EasyChair Preprint

№ 1792

IoT enabled Android application based Smart wearable device

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October 31, 2019

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***Abstract*— Multi-function, multi-sensor and even multi-standard following wearable devices are going to play an important role in everyday life. Just as the Internet of Things will bring automation to many commonplace tasks, wearable devices will not only monitor our physical wellbeing but will blend seamlessly into our lives, providing a link to the IoT and beyond. According to a survey, enthusiast people feel that they would be wearing 5-6 wearable devices by 2020 [1]. The main motive behind this project is to integrate all the necessary features into one wearable and to optimize the cost of the device to make it affordable for everyone. The user-friendly interface and compatibility with various major operating systems of mobile phones make this device (called Sukoon device subsequently in this paper) convenient and more desirable. Sukoon device is capable of providing emergency contact details to the user at the time of emergency, send the medical history of the patient at times of accident, send current location along with latitude and longitude when in an emergency to all contacts of interest with the help of panic button and helps to automate functioning of nearby devices. Bluetooth technology (BLE) is utilised for communication purposes with the mobile device and the Wi-fi module is used for communication with other devices. An Android app *Sukoon* is made to provide the interface between the Sukoon hardware and other devices.**

Keywords: Wearable Technology, IoT, emergency, Medical history, Android, Bluetooth, Mobile App, Wi-fi.

I. INTRODUCTION

Today, we all live in a densely networked world, where all are connected with each other, and to a huge and an astronomically scaled reservoir of information and entertainment. Around 60% of the global population now uses a smart-phone device. Today, we use our smart devices for almost everything knowledge, work, entertainment, play, communication, and exploration. According to recent studies, by 2024, 10^{12} devices will be connected to the internet and total global worth of IoT could be 6.25 trillion dollars (US); out of what most is from devices in health care (2.4 trillion USD) showcasing a growth of 31 % [2][5]. That will be around 26 wearable smart objects for every human being on Earth. Table-1 depicts how densely networked the world of today is and shows the rise of connected devices over the years. The volume of data generated by IoT platform, involving thousands of connected devices, will be astronomically huge by any standards. Communication between electronic or mechanical devices is automated by M2M (machine-to-machine) technologies, which are found in smart buildings (for energy conservation), transportation companies (for tracking packages), , and instrumentation manufacturers (for controlling product quality). The world has ushered into a new era of connectivity involving human sphere as well.

TABLE I
THE RISE OF CONNECTED DEVICES OVER YEARS[10]

1990	0.3 million
1999	90.0 million
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

More devices and objects present in our physical world can now communicate with other devices and with us through embedded actuators and sensors without human involvement. These 'Smart Objects comes with an ability to see, feel, smell, and hear the world encompassing them. According to the various surveys conducted by the plethora of institutions predicts that the wearable technology is soon going to become one of the major industries in the world. 1 in 5 users of wearables say they feel naked when not wearing the device with a quarter even sleeping with it on. 6 out of 10 smartphone users are confident that wearable's will have uses beyond health and wellness [2]. Consumers product that most wearables ideas will only become mainstream beyond 2020. However current uses of wearable believe the development will be much faster 40% of those surveyed, believe wearables will replace smart phone, while 40% of users of smartphone already interact less with smartphones today as wearables get smarter [1]. The integration of various technologies is not a new phenomenon today. The device Sukoon incorporates numerous features that helps the user and also provide assistance at times of emergency. With an affordable cost and less hardware used, Sukoon also presents an optimum solution to numerous problems existing in the contemporary society. Wearable technology adoption is rising. Analysis suggests that even new owners, who purchased their device in the past three months, are disappointed with the current generation of wearables. Of all users of wearables surveyed, 1 in 10 said they no longer use their wearable devices, with 33% of owners abandoning them within a couple of weeks of purchase [1]. Health data compiled from 192 nations show cardiac diseases remains the No. 1 global cause of death, 17.4 million deaths each year, according to Heart Disease and Stroke Statistics 2015 Update: A Report From the American Heart Association. The number is expected to rise above 24 million by 2030[3]. Cardiac arrest is the major cause of death in majority of cases that are related with heart

diseases. The untimely medical assistance is the major reason for death caused due to cardiac arrests.The IOM (Institute of Medicine) noted survival of $< 6\%$ percent when cardiac arrest occurs outside the hospital [4]. Our device can solve this problem in an optimal manner and thus, could reduce the number of casualties by a significant amount. There are a number of cases of women molestation and ill treatment of women across the globe. There is a direct need of having an emergency feature that could in turn, give a safety measure to women at times of emergency. The project also incorporate a feature of providing the necessary information to the persons of interest at the time of emergency. Many people die across the globe because they could not get treatment in time because of lack of medical history. A lot of research is going on across the globe to provide medical history of the patient to the doctor at times of emergency. Sukoon provides medical history to the doctor along with the other necessary information required for the treatment, thus assisting doctors in a humongous manner. In this way Sukoon provides solutions in various domains incorporated in a single, easy to wear wearable. The paper is organized in the following sections: Section II presents the proposed methodology of design of embedded module, Section III discusses the results obtained and Section IV presents the conclusion.

II. Proposed Methodology

Figure 1 illustrates the flow chart of the proposed Sukoon hardware and software. The proposed network mainly consists of several fundamental domains, namely, proposed Hardware (wearable on wrist), Android Platform as user device and the cloud infrastructure and services. Temperature Sensor and Humidity Sensor, both are embedded in DHT-11 sensor which provides real time data to the Arduino, which sends it to the android device via HC-05 module. If the coupled values of this sensor exceeds threshold value, then a message pops up on the screen of the android app requiring permission from the user to turn on air conditioner/fan. A simple Push button acts as a panic button and pressing it 5 times within a span of 3 seconds triggers various actions on app, first, send latitude and longitude values (real-time location) to contacts of emergency and police department, second, it automatically connects a call to one emergency contact, assigned by user previously and third, it automatically navigates to the screen on app which consists of emergency contacts of live location which includes women helpline number, local police station number and ambulance services contact number.

Pulse rate sensor and accelerometer works together in the device. If the pulse rate of the user is above the critical level, same functionalities are reciprocated as implemented with panic button. In addition to that, real time pulse rate is sent to cloud via ESP8266 Wi-Fi Transceiver module. This serves to provide a medical history to the doctor at times of emergency. At times, when patient needs to be treated/operated, doctors have to perform pre-medical checkup and lack of pulse rate data makes their problem tougher and they work on prob-

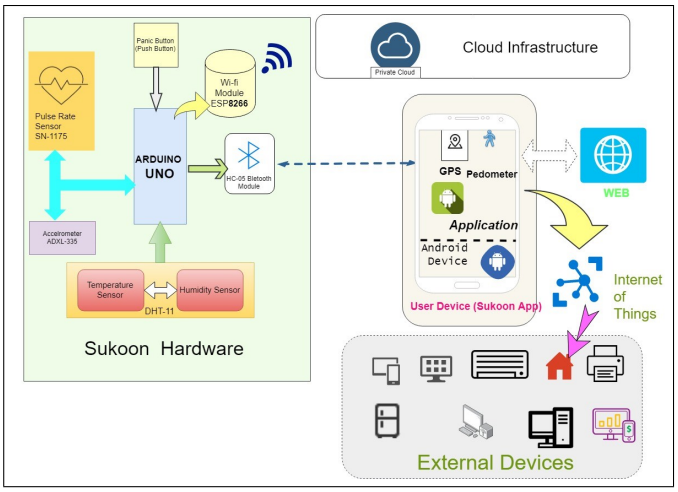

Fig. 1. Flow chart representation of the system

ability often leading to catastrophic outcomes. The medical history on the cloud also includes other basic information of the patient like blood group, other ailments (if any) along with the real time data. The real time data older than 4 months is automatically deleted from the cloud. User, may however save that in a file. There are two critical values for different cases above which emergency signal is sent. First, when the user is not involved with any major physical activity like running or swimming and the pulse rate instantaneously fires up and the other is with the ongoing physical activities. The measure of physical activity is quantified with the accelerometer. The critical values are chosen according to the standards discussed in [8],[9]. Android application receives data from hardware via BLE technology.

A. Hardware Requirements

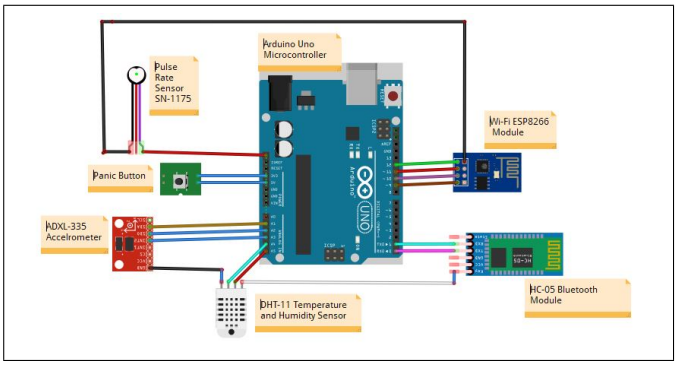

Fig. 2. Schematic of Sukoon Hardware

Figure 2 and Figure 3 illustrates the schematic of the Sukoon Hardware and hardware meshing used for the device respectively. The hardware utilised in the device are:

- Arduino Uno Microcontroller
- Temperature and Humidity Sensor DHT11
- Bluetooth HC-05 Module
- Pulse Rate sensor SN-1175
- Accelerometer Module ADXL 335

- ESP8266 Serial WIFI Transceiver

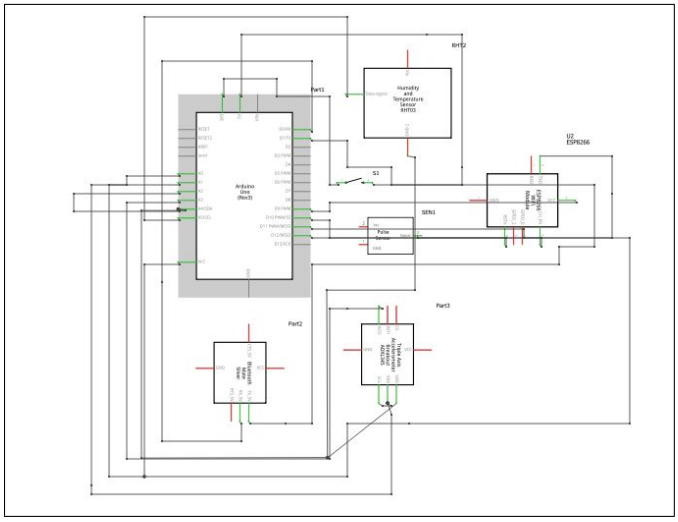

Fig. 3. Hardware meshing of the proposed hardware

B. Software Requirements

The following software are used for the implementation of the device.

- Arduino IDE platform
- Android Studio
- Cloud Services

Arduino IDE is used for satisfying functional requirements by providing the interface between Arduino Uno and code. Android studio 3.1.3 is used here to make the android application *Sukoon* for interaction between the android device and Sukoon hardware. The cloud services and infrastructure are provided by Thingspeak[7], which is an open source cloud infrastructure and service provider.

C. Android Application (Sukoon)

Sukoon App acts as an interface between the hardware and the user. Android have created a duopoly in the smartphone market, with more than 95% of the 3.1 billion active smartphone devices in the world [6]. Therefore, Android application is preferred in this paper. Bluetooth 2.0 and above versions are compatible with the devices. It enables data transmission from the user's device to the proposed hardware and vice versa and from user's device to nearby devices of convenience as well like Air conditioner, lights, fans etc. Sukoon app gives the current location: latitude and longitude in case of emergency situations to the necessary contacts and also places a call to them when either panic button is pressed or the combined values of accelerometer and pulse rate sensor crosses the upper limit threshold. The GPS coordinates sent in case of emergency is obtained from GPS of the phone only, thus avoiding extra cost of external GPS system. It allows to control the nearby Iot enabled devices by providing an user-friendly UI. DHT-11 sensor values automatically control certain devices and the control can be manual too with the help of the app. It also has inbuilt pedometer which determines the distance traveled by the user and helps in health monitoring.

Following prerequisites are required for the use of Sukoon (device and Android application):

1) User's device should have Bluetooth 2.0 or above
2) User's device and sukoon hardware should not be separated by a distance more than 14m.

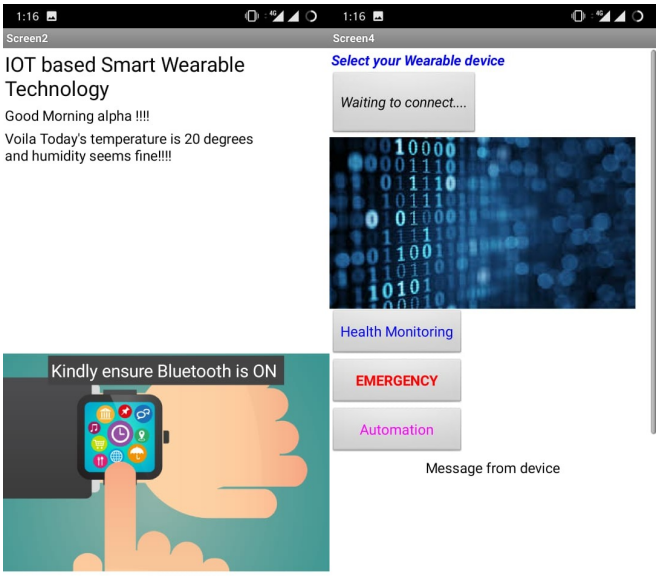

Fig. 4. Application Implementation

III. RESULTS

The project aims to provide an optimal solution to various problems present in contemporary society. The multidisciplinary objectives that cover a plethora of features have been incorporated in the device. Bluetooth technology is used for the functional requirements as it is the most affordable and reliable source of communication making it a perfect fit for the communication purpose(s). The range of operation is satisfactory and upto 14m, and power requirements of the device is also very low. Communication between user device and Sukoon hardware takes place at a baud rate of 9600 symbols per second.The android app that has been created on Android Studio 3.1.3 platform is free of cost and provides an interface between user and the device without any further complications. The hardware also has reduced cost since many of the features of this integrated system, for e.g. GPS and pedometer is in phone of the user itself. Figure 4 presents the snapshots of the Sukoon app interface. Fig 5 and Fig 6 are the results observed on the cloud, whose data is given by various sensors. Fig 5 has data of Accelerometer and temperature and humidity sensor. Fig 6 is the real time pulse rate of co-author observed on cloud. The data points are taken in regular intervals and changes are observed.

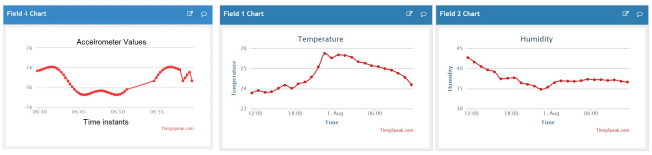

Fig. 5. Various sensor data on cloud

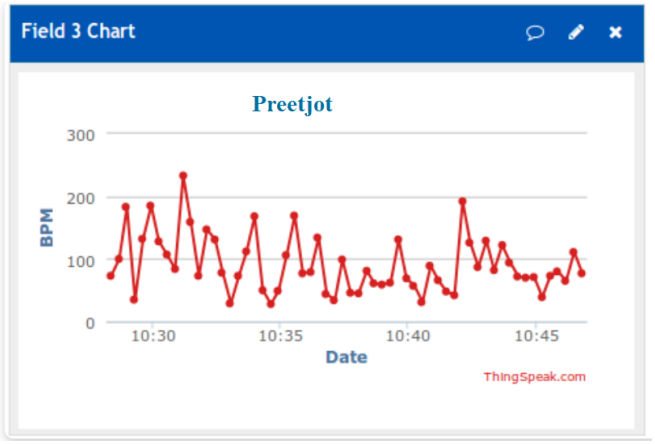

Fig. 6. Heart beat record on cloud in terms of beats per minute (BPM)

IV. CONCLUSIONS

The wearable technology will be an integral part of an individual's day to day life. Various multi-purpose functional requirements for user convenience needs to be implemented in future, but carrying more than 2 wearable devices will be cumbersome for the user. The multidisciplinary objectives that cover a plethora of features have been incorporated in the proposed system. The proposed system provides an optimal solution and integrates myriad of technologies under one wearable. Health Monitoring, remote tele-medicine, contacting and giving necessary information to relevant authorities and people of interest in times of emergency, connectivity of nearby intelligent devices through IoT are some of the prominent features assimilated in the proposed system. The user-friendly application and user interface coupled with efficient integration of technologies consuming less power and memory makes the complete system into a mandatory future utility system.

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