Health Activity Recognition using a Wearable Watch

Using BLE technology for sending sensed data to the mobile application and sending of alert messages in case of emergency

Neha Tanksale, Aaditi Pikale, Akanksha Pandharkame, Kumari Juhi, Prof. Abhilasha Kulkarni
Student, Student, Student ,Student, Assistant Professor.
Computer Engineering,
MMCOE, Pune, India

Abstract : Wearable Watch is a popular technology in the field of IoT which autonomously senses the various body parameters without any need of human intervention. This paper tells how a wearable watch is used to sense the various health parameters using sensors and the use of BLE technology to transfer the data from the embedded board to the mobile application and also covers sending of alert messages in case of emergency. The descriptive aspects covered in this paper are: 1)sensing various health parameters such as temperature, blood pressure, pulse rate etc, 2)sending alert messages in case of emergencies through a mobile application using BLE technology**.**

Keywords **-** IoT, Adafruit nRF52 Bluefruit LE ,Temperature, Pulse Rate, Blood Pressure, Communication, Real-Time Monitoring System.

I. INTRODUCTION

Over the decades, Internet of Things(IoT) has been an emerging trend in technology. One of the major applications is Wearable Technology. A smart wearable watch used for health activity detection is a computer which can perform tasks such as generalized monitoring of health parameters. [7]It can connect various fields through the Internet using Wireless Body Area Network(WBAN).It is used for early detection of medical issues and emergencies. Health monitoring can be done at any location. This paper proposes wearable device with Bluetooth Low Energy transmission. An BLE based smart phone application is used for displaying sensor data. Here, sensors are the main components to collect the data of the human body. The health data can be obtained for further research. This, health related activity can be tracked in mobile environment. First stage will give us the current activity of the user while second stage will generate alert messages. It is convenient to detect these vital signs using latest technology. [3]The activity recognition comprises of retrieving the parameter values. The end user can set a particular threshold for certain parameters such as temperature, blood pressure and pulse rate based on their health condition. The wearable watch will send the sensed data to the mobile application. Once the data is sent to the mobile application using BLE technology, the sent data is compared with the set threshold and an emergency message is sent in case the data crosses the set threshold. The messages are sent using a connection network i.e. BLE(Bluetooth Low Energy).

.

II. PROPOSED METHODOLOGY

We have sensed 3 health parameters through the wearable watch namely body temperature, blood pressure and pulse rate. These parameters are the basic three parameters which can be directly sensed through the skin with the use of sensors. The sensors used are: 1)LM35 for temperature, 2)SpO2 for blood pressure, and 3)SEN for pulse rate. We have used an Android application as our user interface and the alert messages to be sent in case of emergencies would also be done through this application using BLE technology. We have made use of BLE technology as our main communication medium. The figure below shows the System Architecture for the same in which a wearable watch containing the embedded board and required sensors is shown. A mobile application is displayed and the data flow between the components is shown.

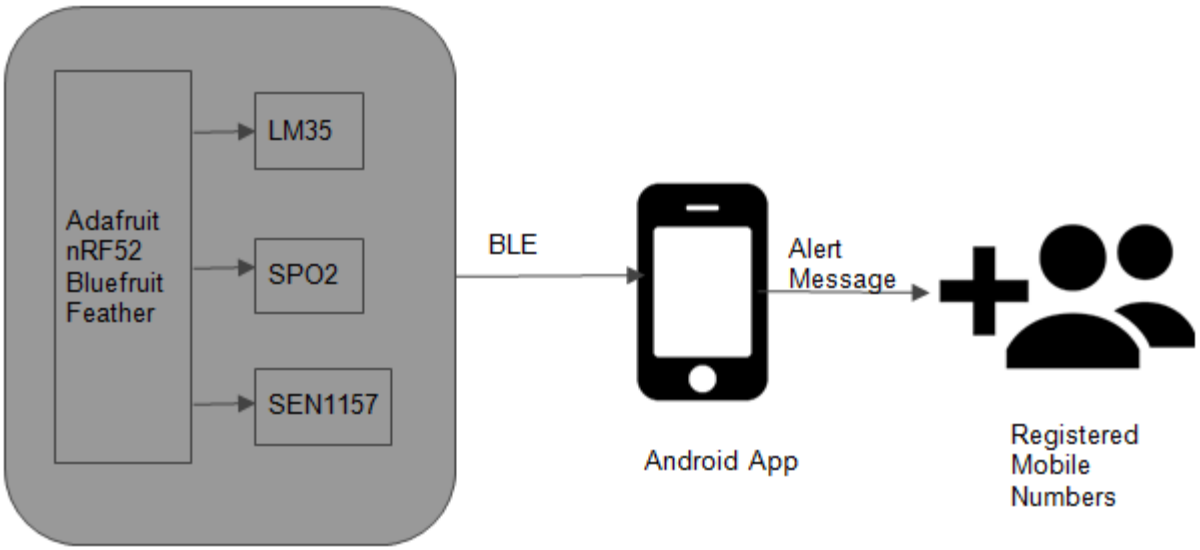

Fig 1:System Architecture of Wearable Watch

III. BOARD COMPARISONS

The figure below shows the board comparisons and gives the help in our study for selecting the right board in our project.

3.1 Comparison of Embedded Boards:

Name	Arduino	Raspberry Pi	BeagleBone
Size	2.95"x2.10"	3.37"x2.125"	3.4"x2.1"
Processor	ARMMega328	ARM11	ARM Crtex-A8
Analog Input	6 10-bit	NA	7 12-bit
Ram	2KB	256MB	256MB
Input Voltage	7-12v	5v	5v

For Applications that interface with External Sensors Arduino is the best as it makes it easiest to interface with any sensor. There are different versions of the board that make the connection with external sensors easier.

For Battery Powered Applications Arduino is good as the Arduino uses the best power of the bunch as in terms of computer power per watt.

IV. BLE TECHNOLOGY

BLE stands for 'Bluetooth Low Energy' which is a wireless personal area technology. BLE is intended to provide reduced power consumption and cost while maintaining the same range as our normal Bluetooth. This making the overall wearable device cost effective and providing the services without any compromise on the performance with the various technologies used. The range provided by classic Bluetooth technology is 100m and that provided by BLE is >100m .

V. BOARD USED AND CONNECTIONS

We have used Adafruit nRF52 Bluefruit LE as the embedded board in our project. The main reason for choosing this board were its compact size and its inbuilt BLE support, which is the main communication medium in our project. A temperature sensor is shown in the figure below. The left pin of the sensor is connected to GND, central pin to any analog input such as A0 and the right pin to 3.3v or 5v.

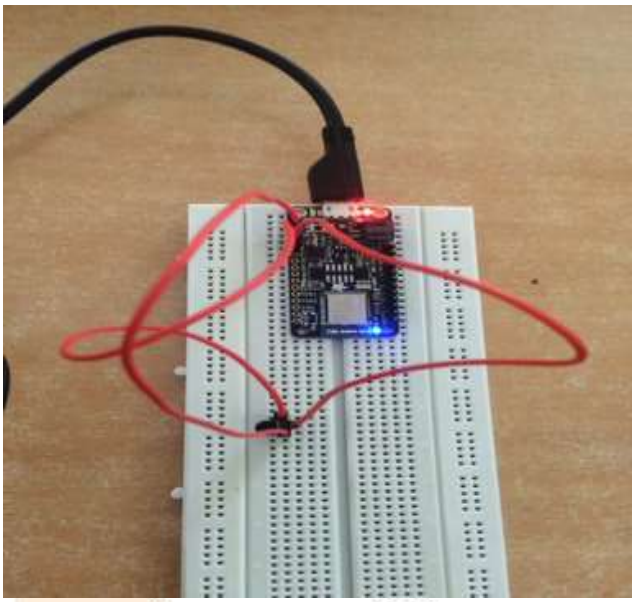

Fig 2:Board Connections

VI. APPLICATION DEVELOPMENT

An Android application is developed as an user interface. The sensed data through the sensors is sent to the mobile application from the board using BLE technology. The main difference between normal android application and the application used here is that we have used a Bluettoth Le Gatt sample for developing our android application. Using this sample is quite easy as you just need to add the various BLE services and characteristics related to the specific health parameter and accordingly the BLE device is scanned by the application and the required sensed data is obtained. The two main things required for this application to work are: **1)**The device which sends the data to this application should be BLE compatible, **2)**the code developed for developing the android application should include the various BLE services and characteristics for the particular health parameter(temperature, blood pressure, pulse rate, etc).The steps for developing the android application are shown in the snaps below:

6.1 Importing Bluetooth Le Gatt Sample:

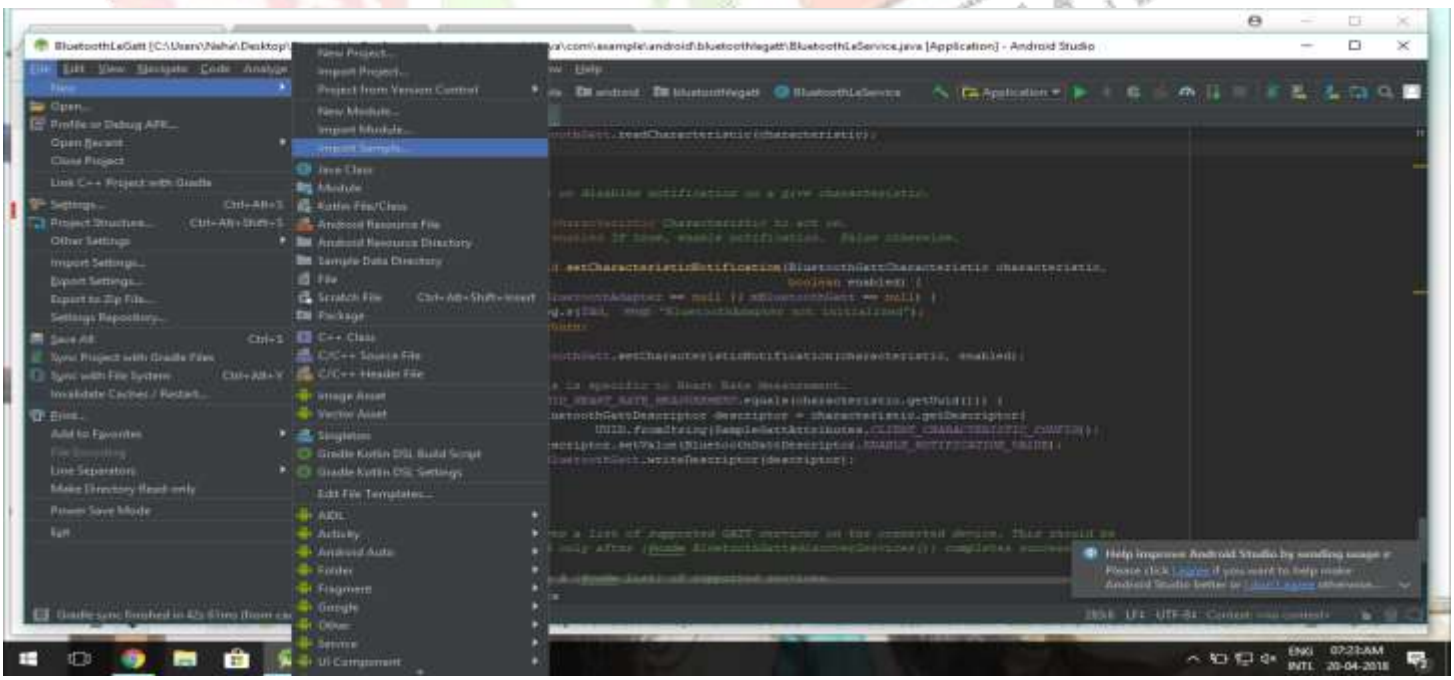

Fig 3:Import Sample from File>New>Import Sample

Step 1: Import the Bluetooth Le Gatt Sample by clicking on File>New>Import Sample.
Step 2: Select the Bluetooth Le Gatt Sample ,you may also find various inbuilt samples there which can be used according to your project. The screen shot below shows the Android Window for selecting samples.
Step 3: You can start writing your code in the selected window as shown in Fig 4.

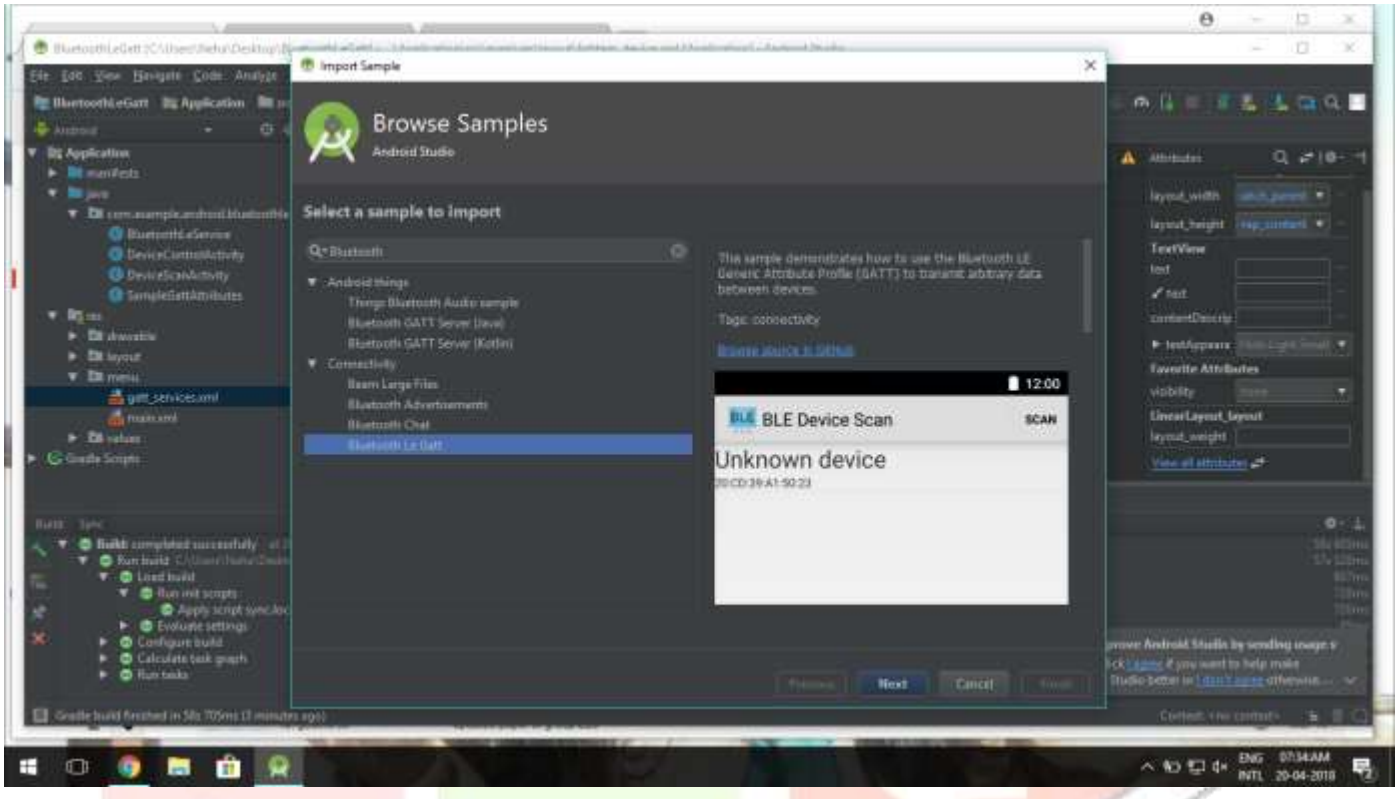

Fig 4:Selecting of Bluetooth Le Gatt Sample

6.2 Developing Android code using BLE Services and Characteristics:

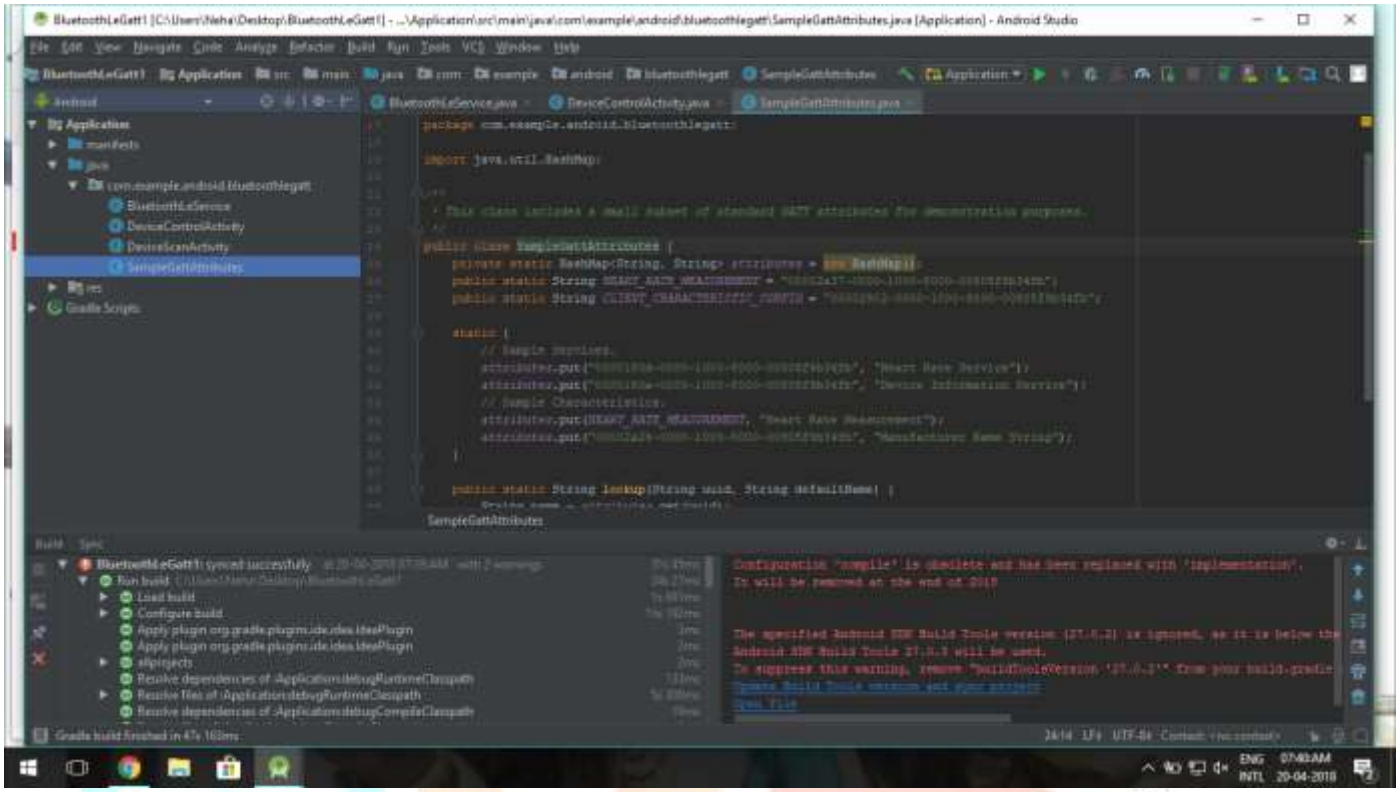

Fig 5:Start writing your code here.

VII. RESULTS AND DISCUSSION

7.1 Standard Values and Thresholds for various Parameters:

Parameter	Minimum	Maximum	Threshold			
Temperature	36.3^0C	37.3^0C	38^0C			
Blood Pressure	75mm Hg	100mm Hg	Set by user			
Pulse Rate	60bpm	100bpm	Set by user			

Table 7.1 shows the standard values of the proposed health parameters and the threshold cases. If the set thresholds are crossed then alert messages are sent to the registered mobile applications.

REFERENCES

[1] Vikas Vippalapalli and Snigdha Ananthula 2016. Internet of things based smart healthcare system. International conference on Signal Processing, Communication, Power and Embedded System (SCOPES) ,978-1-5090-4620-1/16.

[2] Alexandros Pantelopoulos and Nikolaos G. Bourbakis 2010.A Survey on Wearable Sensoe-Based Systems for Health Monitoring and Prognosis. IEEE, VOL. 40, NO. 1.

[3] Ebrahim Al Safadi, Fahim Mohammad, Darshan Iyer, Benjamin J. Smiley, Nilesh K. Jain 2016.Generalized Activity Recognition Using Accelerometer in Wearable Devices for IoT Applications. IEEE, 978-1-5090-3811-4/16.

[4] Amilcare Francesco Santamaria, Pierfrancesco Raimondo, Floriano De Rango and Abdon Serianni 2016.A two stages fuzzy logic approach for Internet of Things(IoT) wearable devices, IEEE, 978-1-5090-3254-9/16.

[5] Haojun Huang, Jianguo Zhou1 , Wei Li1, Juanbao Zhang, Xu Zhang, Guolin Hou 2016.Wearable indoor localisation approach in Internet of Things, IET Netw, Vol. 5, Iss. 5, pp. 122–126.

[6] Akash Moodbidri and Hamid Shahnasser .2017. Child Safety Wearable Device. IEEE, 978-1-5090-5124-3/17.

[7] Taiyang Wu, Fan Wu, Jean Michel Reoute and Mehmet Rasit Yuce 2017.An Autonomous Wireless Body Area Network Implementation towards IoT Connected Health Care Applications**,** IEEE ,Vol 5..