Independent Medical Care Unit for Initial Determination of Patient's Health

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***Abstract*: The Independent Medical Care Unit for initial determination of patient's health is an interactive machine that will acquire data in the form of tests and queries from the patient. The tests such as, temperature test (using sensor DS18B20, Pulse oximeter (using sensor MAX30100) and ECG (using sensor AD8232) produce immediate results. These machines are placed in various medical centers in the villages and hospitals, also collecting the existing patient records and required details which are added to a database. The current test results of patients are compared with the database and if a record matches, the determination of health issue is found for patient. This unit thus helps the rural healthcare development**

***Keywords*: Rural healthcare, temperature sensor(DS18B20), pulse oximeter(MAX30100), ECG(AD8232), database.**

1. Introduction

In a wide spread nation like India with a huge population providing medical care to whole population is a huge task, the present situation is that there is development in the medical field in the urban areas but in the rural areas there is still lack of basic medical facilities, people in those areas suffer a lot due to absence of hospitals at their reach. The doctor –patient ration in our nation is very low. This made us to do an innovation in the medical field with combination of electronics and software which imparts the primary medication to the rural people and also making the medicines available to them easily and in the urban areas our unit helps to control the crowd and makes it an easy task to receive medication immediately in an way which is as easy as drawing cash from an atm. We believe that once this unit is implemented in our nation we can impart medical assistance to almost every individual then and there he wants in a very nominal cost.

A. Technical background

In the previous concept we can see that there is lack of medical assistance in rural areas. People in villages have to travel all the way to the hospital for their health issue, which leads to lack of medical assistance. This unit provides instant determination of what the patient is suffering from.

B. Proposed solution

The Fig. 1, shows the top level block diagram, the first phase involves gathering information on the sensors and micro controllers required. Soldering of sensors to Arduino is also done in the initial stage. In phase two, the UI is designed and the user's personal information with database. The third phase involves integrating sensors with UI. The fourth phase involves the SQL queries which involve values from sensors compared with the database which is done using the SQL queries. The fifth or final phase is the validation and testing phase.

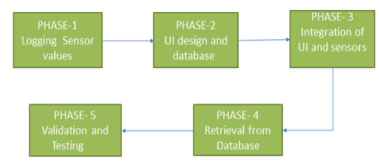

Fig. 1. Top level block diagram of the unit

C. Organization of the paper

In the rest of the report the complete working of the project both the hardware and the software part is explained. This project has three main parts sensor unit, integrating UI with sensors, database. The step by step process in the unit thus could be analyzed and inferred into. Each unit is explained in detail.

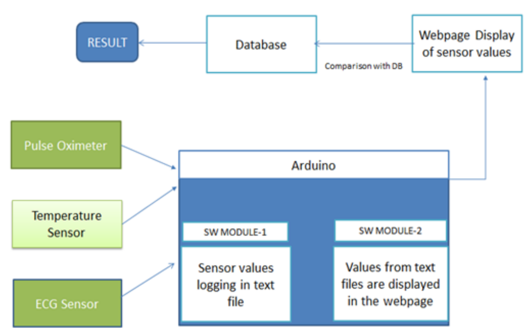

Fig. 2. Block diagram

2. Proposed solution

In this project we have added three preliminary tests, namely body temperature, pulse oximeter and ECG. The outputs received from the temperature sensor (DS18B20), pulse oximeter (MAX30100) and ECG are logged from the putty and displayed in the webpage. The values from the putty are also the values from the sensors which are displayed in the putty are also logged in the text file. The values of temperature, pulse and ECG which are displayed in the webpage are then stored in the database. With data got from the GUI and the sensors, the back-end database in which the queries are fed for each of the age criteria does the comparisons. The result is displayed in the GUI. In this proposed system when a person places his/her finger on the temperature sensor, pulse oximeter and BP sensor the values are read from the sensor and compared with the database and what the person is suffering from is determined. The user inputs are also collected from the user as what the person he/she is presently suffering from and the temperature, pulse, BP are collected and compared with the database which is already stored age group wise. The user's personal information (Name, age, phone number) is also collected and stored in the database.

3. Implementation

A. Hardware implementation

Here the complete design of the circuits will be explained block by block with the assistance of the schematics.

1) Temperature sensor

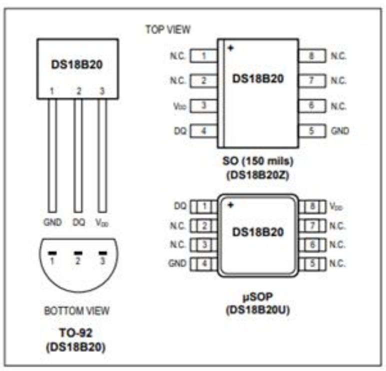

Fig. 3. Schematic of the temperature sensor

The DS18B20 which is used to sense the body temperature provides 9-bit to 12-bit Celsius temperature measurements. It also has a feature which provides with nonvolatile user programmable upper and lower trigger points with an alarm function. A communication of over a 1-Wire bus, that by process requires of that only one data line (and ground) for communication with a central microprocessor. Additionally, the purpose of DS18B20 which also involves the process is that it can obtain the data line through the power ("parasite power"), and it thus eliminates the need for an external power supply. The use of each unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, in order to control many DS18B20s distributed over a large area the use of one microprocessor is used. Thus the use of this sensor is that it could be used to determine the body temperature of human beings, HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems. Thus with minimal amount of hardware and wiring, the One-wire temperature sensors like the DS18B20 are devices that can measure temperature. Thus with the use of a digital protocol to send accurate temperature readings directly to the development board without the need of an analog to digital converter or other extra hardware is the feature of DS18B20. The one-wire sensors can be used in different form factors like waterproof and high temperature probes--these are perfect for sensing temperature in many different projects and applications. Thus, they can even have multiple of them connected to the same pin and since these sensors use the one-wire protocol you and read all their temperature values independently.

2) Pulse oximeter

The integrated pulse oximetry and heartrate monitor sensor solution is the MAX30100 which combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detects pulse oximetry and heart-rate signals. The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times. A I2C digital interface to communicate with a host microcontroller is what an MAX30100 has. The ambient light cancellation (ALC), 16-bit sigma delta ADC is the feature of pulse oximetry subsystem in MAX30100 consists of, and proprietary discrete time filter. For the battery operated system has an ultra-low-power operation which makes it ideal. It is fully configurable through software. Thus to measure heart rate and blood oxygen concentration, the pulse oximeter is used. This device as such could thus is especially important for people who need to monitor these parameters due to certain health conditions, such as asthma or congestive heart failure. Thus in this implementation of a pulse oximeter of how it could be used, we will be using the MAX30100 chip within a breakout board, integrated with Arduino Uno and an LCD keypad shield. The chip(MAX30100) acts as an integrated pulse oximetry and heart-rate monitor sensor solution at a same time. The notable point is that the MAX30100 is not an FDA-approved medical device. Our overall goal is to make a pulse oximeter in a way that it modulates light from an IR LED and also a red light LED simultaneously. It also uses MAX30100 and Arduino, displays pulse rate levels on a Webpage thus providing the user to know whether the pulse is normal or low or high.

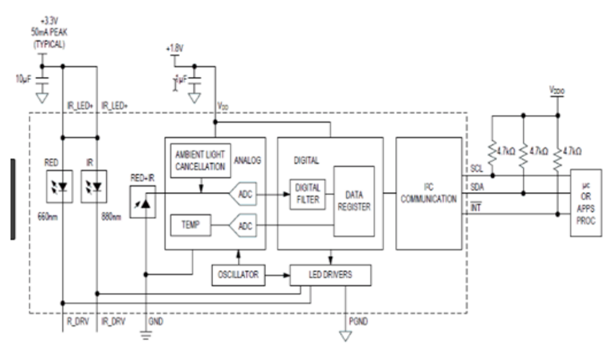

Fig. 4. Circuit diagram of the MAX30100 pulse oximeter

The software registers are fully configurable, and the digital output data is stored is stored in a 16-deep FIFO within the device. MAX30100 operates on a supply in the range of 1.8 to 3.3V. It can be used in wearable devices, fitness assistant devices, medical monitoring devices, etc.

Thus in our medical care project the pulse oximeter takes the pulse rate of human beings and the values from the sensors which are displayed in the putty which is then logged in a text file and displayed in the webpage. The value is also stored in the database and then it is compared and result is displayed.

3) ECG Sensor

The integrated front end for signal conditioning of cardiac biopotentials for heart rate monitoring is the sensor AD8232 for the ECG. It consists of a specialized instrumentation amplifier (IA), an operational amplifier (A1), a right leg drive amplifier (A2), and a mid-supply reference buffer (A3). The leads off detection circuitry and an automatic fast restore circuit that brings back the signal shortly after leads are reconnected is an additional feature in the AD8232. The AD8232 contains a specialized instrumentation amplifier that amplifies the ECG signal while rejecting the electrode half-cell potential on the same stage. The indirect current feedback architecture, which reduces size and power compared with traditional implementations is the possible solution to this. The AD8232 ECG sensor which is a cost-effective board is used to measure the electrical activity of the heart rate. The analog reading for the electrical activity can be charted as an ECG or Electrocardiogram. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

The AD8232 is an integrated signal conditioning block for ECG which could also be used in other biopotential measurement applications. The MAX30100 is thus designed to extract, amplify, and filter small signals in the presence of noisy conditions, such as those created by motion or remote electrode placement which could be used extensively.

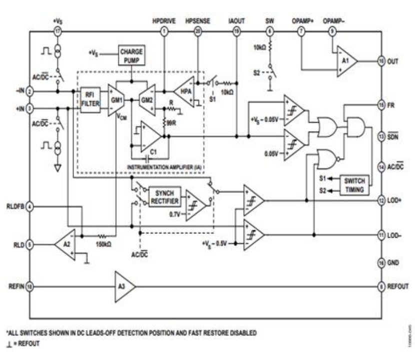

Fig. 5. Circuit diagram of AD8232 ECG Sensor

The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. The MAX30100 thus also provides on this board are some of them as RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, to this MAX30100 are some of it is that, there is an LED indicator light that will be used to pulsate to the rhythm of a heartbeat.

AD8232 could be used to determine the ECG for the persons of different rates. The AD8232 is thus a feasible one that could be used to determine the leads of ECG in the person. In our project the AD8232 is thus interfaced with the Arduino Uno and then the result is displayed. The leads are thus determined.

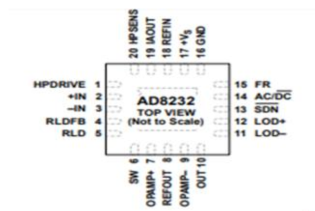

Fig. 6. Pin configuration of AD8232

The above shows the pin configuration of the AD8232 ECG sensor.

4) Graphical user interface (GUI)

The user interface is designed Bootstrap and HTML to design the GUI. In the UI, the patient has to tick on the symptoms (represented as radio box in the checkup page) which he/she has and the values are take in the form of 1's and 0's. These inputs are taken as USER INPUT and the inputs from sensors are stored in the database are compared with the TEST INPUT which is previously stored database according to previous medical records. From the comparisons with the database, the result is determined in the final page.

4. Conclusion

In this project we have described the extensive application of telemedicine need in rural areas and also this implementation of technology in the medical field. In countries like India the doctor to patient ratio is very poor by implementing these kinds of units we can reduce the crowd in hospitals and we can impart good medical care in cheaper cost to all classes of people. Thus we conclude that implementing our project will be beneficial for people from all walks of life.

5. Acknowledgement

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References

[1] Mas Azalya Yusof, Yuan Wen Hau, "Mini Home-Based Vital Sign Monitor with Android Mobile Application (myVitalGear)", IEEE-EMBS Conference on Biomedical Engineering and Sciences (IECBES), 2018.

[2] Alejandra Camacho-Perea, Sergio U. Maya-Martinez, Blanca Tovar-Corona, "Electrocardiographic Signal as a Biometric Feature",14th International Conference on Electrical Engineering, Computing Science and Automatic Control (CCE), Mexico City, Mexico. September 20-22,2017.
[3] Kerim Bedri Saçan ve Gokhan Ertaú, "MAX30100 SpO2/Naboz Duyargason on Performans Deerlendirmesi Performance Assessment of MAX30100 SpO2/Heartrate" Sensor,Medical technologies, National Congress , 2017.
[4] Melisa Pereira, Nagapriya Kamath K, "A Novel IoT Based Health Monitoring System Using LPC2129", 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), India, May 19-20, 2017.
[5] Jiaxi Wan, Yuhua Zou, Ye Li, Jun Wang, Pattern Analysis and Cybernetics(SPAC), "Reflective type blood oxygen saturation detection system based on MAX30100", International Conference on Security,2017.
[6] Nina Djermanova, Marin Marinov, Borislav Ganev , Serafim Tabakov and Georgi Nikolov," LabVIEW Based ECG Signal Acquisition and Analysis," , Proc. XXV International Scientific Conference Electronics - ET2016, , Sozopol, Bulgaria September 12 - 14, 2016.
[7] Muhammad Wildan Gifari, Hasballah Zakaria, Richard Mengko, "Design of ECG Homecare:12-Lead ECG Acquisition using Single Channel ECG Device Developed on AD8232 Analog Front End", The 5th International Conference on Electrical Engineering and Informatics 2015 August 10-11, 2015.
[8] Justin Turner, Chase Zellner, Tareq Khan, Kumar Yelamarthi, "Continuous Heart Rate Monitoring using Smartphone", IEEE International Conference on Electro Information Technology(EIT) ,2014
[9] Zhou Runjing, Xu Hongwei, Ren Guanzhong, "Design of Temperature Measurement System Consisted of FPGA and DS18B20", International Symposium on Computer Science and Society, 2011.