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Design of High Security Smart Health Care Monitoring System using IoT

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ABSTRACT

Smart Health Care Patient data privacy and security system using IOT presents to monitor the patient health care data like temperature and blood pressure, heart rate is monitored securely in webserver. However, the particular patient data would be monitor anywhere in the world with the help of IoT technology. For patient identification we use RFID technology, the RFID reader reads the particular card data. In past days we use Bluetooth and zigbee communications, with the help of this communication you can access the patient data in a particular range, with the help of IoT technology we stored this patient data in cloud and this cloud server protects the patient information also. For IoT communication we are using GPRS module for internet connectivity and the whole patient data should be controlled and processed with the Arduino microcontroller. The Internet of Things (IoT) is most commonly used for interconnecting medically available resources, providing the elderly and patients with a chronic disease with safe, efficient and smart health care services.

Key words: Arduino, RFID reader, RFID cards, GPRS, GSM, temperature sensor, blood pressure sensor, memory, LCD, adapter, power supply.

1. INTRODUCTION

The growth of the aging population has raised many health care challenges. For example, after stroke rehabilitation services for elderly people are a growing problem, requiring a long-term medical commitment. The focus and curiosity of the globe has recently grown dramatically in traditional medicine and oriental medicine. Constant monitoring will increase early detection of emergency conditions and diseases for at risk patients and also provide wide range of healthcare services for people with various degrees of cognitive and physical disabilities [6]. Not only the elderly and chronically ill but also the families in which both parents have to work will derive benefit from these systems for delivering high quality care services for their babies and little children. In particular, the use of acupuncture as an alternative cure for sicknesses in oriental medicine was studied more in depth and it is now noteworthy that some endless infections are effective in the treatment and prevention.

The Internet of Things provides many benefits in healthcare, such as the prospect of tracking patients more closely. Focusing on the consumer end, such as glucose meters, blood pressure cuffs and other devices, enables healthcare providers to automatically gather information and make data-based decisions to ensure early intervention in the treatment process.

The internet of things (IoT) is the networking of all wired and intelligent physical objects. Such instruments have the capability to capture and share data with applications, sensors and network connectivity. The IoT can be remotely controlled through existing network networks, creating the potential to incorporate devices more directly into computer systems, thus improving performance and accuracy. It, in effect, gives those who use it an economic advantage. The technology is part of cyber-physical systems an IoT computer that uses sensors and drives.

IoT is more promising than in the field of healthcare, where the concepts also apply to increase access to treatment, improve the quality of treatment and above all that the cost of healthcare. With intelligent awareness within an IoT, intelligent sanitation will enhance the efficiency of public services and medical infrastructure to enable the prompt collection and analysis of real-time data, the prompt identification and response to sudden and emergent incidents, and proper management and control of resources within a medical center.

In a modern model in healthcare, smart healthcare will provide patients with more effective and reliable medical services. In the event the smart healthcare system lacks efficient protection protocols, however, smart healthcare requires patients to share their physiologic information for online diagnosis; unauthorized or malicious users can exploit such sensitive information.

2. RELATED WORK

There is no cheaper device according to the survey. Different devices are difficult to install, hard to use and maintenance. Present systems are usually proprietary and shut down, not really user-friendly.

In 2010, Hande Alemdar, CemErsoy et al. [1] have provided a rich contextual knowledge and warning mechanisms to strange situations with continuous monitoring across the wireless sensor network of health care systems. Their work offers many state-of - the-art examples and offers a thorough overview of the benefits and challenges of these systems along with design considerations like flexibility, scalability, energy efficiency, protection.

In 2014, Kuan Zhang, Xiaohui Liang et.al, [2] have offered priority-based health data aggregation technique for privacy preservation for the patient's data with cloud assisted WBAN. The authors worked for improving aggregation efficiency among various health data with the help of WBANs. Their work has led to the improvement in the security of health data.

In 2015, Jun Zhou, Zhenfu Cao [3] have developed privacy-preserving protocols for secure data aggregation in cloud-assisted e-healthcare systems. In their work they have proposed fully homomorphic data aggregation technique which in turn work as the basis for the PPDM and achieved optimized efficiency advantage in terms of communication as well as computational overload.

In 2017, Bahar Farahani, Farshad Firouzi et. al [4] have discussed promising challenges in of IoT in medicine and healthcare and keenly expressed the importance of IoT platform in connecting the people for making the human life enriching as well as easier. The authors proposed fog-driven IoT eHealth concept.

In 2017, Farshad Firouzi, Amir M. Rahmani et. al, [5] have examined the highest concerns in IoT technologies concerning intelligent sensors for the health sector; particularly applications for individual telehealth interventions in order to enable healthier lifestyles. Such technologies include wearable and body sensors, advanced healthcare systems and the large-scale data analysis necessary to inform such equipment.

In 2018, Wencheng Sun, Zhiping Cai et.al, [6] adressed the value of the Medical Internet of Things, including an comprehensive analysis of potential solutions to security concerns and privacy problems, as well as open problems and research problems for future work. In addition, the work focused on data flow protection and privacy standards in MIoT.

In 2018, Sagar Sharma, Keke Chen, et.al, [7] proposed Toward Practical Privacy-preserving Analytics For IoT And Cloud-based Healthcare Systems. Their analysis is focused on a customized digital health information system that is being built and tested to track diseases, evaluating data and analytical criteria for the parties involved, defining the confidentiality assets, examining data protection substrates present, and addressing possible tradeoffs between privacy, efficiency and quality modeling.

In 2019, Yunfei Meng, Zhiqiu Huang et.al, [8] have offered SDN- based security enforcement framework for sharing the data systems of smart health care. In their work they mainly focussed on developing the framework which acts as firewall mechanism and assures that only authorized data can be accessed using patient's virtual machine.

By keeping the drawbacks of some existing techniques, a new security system for patient's data is designed using IoT [9].

The following section discusses about the design of the system followed by hardware and software requirements, results and discussions then conclusion

Actual System

SDN (Software Defined Network) is a extension of the current project. Through patient has a dedicated virtual data-sharing machine and every virtual machine provides a group of data services to those approved consumers in our sector. Virtual machines are protected by a firewall gateway which only allows approved things to access the virtual machine of the patient. SDN suggests that the control process (controller plane) be decoupled from the transit process (data plane), to centralize network intelligence into one network portion. Open Flow Transition is the center of the three parts data plane: flow chart. Open Flow switch is the core of data plane, which consists of three parts: flow table, Open Flow protocol and secure channel.

3. DESIGN METHODOLOGY

The technology advancements in consumer electronics have reduced the production costs and have made it possible to afford inexpensive sensor devices [10], for ordinary users as well. Together with the mature and also inexpensive RFID technology, the costs for pervasive healthcare systems are within the affordable range for many people. In Caregiver's Assistant, inexpensive RFID tags are placed on household object and the systems precision can be increased at very low costs, by tagging more objects with these RFID tags.

Hence RFID technology has been implemented in the design. RFID technology is a communication system that can automatically and remotely identify a specific target and read the data through a radio signal. RFID has already been commonly used in many contactless devices, such as personal authentication, libraries, and eventually. In the medical sector of the RFID network for almost a decade, the successful monitoring of hospital equipment [11], medical services, medications and patients is awaited. Many products such as drug monitoring devices, first assistance, medical supplies and even the patients themselves are labeled with this RFID tag. In addition, this tag is recognized by a fixed or portable reader search for useful information on these items and then for efficiently communicating with the server on a variety of computer terminals [12]. In addition, legitimate managers of the various parts can access the server's information through the Internet that is effective and knowledgeable in its entirety. The RFID reader includes different RFID tags, each tag has one patient, and when your specific data is sent to the server, you have the RFID tag on your device, offering greater protection to patient data [13].

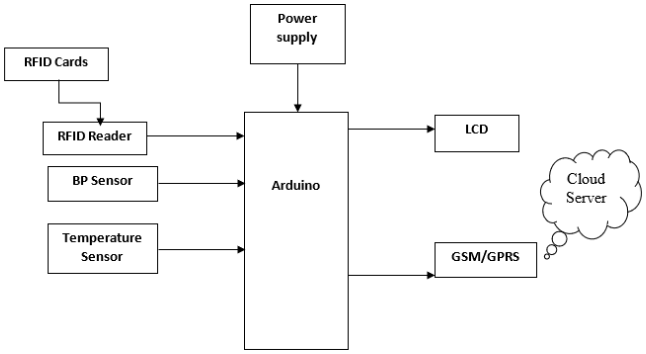

Figure 1: Proposed system Block diagram

Working:

- For this work, first, the program is developed using embedded C language and save the program using Arduino IDE.
- The program is then verified and then compiled. If any errors appear, then the program will be checked and modified as per the desired requirements.
- After compilation, the program will be uploaded into the Arduino kit.
- The developed kit can work using direct switch as well as particular RFID tag.
- Once the RFID tag is sensed using RFID reader then the B.P sensor starts automatically reading the data of the patient like B.P.H, high B.P.M, Heartbeat and the temperature information.
- After successfully reading the data from the patient, the data will be processed.
- The processed data information will be sent to patients registered mobile number with the help of GSM as well as the data is uploaded into cloud server [12].
- The status of the working can be observed with the help of LCD panel interfaced with Arduino kit.
- In this manner the patient's data is secured with RFID and the cloud server.

The hardware components used for this project are

- Arduino
- RFID Module
- GSM/GPRS module
- LCD Display Module
- Blood Pressure Sensor
- Temperature Sensor

The softwares used for this project are;

- Arduino IDE
- Embedded C language
- Thingspeak server

Arduino:

A basic but efficient single board device that has gained considerable popularity in the hobby and the business worlds is the Arduino microcontroller. The Arduino is an open source, meaning that hardware is relatively pricey and software is free to build. A condensed version of C / C++ is the Arduino programming language. If you know C, you should learn how to program Arduino. If you don't know C, you don't have to worry about that, as only few commands are required. The Arduino's important feature is that the control software can be created on the host Computer and downloaded to Arduino and run automatically.

Figure 2: Arduino kit

RFID reader and Tag

RFID represents ID of radio frequencies. RFID labels are little chips (more often than not as a keen card or a meeting card) that are utilized in our day by day lives to open lodgings, enter autos, and so on. These little chips structure the RFID framework together with a RFID reader. Two parts of an RFID system are 1) RFID Reader and 2) RFID Tag. Data is stored electronically in the RFID tag. The reader collects this data using electromagnetic waves.

Figure 3: RFID Module

EM-18 RFID Reader operated at 125kHz frequency and has a read range of 5cm-10cm.The RFID reader has a radio transmitter and recipient inside. It is likewise called as an investigative specialist. The reader transmits radio recurrence flags persistently after controlling. At the point when a RFID tag is set inside the range region of a reader, it invigorates the tag through electromagnetic enlistment and gathers the data from it.

RFID Tag:

The Tag contains an IC for putting away the information, a reception apparatus for transmitting and accepting, and furthermore a modulator. Tags are very small in size and they can hold only few bits of data.

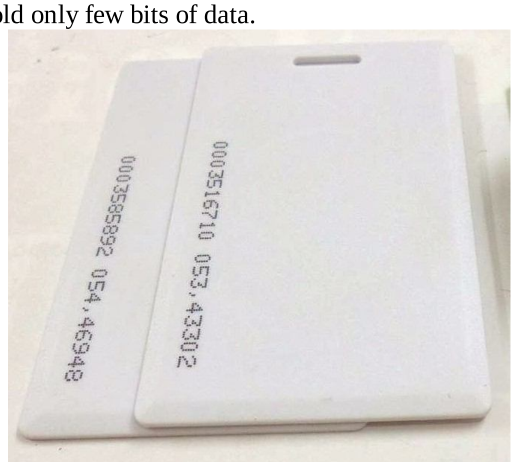

Figure 4: RFID Tag

Blood pressure sensor:

Blood Pressure (BP) is one of the important vital signs. It is the pressure exerted by the circulating blood on the walls of blood vessels. Blood Pressure is expressed as the ratio of the systolic pressure over diastolic pressure. Mercury sphygmomanometer is being used for measuring blood pressure. In this, the height of the column of mercury is considered for measuring the blood pressure. The oscillometric method is used for automated blood pressure measurements since 1981. With the advance in technology devices for measuring blood pressure through the non-invasive oscillometric method are being developed. One such device is the Blood Pressure Sensor.

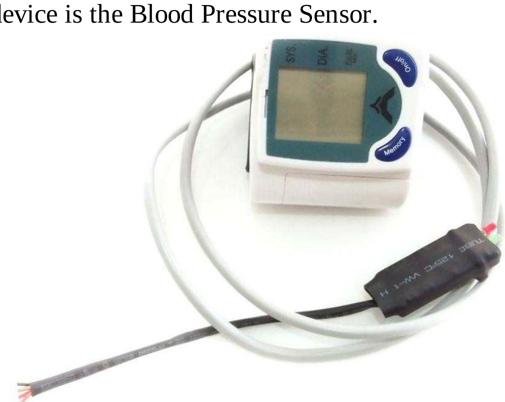

Figure 5: Blood pressure sensor

LCD Display:

A 16x2 LCD implies 16 characters can be shown per line and 2 such lines exist. Each character is shown in a lattice of 5x7 pixels in this LCD. There are two registers in this LCD, in particular Command and Data.

The directions given to the LCD are put away by the order register. An order is a direction given to LCD to play out a predefined assignment, for example, introducing it, clearing its screen, setting the situation of the cursor, controlling presentation, and so forth. The information register will store the information that will be shown on the LCD. The information is the character's ASCII incentive to show on the LCD

Figure 6: 16x2 LCD Display

DS18B20 Temperature Sensor

The DS18B20 is an integrated 1-wire temperature sensor. It is commonly used in hard conditions like chemical solutions, mines, soil etc. Temperature is measured. The sensor is durable and can be bought with a waterproof option to ease the installation process. With a proper precision of ±5 ° C, it can calculate a wide range of temperatures from -55 ° C to + 125 ° C. There is a unique address for each sensor and only one MCU pin is needed to pass data, so it's a great option for multi-point temperature measurements without losing many of your digital pins on the microcontroller.

GSM/GPRS Module:

A GSM/GPRS module is an IC or chip that utilizes a SIM (Subscriber Identity Module) and Radio Waves to interface with the GSM arrange. Basic radio frequencies are 850MHz, 900MHz, 1800MHz and 1900MHz in which a run of the mill GSM module works.

It comprises of the GSM/GPRS module, SIM card addition space, PC or microcontroller association RS-232 interface, LED flag status, control supply and mouthpiece and speaker association arrangement. Each GSM/GPRS module is remarkable and its IMEI number makes it conceivable to separate it. IMEI or International Mobile Equipment Identity Number is a one of a kind 15-digit number for cell phones, satellite telephones and other GSM organize gadgets.

Figure 7: GSM/GPRS Module

4. RESULTS AND DISCUSSIONS

Once the patient's hand is kept in blood pressure monitoring system kit, the Arduino kit starts functioning after the reading the RFID tag using RFID reader module as shown in below Figure 8.

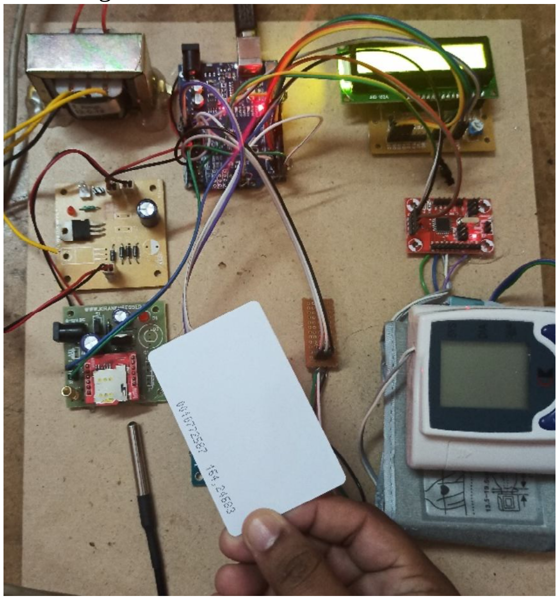

Figure 8: RFID tag read by RFID module

Once RFID tag is read by RFID reader module, the patient ID is displayed on the LCD display and the Reading BPM command appears on LCD as shown in figure 9.

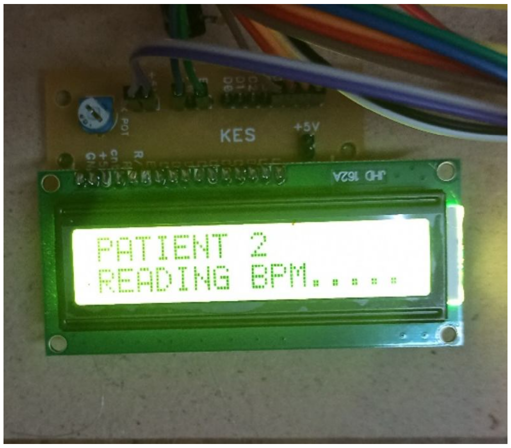

Figure 9: Patient information on LCD display after reading RFID tag

The analog data of blood pressure, heartbeat and temperature are calculated and then processed into digital data. After processing the BPM data from the blood pressure monitoring system, the data is displayed on blood pressure monitoring system as well as on the LCD display as shown in Figure 10 & Figure 11.

Figure 10: Readings from BP monitoring system

Figure 11: Readings from LCD Display

The recorded data from the blood pressure monitoring system is sent to the registered mobile number with the help of GSM module on the kit. Sending SMS status is displayed in the LCD as shown in Fig.12.

Figure 12: Sending SMS data

After the SMS is sent to the registered number, the same data is uploaded into the cloud sever. The status of uploading data is displayed on LCD display as shown in Fig.13.

Figure 13: Uploading data to cloud server

After the patient's data is uploaded on to the cloud server, the data can be analyzed using thingspeak server in the form graphs as shown in figures.

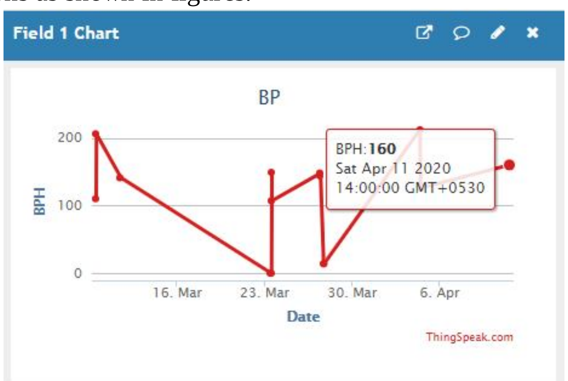

Figure 14: Graphical representation of BPH data

The above figure shows several readings of BPH values corresponding to the dates. For the patient 2 the obtained BPH value is 160 as shown in figure 10 ad the same value is replicated on the graph, the corresponding date is April 11.

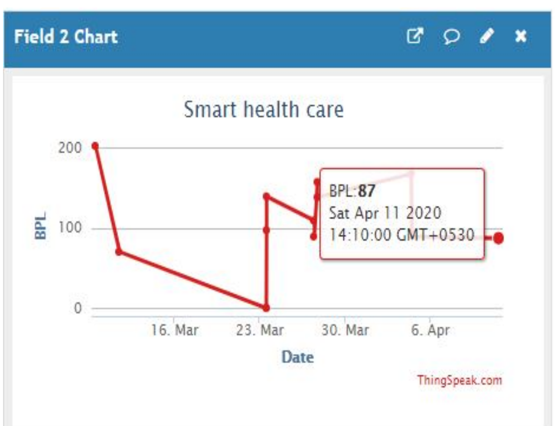

Figure 15: Graphical representation of BPL data

The above figure15 shows several readings of BPL values corresponding to the dates. For the patient 2 the obtained BPL value is 87 as shown in figure 10 ad the same value is replicated on the graph, the corresponding date is April 11.

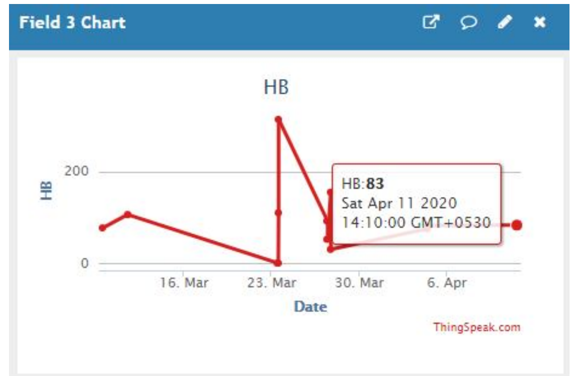

Figure 16: Graphical representation of heartbeat data

The above figure shows several readings of heartbeat values corresponding to the dates. For the patient 2 the obtained heartbeat value is 83 as shown in figure 10 ad the same value is replicated on the graph, the corresponding date is April 11.

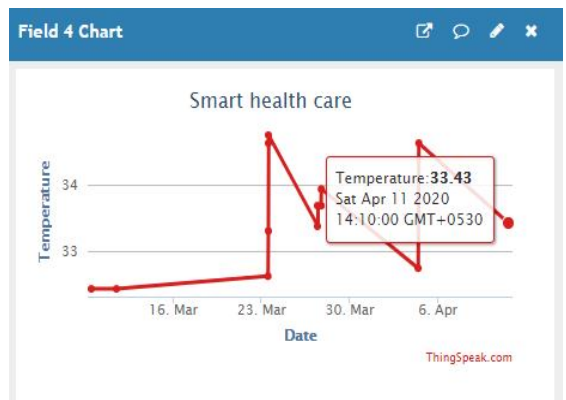

Figure 17: Graphical representation of temperature data

The above figure shows several readings of temperature values corresponding to the dates. For the patient 2 the obtained temperature value is 33.43 as shown in figure 10 ad the same value is replicated on the graph, the corresponding date is April 11.

5. CONCLUSION AND FUTURE SCOPE

The conclusion about this ppaper is the patient health information can be stored in server. This data should be maintained in most secure way and don't access this information third party persons without user permissions. With the help of internet connectivity one can access this information anywhere. Advanced security techniques may be implemented which can replace RFID technology and provide better security.

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