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Smart Health Monitoring System

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ABSTRACT
Smart Healthcare is important for people who need continuous monitoring which cannot be provided outside hospitals. It is also important at rural areas or villages where nearby clinics can be in touch with city hospitals about their patient's health condition. This work presents a smart health monitoring system that uses biomedical sensors to check patient's condition and uses internet to inform the concerned. The biomedical sensors here are connected to Arduino UNO controller to read the data which is in turn interfaced to an LCD display/serial monitor to see the output. Data is uploaded to the server to store and converted it into JSON link for visualizing it on a Smartphone. An android application has been designed in order to easily see the patient's information by their doctors and family members.
***Keywords*: -** Android application, SD card shield, Server, RTC DS1302, Arduino UNO.

I. INTRODUCTION

Population aging is inevitable, and with the progress of civilization and medicine, the primary cause of death has changed from infectious to immedicable diseases. Thus, rescuing elderly patients in the event of accidents and illness are of primary importance. Improvement of healthcare, both at home and in hospital, have become more important for patients. Telemedicine information systems have become increasingly essential, particularly intelligent systems used to provide highquality healthcare monitoring, which save on medical and manpower costs.

With newer technologies, the computer based portable embedded devices have taken our healthcare to another level, So that people may manage their daily routine checkup at home. In addition, this is important to provide people continuous monitoring in non-clinical environments. However, such health management only can be achieved if the computer based portable monitoring devices with smart sensor technologies are available. [1-4]. Basic structure of smart healthcare is shown in Fig.1.

Fig. 1: Basic Structure

In our work, "Smart Health Monitoring System", there is a complete package of hardware and software .i.e. Different biomedical sensors like temperature and heartbeat rate sensor are interfaced with Arduino UNO microcontroller and get the reading from sensors. These are sent to server and then mobile app wirelessly.

II. ARCHITECTURE

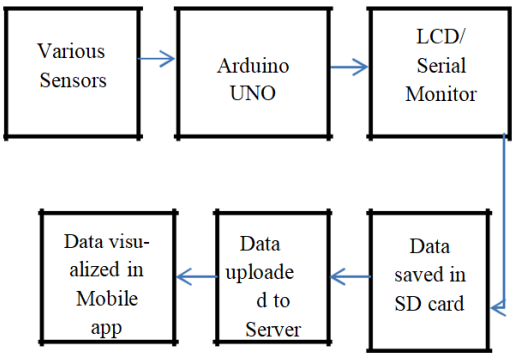

Fig. 1: Basic Architecture

The proposed solution based on integration between medical sensors and controller responsible for collecting patients physical parameters. We are reading the patient name from serial monitor, which was taken as user input. We have used SD card shield and RTC to save sensors reading, name and date, time of that reading taken. Then we save this data in SD Card in CSV format.

We have uploaded this csv file in online database and write a php code to convert this csv format data into JSON link format. By using JSON link we are receiving our data in s-Health application wirelessly.

III. HARDWARE DESCRIPTION

1) **Arduino UNO***:* It is a microcontroller based on the

ATmega328P. It has 14 digital I/O pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button[5]. This controller has everything needed to support the microcontroller by simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter.

Fig.3: Arduino UNO.

2) **Temperature Sensor:** It is an analog signal and microcontrollers usually don't accept analog signals as their input directly. We need to convert this analog output signal to digital before we can supply it to a microcontroller's input. Since Arduino Uno has a 6 channel inbuilt ADC, there are 6 analog input pins numbered from A0 to A5. Connect analog out of LM35 to any of these analog input pins of Arduino [6]. The Arduino Uno ADC is of 10 bit resolution (so the integer values from (0-(2) 1024)).

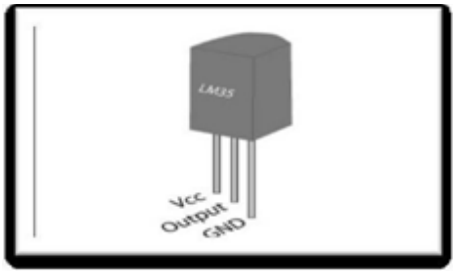

Fig.4: Temperature Sensor

3) **Heart beat sensor:** It is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate [7]. It works on the principle of light modulation by blood flow through finger at each pulse.

Fig.4: Heart Beat Rate Sensor

IV. CALCULATION AND RESULT

Calculation of Temperature sensor:

Convert the sensor value from mV/°c to °c, small calculation is required.

Temp (°c) = (analog Val/1024)*5 Volts * 100 degrees/Volt

To find what value "ADC data" is in volts we need to divide it with the resolution (1024) and multiply with 5 volts.

We need to multiply it with 100 to get Celsius.

Calculation of Heartbeat Rate Sensor

The procedure of calculation of heart rate is following:

When first pulse comes, we start counter by using timer counter function in Arduino that is Millis (). And take first pulse counter value form Millis (). Then we wait for 60 pulses. x After getting 60 pulses we again take counter value in time2.

Then we subtract time1 from time2 to take original time taken by 60 pulses. And then divide this time by 60 for getting single pulse time.

Now we have time for single pulse and we can easily find the pulse in one minute, dividing 60000 ms by single pulse time.

Rate = 60000/single pulse time

Interfacing of temperature and heart beat rate sensor with Arduino UNO and RTC

Fig.5: Experimental Connection Setup

RESULT

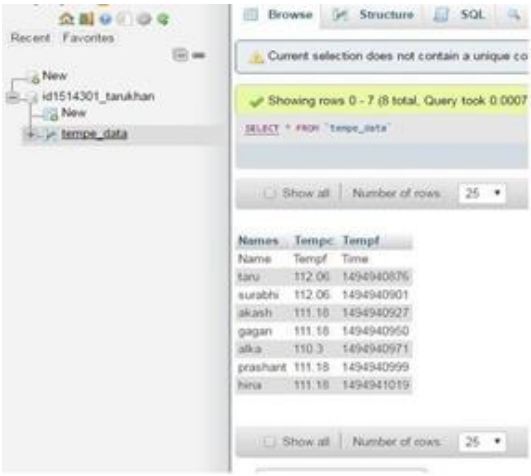

Fig.6: Results on Serial Monitor

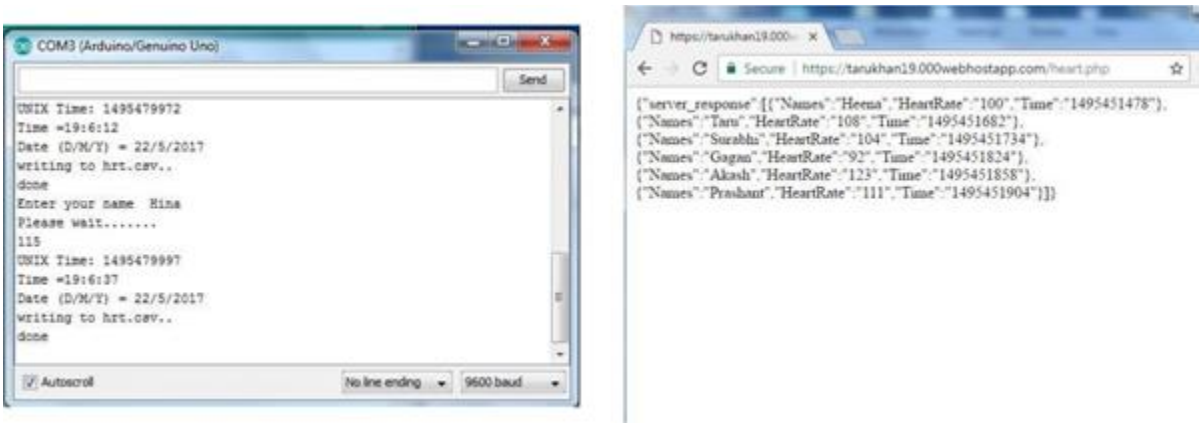

Fig.7: Sensors reading saved in online database the disease wise nearby hospitals

6) **Development of OFS System**

Several Medical related Systems have been developed based upon android platforms and concepts [8-9]. There are many issues related to growing healthcare related apps and their functionality. These are summarised in Table 1. It shows the comparison between different application like Med-Helper Pill Reminder and Dose cast [10-11] with s-Health application developed by us.

Fig 9 shows the different functionalities of our android application named s-Health. Fig.10 shows the screen shots of our s-Health application. In our s-Health application BMI Calculator activity calculate our BMI according to our height and weight. Hospital activity shows

There is also a medicine reminder to remind the patients of their dosage timings through Alarm Ringing system so that they can stay fit and healthy.

Table 1: Comparison list of applications

SPECIFICATION	MEDHELPER PILL REMINDER	DOSECA ST	SHEALTH
Medicine Reminder	Yes	Yes	Yes
Nearby Hospitals	No	No	Yes
Health care tips and Home remedies	No	Yes	Yes
Send sensors data to app	No	No	Yes
BMI calculator	No	No	Yes

Remedies activity has some homemade remedies for headache, fever, teeth ache, and cold cough. Temperature and heart rate activity have the biomedical sensors reading with patient name and date time of that reading taken.

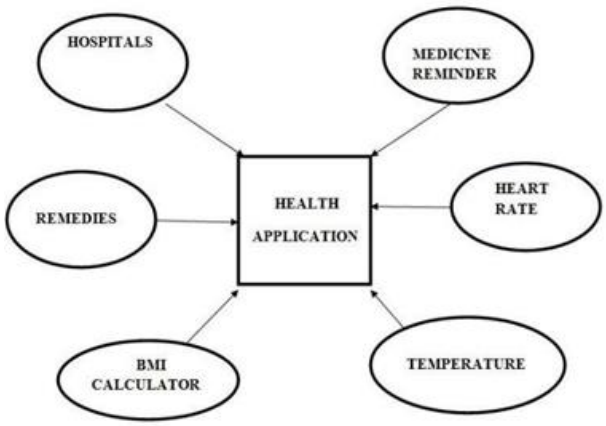

Fig.9: Application Structure

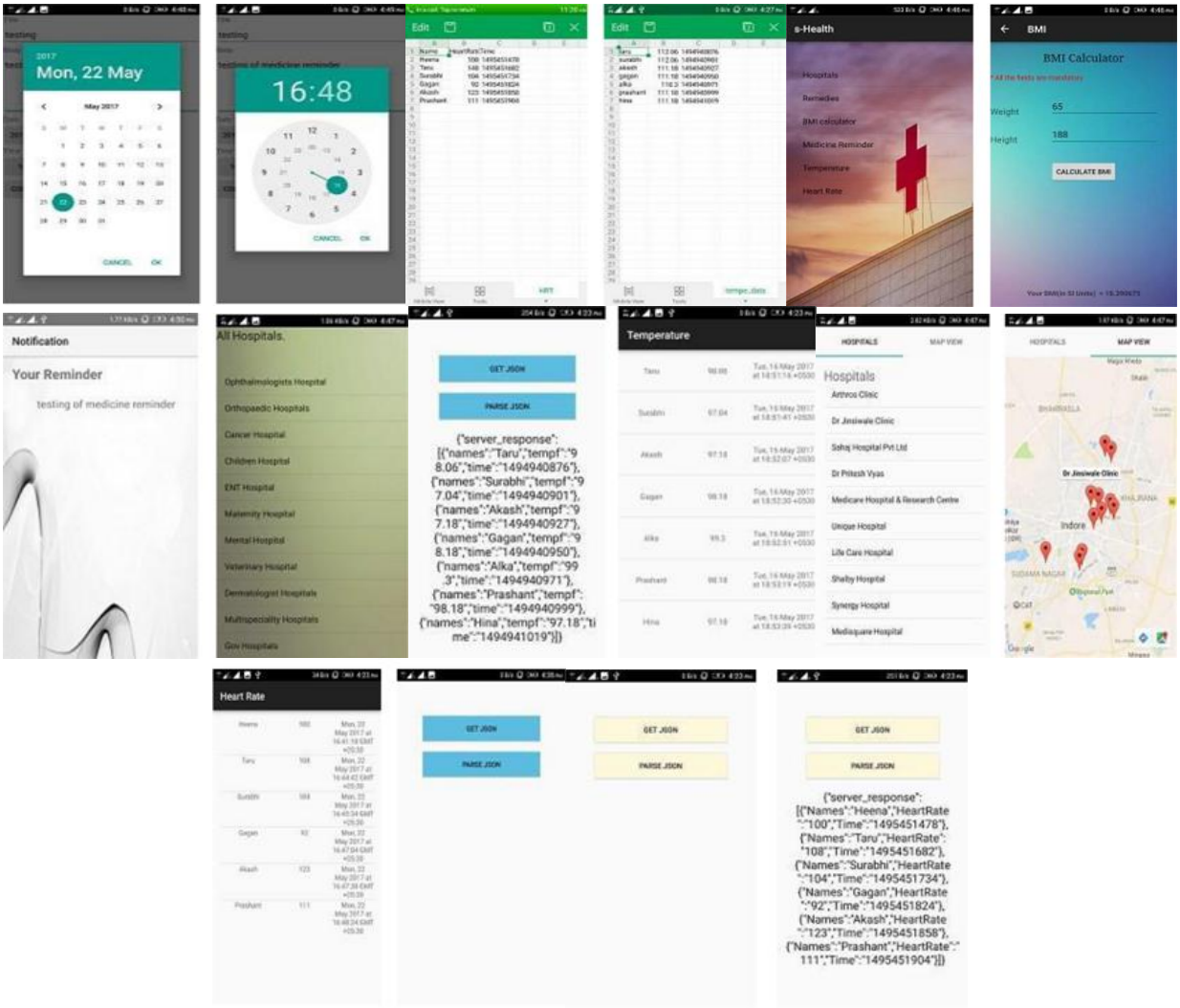

Fig.10: Snapshot of s-Health application - front screen, BMI calculator, Home Remedies, Medicine reminder, Disease wise nearby hospitals, Sensors data saved in SD card, sensors data on s-Health app.

V. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we have proposed and implemented a Smart Health Monitoring System. It is working successfully. By using biomedical sensors, we saved patient's data viz. temperature and heart beat rate in SD card. The data is further uploaded in the server. We also developed an android application named s-Health. In this app patient can see nearby hospitals, home remedies , use medicine reminder [13] and doctors' can see their patients' health parameter in s-Health application to diagnose the results sitting far away from the patients.

For future work, we can increase the functionality of system by adding more sensors and by making our app more dynamic in terms of nearby hospitals and home remedies.

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