INTERNET OF THINGS

(CSE-3008)

Domain: IOT in health

Topic: Smart Health Monitoring System

Submitted to Prof. Priya G

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ABSTRACT

Internet of things (IoT) is a fast growing, a user-friendly technology which allows everything to is connected and also allows effective communication between the connected "things." The Internet of Things, likewise called The Internet of Objects, alludes to a remote system between items, as a rule, the system will be remote and self-designing, for example, family unit machines. The past decade and majorly the past few years have seen an enormous rise in a discipline of computer science known as IOT (Internet of things). The number of people working in this field have increased enormously which has led to new applications and business product which has made those things possible which was a mere dream a few decades ago. It has made live easier to live and is still effectively doing that. Built on its 4 pillars Scada, Machine to Machine, RFID (Radio Frequency Identification) and WSN (Wireless Sensor Network), the field is promising and has flourished the human fraternity with a number of products. Out of many applications of IOT, one of its application is in the domain of medicine and health care. This project focuses on that domain "Health Care". In this project, we have tried to create and implement a model that would monitor aspects of a human body such as his Pulse rate, Temperature and other things. We have tried to create a small model that a patient (mostly elderly people or anyone else who need constant health inspection) can use regularly merely sitting at his home. His data can be accessed by his/her doctor and immediate actions can then be taken.

The term "Internet of Things" has come to describe some technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. IoT has top five applications are Traffic monitoring, Healthcare, Security, Transport and logistics, and Daily life. In this paper, we are going to develop Health Care application. The Internet of Things could be a game-changer for the healthcare industry. It is transforming healthcare industry by increasing efficiency, lowering costs and put the focus back on better patient care. IoT in Healthcare is a heterogeneous computing, wirelessly communicating system of apps and devices that connects patients and health providers to diagnose, monitor, track and store vital statistics and medical information. It serves as a fundamental basis for achieving robust, efficient, and secure health monitoring. The primary aim of this project to design an IOT based architecture for health related issues such as Diabetics, Heart Monitoring system, Pulse rate measurement, Daily Activity, Temperature measurement. The Data obtained through sensors are uploaded to the cloud and shared with others. Data obtained through sensors are processed and accessed through a smart phone an app which shows us the whole info of the user’s body.

INTRODUCTION

Internet of things is something that has surely changed the way people live, the way people consume their lives. IOT has risen up so high in only few years of time. Today, you cannot feel yourself separated from IOT. You open your Google Account login, use Google drive that's a Cloud service (IOT), you went to the other city, crossed a toll booth received a slip (RFID), you came to your clap with your hands and the lights are on, clap again off (Home Automation). And many Smart TV, Smart Phones, Smart Agriculture. There are so many applications of IOT which has made life easier for the fellow citizens. And we are still working, working to achieve automation in every field using IOT, constructing Smart cities, transforming the world, making it a better place to be in. The opportunities are never ending and IOT delivers it all.

The reach of IOT is never ending and extends to almost every domain of life from Transportation to agriculture, home automation to Robots. One such domain of IOT in which it could change the whole human fraternity and affect their life to maximum is the field of "HealthCare". So, many people die every day, many with accidents, some because of serious chronic diseases and other due to casualties. Yes, a healthy percentage of people die just because their ignorance. Laziness to visit the doctor and get their checkups done and it is so common when it come to our elders. Although, they require constant health monitoring but they ignore with sometimes lead to problems. But, the pace at which our lives are moving is it possible for us to go to a doctor regularly just to keep check on our BP or ECG. No, we don't have the time. Thus, there is a strong need of a system which can achieve these normal check-ups at home.

So, in this project of ours we have tried to create a system using IOT which addresses this problem domain. The need of a system which can constantly monitors an individual's health so that any future problems can be detected at the earliest before it changes to something chronic is fulfilled by our system. In our system we have created a small device using a few sensors and microcontroller which would constantly monitor the health of a patient without any need of him visiting the doctor in personal. The information gathered from the patient is uploaded to a cloud service from where the doctor can directly monitor the patient's health. So, in this way, both the problems are addressed and that to at a low cost. This system is extremely beneficial for old age people who require monthly checkups.

LITERATURE REVIEW

The research paper by Prosanta Gope and Tzoneilh Hwang is a paper on the BSN- care: A modern healthcare system using the body sensors network [1]. The body sensor network (BSN) technology is one of the core technology of IOT where a patient can be monitored using large number of lightweight WSNs also known as wireless sensor network. The main focus of this paper is the security since the BSN is totally wireless and it may lead to attackers to hack the data of each patients present in the database. The key requirements in IOT based healthcare system using BSN are Data privacy, Data integrity, Data freshness, Authentication, Anonymity, Secure Localization. There are certain phases in order to enforce the security based BSN care system. Phase 1 is the registration phase which submits the identity to the BSN server. Then the server generates the key for each identity and then saves it in the database. Phase 2 is the lightweight anonymous authentication protocol to achieve the mutual authentication among the LPUs.

The paper by Sapna Tyagi et al, Amit Agarwal et al, Piyush Maheswari et al is a conceptual framework for IOT based healthcare system using cloud computing [2]. They are mostly working on the bring your own device (BYOD) policy such that sharing of data and collaborative services could be increased. Mostly the patients are mostly concerned about their diseases and they want it to be done in amore secured as well easy way. So cloud computing with IOT is employed. The Cloud- IOT will be based on integrated solution of various applications such as e-prescribing system, EHR (electronic health records), personal health records, clinical decision system, pharmacy system etc. The physicians can use Cloud IOT for their better results and improved diagnosis of patients. The patients can find their related diseases by providing the symptoms in that particular app/ web portal. They can even find the clinics related to their problems too. Besides this the cloud service provides Platform as a Service (PAAS) and infra as a service (IAAS) to host cloud IOT architecture.

The paper by Sanaz Rahimi Moosavi et al, Tuan Nguyen Gia et al, Amir-Mohammad Rahmani et al, Ethiopia Nigussie et al, Seppo Virtanen et al, Jouni Isoaho et al, Hannu Tenhunen et al is a paper for a secure and efficient authentication and authorization architecture for IOT based healthcare using smart gateways [3]. The system works as patient problem is recorded by the body worn sensors with which the patient is equipped for personal monitoring of multiple parameters. The health data can be also implemented with context information which is able identify the unusual patterns and can give a more precise information regarding the symptoms. The main components include: 1) Medical sensor network (MSN) enabled with the

identification and sensing. 2) Smart e-health gateway which supports different communication protocols. 43) Back end system to hold the database info and managing it. 4) Web clients as graphical user interface for final visualization and apprehension.

The paper by Kuo-Hui Yeh is the paper regarding the secure IOT based healthcare system with body sensor networks [4]. Their proposed method has some of the sections which include the underlying IOT architecture structure. Then the trust boundary and the desired objectives such as the sytem initialization and two phase authentications . In the underlying architecture there are three indispensable components in the IOT based communication architecture: the wearable sensors , the LOCAL Processing Unit (LPU) and the body sensor network server (BSN servers). The IOT biomedical device is used for collecting the bio-data from the humans. All the collected data will be forwarded to the LPU and BSN for the data analysis.

The paper by TAIYANG WU et al, FAN WU et al, JEAN-MICHEL REDOUTÉ AND MEHMET RASIT YUCE et al is a paper regarding the wireless body area network implementation towards IOT connected healthcare applications [5]. The paper presents the implementation of an autonomous WBAN . It consists of 3 parts: 1) a flexible solar energy harvester with MPPT 2) A wearable sensor node 3) A smartphone app acting as an interface as well as a gateway for sensor data visualization and emergency notification. The power solar harvester is chosen as the power source for the energy harvester. Due to its flexibility it can be easily attached to the human body. The main components of the WSN are 3 sensors : MCU, pulse sensor and temperature sensor. App analyses all the data collected from the wireless sensors and then presents a particular information regarding the health of the person.

The paper by Prosanta Gope and Tzonelih Hwang is focusing on the use of BSN which is actually a light weight sensor which can sense certain things. A network of these sensors refers to what BSN is, a network of sensors which is used to monitor a patient remotely. This focus basically focuses on what a BSN is and what its flaws are: security of a patient. This highlights the security issue in a BSN due to its wireless nature which can be easily hacked by a third party user. Security is also one of the biggest flaws in IoT because of the nature of all IoT devices but when these devices carry sensitive information about any patient, this can cause problems in many ways for all parties involved. The author also has a way to counter this flaw in two phases that involved first identification and authentication in the form of exchange of keys and then allows data transfer through an anonymous authentication protocol.

The paper by Sanaz Rahimi Moosavi et al, Tuan Nguyen Gia et al, Amir-Mohammad Rahmani et al, Ethiopia Nigussie et al, Seppo Virtanen et al, Jouni Isoaho et al, Hannu Tenhunen et al

have focused on a secure and efficient authorization and authentication architecture for basic IoT-based healthcare is developed. Security and privacy of the patients' medical data is one of the most crucial things for the acceptance and ubiquitous use of IoT in healthcare. Secure authorization and authentication of any remote healthcare professional is the main focus of this paper. Due to the obvious resource constraints of medical sensors, it's infeasible to utilize conventional our cryptography in IoT-based healthcare. In addition, the gateways in the existing IoTs focus only on trivial tasks without alleviating the authorization and authentication challenges. In the presented architecture, authentication and authorization of any remote end-user is done by distributed smart e-health gateways to unburden the medical sensors from performing these tasks. The proposed architecture relies on the certificate-based DTLS handshake protocol as it is the main IP security solution for IoT. The proposed authentication and authorization architecture is tested by developing a prototype IoT-based healthcare system.

Paper by Alok Kulkarni, Sampada Sathe.The fields of electronics and electronics have merged to result into one of the most notable technological advances in the form of realization of the Internet of Things (IoT). The impact of IoT in healthcare, although still in its initial stages of development has been significant. This paper attempts to review and understand the applications of IoT in personalised healthcare to achieve excellent healthcare at affordable costs. We have explained in brief how IoT functions and how it is used in conjunction with wireless and sensing techniques to implement the desired healthcare applications. This paper further focuses on the additional benefits of IoT in healthcare and also what IoT has done so far in such short time. This paper also goes on to define the scope of IoT in this field and what it is capable of in a given amount of time.

The paper by Charalampos Doukas and Ilias Maglogiannis focuses on healthcare applications utilizing body sensor networks that generate a vast amount of data that need to be quickly and efficiently managed and stored for processing and future usage. The solution being Cloud computing among with the Internet of Things (IoT), which is a new trend for efficient managing and processing of sensor data online. This paper presents a platform based on Cloud Computing for management of mobile and wearable healthcare sensors, demonstrating this way the IoT paradigm applied on pervasive healthcare. This paper shows us the betterment of both IoT and cloud computing which would help the IoT devices both in term of security and efficiency.

Paper by Taiyang Wu, Fan Wu, Jean-Michel Redoute and Mehmet Rasit Yuce.Internet of Things (IoT) is a new technological paradigm that can connect things from various fields through the Internet. For the IoT connected healthcare applications, the wireless body area

network (WBAN) is gaining popularity as wearable devices spring into the market. This paper proposes a wearable sensor node with solar energy harvesting and Bluetooth low energy transmission that enables the implementation of an autonomous WBAN. Multiple sensor nodes can be deployed on different positions of the body to measure the subject's body temperature distribution, heartbeat, and detect falls. A webbased smartphone application is also developed for displaying the sensor data and fall notification. To extend the lifetime of the wearable sensor node, a flexible solar energy harvester with an outputbased maximum power point tracking technique is used to power the sensor node. Experimental results show that the wearable sensor node works well when powered by the solar energy harvester. The autonomous 24 h operation is achieved with the experimental results. The proposed system with solar energy harvesting demonstrates that longterm continuous medical monitoring based on WBAN is possible provided that the subject stays outside for a short period of time in a day.

Project Components

Hardware Components:

1) Arduino Uno: It 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.
2) Pulse Sensor: The Pulse Senso is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications.
3) DHT11 sensor: The DHT11 is a temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed since it is digital).
4) LM35 Temperature Sensor: The LM35 series are precision integrated circuit LM35 temperature sensors, whose output voltage is linearly proportional to the temperature in Celsius (Centigrade). The LM35 sensor thus has an advantage over linear temperature sensors, calibrated in °Kelvin, as the user is not required to

subtract a large constant voltage from its output to obtain convenient centigrade scaling. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air.

5) Bluetooth Module: This module allows you to wirelessly extend your serial interface over a wireless bluetooth link. The 4 pins are +5V, GND, TXD, RXD. Supply voltage should be 3.3 - 6 V. Absolute maximum is 7 V.

Software Components:

1) Arduino uno IDE for writing our embedded C.
2) Android Studio for making our app and showing the result.
3) Online database, cloud service and app notification on Firebase

ALGORITHM

1: start

2: start temperature sensor, pulse sensor, DHT 11 sensor

3: capture temperature, pulse, environmental temperature and humidity

4: use GET request to send field data to firebase server by using SSID and password and unique API key

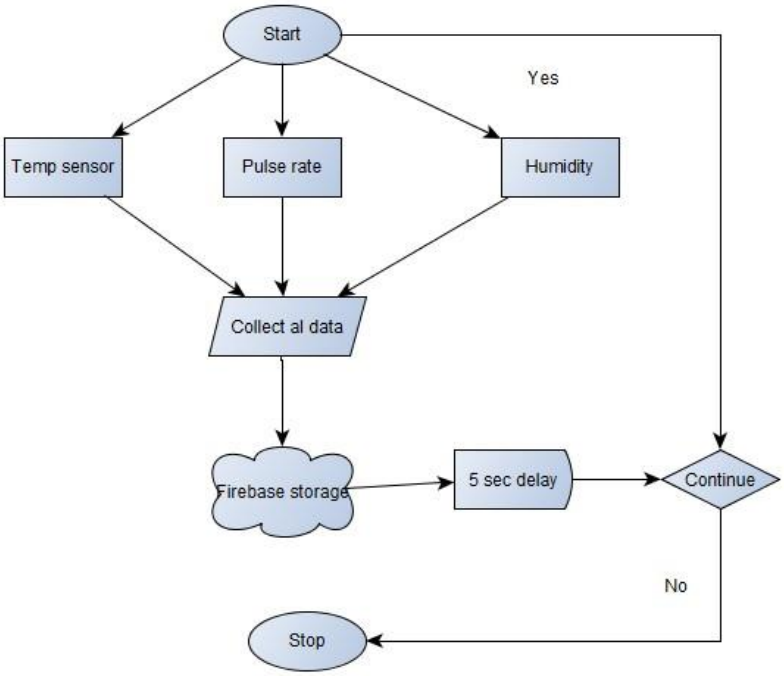
5: if continue go to 2

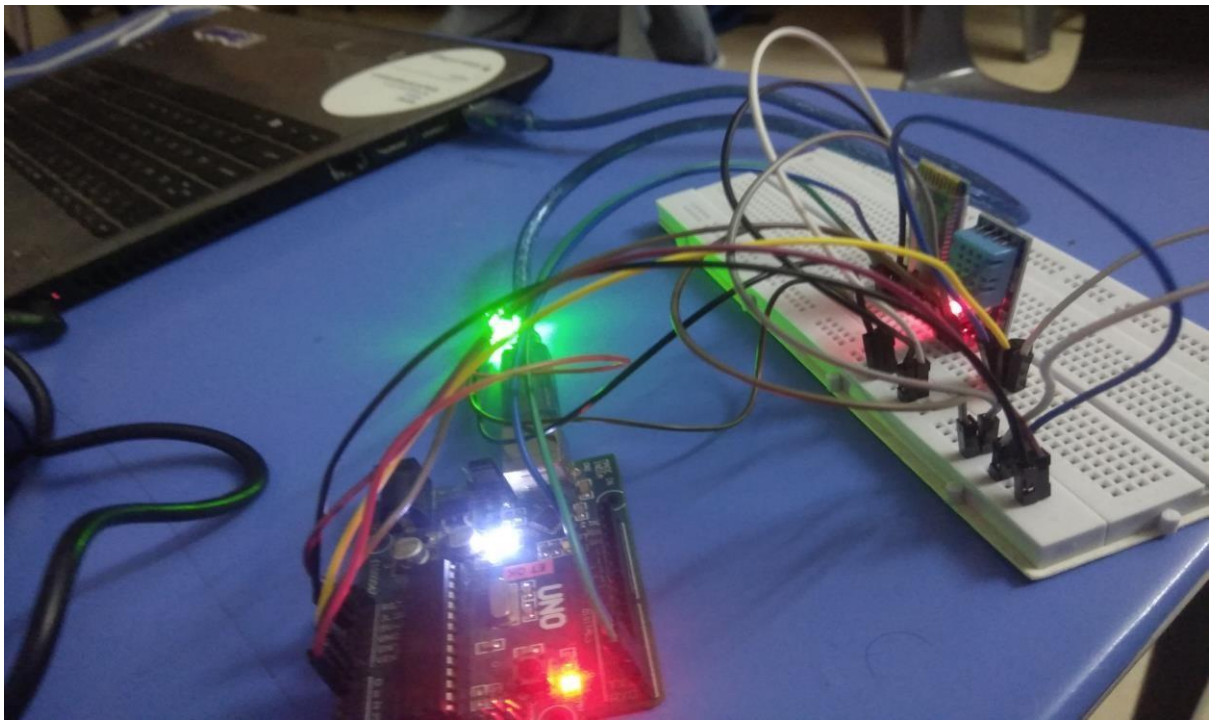
6: else go to 7

7: end

The arduino code for Smart Health Monitoring System is given in appendix.

FLOW DIAGRAM and Circuit Diagram



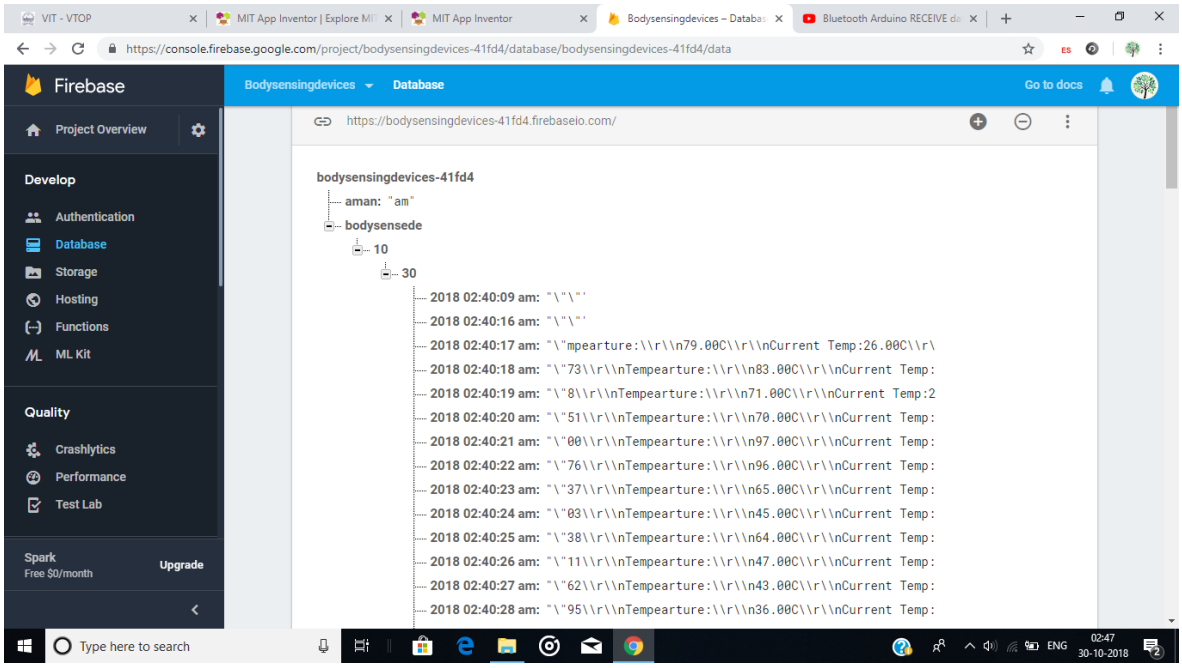


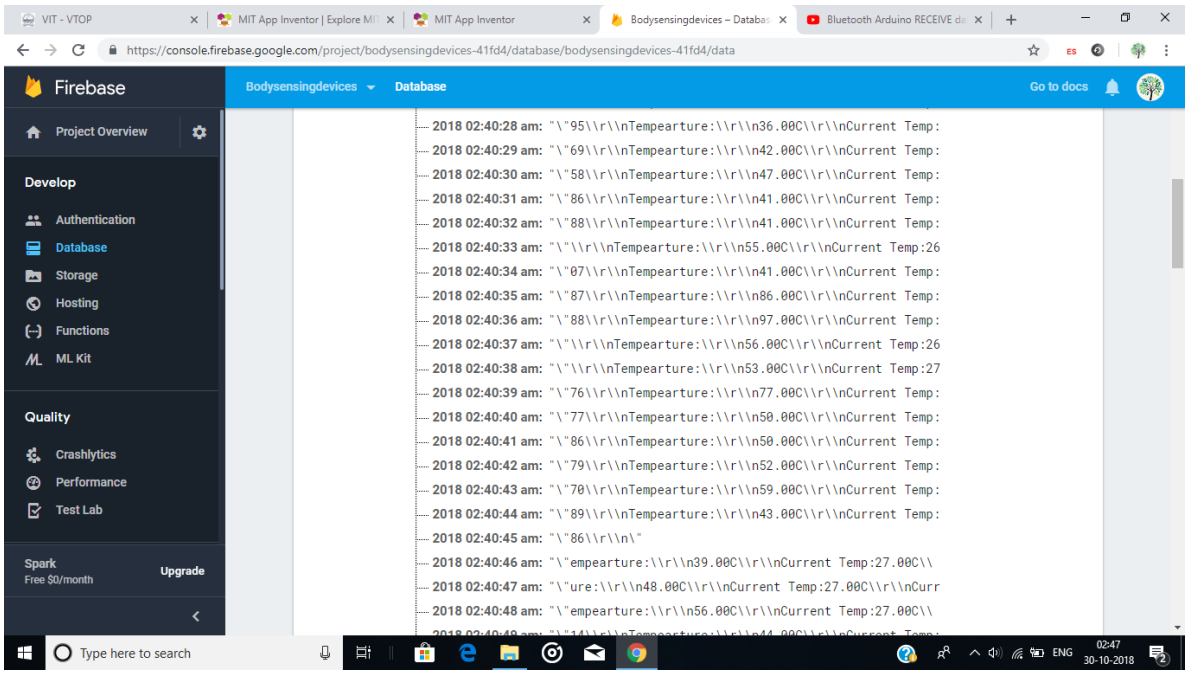
CODE

```
#include <dht.h>

dht DHT;

float temp;

void setup() {

  // put your setup code here, to run once:

  Serial.begin(9600);

delay(1000);

Serial.println("Temp and hum sensor");

delay(1000);

}


void loop() {

  // put your main code here, to run repeatedly:

  DHT.read11(A1);

temp=analogRead(A0);

Serial.println("Tempearture:");

Serial.print(temp);

Serial.println("C");

Serial.print("Current Temp:");

Serial.print(DHT.temperature);

Serial.println("C");

Serial.print("Current Hum:");

Serial.println(DHT.humidity);

Serial.println("Pulse Rate:");
```

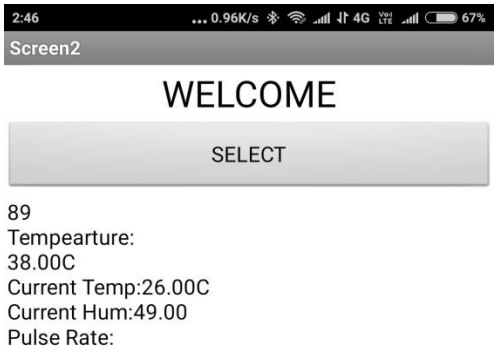
```
delay(1000);

Serial.println(analogRead(A2));

}
```

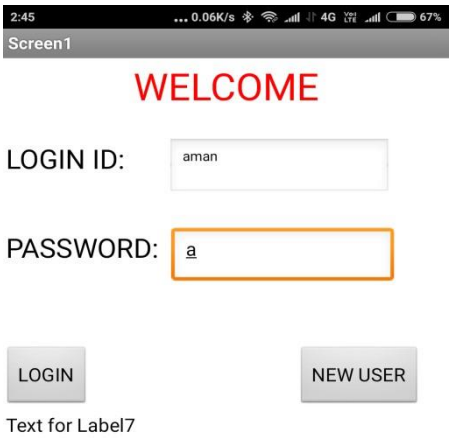
DATABASE AND CLOUD

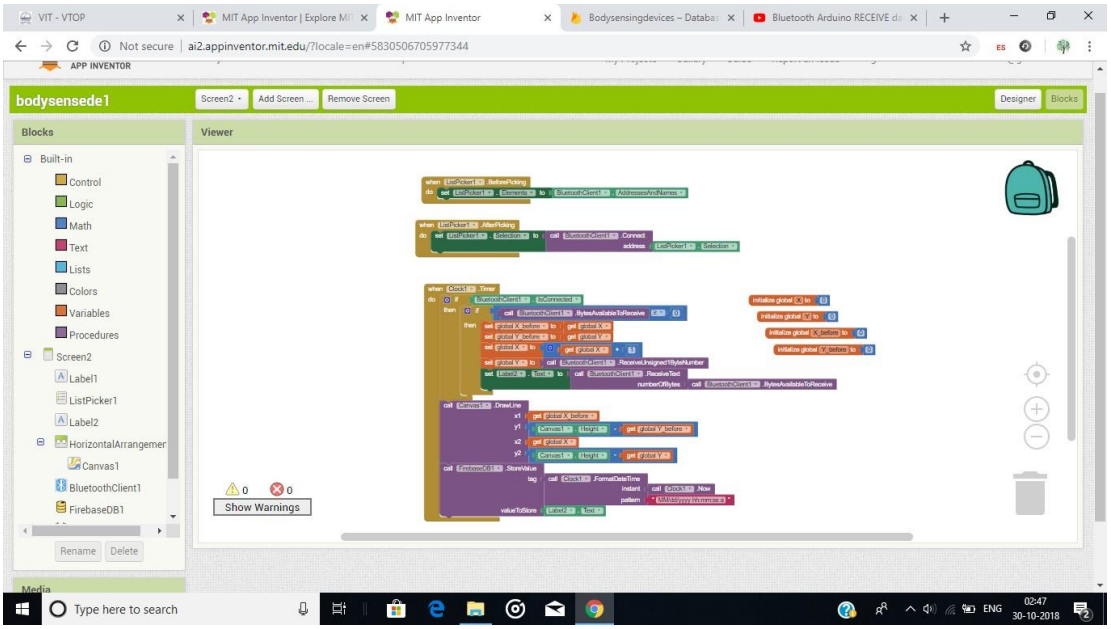


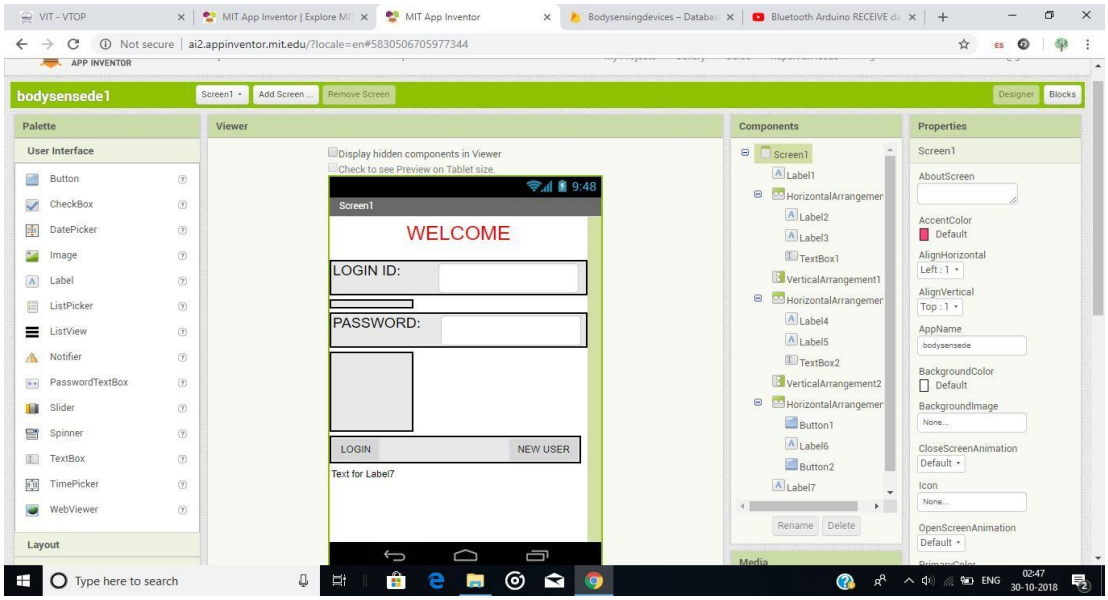


EXPERIMENT RESULTS AND DISCUSSION









RESULT AND DISCUSSION

By using the system the healthcare professionals can monitor, diagnose, and advice their patients all the time. The health parameters data are stored and published online. Hence, the healthcare professional can monitor their patients from a remote location at any time. Our system is simple. The Future work of the project is very essential in order to make the design system more advanced. In the designed system the enhancement would be connecting more sensors to internet which measures various other health parameters and would be beneficial for patient monitoring i.e. connecting all the objects to internet for quick and easy access, establishing a Wi-Fi mesh type network to increase in the communication range.

In system that we have implemented, our data that is acquired is sent to the thingspeak server and the graph that is generated is displayed to the end user for monitoring the data.

Above we have two graphs displaying the temperature, humidity and pulse rate data generated by the sensors and sent to the server. This data can be monitored by a doctor and any abnormality in the health of the patient can be easily understood through the graphs.

CONCLUSION AND FUTURE WORK

By using the system the healthcare professionals can monitor, diagnose, and advice their patients all the time. The health parameters data are stored and published online. Hence, the healthcare professional can monitor their patients from a remote location at any time. Our system is simple. The Future work of the project is very essential in order to make the design system more advanced. In the designed system the enhancement would be connecting more sensors to internet which measures various other health parameters and would be beneficial for patient monitoring i.e. connecting all the objects to internet for quick and easy access. Establishing a Wi-Fi mesh type network to increase in the communication range.

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