VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

Department of Computer Engineering

Project Report on

Swasth Suvidha: An IOT Based Health Monitoring System

In partial fulfillment of the Fourth Year, Bachelor of Engineering (B.E.) Degree in Computer Engineering at the University of Mumbai Academic Year 2017-2018

Submitted by

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(2017-18)

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

Department of Computer Engineering

Certificate

This is to certify that ***Sanket Mhatre, Yohanth Shetty, Akash Patil, Sameer Udgirkar*** of Fourth Year Computer Engineering studying under the University of Mumbai have satisfactorily completed the project on "***Swasth Suvidha: An IOT Based Health Monitoring System***" as a part of their coursework of PROJECT-II for Semester-VIII under the guidance of their mentor ***Prof. Anjali Yeole*** in the year 2017-2018 .

Programme Outcomes	Grade
PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8, PO9, PO10, PO11, PO12 PSO1, PSO2	

Date:

Project Guide: Internal and External

Project Report Approval

For

B. E (Computer Engineering)

This project report entitled ***Swasth Suvidha: An IOT Based Health Monitoring System*** by ***Sanket Mhatre, Yohanth Shetty, Akash Patil, Sameer Udgirkar*** is approved for the degree of B.E, Computer

Internal Examiner

External Examiner

Head of the Department

Principal

Date:

Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date:

ACKNOWLEDGEMENT

We are thankful to our college Vivekanand Education Society's Institute of Technology for considering our project and extending help at all stages needed during our work of collecting information regarding the project.

It gives us immense pleasure to express our deep and sincere gratitude to our mentor **Prof. Anjali Yeole** (Project Guide) for her guidance and valuable advice during the entire course of the project.

We are deeply indebted to Head of the Computer Department **Dr Nupur Giri** and our Principal **Dr J.M. Nair ,** for giving us this valuable opportunity to do this project. We express our hearty thanks to them for their assistance without which it would have been difficult in finishing this project synopsis and project review successfully.

We convey our deep sense of gratitude to all teaching and non-teaching staff for their constant encouragement, support and selfless help throughout the project work. It is great pleasure to acknowledge the help and suggestion, which we received from the Department of Computer Engineering.

We wish to express our profound thanks to all those who helped us in gathering information about the project. Our families too have provided moral support and encouragement at several times.

Computer Engineering Department
COURSE OUTCOMES FOR B.E PROJECT

Course Outcome	Description of the Course Outcome
CO1	Able to apply the relevant engineering concepts, knowledge and skills towards the project.
CO2	Able to identify, formulate and interpret the various relevant research papers and to determine the problem.
CO3	Able to apply the engineering concepts towards designing solution for the problem.
CO4	Able to interpret the data and datasets to be utilized.
CO5	Able to create, select and apply appropriate technologies, techniques, resources and tools for the project.
CO6	Able to apply ethical, professional policies and principles towards societal, environmental, safety and cultural benefit.
CO7	Able to function effectively as an individual, and as a member of a team, allocating roles with clear lines of responsibility and accountability.
CO8	Able to write effective reports, design documents and make effective presentations.
CO9	Able to apply engineering and management principles to the project as a team member.
CO10	Able to apply the project domain knowledge to sharpen one's competency.
CO11	Able to develop professional, presentational, balanced and structured approach towards project development.
CO12	Able to adopt skills, languages, environment and platforms for creating innovative solutions for the project.

Abstract

In today's world the use of internet has been spread in every sector of the life. People in India have now turned to buying almost everything ranging from books, lifestyle accessories, electronic equipment, beauty products and even household items from the online mobile application.

But the use of internet in the health sector hasn't seen much improvement. This paper brings to light the use of IoT in healthcare and compares different architectures available in the market. These models help to improve the efficiency and decision making in hospitals. The Internet of Things for the medical equipment will produce data that can go a long way in not only increasing equipment efficiency, but also patient health.

The need of delivering quality care to patients while reducing the healthcare costs is a main issue. Recent advances in the design of IoT technologies are stepping stone towards development of smart systems to support and improve healthcare system. Now days with the increasing use of sensors by medical devices, remote and continuous monitoring of a patient's health is becoming possible. This network of sensors, actuators and other mobile communication devices, referred to as the Internet of things – Medical Devices, is on the edge of revolutionizing the functioning of healthcare industry.

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Chapter 1: Introduction

1.1 Motivation

India is a developing country and is known all over the world for its advancement and new innovation in technology.
However India has not made any great efforts for using technology in the field of medicine.
The death rate of people due to medical issues has not reduced substantially over the years
Using IOT based device in this field may help to reduce this issue. It will provide assistance to the doctors as well as will help them take important decisions in case of emergency.
It will also enlarge the path for new innovations in these fields when people notice its significance and what crucial role it plays in developing the healthcare domain.

Now a days with the increasing use of sensors by medical devices, remote and continuous monitoring of a patient's health is becoming possible. This network of sensors, actuators and other mobile communication devices, referred to as the Internet of things – Medical Devices, is on the edge of revolutionizing the functioning of healthcare industry.

Thus, this project aims to build a device with two primary functionalities- a IOT based sensors board with sensors such as temperature sensor, heart rate sensor, spo2 sensor and a website which will help in regular patient's data monitoring. It also includes an alert system which will send alerts to the registered person's mobile number in case of any emergency.

1.2 Problem Definition

In our project, we are basically providing services to the patient who has been given discharge from the ICU and is transferred to LTCU(long term care unit).The doctors can keep the track of patient's health and will get notified at times when any of the patient's heart-rate, temperature, blood pressure vary or any kind of motion change is detected by our system. The IoT is the Internet of Things, where sensors are connected to the Internet, which collect data for analysis to make our world more interconnected and intelligent. A common person carries on average one or two mobile devices nowadays.

Hence, by taking advantage of the increasing presence of mobile devices the cost of equipment can be reduced significantly in many industries like healthcare. Thus the doctors as well as the patient's guardians or relatives will get notified about all the changes and reminder about the timely medications.

1.3 Relevance of the Project

As per the reports submitted by the P&S Market Research, there will be a compound annual growth rate (CAGR) of 37.6% in the healthcare Internet of Things industry between the years 2015 and 2020. They claim that this rise could be attributed to the upper hand of remote monitoring healthcare systems that can detect chronic life-threatening diseases.

By this we can assume that IoT has taken the reins and people can enjoy personalized attention for their health requirements; they can tune their devices to remind them of their appointments, calorie count, exercise check, blood pressure variations and so much more.

The Internet of Things (IoT), also called the Internet of Everything or the Industrial Internet, is a new technology paradigm envisioned as a global network of machines and devices capable of interacting with each other.

1.4 Methodology Used

In our project, we are basically providing services to the patient who has been given discharge from the ICU and is transferred to LTCU(long term care unit).

Here we will be integrating various sensors viz. temperature sensor, heart rate sensor and the SPO2 sensors to the arduino.

These sensors will collect data at determined regular intervals of time and will pass that data to the arduino.

The time duration for each sensor will be taken by the hospital officials and then it will be encoded accordingly in the arduino. The code in the arduino will cause functioning of the sensors.

The arduino will also be connected to the cloud .

So the data that comes from the patient's respective sensors will be finally stored in the cloud storage.

This data can also be accessed by the doctor to keep a track on the patient's health..

Chapter 2: Literature Survey

2.1 Papers:

Paper 1: "Healthcare Using Internet of Things"

[1] Chirag Charania, Girish Nair, Siddhant Rajadhyaksha, Aniruddha Shinde,March 2016, "Healthcare Using Internet of Things," International Journal of Technical Research and Applications, pp. 42-45.

Summary:
In India, there are roughly 48 doctors for every 100,000 people. Many of our nation's healthcare providers have been ill-equipped to diagnose, treat and monitor the progress of patients within urban population centers and rural villages. This paper report brings light on how healthcare can be perfected using Internet of Things (IoT). The IoT is expected to have a profound effect on healthcare in India. Envision doctors leveraging a variety of small, powerful wireless monitors connected through the IoT, to reach and track patient health in India's most remote communities, where healthcare facilities are almost non-existent. All of this suggests we are at the dawn of an exciting revolution in patient care across India. But at the same time, there are concerns that healthcare organizations could "overdose" on the digital information coming their way because they are ill prepared from a technological standpoint to handle it. Healthcare organizations must consider the critical role of the network in managing and analyzing these gigantic volumes of data coming from all those health and fitness devices. Employing Software Defined Networking (SDN), Network Function Virtualization (NFV) and cloud computing technologies will prepare the network to rapidly capture, curate, manage, and process massive amounts of data.

Paper 2: "A Review paper on Smart HealthCare System Using Internet of Things"

[2] Zankhana Mehul Kalarthi,March 2016, "A Review paper on Smart Health Care System Using Internet of Things," International Journal of Research in Engineering and Technology, pp. 80-84.

Summary:

Health is fundamental need. And it is human right to get quality Health Care. Nowadays India is facing many health issues because of less resource. This review paper presents the idea of solving health issues using latest technology, Internet of Things. It presents the architectural review of smart healthcare system using Internet of Things which is aimed to provide Quality Healthcare to everyone. Using this system architecture, patients' body parameters can be measure in real time. Sensors collects patients body parameters and transfers that data to Arduino Uno which further transfer that data to cloud with the help of WiFI module. This data is stored into MySql database server which manages data and provides accessibility. User can view this data with the help of Android App, which one can install in Smartphone, Tablet or PC. Cloud computing handles authentication, privacy, security, data management etc. If data is abnormal then patient gets notification also caretakers will get mail. With the help of different decision making algorithms decisions can be made and according to it, people have access to database. Patient can check their medical record Hence, this system provides Quality Healthcare to everyone and error free and smooth communication to patients.

Paper 3: "Smart Health Care System Using Internet of Things"

[3] K. Natarajan, B. Prasath, P. Kokila,March 2016, "Smart Health Care System Using Internet of Things," Journal of Network Communications and Emerging Technologies, pp. 37-42.

Summary:

The rapid development of Internet of things (IoT) technology makes it possible for connecting various smart objects together through the Internet and providing more data interoperability methods for application purpose. Recent research shows more potential applications of IoT in information intensive industrial sectors such as healthcare services. However, the diversity of the objects in IoT causes the heterogeneity problem of the data format in IoT platform. Meanwhile, the use of IoT technology in applications has spurred the increase of real-time data, which makes the information storage and accessing more difficult and challenging. Here in this paper a more efficient machine to machine communication is achieved for health care data.

Paper 4: "A Survey Paper on Internet of Things based Healthcare System"

[4] Ms. Shinde Sayali P , Ms. Phalle Vaibhavi N ,January 2017, "A Survey Paper on Internet of Things based Healthcare System," International Advanced Research Journal in Science, Engineering and Technology, pp. 131-133.

Summary:

IOT is the advanced network infrastructure of connectivity, transportation and technology. IOT smart devices can implement the facilities of remote health monitoring and also emergency notification system .IOT has appreciable application of smart healthcare system. In the healthcare system the highlighted policies and strategies that help to the researchers and scientists and experts who develop smart device which is the upgradation to the existing technology. This survey paper states that how IOT interrelate to various system including the smart healthcare which is one of the prevalent system. Healthcare system has the surveillance

that proposed the need of smart devices and smart objects to decrease the inefficiency of available healthcare system. The IOT based healthcare has enhanced technology which is exclusive from the traditional healthcare and whole medical system.

Chapter 3: Requirements

3.1 Functional Requirements

- Monitor Temperature
- Monitor Heart rate
- Monitor Blood Oxygen Saturation
- Login(Doctor/Nurse)
- Patient Registration
- Alerts

3.2 Constraints

- The hospital staff will need to be briefed about the working of the system, once before installation.
- Active Internet Connection is a must for the sensor data to get saved on the thingspeak server.
- The sensors should be placed accurately on the patient's' body for best results otherwise warning will be displayed.
- The sensors should be connected properly to the arduino.
- A provision for constant power supply is required.

3.3 Non-Functional Requirements

- Error Handling
- Performance
- Safety Requirements
- Availability
- Efficiency
- Reliability

3.4 Hardware & Software Requirements

- Arduino UNO board (2 nos.)
- Temperature Sensor(DS18B20)
- Heart Rate Sensor(Easy Pulse Sensor)
- WIFI module (NodeMCU).
- SpO2 Max 30105 sensor.
- Website’s UI and backend using HTML, CSS, JavaScript, Ruby on Rails, etc.

Chapter 4: Proposed Design

4.1 Detailed Design

A. **Data Flow Diagram:**

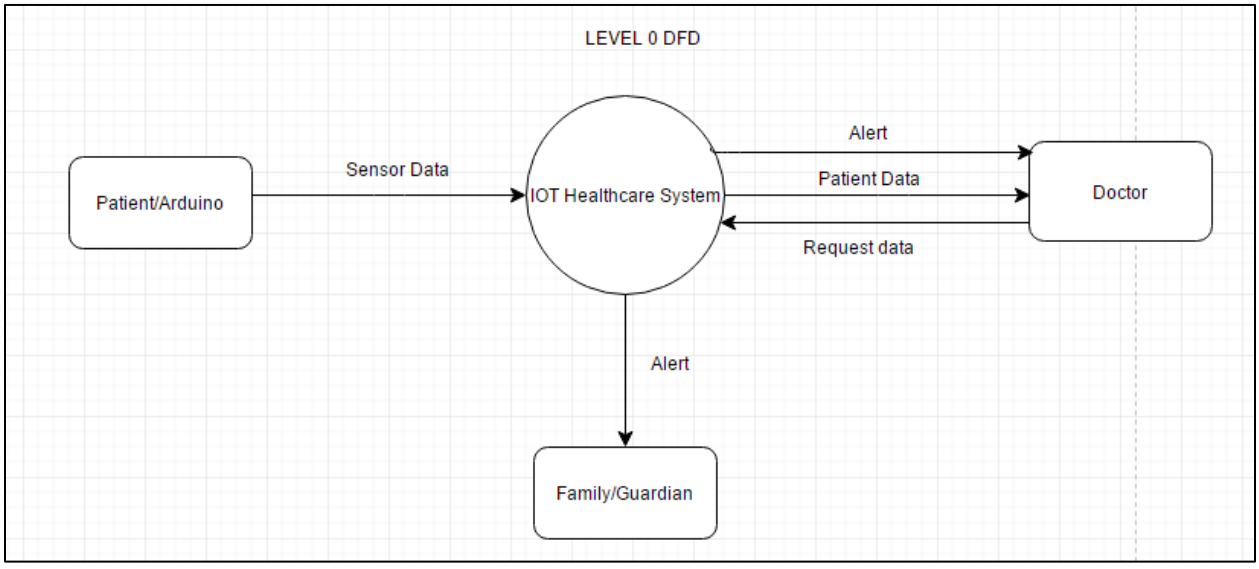

Fig. 4.2.1 Data Flow Diagram: Level 0

Above is the Level 0 DFD. The arduino attached to patient sends sensor readings to the IOT Healthcare System.

Timely alerts are sent to the doctor and family of patient in case of any anomaly.

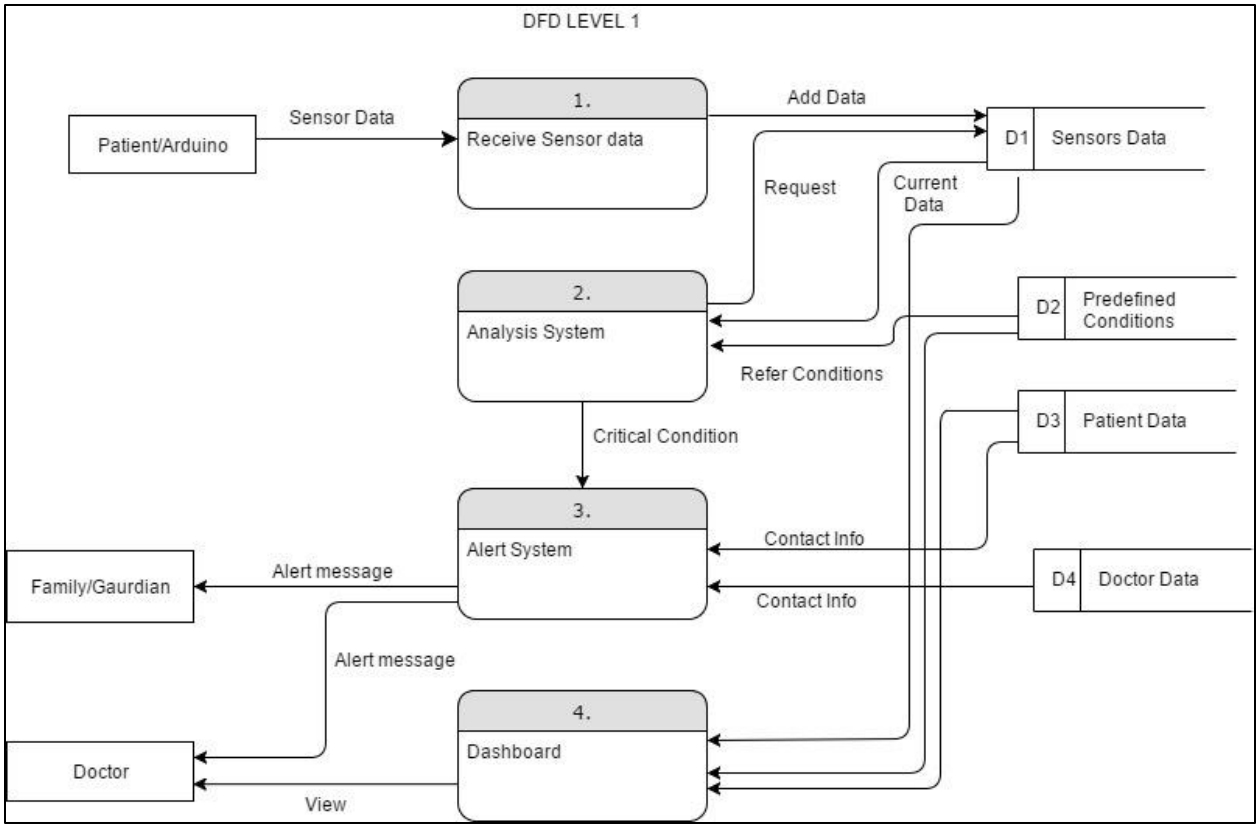

Fig. 4.2.2 Data Flow Diagram: Level 1

Above is the Level 1 DFD. The sensor data is stored into the cloud. The Analysis system checks for any anomaly, and if present, it sends a message to the Alert system which sends alerts to the doctor/family of patient.

The patient and doctor data is stored in database and can be retrieved as per need.

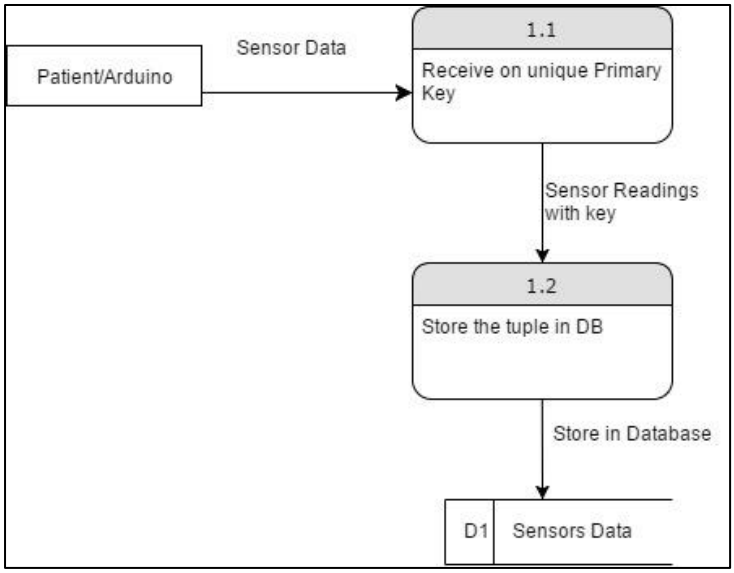

Fig. 4.2.2 Data Flow Diagram: Level 2

The above Level 2 DFD highlights the collection of sensor readings from a patient and the storage onto cloud.

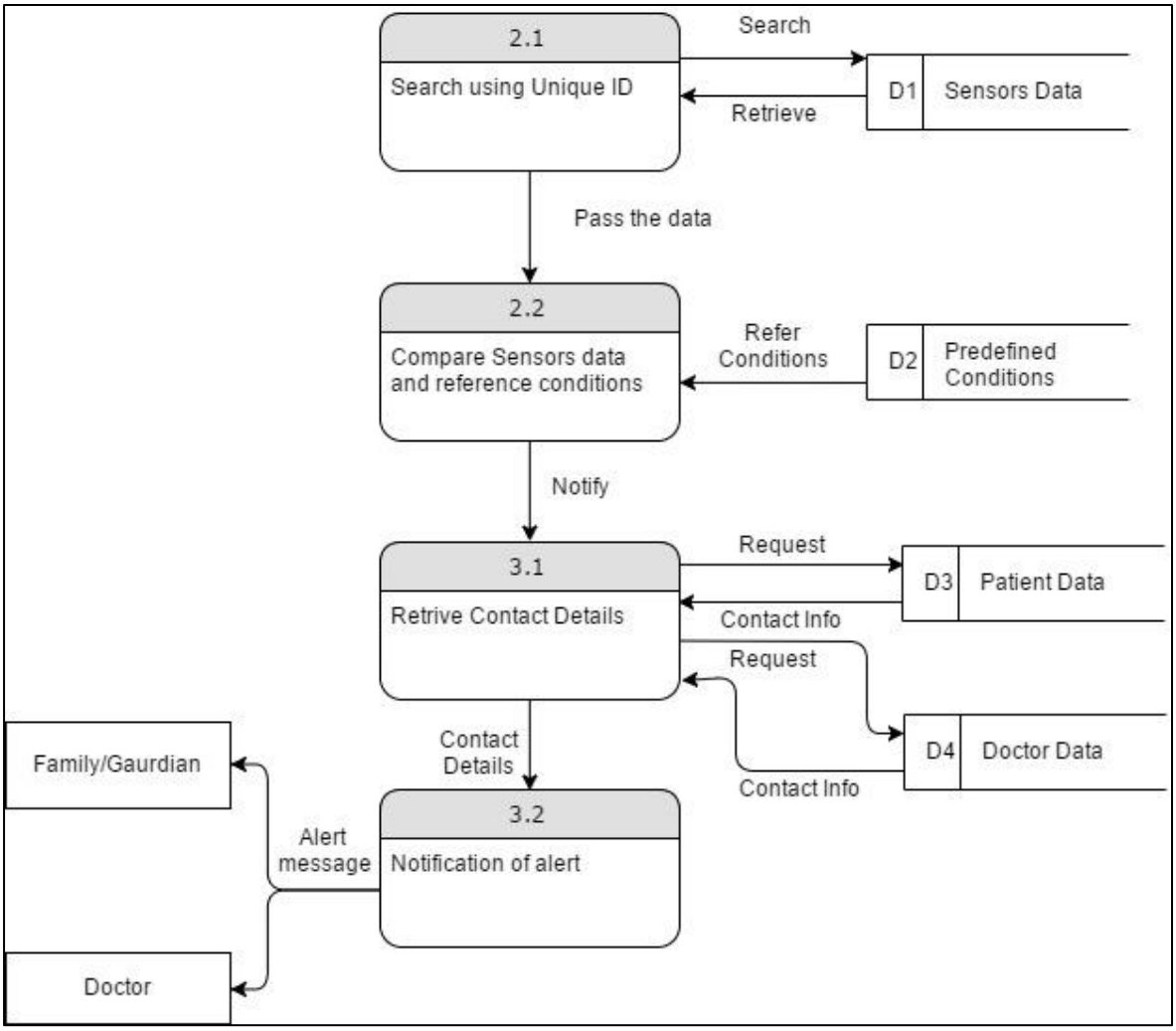

Fig. 4.2.2 Data Flow Diagram: Level 3

The above Level 2 DFD highlights the alert system used to send notifications to the doctor in-charge of patient and as well as the family members of patient.

4.2. Project Scheduling and Tracking: Timeline Chart

	Prio	Task Name	Start Date	End Date	Assigned To	Status	% Done	Duration
1		**Project's Introduction**	**05/15/17**	**03/25/18**				**270d**
2		**Start date**	05/15/17	07/12/17				51d
3		Discuss Details with Mentor about project	05/15/17	05/15/17	sm, ys, ap, st	Complete		1d
4		Problem Statement	05/16/17	06/10/17	sm, ys, ap, st	Complete		23d
5		Objective	05/17/17	06/12/17	sm, ys, ap, st			23d
6		Scope	05/17/17	07/12/17	sm, ys, ap, st	Complete		49d
7		**Project Synopsis, Review and Literature Work**	07/13/17	09/27/17				66d
8		Review Literature (IEEE Papers and sensors information)	07/13/17	07/13/17	sm, ys, ap, st	Complete		1d
9		Finding additional information about the project	07/15/17	07/19/17	sm, ys, ap, st	Complete		4d
10		Preparation of Project Synopsis	07/19/17	07/25/17	sm, ys, ap, st	Complete		6d
11		Review and approval of Synopsis	07/26/17	07/26/17	ay,ng	Complete		1d
12		Planning	07/27/17	08/29/17	sm, ys, ap, st	Complete		29d
13		UML diagrams	09/14/17	09/25/17	sm, ys, ap, st	Complete		10d
14		Project Review 1	09/26/17	09/26/17	sm, ys, ap, st	Complete		1d
15		Obtaining Feedback	09/26/17	09/27/17	ay,ng	Complete		2d

	Prio	Task Name	Start Date	End Date	Assigned To	Status	% Done	Duration
16		**Implementation and Project Review 2**	10/01/17	02/08/18		In progress		113d
17		Sensors and other equipments Collection	10/01/17	10/03/17	sm, ys, ap, st	Inprogress		3d
18		Coding and backend designing	10/03/17	02/08/18	sm, ys, ap, st	Inprogress		111d
19		Report Generation Module Development	10/04/17	10/21/17	sm, ys, ap, st	Inprogress		16d
20		Project Review 2	10/27/17	10/27/17	sm, ys, ap, st			1d
21		**Technical Paper Writing and Code testing**	02/09/18	03/25/18		Not Started		38d
22		Complete Document in IEEE format	02/09/18	02/19/18	sm, ys, ap, st	Not Started		9d
23		Code review	02/09/18	02/12/18	sm, ys, ap, st	Not Started		3d
24		Code fixation	02/12/18	02/12/18	sm, ys, ap, st	Not Started		1d
25		Checking our project in live environment	02/26/18	02/28/18	sm, ys, ap, st	Not Started		3d
26		Present Final Project	03/21/18	03/21/18	sm, ys, ap, st	Not Started		1d
27		Project Report Verfication and Finalization	03/21/18	03/21/18	sm, ys, ap, st	Not Started		1d
28		**Obtaining Feedback**	03/25/18	03/25/18	ay,ng	Not Started		1d
29								

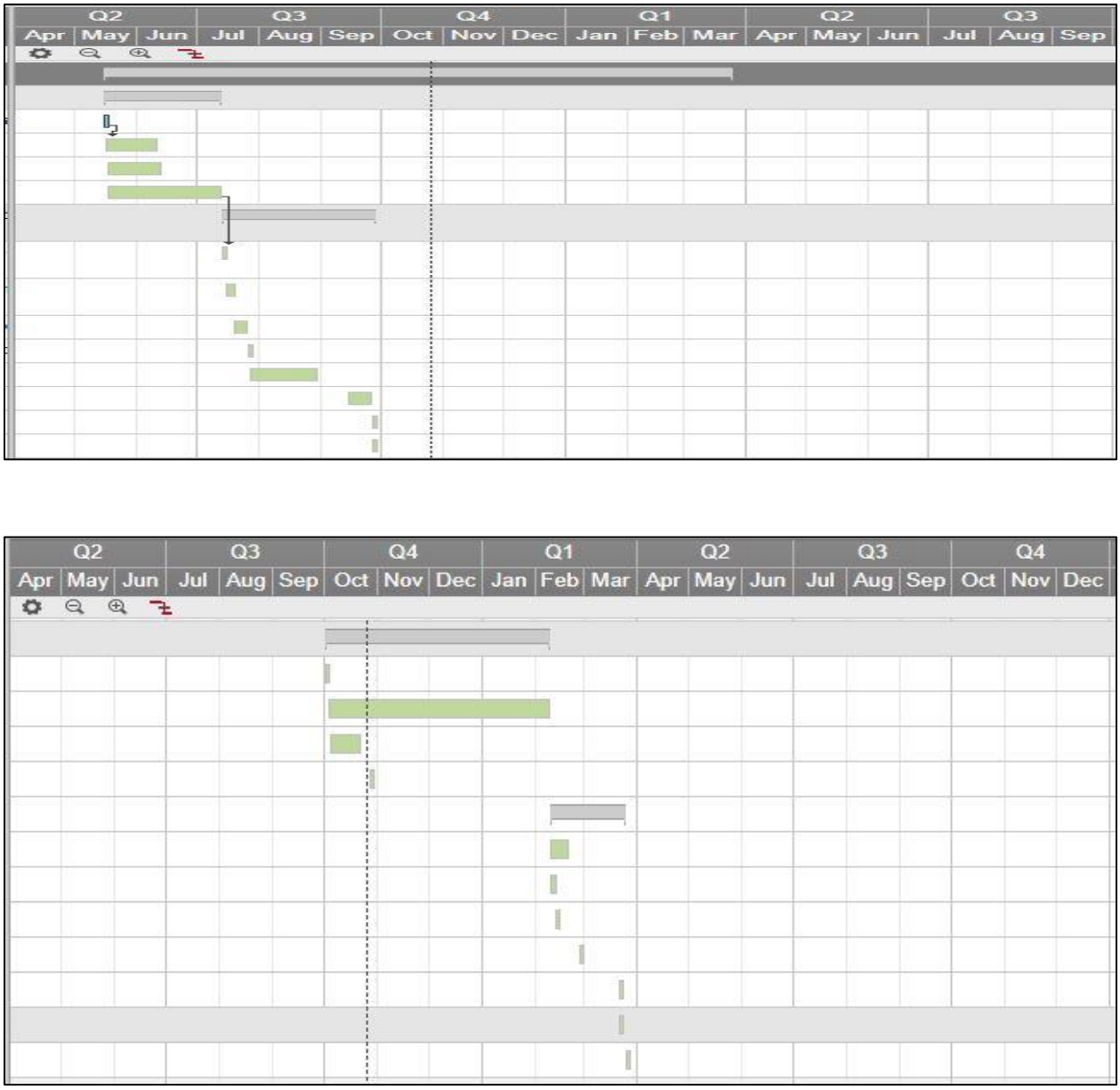

Fig. 4.2.1 Timeline Chart/Gantt Chart

Chapter 5: Implementation

5.1 Working

5.1.1 Block Diagram Description:

The system consists of three main modules- the temperature sensor module, pulse rate sensor module, spo2 sensor module. Once the patient's data is input to the web application, proper visualization is provided. An alert system is provided in case of any emergency.

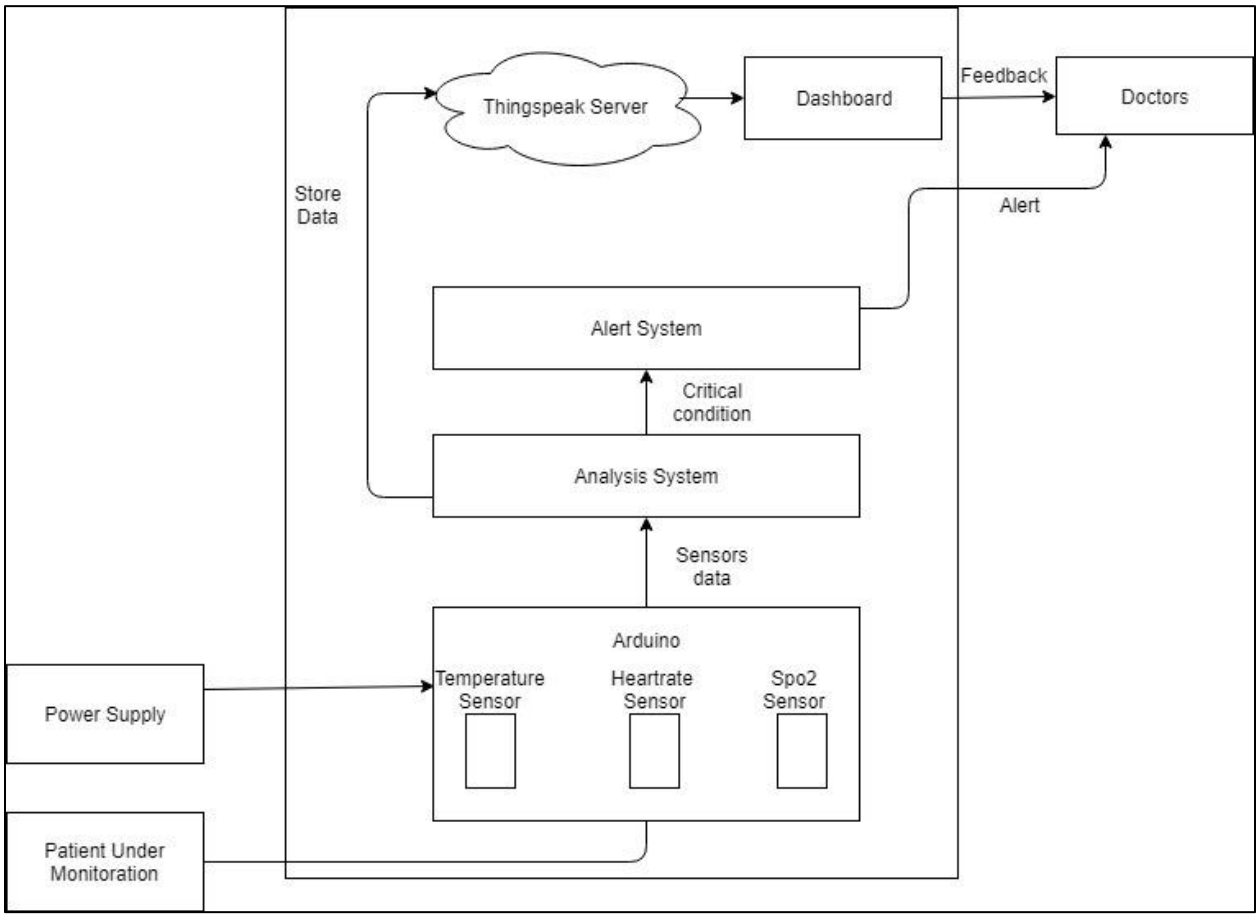

Fig 5.1 Block Diagram

5.1.2 System Description:

In our project, we are basically providing services to the patient who has been given discharge from the ICU and is transferred to LTCU (long term care unit). Here we will be integrating various sensors such as radio frequency identification (RFID), temperature sensor, heart rate sensor and the SPO2 sensors to the arduino. These sensors will collect data at determined regular intervals of time and will pass that data to the arduino.

The time duration for each sensor will be taken by the hospital officials and then it will be encoded accordingly in the arduino. The code in the arduino will cause functioning of the sensors.

The arduino will also be connected to the cloud .So the data that comes from the patient's respective sensors will be finally stored in the cloud storage. This data can also be accessed by the doctor to keep a track on the patient's health.

CIRCUIT DIAGRAM:-

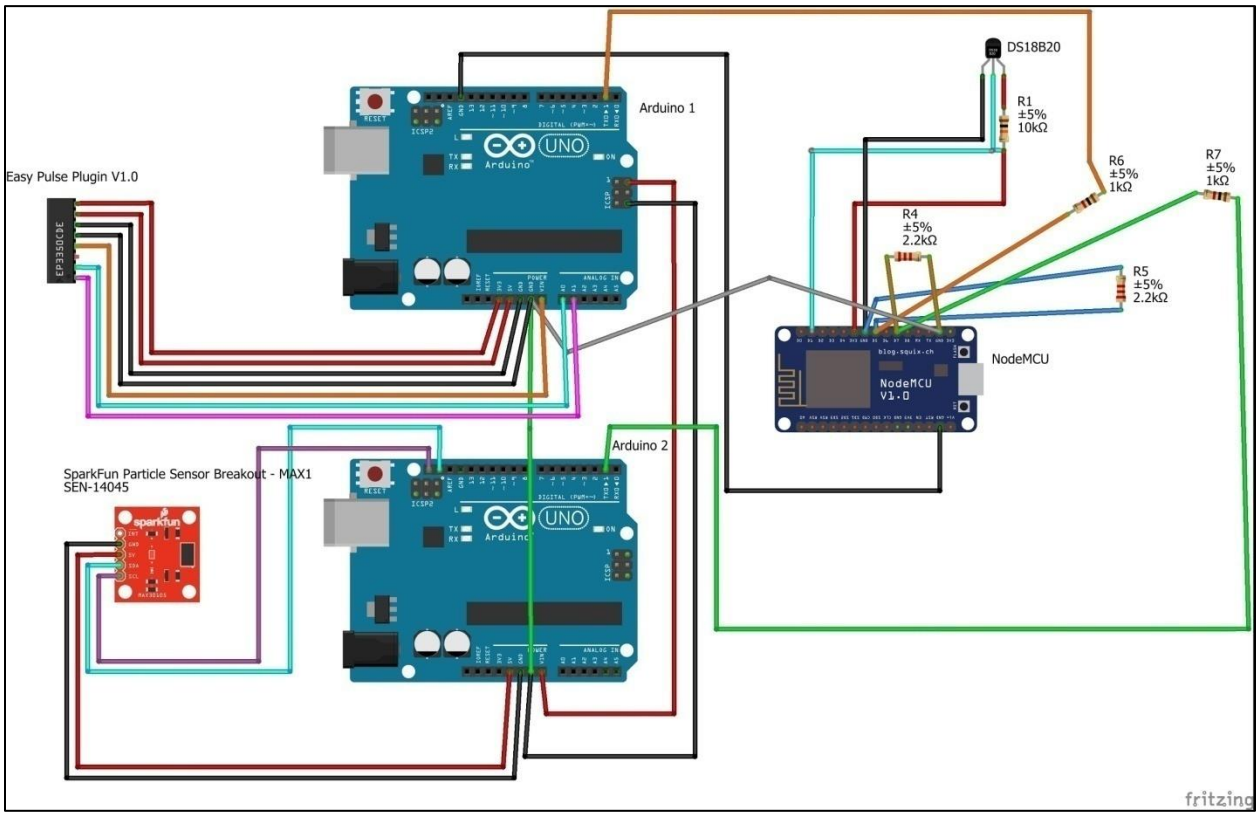

Fig.5.2 Circuit Diagram of IoT Device

Esp8266	**DS18B20**
3V3	VDD
D1	DQ
GND	GND
Esp8266	**Arduino 1**
D5	TXD
GND	GND
Esp8266	**Arduino 2**
D7	TXD
Arduino 1	**Arduino 2**
VCC(ICSP)	Vin
GND(ICSP)	GND
GND	GND
Arduino 2	**max30105**
GND	GND
5V	5V
SDA	SDA
SCL	SCL
Arduino 1	**Easy Pulse Plugin v1.0**
3V3	3V3
5V	5V
GND	GND
GND	GND
A0	A0
A1	A1

Table 1: Circuit Diagram Connections

ESP8266 :

The ESP8266EX integrates a Tensilica L106 32-bit RISC processor, which achieves extra low power consumption and reaches a maximum clock speed of 160 MHz. The Real-Time Operating System (RTOS) and Wi-Fi stack allow 80% of the processing power to be available for user application programming and development.

ESP8266EX is designed with advanced power management technologies and intended for mobile devices, wearable electronics and the Internet of Things applications.

The low-power architecture operates in three modes: active mode, sleep mode and Deepsleep mode. ESP8266EX consumes about 20 μA of power in Deep-sleep mode (with RTC clock still running) and less than 1.0 mA (DTIM=3) or less than 0.6 mA (DTIM=10) to stay connected to the access point.

Arduino :

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds. The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature (Tstg max). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Temperature Sensor:

The DS18B20-PAR digital thermometer provides 9 to 12–bit centigrade temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20-PAR does not need an external power supply because it derives power directly from the data line (“parasite power”). The DS18B20-PAR communicates over a 1-Wire bus, which by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of –55°C to +100°C and is accurate to ±0.5°C over a range of –10°C to +85°C. Each DS18B20-PAR has a unique 64-bit

identification code, which allows multiple DS18B20-PARs to function on the same 1–wire bus; thus, it is simple to use one microprocessor to control many DS18B20-PARs distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment or machinery, and process monitoring and control systems.

Pulse Sensor:

Easy Pulse Plugin is an Arduino compatible and breadboard friendly pulse sensor based on the principle of photoplethysmography. It operates at both 3.3V and 5.0V power supply and can be easily plugged into Arduino Uno, chipKIT Uno32, or any other compatible boards for rapid prototyping. With a two-stage filtering and amplification on board, the output of Easy Pulse Plugin is a clean PPG waveform that can be fed to the A0 or A1 analog input pin of Arduino Uno through a user-configurable shunt jumper on board. There is a application example: Arduino Pulse Meter.

SpO2 Sensor:

The SparkFun MAX30105 Particle Sensor is a flexible, powerful sensor enabling sensing of distance, heart rate, particle detection and even the blinking of an eye. The MAX30105 has been equipped with three LEDs as well as a very sensitive photon detector. The idea is to pulse the different LEDs, then detect what shines back. Based on the reflected signature it's possible to detect different types of particles or materials (such as oxygenated blood or smoke from a fire).

The MAX30105 utilizes a red LED, a green LED, and an IR (Infrared) LED for presence sensing, heart-beat plotting and heart-rate monitoring among its multitude of uses, including Pulse Oximetry. The MAX30105 is designed to operate at 5V and can communicate with both 3.3V and 5V microcontrollers. We've also written an Arduino library for the MAX30105 Breakout which takes care of all of the I C communication, bit shifting, register writing and sample reading.

5.1.3 PseudoCode

A] Arduino code for spo2

Step 1: Read 50 samples from the spo2 max30105 sensor.

Step 2: Calculate spo2 value.

Step 3: Send the spo2 Value to esp8266 through TXD pin.

Step 4: goto Step 1 and continue.

B] Arduino code for pulse:

Step 1; Take the reading from the easy pulse plugin sensor at A0 pin.

Step 2: Send the heart rate value to esp8266 through TXD pin

Step 3: goto Step 1 and continue.

C] ESP code:

Step 1: Connect to wifi.

Step 2: Read the temperature from DS18B20 sensor

Step 3: If no error then,

Write the temperature data to Thingspeak channel.

Else

Print error message.

Step 4: Read the Heart rate data coming from arduino 1.

Step 5: If no error then,

Write the heart rate data to Thingspeak channel.

Else

Print error message.

Step 6: Read the spo2 data coming from arduino 2.

Step 7: If no error then,

Write the spo2 data to Thingspeak channel.

Else

Print error message.

Step 8: goto Step 2 and continue.

Chapter 6: Testing

6.1 Unit Testing

In this stage of testing every user interface was individually build and after a successful build it was run as a website. The errors reported were fixed back and the testing was performed recursively until the application gave result as per specified in the requirements document by making the appropriate changes.

The following table shows the various test cases under unit testing:

Test case No.	Test Case	Description	Input	Expected Output	Actual Output	Pass /Fail
1.	Load website	The website must load on entering the URL.	Mouse click	Homepage of website	Homepage of website	Pass
2.	Pulse sensor output.	On placing finger in the easy pulse sensor the reading should appear on serial monitor on Arduino IDE.	Place finger in pulse sensor.	The pulse rate of the the user.	The pulse rate of the the user.	Pass
3.	SPO2 sensor output.	When the spo2 sensor is placed on the wrist vein, the spo2 reading should appear on serial monitor on Arduino IDE.	Place spo2 sensor on vein.	The blood oxygen saturation of the user.	The blood oxygen saturation of the user.	Pass
4.	Temperature	When the temperature	Press	The	The	Pass

	sensor output.	sensor is pressed between two fingers, the reading should appear on serial monitor on Arduino IDE.	the temperature sensor between fingers.	temperature of the user.	temperature of the user.	
5.	Alerts	When any sensor readings are abnormal then an alert should be sent on the registered mobile number.	-	Alert message.	Alert message.	Pass
6.	Login (User/Staff)	The user/staff logins to his account.	Username, password	Login to the account.	Logins in to the account.	Pass
7.	Register(User/Staff)	The user/staff Registers.	All details provided in the form	Create a account.	Creates a account.	Pass
8.	Home Page	The home page provides graphs based on the readings taken from the device.	Login	Show Graphs of heart rate, temperature, spo2	Shows Graphs of heart rate, temperature, spo2	Pass
9.	Table Listing	Shows the last 5 readings taken.	Login	Show Listing.	Shows Listing	Pass

Table 2: Modules of Unit Testing

6.2 Integration Testing

The IoT device and website were integrated through the use of Thingspeak. The modules work as expected together.

Chapter 7: Results Analysis

7.1 Outputs and Screenshots

On opening the Swasth Suvidha website the homepage will load. The doctor/staff will first register on the Swasth Suvidha website. They have to enter their details, choose a password and username to sign in with. The below image shows the registration page.

There is also a provision for the entry of patient's history. This will help the doctor with better diagnosis and faster judgment on the patient's condition. This can be seen in the next image.

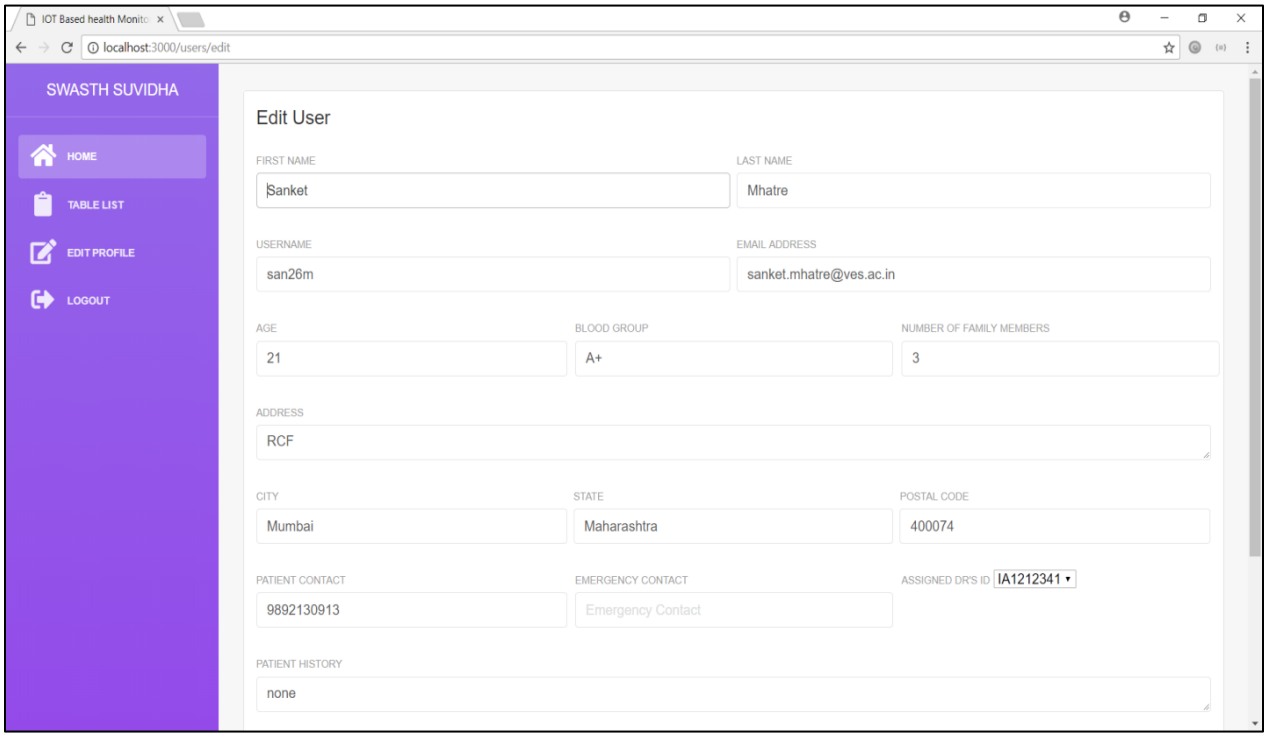

Fig 7.1.1 UI Screenshot

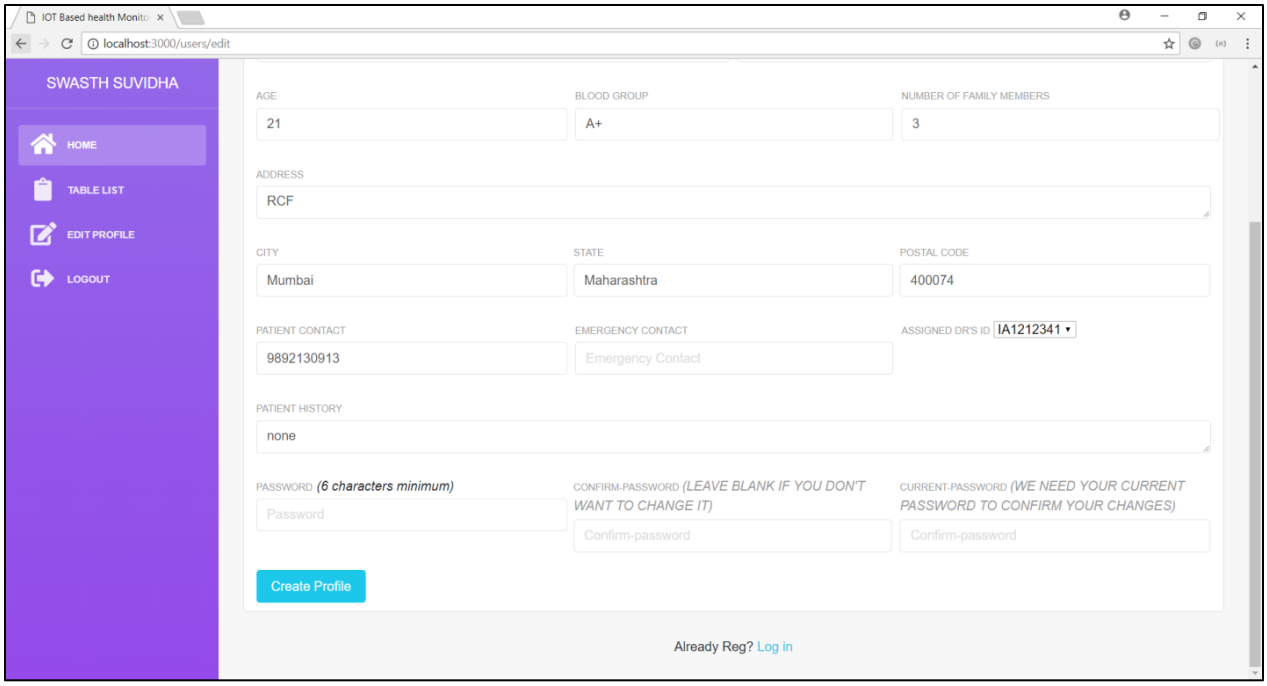

Fig 7.1.2 UI Screenshot

The doctor/staff will login with their valid credentials and gain access to the patient data and charts. The charts display the graph of the patient's heart beat rate, temperature and oxygen saturation.

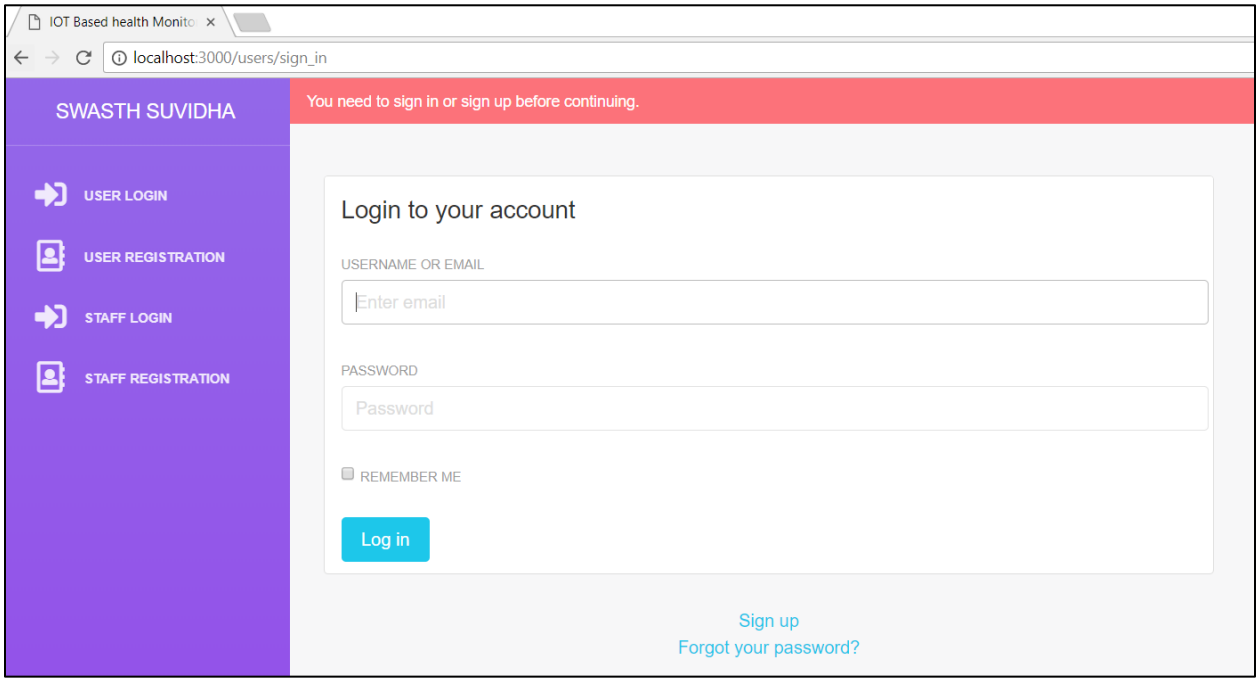

Fig 7.1.3 UI Screenshot

The following images show the graphs for heartbeat rate, temperature and oxygen saturation of the patient. They help in better judgment of the patient's condition because it is visually easy to read and analyze.

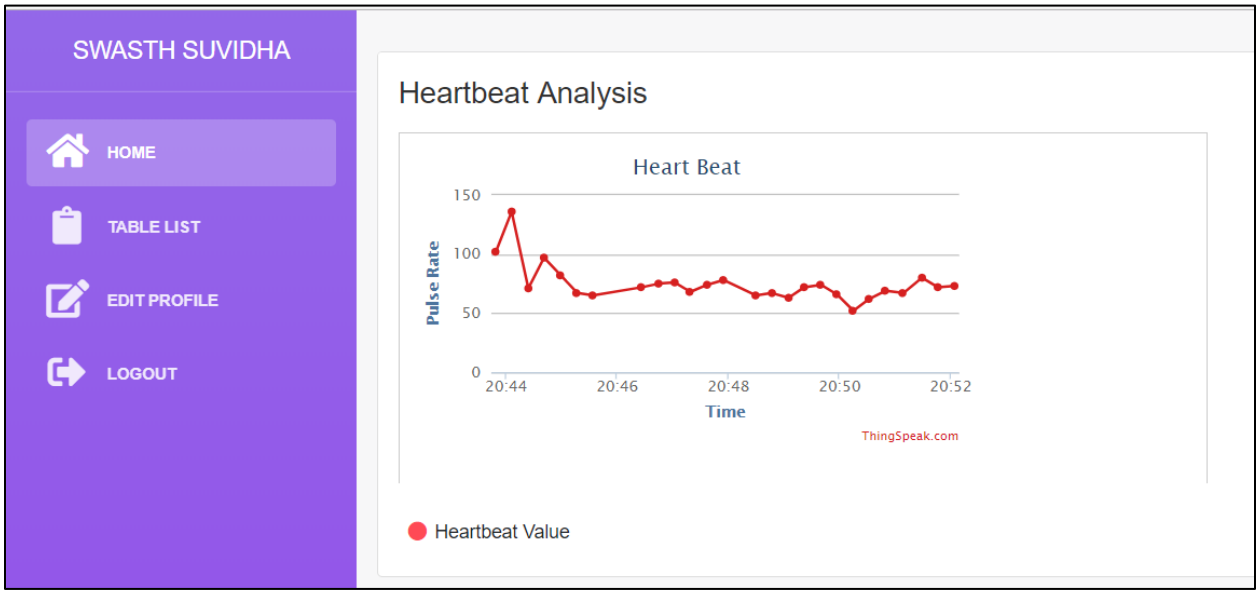

Fig 7.1.4 UI Screenshot

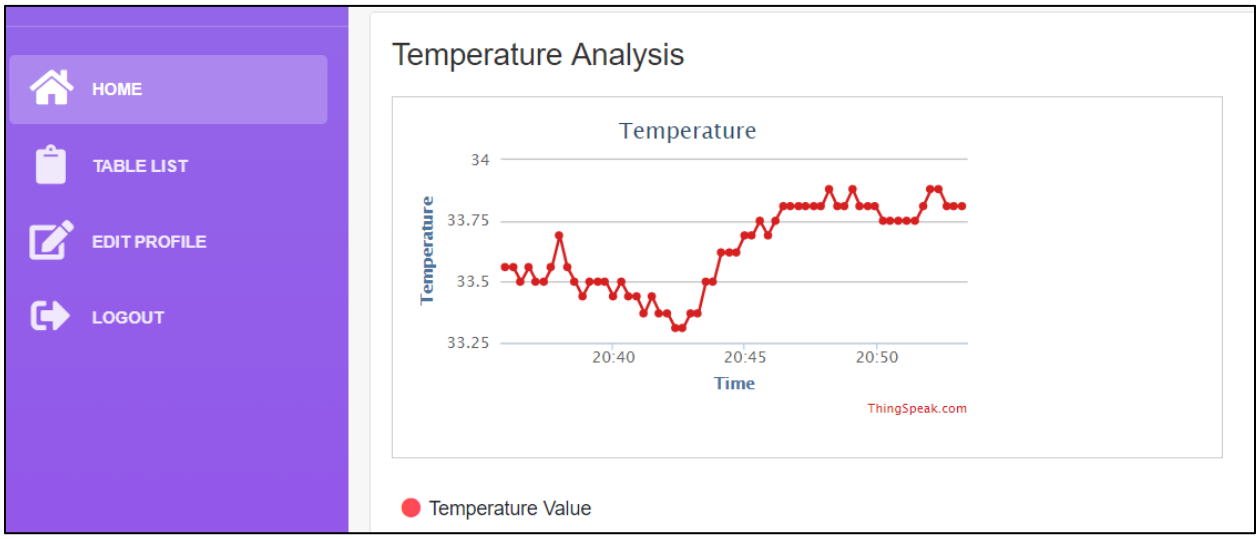

Fig 7.1.5 UI Screenshot

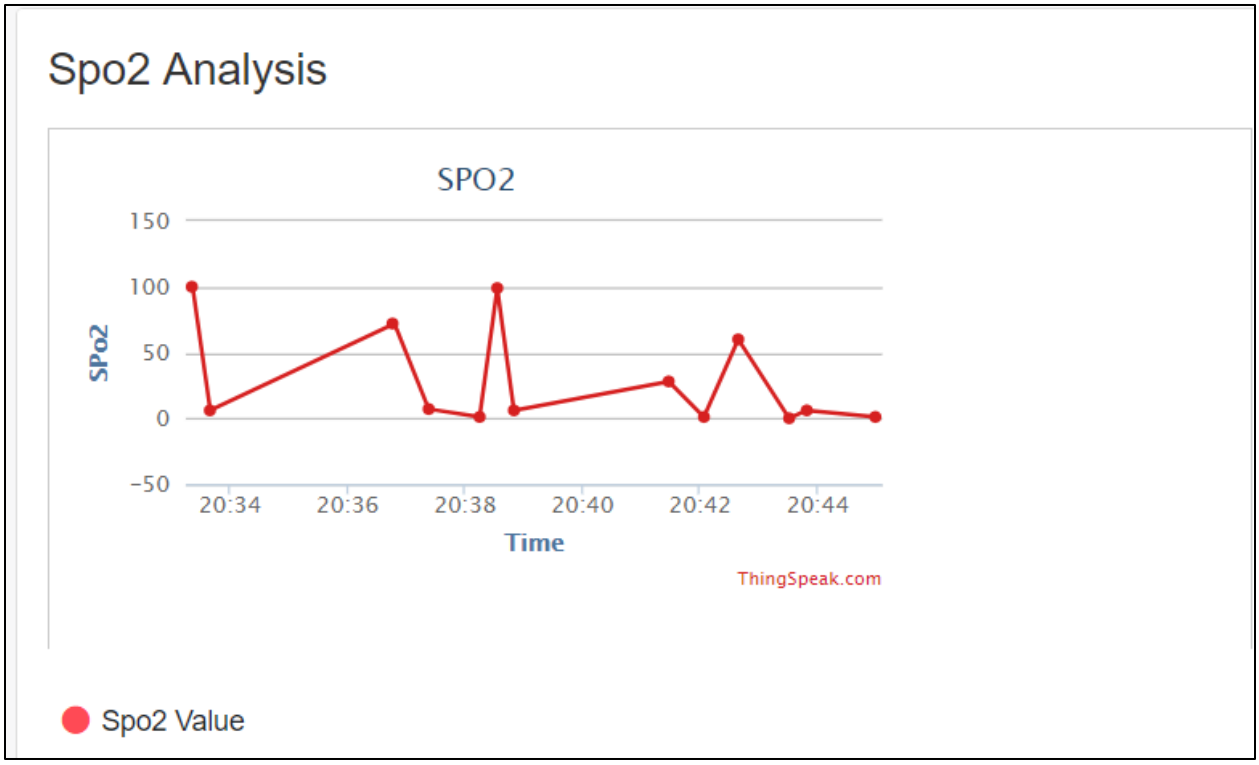

Fig 7.1.6 UI Screenshot

The below image shows the top 5 heartbeat and temperature readings for a patient. They get updated from time to time in order to display the most recent readings.

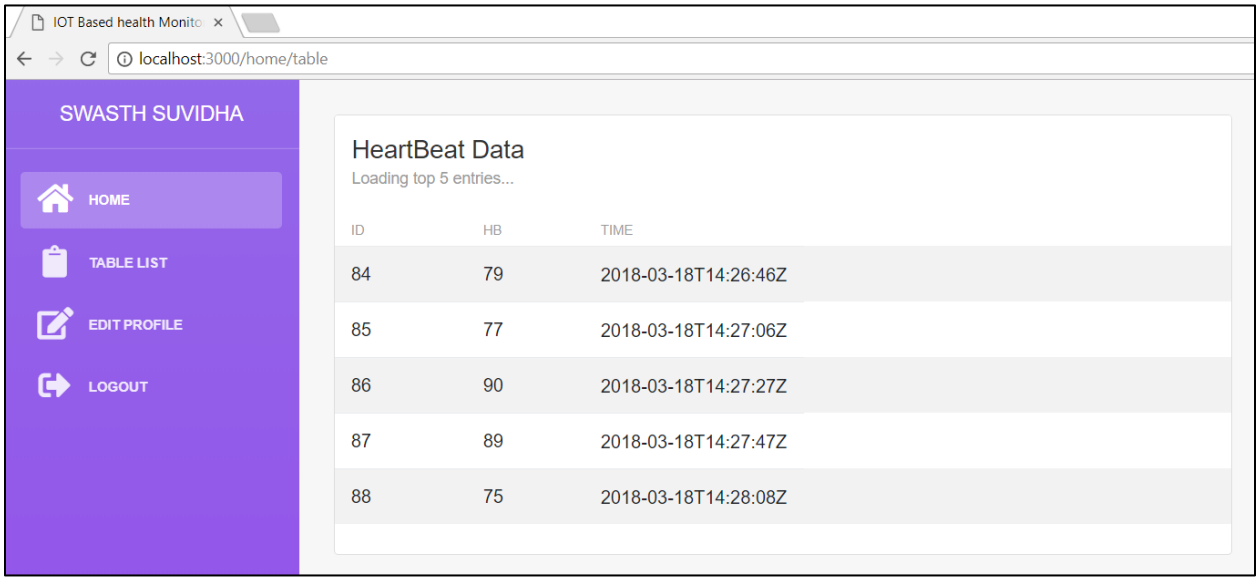

Fig 7.1.7 UI Screenshot

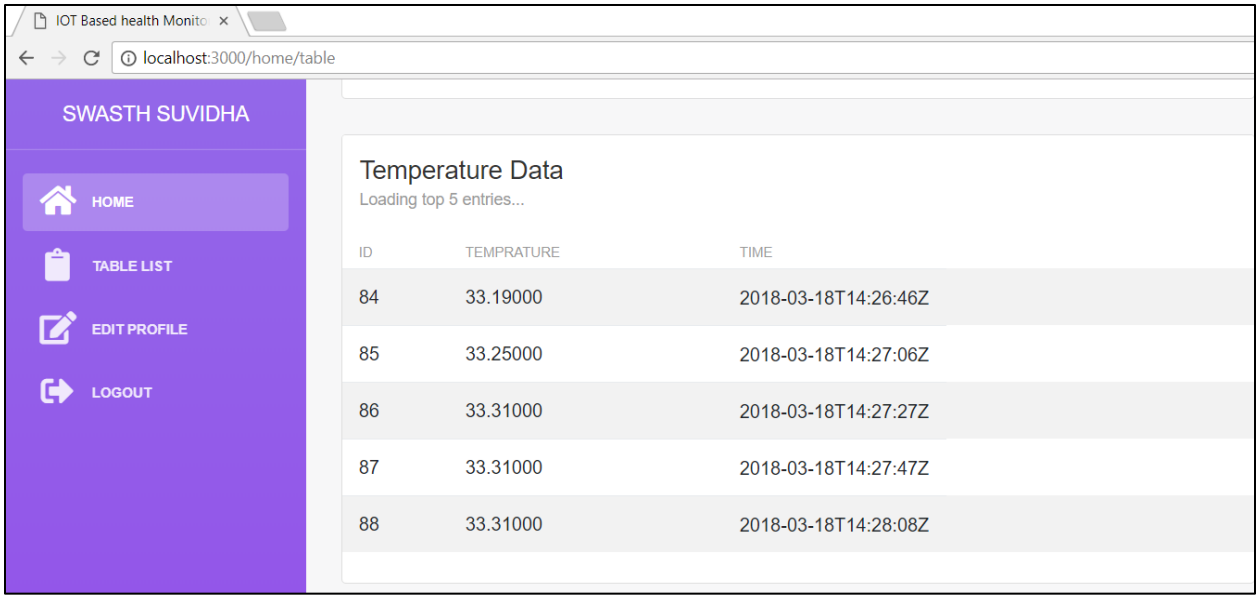

Fig 7.1.8 UI Screenshot

Chapter 8: Conclusion

8.1 Limitations

A major problem that can arise with our device is issue of perfect accuracy as we have compromised with the cost as our project is dedicated mainly to the poor who have been given discharge from the ICU. Increasing the number of sensors to include detection in more directions can be problematic when it comes to integrating the various sensors to the arduino board. Wired connection cannot be an option here and wireless connection can be complex and shorten the battery life of the device.

Another important limitation is that, the finger should be placed properly and the hand should be still, without any movement of it.

8.2 Conclusion

In today's world of connectivity, with the advancement of Internet of Things (IoT) all entities are connected to each other by some communication means and has provided open doors for various developments in different domains.

In our project, we are basically providing services to the patient who have been given discharge from the ICU and is transferred to LTCU(long term care unit).So that we can easily and precisely keep track of their health and take immediate actions in case of an emergency.

In our project we will be using a number of different sensors like the temperature sensor, heart sensor and so on. These sensors will be integrated to an arduino board from where we will operate them and the data will be stored on cloud .The data will refresh at regular intervals of time for respective sensors and stored in the cloud.

This will eventually transform healthcare industry by increasing efficiency, lowering costs and put the focus back on better patient care.

This project will not only help the patients but will also increase the precision and efficiency with which hospitals work and handle their patients.

8.3 Future Scope

IoT has enabled healthcare monitoring to become more widespread and effective. In the past, patients could only be monitored in a medical facility or under the care of family or home nurses. If a patient decided to heal in a hospital, their vital signs - blood pressure, blood sugar levels, and heart levels - could be monitored by healthcare professionals. But if a patient decided to heal at home in the care of family, they risked not being able to immediately detect complications from illness and disease. The stress of leaving a sick or elderly family member at home by themselves can affect the day-to-day life of their relatives. Many family members take time away from their jobs to take care of sick relatives because they worry about what might happen while they're away. However IoT home health monitoring will automatically detect and report emergencies to caregivers.. IoT home health monitoring will allow monitoring of patients' vital health information through the use of wearable technology that tracks their condition. These wearables range from blood pressure and pulse detectors worn around the wrist to personal emergency response systems worn as a necklace to sleep apnea machines worn on the face, and they report health information and statistics through cellular networks and the internet. This flow of health information allows health abnormalities and emergencies to be detected and cared for immediately, either through text or email alerts to family and doctors, or by contacting emergency services to send an EMT. For example, an elderly parent with a heart condition can be monitored by IoT home health monitoring, and should a health emergency occur, an ambulance can be summoned automatically. IoT is such a field in today's world that has huge scope in transforming our lives. IOT can bring a big revolution in the process of treatment and diagnosis of diseases. Embedding the medical equipment with IOT devices will help to monitor the patients more effectively. Personal fitness and wellness trackers are already gaining popularity. Remote patient monitoring will also become more efficient with IOT.

Our device can be improved by making it more compact. Also the cost can be further reduced by using cheaper alternatives to the sensors used but this can pose a problem of low accuracy and then the calibration will take much longer.

Chapter 9: References

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[8]https://tkkrlab.nl/wiki/Arduino_37_sensors

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Appendix

a. List of components and their costs

Sr No.	Element	Quantity	Price per piece	Amount
1	Temperature Sensor	1	80	80
2	Pulse Sensor	1	1200	1200
3	Arduino UNO	2	450	900
4	Spo2 Sensor	1	850	850
5	Wifi Module	1	450	450
6	Resistors and Wires		100	100
			Total	**3580**

Table 3: List of Components and their costs

In addition there might me some packaging and rounding up costs. However, mass production will decrease the price in large amounts. Thus, approximately, the product would cost ₹ 3600.

b. List of tables

c. List of Figures

d. Paper Publication

Paper 1 published

Overview study of IoT Healthcare Models

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ABSTRACT: In today's world the use of internet has been spread in every sector of the life.People in India have now turned to buying almost everything ranging from books, lifestyle accessories,electronic equipment, beauty products and even household items from the online mobile application.But the use of internet in the health sector haven't seen much improvement.This paper brings to light the use of IoT in healthcare and compares different architectures available in the market.These models help to improve the efficiency and decision making in hospitals.

KEYWORDS: Internet of Things(IOT),Arduino,ESP8266,Pulserate,Healthcare.

I. INTRODUCTION

Internet of Things (IoT) is the application of networking of physical devices and embedded systems along with the help of sensors and actuators which communicates to share knowledge and helps in attaining precision in various domains. Internet of things has flourished in many domains . IoT in healthcare is one of the most trending domains of today's generation. It has had a great impact on the medical discipline. It is basically integration of various sensors along with microcontroller like the Arduino(many versions are available), ESP8266 and so on. It plays a vital role in providing assistance to doctors in decision making in the case of emergency. It will also improvise the traditional measures taken to observe heart beat, pulse, blood pressure , motion and similar related parameters.

II. **LITERATURE SURVEY**

Healthcare is rapidly adapting to the use of IoT. Various models have been proposed to enhance the healthcare domain. Also the advancement in Cloud computing have greatly benefited IoT.

Fig 1.
Basic working of IoT in healthcare [1]

The above figure depicts the basic working of IoT in healthcare. The patient being monitored has the different sensors attached which read the parameters.This data which is read with the help of the sensors is sent through internet to the server for storage of the data.Doctor/User can access this server to analyses the data and take decisions as needed.

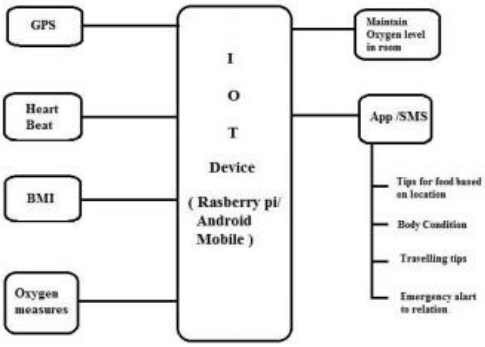

Fig. 2
IoT model with sensors [2]

Sensors are used for monitoring different parameters.The parameters that can be measured are heart beat, BMI, oxygen measures, body temperature,etc. Application can also be provided to help the patients and doctors to provide tips and body condition.Using the IoT device such as arduino or raspberry pi we

can collect the sensor data and analysis can be done based on certain predefined conditions.Thus alerts and notifications can also be sent to the respective users on their smartphones.

Fig. 3
The confluence brought about by the IoT [3]

The above diagram shows how Arduino is connected to various sectors of the world. How IoT cloud takes up the data from various sectors and stores it and will update it at regular intervals of time as per the requirement of the field.

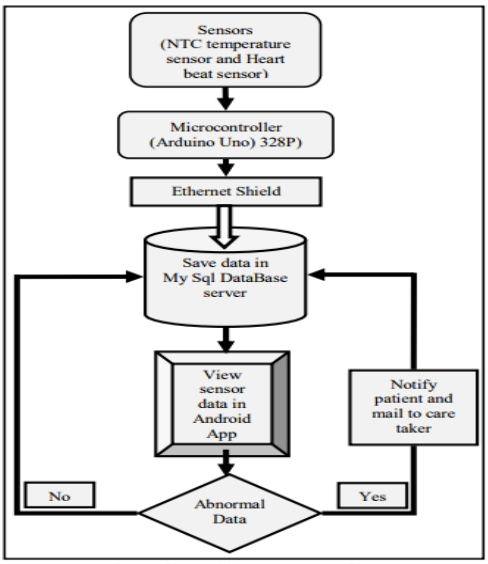

Fig. 4
Flowchart of the process [3]

In flowchart sensors are at apex. Sensors include NTC temperature sensor and heart beat sensor. These sensors will be connected to a microcontroller like the Arduino. Ethernet shield is used to protect entire setup from vulnerabilities. The data obtained from the Arduino with the help of sensors will be saved in the Sql database server. The data will then be accessed from the application developed. Notifications will be given to the patient.

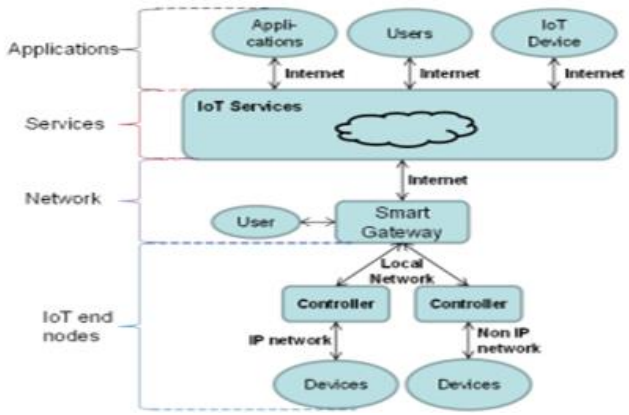

Fig. 5
Cloud Storage for IoT [4]

In the above proposed model there are four layers specified. The first layer is the IoT and nodes. This layer has devices which are the various sensors. These sensors are connected to the microcontroller through the IP Network. The controller will then be connected to the smart gateway through the local network. The second layer is the network consists of the smart gateway. The user will access the data through this gateway. The third layer will provide IoT services through the internet to the smart gateway. The last layer is the application layer. Here there will be applications, users , and IoT devices connected to the third layer via internet.

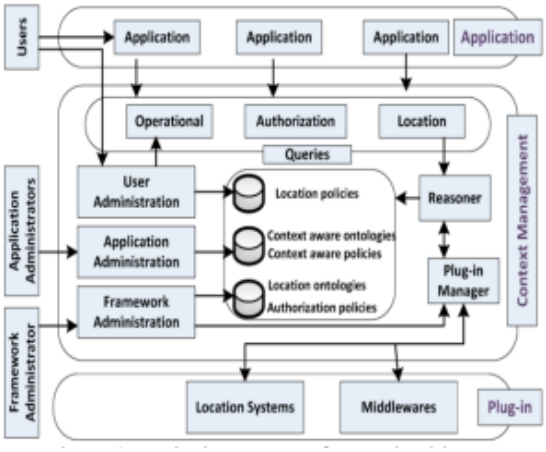

Fig. 6
Logical Structure of Healthcare [4]

The logical structure above explains how the the users are connected to the IoT healthcare systems through application.The system provides authorization of the user and gains the location of the user to alert the doctor/guardian in case of emergency.Queries are created and executed to store the data coming from the sensors. Administration of the system is done by the Application Administration and Framework Administration.

III. COMPARISON OF ALL MODELS

Sr no.	Parameters	IoT model with Sensors	The confluence brought by IoT	Flowchart of Process	Cloud Storage of IoT
1	Role of Model	Sensors are used for monitoring different parameters.	It shows how Arduino is connected to various sectors of the world.	In flowchart sensors are at apex which include NTC temperature sensor and heart beat sensor.	In the proposed model there are four layers specified.
2	Features of First Layer	Using the IoT device such as arduino or raspberry pi we can collect the sensor data	IoT cloud takes up the data from various sectors.as per the requirement of the field.	Sensors connected to arduino. Ethernet shield is used as protection.	The first layer is the IoT and nodes.
3	Features of Second Layer	The parameters that can be measured are heartbeat, BMI, oxygen measures, body temperature,etc.	Storage and update at regular intervals of time as per the requirement of the field.	The data obtained from the Arduino with the help of sensors will be saved in the Sql database server.	The second layer is the network consists of the smart gateway.
4	Final Layer	Alerts and notifications can also be sent to the respective users on their smartphones.	Retrieval as per the demand of the user.	The data will then be accessed from the application developed.	The third layer will provide IoT services through the internet to the smart gateway. The last layer is the application layer.

IV. CONCLUSION

Sensors play a vital role in healthcare domain. These sensors include temperature sensor , motion sensor ,blood pressure sensor and so on . These sensors are integrated to the arduino microcontroller. The data is collected in a cloud storage or a sql database server .The data will be updated at regular intervals of time as per the guidance of the doctor .The patient can view the data on the dashboard ,

display monitor as per the implementation requirements. So keeping the track of all the details becomes easy ,compact and efficient .IOT in healthcare will enhance the healthcare domain .It will provide assistance to doctors in case of emergencies as well as help the hospitals to take better care of the patients.

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ISSN (Online): 2320 – 9801 ISSN (Print): 2320 - 9798

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Student, Department of Computer Engineering, Vivekanand Education Society's Institute of Technology, Mumbai University, Mumbai, India

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"Overview Study of IoT Healthcare Models"

in IJIRCCE, Volume 6, Issue 2, February 2018

Certificate No: V6I0C586
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ISSN (Online): 2320 – 9801 ISSN (Print): 2320 - 9798

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in IJIRCCE, Volume 6, Issue 2, February 2018

Certificate No: V6I0C588
Date: 28th February 2018

IJIRCCE
Impact Factor: 7.194

Editor-in-Chief


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ISSN (Online): 2320 – 9801 ISSN (Print): 2320 - 9798

PUBLICATION CERTIFICATE

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Impact Factor: 7.194

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ISSN (Online): 2320 – 9801 ISSN (Print): 2320 - 9798

PUBLICATION CERTIFICATE

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ISSN (Online): 2320 – 9801 ISSN (Print): 2320 - 9798

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Draft of the Paper 2

Iot Device For Healthcare

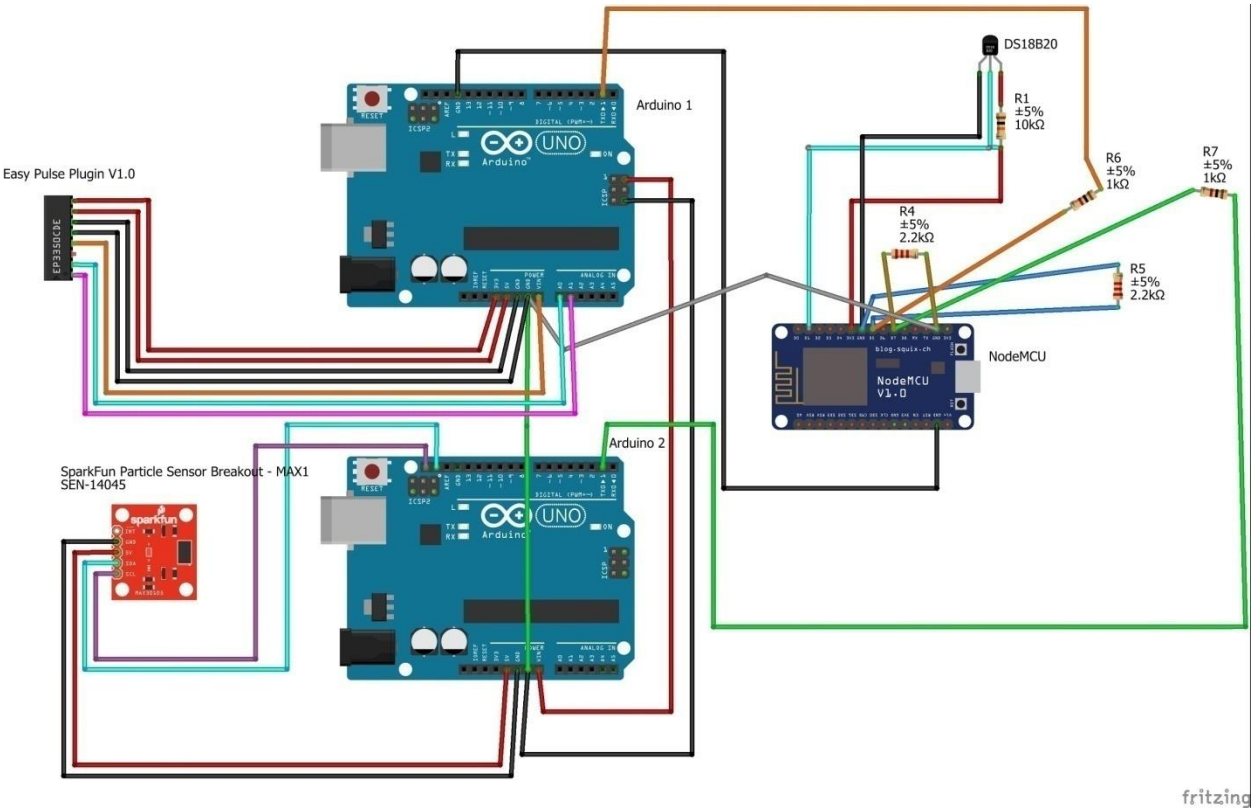
ABSTRACT:
The use of internet is widespread in our daily lives and has been spread in every sector. Nowadays people in India use online mobile application for buying electronic equipment, books, beauty products and so on.There hasn't been much improvement of IoT in the health sector. This paper brings light to the Iot device we have proposed to monitor patients.This device monitors patients pulse rate, temperature and oxygen saturation in blood(Spo2).

KEYWORDS:
Internet of Things(IOT),Arduino UNO, ESP8266, Pulse rate, Healthcare, Oxygen Saturation(Spo2).

INTRODUCTION:
Internet of Things (IoT) is the implementation of integrating of physical devices and embedded systems along with the help of sensors and actuators which communicates to share information and helps in achieving precision in various fields. Internet of things has seen development in many domains . IoT in healthcare is one of the most trending domain of today's generation. It has had a great impact on the medical discipline. It is basically integration of microcontroller like the Arduino(many versions are available), ESP8266 and so on with various sensors that collect data and send to the microcontroller. It plays a vital role in providing assistance to doctors in decision making in the case of emergency. It will also improvise the traditional measures taken to observe pulse rate, temperature, oxygen saturation(Spo2) and similar related parameters.

DESCRIPTION:
In our project, we are basically providing services to the patient who has been given discharge from the ICU and is transferred to LTCU(long term care unit). Here we will be integrating various sensors such as temperature sensor, pulse rate sensor and the SPO2 sensors to the arduino/Esp8266. These sensors will collect data at determined regular intervals of time and will pass that data to the arduino, the arduino then in turn sends the data to the ESP8266.The ESP8266 has the temperature sensor connected to it.The code in the arduino will cause functioning of the sensors.

The data collected from the sensors is sent to the cloud for storage. On insertion of data to the Thingspeak cloud if any abnormal/critical values an alert is sent to the doctor.



[2] Circuit Diagram

Two arduinos are used in the device and ESP8266 along with different sensors. The pulse rate sensor is connected to the first arduino and the spo2 sensor is connected to the second arduino, temperature sensor is connected to the ESP8266. Power supply for the ESP8266 and first arduino are supplied through USB supply and as of the second arduino the power supply is given through the first arduino. The data collected from the two arduino and the ESP8266 is collected at the ESP8266 itself which in turn sends the data to the Thingspeak cloud. We have created a channel on Thingspeak server which has three fields to store our data. So the data that comes from the patient's respective sensors will be finally stored in the cloud storage. This data can also be accessed by the doctor to keep a track on the patient's health. Dynamic graphs are created on the Thingspeak cloud for temperature, pulse rate and spo2.

We have created a website that renders the graphs created on the thingspeak cloud to our website. The patient and staff/doctor can register/login to our website. Graphs can be seen created by taking the readings and storing them in the thingspeak. List of the latest 5 readings is also provided.

ESP8266 :

The ESP8266EX integrates a Tensilica L106 32-bit RISC processor, which achieves extralow power consumption and reaches a maximum clock speed of 160 MHz. The Real-Time Operating System (RTOS) and Wi-Fi stack allow 80% of the processing power to be available for user application programming and development.
ESP8266EX is designed with advanced power management technologies and intended for mobile devices, wearable electronics and the Internet of Things applications.
The low-power architecture operates in three modes: active mode, sleep mode and Deepsleep mode. ESP8266EX consumes about 20 μA of power in Deep-sleep mode (with RTC clock still running) and less than 1.0 mA (DTIM=3) or less than 0.6 mA (DTIM=10) to stay connected to the access point.

Arduino :

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds. The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature (Tstg max). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Temperature Sensor:

The DS18B20-PAR digital thermometer provides 9 to 12–bit centigrade temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20-PAR does not need an external power supply because it derives power directly from the data line (“parasite power”). The DS18B20-PAR communicates over a 1-Wire bus, which by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of –55°C to +100°C and is accurate to ±0.5°C over a range of –10°C to +85°C. Each DS18B20-PAR has a unique 64-bit identification code, which allows multiple DS18B20-PARs to function on the same 1–wire bus; thus, it is simple to use one microprocessor to control many DS18B20-PARs distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment or machinery, and process monitoring and control systems.

Pulse Sensor:

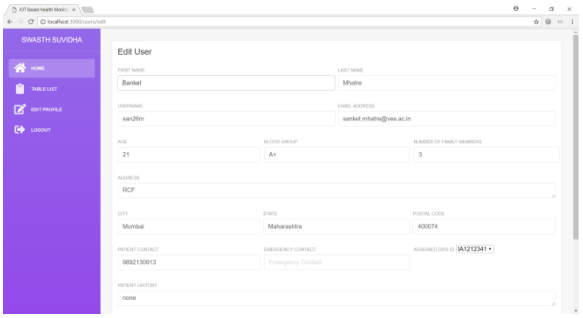
Easy Pulse Plugin is an Arduino compatible and breadboard friendly pulse sensor based on the

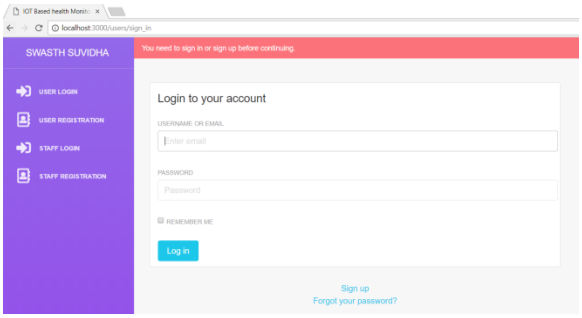
principle of photoplethysmography. It operates at both 3.3V and 5.0V power supply and can be easily plugged into Arduino Uno, chipKIT Uno32, or any other compatible boards for rapid prototyping. With a two-stage filtering and amplification on board, the output of Easy Pulse Plugin is a clean PPG waveform that can be fed to the A0 or A1 analog input pin of Arduino Uno through a user-configurable shunt jumper on board. There is a application example: Arduino Pulse Meter.

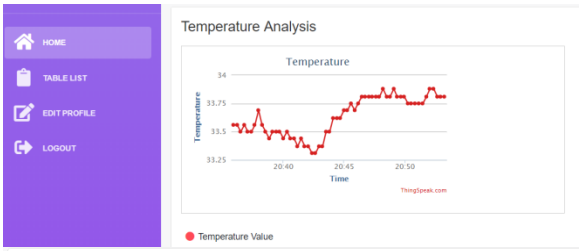
SpO2 Sensor:

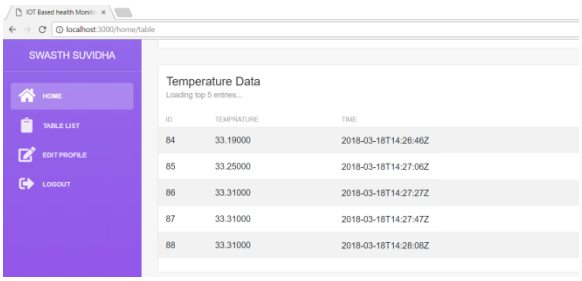
The SparkFun MAX30105 Particle Sensor is a flexible, powerful sensor enabling sensing of distance, heart rate, particle detection and even the blinking of an eye. The MAX30105 has been equipped with three LEDs as well as a very sensitive photon detector. The idea is to pulse the different LEDs, then detect what shines back. Based on the reflected signature it's possible to detect different types of particles or materials (such as oxygenated blood or smoke from a fire).

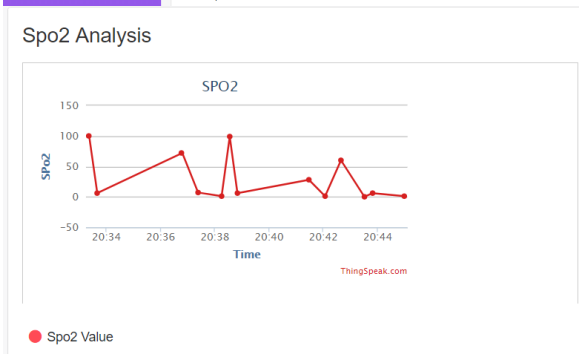
The MAX30105 utilizes a red LED, a green LED, and an IR (Infrared) LED for presence sensing, heart-beat plotting and heart-rate monitoring among its multitude of uses, including Pulse Oximetry. The MAX30105 is designed to operate at 5V and can communicate with both 3.3V and 5V microcontrollers. We've also written an Arduino library for the MAX30105 Breakout which takes care of all of the I C communication, bit shifting, register writing and sample reading.

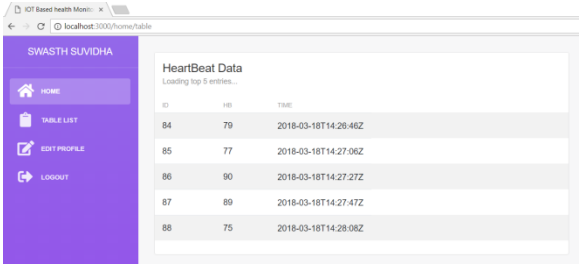












[3] Website Snippets

Sr No.	Element	Quantity
1	Temperature Sensor(DS180b)	1
2	Pulse Sensor(Easy Pulse Sensor V1.0)	1
3	Arduino UNO	2
4	Spo2 Sensor(MAX30105)	1
5	Wifi Module(ESP8266)	1
6	Resistors and Wires	-

Components Required

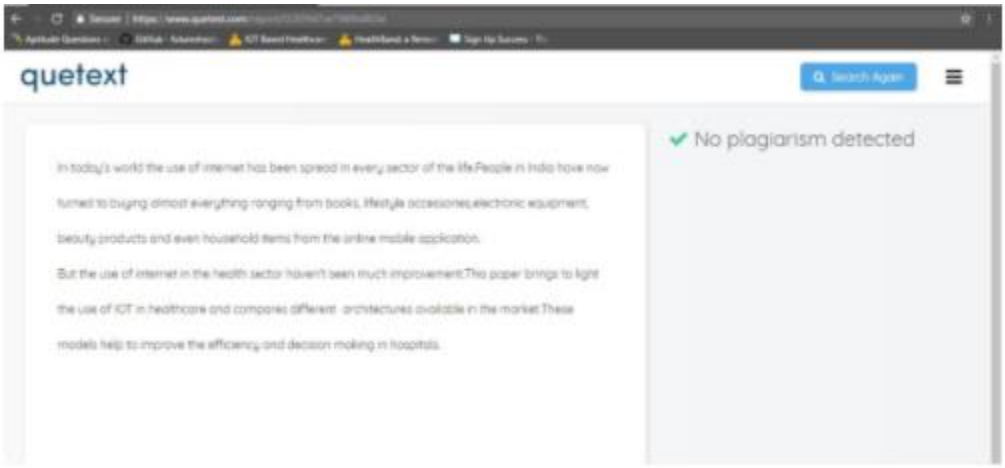
Testing

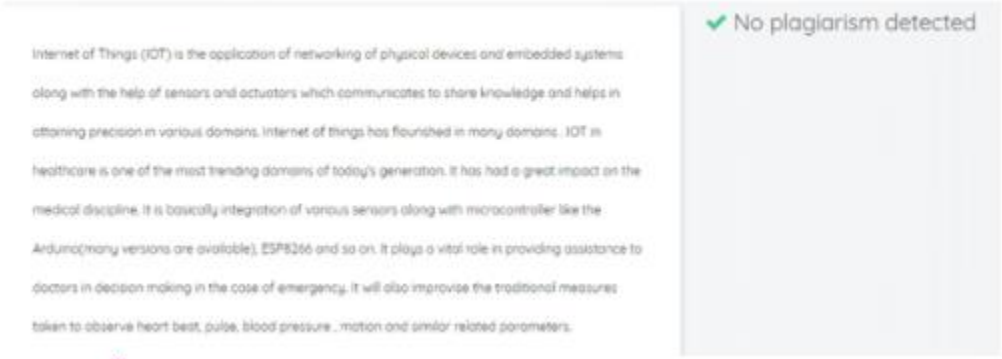
In this stage of testing every user interface was individually build and after a successful build it was run as a website. The errors reported were fixed back and the testing was performed recursively until the application gave result as per specified in the requirements document by making the appropriate changes. The IoT device and website were integrated through the use of Thingspeak. The modules work as expected together.

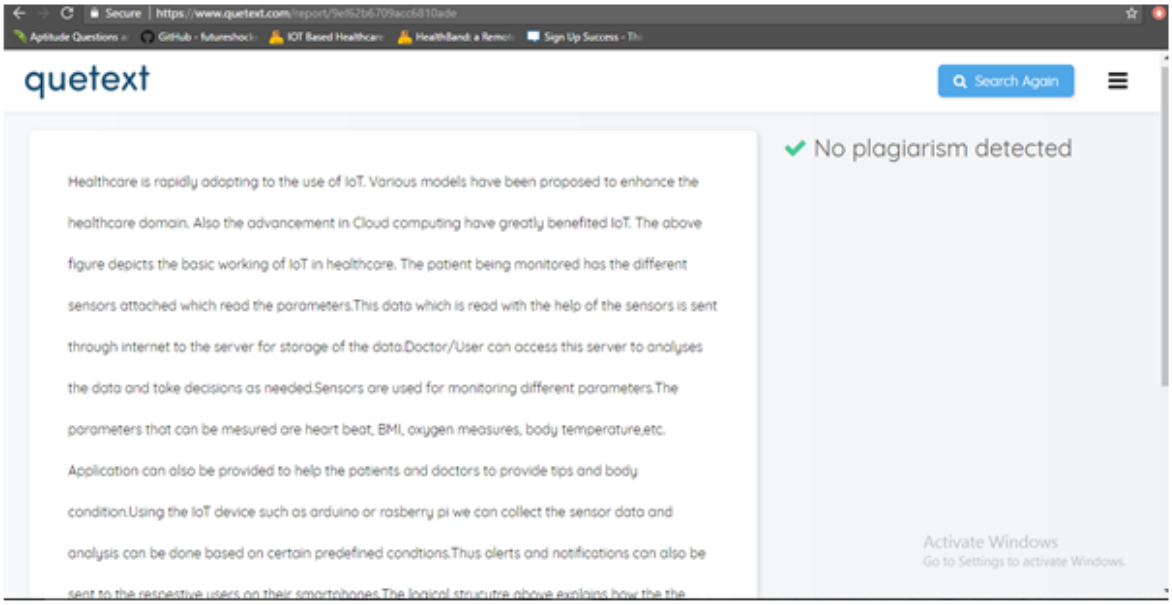
Future Scope

This project focuses on measuring accurate pulse reading, SPO2 reading and temperature. It also sends an alert if the reading cross their respective threshold value. This enhances the doctor and the staff ability of efficiently monitoring the patients. It overcomes the old manual method of monitoring the patients. This project can be further developed on Arduino Mega to make it more compact. It will also enable the ability of the three sensors to work on the same Arduino because Arduino Mega supports large RAM. It will also overcome power supply issues.

Plagiarism Report of the paper I



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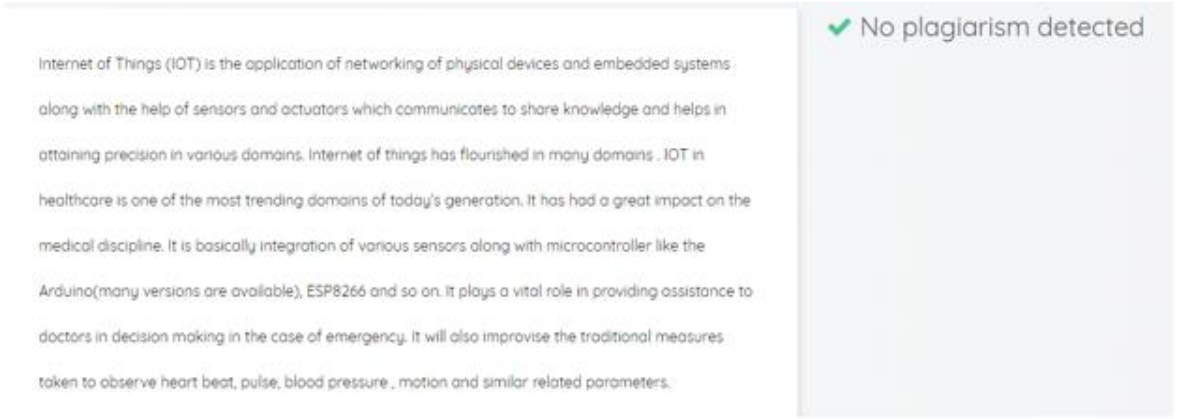
Healthcare is rapidly adopting to the use of IoT. Various models have been proposed to enhance the healthcare domain. Also the advancement in Cloud computing have greatly benefited IoT. The above figure depicts the basic working of IoT in healthcare. The patient being monitored has the different sensors attached which read the parameters.This data which is read with the help of the sensors is sent through internet to the server for storage of the data.Doctor/User can access this server to analyses the data and take decisions as needed.Sensors are used for monitoring different parameters.The parameters that can be mesured are heart beat, BMI, oxygen measures, body temperature,etc. Application can also be provided to help the patients and doctors to provide tips and body condition.Using the IoT device such as arduino or rasberry pi we can collect the sensor data and analysis can be done based on certain predefined condtions.Thus alerts and notifications can also be
Activate Windows
Go to Settings to activate Windows.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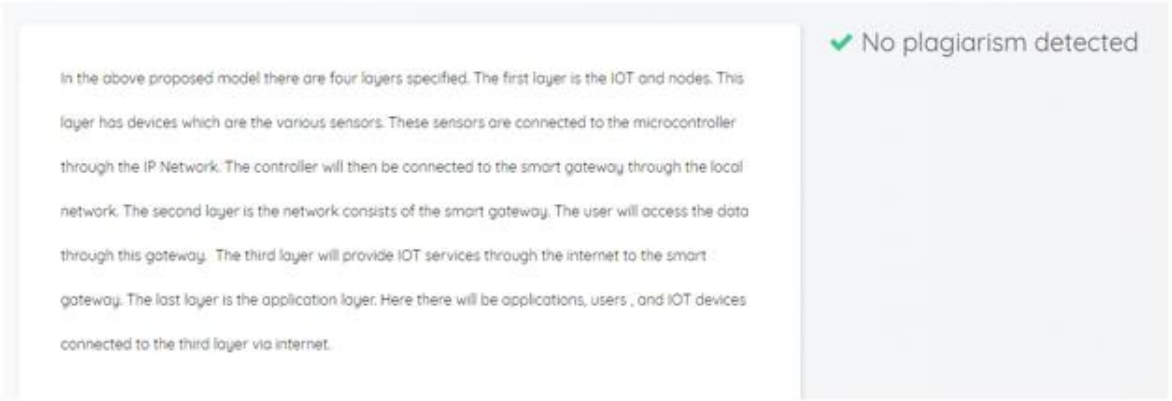
Internet of Things (IOT) is the application of networking of physical devices and embedded systems along with the help of sensors and actuators which communicates to share knowledge and helps in attaining precision in various domains. Internet of things has flourished in many domains . IOT in healthcare is one of the most trending domains of today's generation. It has had a great impact on the medical discipline. It is basically integration of various sensors along with microcontroller like the Arduino(many versions are available), ESP8266 and so on. It plays a vital role in providing assistance to doctors in decision making in the case of emergency. It will also improvise the traditional measures taken to observe heart beat, pulse, blood pressure , motion and similar related parameters.


In the above proposed model there are four layers specified. The first layer is the IOT and nodes. This layer has devices which are the various sensors. These sensors are connected to the microcontroller through the IP Network. The controller will then be connected to the smart gateway through the local network. The second layer is the network consists of the smart gateway. The user will access the data through this gateway. The third layer will provide IOT services through the internet to the smart gateway. The last layer is the application layer. Here there will be applications, users , and IOT devices connected to the third layer via internet.
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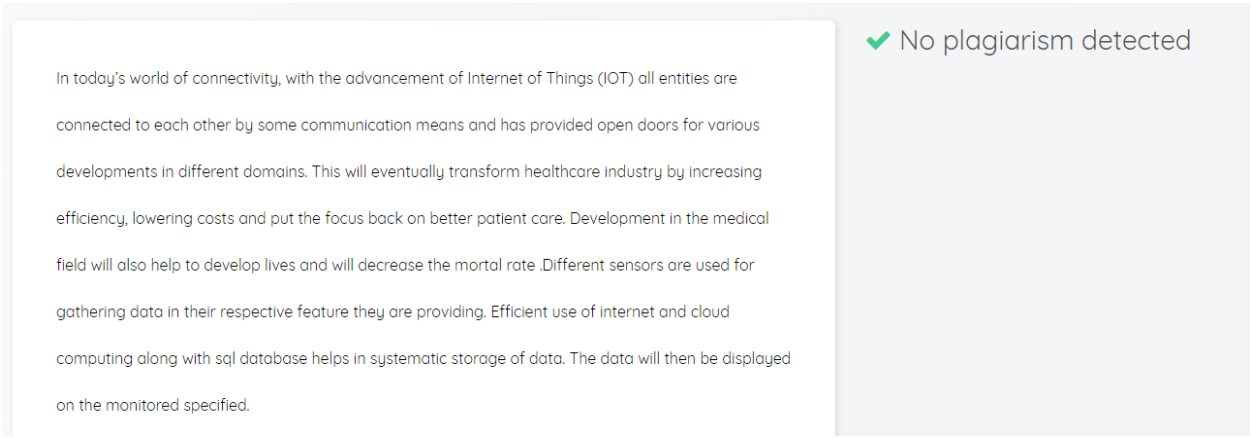
In today's world of connectivity, with the advancement of Internet of Things (IOT) all entities are connected to each other by some communication means and has provided open doors for various developments in different domains. This will eventually transform healthcare industry by increasing efficiency, lowering costs and put the focus back on better patient care. Development in the medical field will also help to develop lives and will decrease the mortal rate .Different sensors are used for gathering data in their respective feature they are providing. Efficient use of internet and cloud computing along with sql database helps in systematic storage of data. The data will then be displayed on the monitored specified.
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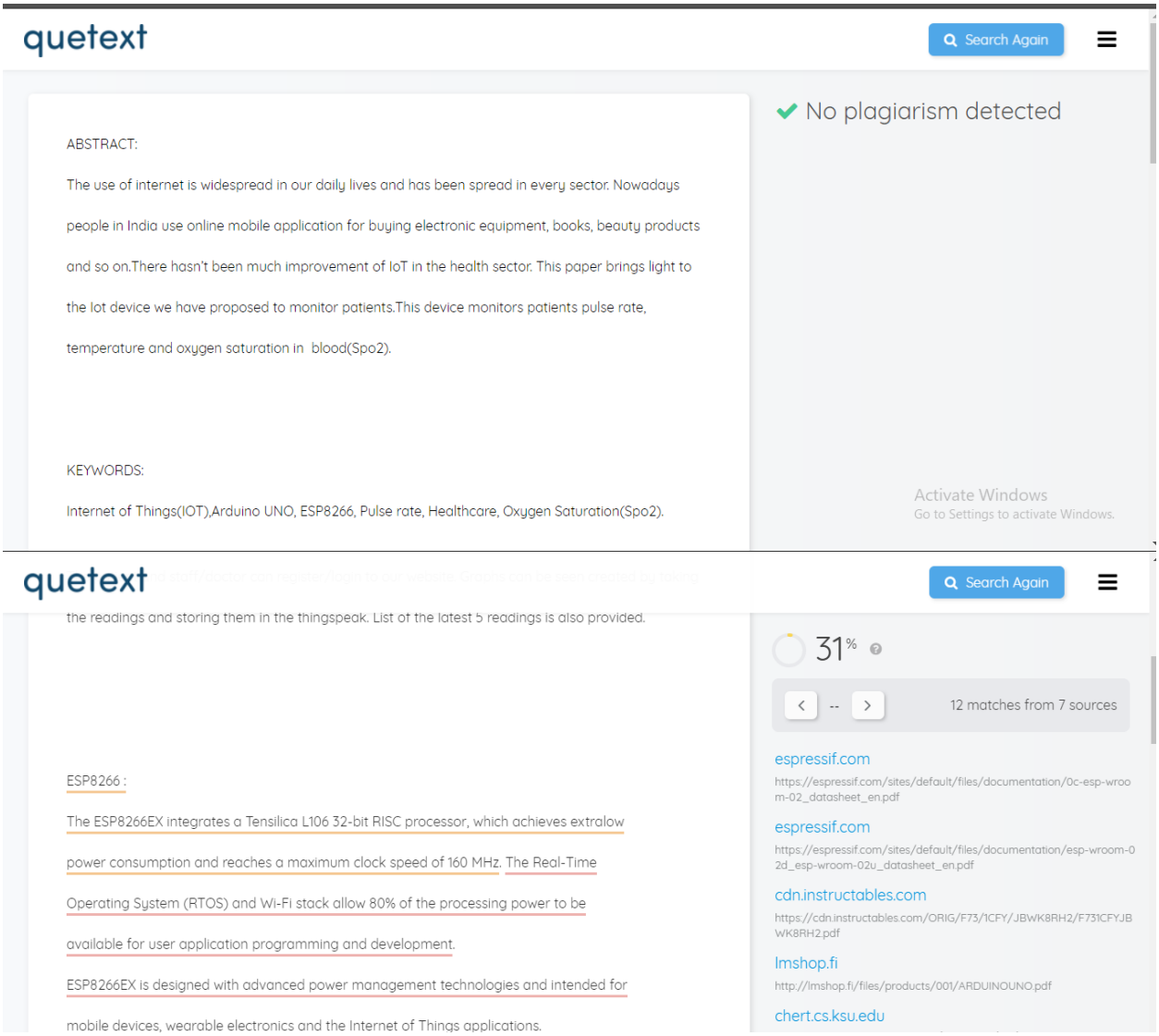
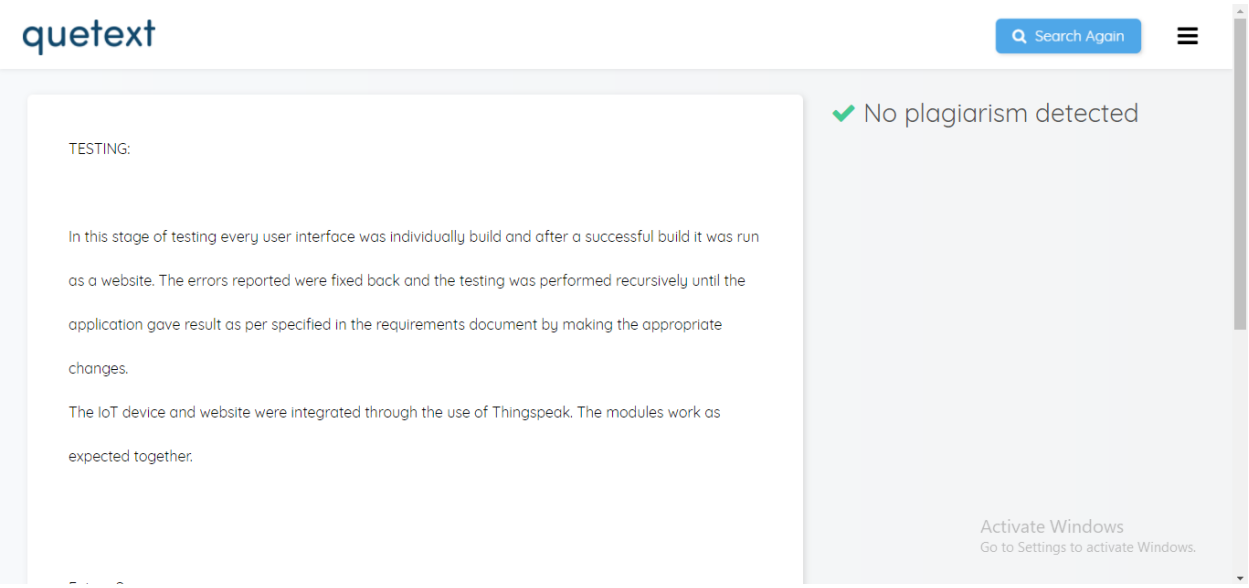
Plagiarism Report of the paper II

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TESTING:
In this stage of testing every user interface was individually build and after a successful build it was run as a website. The errors reported were fixed back and the testing was performed recursively until the application gave result as per specified in the requirements document by making the appropriate changes.
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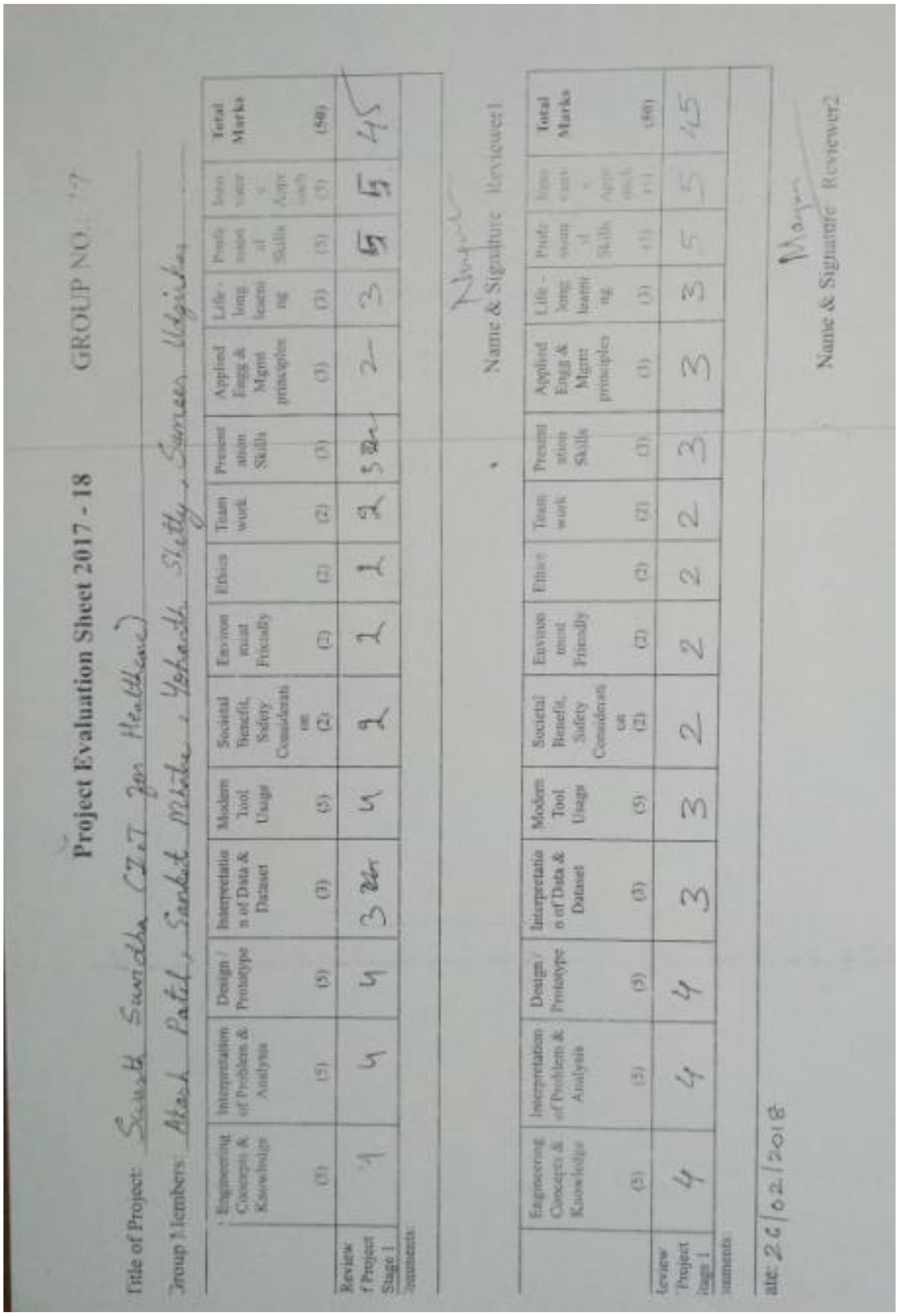
Activate Windows
Go to Settings to activate Windows.

Project Review Sheet 1



Project Evaluation Sheet 2017 - 18 GROUP NO.: 17

Title of Project: Swasth Suvidha (IoT for Healthcare)

Group Members: Akash Patil, Sanket Mhatre, Yohanth Shetty, Sameer Udgirkar

	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage I	4	4	4	3 2/2	4	2	1	1	2	3 2/2	2	3	5	5	45

Comments:

Name & Signature Reviewer1

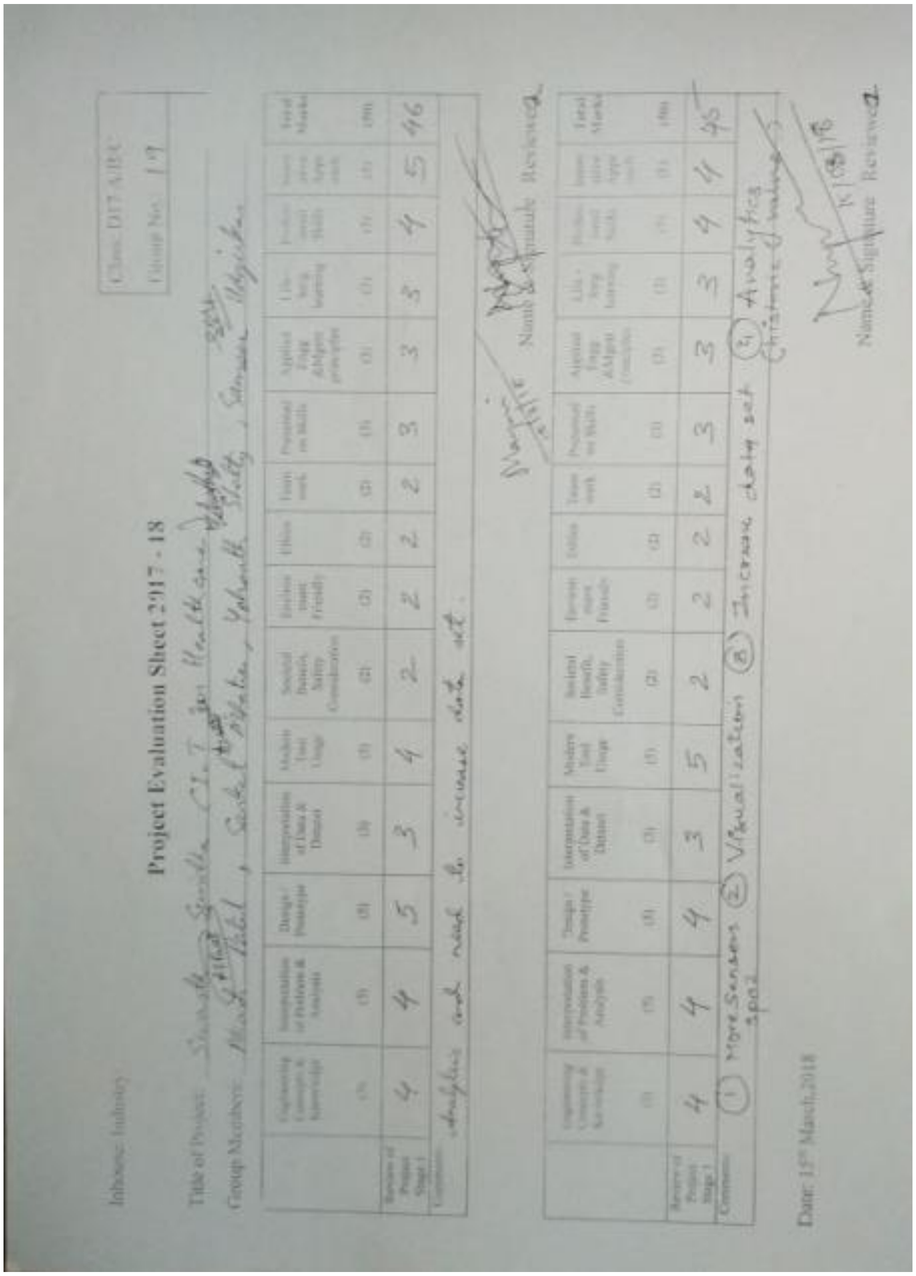
	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage I	4	4	4	3	3	2	2	2	2	3	3	3	5	5	45

Comments:

Date: 26/02/2018

Name & Signature Reviewer2

Project Review Sheet 2



Project Evaluation Sheet 2017 - 18

Review of Project Stage 1	4	4	5	3	4	2	2	2	2	3	3	3	4	5	46

Comments: Analytics and need to increase data set.

Review of Project Stage 1	4	4	4	3	5	2	2	2	2	3	3	3	4	4	45

Comments: (1) More Sensors (2) Visualization (3) Increase data set (4) Analytics

Date: 15th March, 2018

Name & Signature Reviewer