the application is specifically narrow and concise. We can expect the users to refer to other hospitals regarding the application and thus growing the user base. With a growing userbase it will also grow a community and hence it can be said that it is Sustainable in terms of Community.
- **Financial Sustainability:** This refers to how the application's running cost will be maintained after it has been released and whether it will generate enough revenue asacceptable profit. An application's running cost includes - server cost, database storage cost, GPRS package cost, etc. The initial release of the Pashei application will have a small development fee to use but as the user base grows there are plans to introduce new premium services which will eventually be used to generate revenue. A major portion of the revenue generation is planned on focusing the sales of the Pashei device.
- **Organizational Sustainability:** It relates to how the organization will continue to operate after the release of the application. After the release of an application, usually the organization maintains the application via its current team, an extended team or by a fresh new team. Also, organizations update their project by adding newer features to it and organization may pivot to other projects, expand the teams, create new teams, etc. the Pashei application has many more features planned for the future to be worked on and released. Since the application has further plans, the project will be maintained and updated after its release as well and release premiumservices to it. In conclusion, it can be said that the project is Organizationally Sustainable

7.2 Social and Environmental effects and analysis

Social Effect:

The Pashei platform is aimed to introduce and ease the effort of different hospitals and telemedicine firms to provide healthcare to people in different zones which also includes urban remote areas. It will increase the quality of treatment and consistency for the firms. It also provides an efficient and data-orientedadmissions process which develops an ease to use virtual applications where they can speed up the paperwork process and focus more on the treatment side of things.

Environmental effect:

The hospitals here in Bangladesh still have a long way to go in regards to getting with the time and using technology for their advantage. As future iterations of the module start rollingout the company hopes to build an eco-system where all applications merge to create a one system which the hospital staff and doctors will be using without any hesitation thus furthering the growth inside the medical industry here in Bangladesh.

7.3 Addressing Ethics and ethical issues:

Ethics and Ethical issues

In the world of smartphones with so much data collection, hacking, cybercrime, etc. there aresome unspoken rules and ethics guidelines that need to be followed when working on creating and releasing an application. The developers of the VSM software believe that the application does not breach any code of conduct of application release and development since they all have been taken into serious concern. Some of them are:

- Collecting only relevant User data: The app does collect user data, but those are strictly and only relevant for the app. The only data that is being collected are the user's pantry information and preferences information that the user will only provide on their own accord.
- Not Sharing or Selling any User data: Even though the data collected may not be of any privacy concern for most users, the app does not let any service, any applicationor any third party have access to the data collected.
- Data Storage Security: Only the lead developer and the owner of the Pashei application has access to the server and the database. Since they are hosted in the cloud andcan only be accessed via lead developer's and the owner's login credentials; the data stored can be deemed as safe and secure.
- Proper use of third-party services and API: the Pashei application does not violate any rules of the third-party services or the APIs that have been used in its development.
- No Discrimination or Favoritism: the Pashei application does not discriminate of any kindbased on race, sexuality, gender, religious beliefs, color, language, political or other opinion, national or social origin, property, birth, or other status.
- Clear Promotion: the Pashei application only intends to promote the company that created it, itself, and people's health. Other than what has been mentioned, the Pashei application has no intention of promoting anything or anybody else.

Chapter 8:
Lesson Learned

8.1 Challenges faced during the Internship

During my internship program, I have faced lots of challenges while working on this Project.The main ones are:

- **Adapting to New Technologies:** Since this was the first time, I have ever worked on API connection and real-time bidirectional data transferring. I had to learn and adapt to this new technology. Moreover, it was also my first time doing an IOT project as well. Because it was an IOT I also had program for the ESP32 as well while being unfamiliar with the syntax.
- **Choosing the right library:** There were few options while choosing the libraries. Implementing them on the webapp was very straightforward but doing on the ESP32was very difficult. I ended up switching between libraries after spending a lot of time on one. However, eventually everything worked out fine.
- **Staying on track with the Gantt Chart:** In this Pandemic situation and after my full family getting infected in the virus, the internship there after the mid of March became quite a stretch.
- **Identifying and Fixing Bugs:** Often, there were bugs which were very hard to find, andeven after they have been found it became a big problem to fix it. There were bugs that were so difficult to deal with that it would take a whole week to fix it.

8.2 Solution of the challenges

- To get used to the new technologies, I had to do a lot of research about the microcontrollers with IOT compatibility. Then I had to learn the syntax and codes of the system. After many trials and errors, finally I run the system perfectly.
- To get used to new libraries, I watched different tutorials and tried different libraries from GitHub and other sources and used the one that worked the best.
- Completing the project within time frame became a challenging part for me because me and my family was affected by Covid-19 and was in a total isolation. But however, with extensive and overtime work after recovery, I completed the project on time.
- There were many different bugs which included hardware issues and software malfunctions. In the mean time different sensors started showing problems. However, after countless hours and hard work we managed to complete the project with minimal errors and satisfaction.

Chapter 9:
Future Work & Conclusion

9.1 Future Work and Conclusion of the project

The rapid development, uptake of affordable wearables such as wearable devices that involve continuous measurement of vital measures may provide added information to the care of patients. To date, there have been limited studies on the use of wearables in hospitalized medical patients in Bangladesh. Overall, there are numerous benefits of using such technologies. Performing manual observations on patients can take between 5-10 minutes per patient and can be time consuming for staff. The use of automatic monitoring systems such as this can free up staff to perform other tasks. The way that observations are taken currently is open to user interpretation, whereas wearable sensors will help to reduce any bias in recording observations.

Future challenges of using sensor technology to measure vital signs is the need for sensors and data transmission to be reliable, accurate, as well as to ensure that the collected patient data is securely saved (Yilmaz, 2010). Once reliability and accuracy are proven more widespread sensor use can take place. There is the potential for use in the community by patients with chronic medical conditions or high-risk patients at risk of deterioration such as the elderly. Would wide, the vital signs monitoring devices market size is anticipated to reach USD 9.1 billion by 2026, according to the new report of Grand View Research. The key factors in wearable sensor growth are a combination of higher user demand, advancementin sensor technologies resulting in miniaturization, reduced production costs, coupled with both wireless communication streams and a longer battery life. There is a big market in Bangladesh with very few or no leaders in the field. This is a very lightly researched field and hence there is a huge potential for easy market entry. Such devices are mostly very expensive and can currently only be imported from other countries. This increases the costs. Therefore, making it locally not only provides national healthcare institutions an opportunity to improve their healthcare delivery with their own products but also get them at a very affordable price without any compromise in quality.

9.2 Conclusion of Internship

It was a wonderful experience working with the MWorld family as an intern. During the internship period I have learnt and applied a great deal of knowledge from my university courses and experience here. I was introduced to new cutting-edge technologies like ESP microcontrollers, different sensors, PHP, Server Deployment, APIs and so much more. I have learned a lot about developing different kinds of applications also about various development styles. I was pushed to adapt to changes rapidly and come up with logical solutions. During my project, I cooperated with my mentors and seniors to solve the challenges faced. Despite their workload, my supervisors were always there to answer any queries and help me settle nicely. This internship opportunity has paved the way to investigate the development environment and marketplace. I would like to appreciate once again everyone who has made my life as an intern such a great experience.

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