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Bluesense:- Communication and Data transfer (Temperature, Heart Rate) Between a Microcontroller and Android Device Via Bluetooth

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Abstract— Bluesense:-Communication and Data transfer (Temperature, Pulse Rate) Between a Microcontroller and Android Device via Bluetooth. Our main objective is to introduce an electronic gadget which enables transfer of data between microcontroller and android by Bluetooth. Using this system we are implementing a device, which will get data from the sensors. Sensors are embedded on microcontroller. Microcontroller processes the data and with the help of Bluetooth module, it passes it to mobile phone. In mobile phone we get the data in digital form. In android application we can visualize data in the form of graphs and charts. Bluesense will give the information regarding the factors such as gas detection, temperature, heat, heart pulse etc. As we know our mobile devices are not capable of integrating with the hardware components such as temperature sensors, gas leak sensors, heart pulse measurement etc. Hence there is a need of such a device which can get the data from the sensors and pass it to the mobile phone

Keywords—E-Health, Personalised Monitoring, Wearable Computing, Android

I. INTRODUCTION

Nowadays smart phones are becoming more powerful with richer entertainment function larger storage capacities, reinforced processors, and more communication methods. Bluetooth technology, created by telecom vendor Ericsson in 1994, is mainly used for data exchange in wireless communication. The normal working area of Bluetooth is within eight meters. Android includes software package which consists of an operating system, middleware layer and core applications. In this project we present a review of device controlled by mobile phone and discuss a closed loop control systems using channels of mobile devices, such as phones and tablet computers.

We are implementing a device, which will get data from the sensors that are embedded on microcontroller which processes the data. System counts pulse rate of patients and creates data which are forwarded via Bluetooth for further medical diagnosis

The main goal of this project is to implement data acquisition system using an Android device which today has high processing capability and has enhanced battery life, lots more inbuilt features. Android OS has many advantages like free of cost, wide range of devices available, easily available tutorials, which make this ideal for a student for developing projects. All the tools used are open source and free of charge The main advantages of designing data acquisition system using Android OS are the user defined graphical interface and versatility, which make it easy to use and learn.

II. LITERATURE SURVEY

Ambulatory patients benefits from predictive and personalised monitoring system.[1] data collection system are use to acquired physiological data from mobile patients and resultant data is use for robust patients care which includes predictive monitoring. Lei Clifton [1] states that its goal is to provide early warning of serious physiological deterioration, such that preventive clinical action may taken to improve patients outcome.

Early system is developed, based on statistical properties of vital signs of at risk hospital patients [2]. L. Tarassenko [2] introduces a dataset of vital signs data and monitors used in investigate statistical properties of main vital signs. In 12 hours shift with observations 1/8 at risk patient trigger at rating system during the shift. Early warning system identify patients with abnormal vital signs generate an alert when presented with patient with redeem mortality or unavoidable mortality. A. Pantelopoulos [3] states that systems are used for smart text tile, micro-electronics [3], and wireless communication. It is low cost wearable solution and used for managing and monitoring of chronic diseases. These biosensors are miniature sensor, wearable or even implantable. This system is capable of measuring heart rate, blood pressure, oxygen saturation, and body & skin temperature.

Digital Plaster is used in semi-conductor technology [4]. L. Tarassenko and D. Clifton [4] a Long term passive monitoring of chronic disease patients would incorporate both electrical and optical measurement due to which excessive heat gets produced.

S. H. Park [5] ROC analyses the radiological tests, desired rating scales with large number of categories also. AUC gives values as an output between 0 and one which is more precise and nearer or exact result. It can allow both parametric as well as non-parametric estimation [5]. In medical application to decide patient suspect with decisive up to which level is find out efficiently.O. Stegle [6] introduces system which includes accurate assessment of heart rate; locating consecutive recurring features cardiac activation cycle. So this requires complete ECG waveform, but in large scale only fraction is captured because of battery and memory limits. For this we use post processing model. It significantly increases the performance measure and conveys predictions along with uncertain estimates.

C. Orphanidou [7] introduced Visensia is real-time, continuous vital signal acquisition system, using dada fashion in order to predict deterioration to early detection of deterioration in hospital. This system has time limitation i.e. maximum 4 hours at a time. Robustness and reliability of system in an environment will be next to evaluated simultaneous. M. Kemmler [8] estimates smaller hyperspher enclosed by training data. It tightly related to support vector machine on the basic of Radial basic function compares i/p data and estimates it. Due to use of approximation method, lap laces approximation it decreases complexity of problem. It uses efficient clustering like k-mean which makes OCC efficient [8]. OCC contain some image kernel to learn the appearance of specific sub-categories also. OCC have parameterized image kernel after additional performance to its classification and increases accuracy.

III. PROPOSED SYSTEM

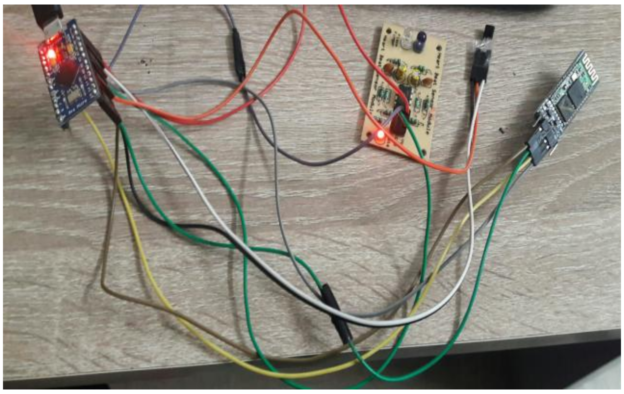

Fig.1: Overview of connection

Bluesense is a device which enables communication between microcontroller & android using bluetooth. Our smart phones has hardware limitations.But they are provided with various modes of communication protocols

These protocols could be used to communicate with a system consisting of sensors.Our system consists of:

1) Bluetooth: A communication protocol over radio waves. Microcontroller: A physical hardware device used for computation.
2) Android device: A mobile device working on Android operating system.
3) temperature and heart rate sensors

IV. IMPLEMENTATION

The Sensor Interface's hardware requirements include a microcontroller, an SD card module, a Bluetooth module, and a battery. The microcontroller is responsible for collecting connected sensor readings, altering sensor parameters, and transferring sensor readings to the other hardware components when necessary. It must be able to read both analog sensors and digital I2C sensors. The SD card module's role is to provide a large memory space to store sensor readings over long periods of time, our minimum requirement was set at one hour. This module should both write to an SD card and read from an SD card when required.

The Bluetooth module is needed to communicate with the Android device. It receives commands from the Android device and sends them to the microcontroller so that it can perform the correct task. The Bluetooth module also transmits sensor readings back to the Android device. Separate modules can be purchased and connected with wires; however this would be clunky and inconvenient for travel. Therefore, to implement small and efficient design, a microcontroller with a all of these parts on one board is designed. Hardware consists of a microcontroller (ATmega8A), a Bluetooth module, various sensors and android device. The ATmega8A is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture.

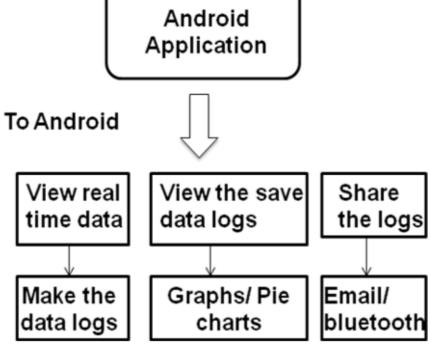

Fig2: Software Interface

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The software is designed such that a user could see the real time data on the screen (e.g. Fig 2). The application has a functionality to store the data in the logs. These logs an be viewed by the user at any time and can also be sent over bluetooth or email for further analysis

The Sensor Interface's hardware requirements include a sensors microcontroller, a Bluetooth module, an SD card module, and a battery (e.g Fig. 3). The microcontroller is responsible for collecting connected sensor readings, altering sensor parameters, and transferring sensor readings to the other hardware components when necessary. It must be able to read both analog sensors and digital I2C sensors. The SD card module's role is to provide a large memory space to store sensor readings over long periods of time, our minimum requirement was set at one hour.

The Bluetooth module is needed to communicate with the Android device. It receives commands from the Android device and sends them to the microcontroller so that it can perform the correct task(e.g. Fig.4). The Bluetooth module also transmits sensor readings back to the Android device. These modules can all be purchased separately and connected with wires together in order to implement a design where all of this functionality is joined; however having separate modules would be clunky and inconvenient for travel. The team's proposed solution was to design a microcontroller that included all of these parts on one board so that it can remain small and efficient in design. In order to create a customized microcontroller first a list was created containing every component the microcontroller would need on the board, first using through hole components in order to create a prototype design and then using SMT package components in order to be prepared for future advances.

The main goal of this project is to implement data acquisition system using an Android device which today has high processing capability and has enhanced battery life, lots more inbuilt features. Android OS has many advantages like free of cost, wide range of devices available, easily available tutorials, which make this ideal for a student for developing projects. All the tools used are open source and free of charge The main advantages of designing data acquisition system using Android OS are the user defined graphical interface and versatility, which make it easy to use and learn. VI approach along with android device shortens the developing time for students and overall system cost. Thus, in this system, we are developing device bluesense, with the help of that device we can get data such of body temperature, pressure to our mobile phone via Bluetooth and we can plot graph and chart from that data. Our other objective is to enhance the performance and battery life of bluesense

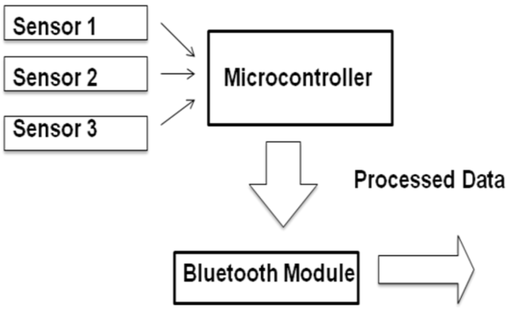

Fig3: Hardware Interface

We address the perceived lack of evidence for the large scale clinical adoption of "intelligent" predictive monitoring systems by describing (in Section II) a study in which wearable sensors are used for the routine care of a large population of high-risk, ambulatory patients. We adopt a machine learning approach to cope with the large quantity of vital-sign data acquired from monitoring ambulatory patients in real time, comparing four techniques, the majority of which have not been applied to the predictive monitoring of patient data.

Patients in our study are connected to conventional bed-side monitors during the first day after their surgery. However, as is common in most hospital wards, the majority of patients are mobilized after the first day, to gain exercise by walking around the ward. This demonstrates the difficulty of monitoring the majority of patients in hospital (and at home), because they are mobile, and which therefore strongly motivates the use of wearable monitors to perform predictive monitoring.

V. TESTING

In this, the black box testing is used to carry out the mobile application testing for the development work. Black Box testing is described as a method of software testing that is focused on functionalities of an application. It is defined as a software testing technique whereby the internal structures (workings) of the item under test are not known to the tester.The minimum requirement for the smart phone is, it should be loaded with Android 2.3.3-2.3.7 Gingerbread (API Level 10). The test carried out extends from installation on Android Phone, and Bluetooth functionalities like connectivity to reading ECG. Data Acquisition application is tested on three devices: Sony Xperia Go, SAMSUNG Galaxy Lite Duos and HTC Explorer, all with different price range and manufacturing company. One thing which was common in all was that all run on Android OS.

- **Testing Signals**

Fig. shows the graph plotted on smart phone for sine wave with amplitude 0V, offset 5V and frequency 1Hz and(fig. 5)shows output for amplitude 0.9V, 1V offset and 3Hz frequency. 1V offset is used because, ADC cannot convert negative voltages.

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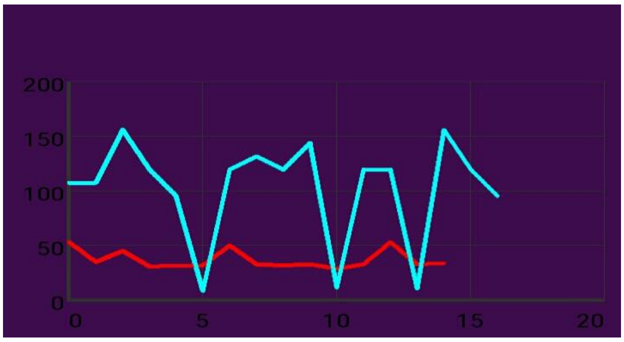


Fig5:Testing Signal

- **Hardware Testing**

The ability to test the capability of the hardware and software was important to the results of the project. Being able to test the hardware however is a difficult task as many of the tests of the hardware and software are a binary result, either it works or it doesn't work. This makes the real test data for the team, the reliability of the different components being used. Creating a reliable product that will consistently work as desired is an obstacle of designing a product from scratch. In order to accomplish this goal, thorough research had to be done for separate portions of the products. The most popular modules were used due to their affordability and accuracy/reliability for the price.

One such module that was ordered was for the project was the HC-05 Bluetooth 2.0 module to allow for Bluetooth communication with the a phone as mentioned above. The main test that was able to be done with the Bluetooth module was the speed of communication that could reliably be used. Communication with this module is done through the serial lines which is measured in units called Baud (Bd) or bits/sec. The module has several settings for the available supported baud rates from 9,600 Bd to up to 460,800 Bd. While the maximal speed available to the device is ideal, other limitations come into play. The availability of serial communication lines on the ATMega328P chip is limited and caused the team to require the Software Serial Arduino Library. This library has been tested reliably up to 115,200 Bd and is as now the upper limit imposed upon the serial communication with the Bluetooth module.

The HC-05 Bluetooth module has a secondary programming mode that allows for communications to be tested with the module itself. The baud rate of the chip was varied between the available baud settings to test the ability to communicate directly with the module. As there were only select number of rates that could be set (9,600; 19,200; 38,400; 57,600; 115,200) the highest available (115,200) was chosen for optimal communication speed. Testing in at 115,200 caused the microcontroller to not reliably receive a signal from the HC-05 Bluetooth module and so the rate was reduced until a fully functioning baud rate was found. In the end, 38,400 Bd allowed very solid results when communicating with the module and so became the set rate. Research on different forums discussing the HC-05 supported this conclusion stating that while the manual of the chip states supported rates of up to 460,800 Bd, the chip only functioned with rates less than 57,600 Bd.

- **Software Testing**

Software testing included more testing of reliability and after reaching certain points in the project began to have constant working expectations, meaning that the developed software would always work after the initial testing had been finished. There were two different pieces of software to be tested and so each had to be subjected to different requirements and tests. These software aspects were the Android code to be developed and Arduino microcontroller code that controlled the data flow of the sensors. Android programming for the phone application is destined to contain flaws as the amount of programming required to create a deployable application is extremely large. To simplify the end goal, the application was tested only under a user correctly navigating through menus as well as starting device use in a specific order (Powering on the microcontroller and then starting the phone application). Each successive feature added to the application needed to be used under various conditions to find flaws in logic that could cause the application to crash or not function as intended.

Therefore, a voltage divider was created manually. First, the minimum and maximum resistances of the light sensor were measured. These values were 32Ω and 2KΩ, respectively(e.g.fig.5). From these values, it was determined to put the sensor in series with a 270Ω resistor. With this configuration, when connected to a 5V source, the voltage across the sensor would be between 0.53V and 4.4V, respectively. Equation shows these calculations. The digital temperature sensor was connected to the appropriate analog pins for I2C communication

$$V_{AIN0} = 5v * \frac{R_{sensor}}{R_{sensor} + R_{pullup}}$$

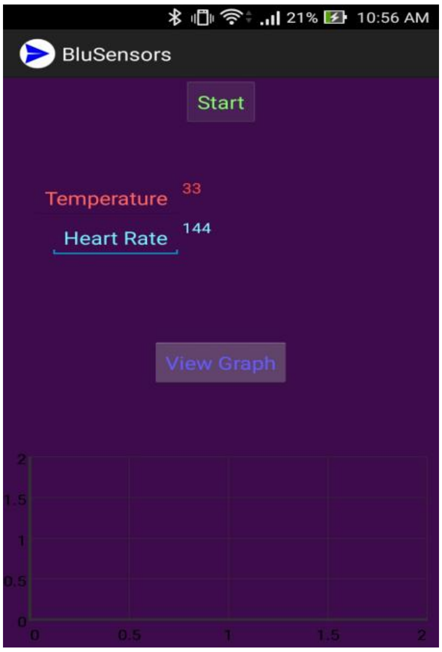
$$R_{sensor} = \frac{R_{pullup} * V_{AIN0}}{5v - V_{AIN0}}$$

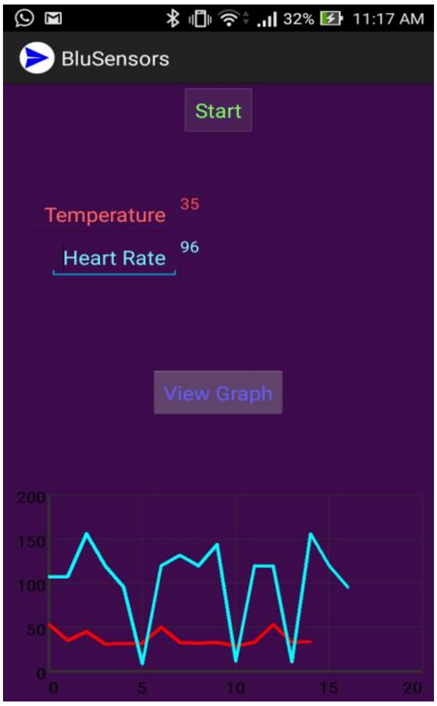
Fig6.Min and Max Luminosity Sensor Voltage Drops

VI. ALGORITHM

STEP 1::Read 600 consecutive ADC samples at 5ms interval
STEP 2: Remove DC component
STEP 3:Check if ADC samples range is enough if not ,the input data is invalid and repeat above step
STEP 4: Scale ADC samples to 1-1023
STEP 5:Apply a 10 point moving average filter to smoothen the PPG waveform
STEP 6:Compute heart rate based on three successive peaks in the PPG signal
STEP 7:Display pulse rate

VII. RESULTS





VIII. CONCLUSION

A wide range of sensors were tested, including analog and digital sensors both wired and wireless, as well as sensors using different protocols. However, the final prototype will showcase a digital temperature and humidity sensor, as well as analog light and water level sensors, as well as a potentiometer to sense angle. Utilizing Bluetooth in Android applications can be daunting for those unfamiliar with the process. However, experience with Android's Bluetooth API can reduce the learning curve tremendously. This is helpful because Bluetooth & Android are popular, well-supported, and effective protocol for wireless communication, and can enhance mobile apps that require such a protocol.

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IX. FUTURE SCOPE

- Some time irritation of skin may be occurring because of sensors so we have to design a sensor so that no side effects are occurring.
- The model we are designing is very simple prototype and need to be further developed
- Bare battery life can be increased so data dropout problem can be reduced.
- The Android application itself requires more development/testing to ensure that the end user can intuitively and without fail use the interface.

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