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Automated Estimation Recording and Storage of Healthcare Data in blockchain Access Control using IOT

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ABSTRACT: IoT enabled healthcare systems are improving the quality of health services, but it also raises many security and privacy issues, where unauthorized access may lead to catastrophic of patient/hospital hence we use Block chain technology which is a permanent record of online transactions. It is a distributed tamper-proof database, shared, and maintained by authorised Users. It is a technologythat is expected to revolutionize healthcare industry.
As we have seen how the Novel Coronavirus had overcrowded the Hospitals, this technology used can help in continuously remote monitoring the health of the patient at the comfort of their homes and the data can be uploaded on the cloud by encrypting the data using blockchain technology so that only the authorised Doctors or Caretakers can monitor the values. If there is any abnormal value of the patient's data an alarm is generated and sent to the Guardian or Doctor. Health monitoring system is one of most important and practical applications of wireless sensor network (WSN). Even though various health monitoring devices based on WSN are used, they are still quite limited in the sense of mobility and accuracy. In this project a new wearable health monitoring system is proposed, which consists of vital sensor node. Here the accuracy of the measurement of electrocardiogram signal is enhanced, and the sensor node is optimized for the use in WSN. The wearable health monitoring system provides the communication between the wearable sensor nodes and relay nodes in the proximity even during the movement of the user, allowing for real-time monitoring of biometric signals. The overall system is depicted in block diagram and it consists of three components: the **wearable vital sensor node, a relay node, and host computer** monitoring the user. The wearable vital sensor node measures and processes the ECG signal, removing the noise and transmitting the processed signal. The relay nodes are used to increase the limited communication range of the wearable vital node, and they are installed on the ceiling of the room. Finally, the host PC uses a terminal implemented as a .net application to monitor the measured biometric signal.

KEYWORDS: IOT, Novel Coronavirus, Wireless Sensor Network, Blockchain, Wearable vital sensor node, relay node, host computer.

I. INTRODUCTION

Home care services are growing up in the past years. Contemplating the patient/family pair, it represents a solution to the medical problems of the modern life. With the social trends, the senior population has been increasing in the last years. However, as living is more stressful than ever, there are more cases of chronic diseases. The difficulties of transport in the big cities and the scarcity of hospital streambeds turn the home care an attractive solution. However, its routines can be switched by telemedicine. This paper describes the implementation of a telemedicine system for patient monitoring using mobile telephony. The major aspect about this application is its generality, which allows the use of any patient monitor with a RS-232 interface. The system proved to be quick and reliable. Therefore, it represents an applicable solution to tele homecare.

II. LITRATURE SURVEY

2.1 S. J. Jung and W. Y. Chung, "Flexible and scalable patient's health monitoring system in 6LoWPAN," Sensor Lett., vol. 9,no. 2, pp. 778–785, Apr. 2011.

The authors studied the Flexible and scalable patient's health monitoring system in 6LoWPAN . The main advantage is enabling factor is the combination of some technologies and communications solution. The results of Internet of Things are synergetic activities gathered in various fields of knowledge like telecommunications, informatics and electronics.

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2.2 Health monitoring and tracking system for patients using IoTGubbi, Jayavardhana, Buyya, Rajkumar, Marusic, Slaven, Palaniswami, Marimuth 2017

The authors studied the Internet of Things (IoT) 2017 A vision, architectural elements, and future direction which proposes on demand positioning and tracking system. It is based on Global Positioning enabled devices and suitable for large environments. Smart phones between two terminals are used for making initial communication. The initial communication is performed by synchronization phase.

2.3 Assessment of Adaptive Rate Response Provided by Accelerometer, Minute Ventilation and Dual Sensor Compared with Normal Sinus Rhythm During Exercise: A Self-controlled Study in Chronotropically Competent Subjects J.L. Kalju 2015

The author developed a system, which is capable of measuring different physiological parameters and are used to design a system for heart rate reconstruction for rate adaptive pacing .

2.4 Research Challenges in Wireless Networks of Biomedical Sensors Loren Schwiebert, Sandeep K.S. Gupta and Jennifer Weinmann 2001

The authors studied the strength of smart sensors which are developed from the combination of sensing materials along with combined circuitry for other biomedical applications .

2.5 A versatile microwave plethysmograph for the monitoring of physiological parameters : G.B. Gentili; V. Tesi; M. Linari; M. Marsili2002

The authors proposed a simple microwave technique to monitor the cardiac activity. This technique is dependent on changes in modulation envelope of amplitude modulated waves passing through the body . It explained the use of wireless microsensors networks for medical monitoring and environmental sensing.

2.6Design of Wi-Fi sensor network that is capable of monitoring patient's chronic diseases at their home :Reza S.Dilmaghani(2016)

The author of this paper design a WiFi sensor network that is capable of monitoring patients chronic diseases at their home itself via a remote monitoring system. So immerging of wireless sensor technology individual test like only blood pressure heart rate, temperature etc. can be measured but this research project enables all this parameter together to be measured under single system.

III. SYSTEM ANALYSIS AND REQUIREMENTS

Hardware and the Software Requirements:

Hardware:

- Microcontroller - AT89C51RD2BN
- LCD - 16 x 2
- Rs232 - MAX232
- GSM Modem [RS232 based]
- 7812/ 7805 voltage regulators for power supply
- Power supply circuit

Software:

- Embedded c
- Keil-c compiler
- Flash magic burner software.
- Embedded java
- Eclipse
- Jdk1.6

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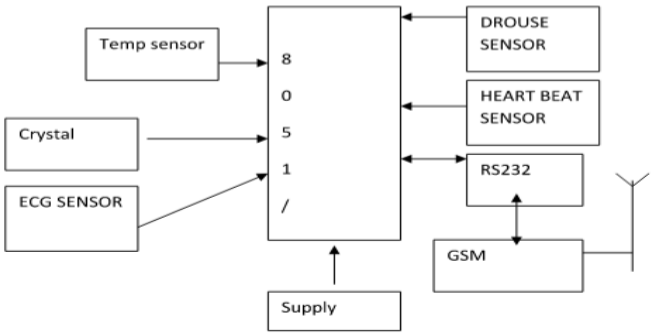
IV. PROPOSED SYSTEM ARCHITECTURE



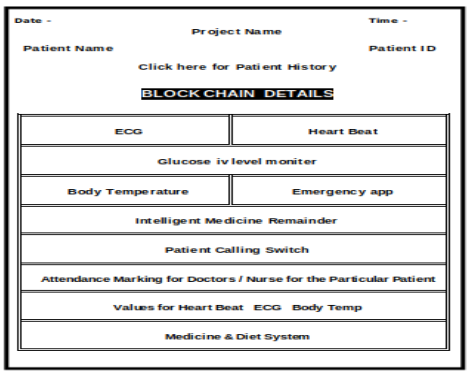
Health monitoring system is one of most important and practical applications of wireless sensor network (WSN).
In this project a new wearable health monitoring system is proposed, which consists of vital sensor node. Here the accuracy of the measurement of electrocardiogram signal is enhanced, and the sensor node is optimized for the use.We consider the above networking model .

The wearable health monitoring system provides the communication between the wearable sensor nodes and relay nodes in the proximity even during the movement of the user, allowing for realtime monitoring of biometric signals. The overall system consists of three components: the wearable vital sensor node, a relay node, and host computer monitoring the user.
The wearable vital sensor node measures and processes the ECG signal, removing the noise and transmitting the processed signal. The relay nodes are used to increase the limited communication range of the wearable vital node, and they are installed on the ceiling of the room. Finally, the host PC uses a terminal implemented as a .net application to monitor the measured biometric signal.

THE MAIN FEATURES OF THIS PROJECT ARE

- All the Parameters can be viewed on the Mobile phone.
- Values from heart rate, temperature, ecg is stored in cloud using block chain.
- Voice announcement to Guardian/ Doctor in case of emergency.
- Viewing all details for references like medical history and diagnosis for further references.
- Block chain helps patient to shift from one hospital to another without much paperwork.
- Emergency app installed in patients smartphone.

The details of the patient are stored in the below manner using block chain



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V. MATERIALS AND METHODS

Data Set:

The data used in the project is generated live by the sensors and is uploaded on the cloud , once the data is uploaded it is encrypted using the AES algorithm and is stored in the form links, so that the data cannot be manipulated.
Access is granted only to the authorized users or the authorized hospital. The authorized users are registered based on their moblie phones IMEI number which is granted access for the cloud. There are two mobile applications involved one is the IOT app which is to be installed in the patients mobile phone which has emergency features like if the phone is shaken 2 times there is an health emergency notification sent to the Guardian or the Doctor, the notification is sent to the mobile of the User where the Guardian app is installed, the owner of the Guardian app can see the location of the patient as well as photos of the patient.

VI. CODING

Below is the source code in C to fetch the details from the wearable sensor and upload it on the cloud and display on the lcd screen on the monitor.

The parameters include patient temprature, SpO2, ECG and heart rate.

```
#include<MAX30100.h>
#include<MAX30100_BeatDetector.h>
#include<MAX30100_Filters.h>
#include<MAX30100_PulseOximeter.h>
#include<MAX30100_Registers.h>
#include<MAX30100_SpO2Calculator.h>
#define BLYNK_PRINT Serial
#include<ESP8266WiFi.h>
#include<BlynkSimpleEsp8266.h>

#include<LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
BlynkTimer timer;
#define REPORTING_PERIOD_MS 1000
// Variables will change:
int page = 0;
const long interval = 10000;

// update time
unsigned long previousMillis = 0;
int temp = A0; /* LM35 O/P pin */
int hydrate=12;
int hydrateval;
int ecg = 14;
int ecgval;
float tempval;

char auth[] = "JcQZMwuZpA0hA4CtjG7cO1M79_
char ssid[] = "iot";// YourWiFi credentials.
char pass[] = "12345678";

// Connections : SCL PIN - D1 , SDA PIN - D2 , INT PIN - D0
PulseOximeter pox;

float BPM, SpO2;
uint32_t tsLastReport = 0;
void onBeatDetected()
{
  Serial.println("Beat Detected!");
}
void setup()
{
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print(" SMART HEALTH");
  lcd.setCursor(0,1);
  lcd.print(" MONITORING ");
  delay(2000);
  lcd.clear();
  pinMode(temp,INPUT);
  pinMode(hydrate,INPUT);
  pinMode(ecg,INPUT);
  pinMode(16, OUTPUT);
  Blynk.begin(auth, ssid, pass);
    Serial.print("Initializing Pulse Oximeter..");
  if (!pox.begin())
  {
    Serial.println("FAILED");
  }
  else
  {
    Serial.println("SUCCESS");
    pox.
    timer.setInterval(1000,tem);
    timer.setInterval(2000,lcdupdate);
    timer.setInterval(250,pu());
  }
// The default current for the IR LED is 50mA and it could be changed by
uncommenting the following line.
  //pox.setIRLedCurrent(
  }
void loop()
{
  pox.update();
  Blynk.run();
  timer.run();
  BPM = pox.getHeartRate();
```

VII. TESTING

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results.

Unit Testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program input produces valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

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Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.
Invalid Input : identified classes of invalid input must be rejected.
Functions : identified functions must be exercised.
Output : identified classes of application outputs must be exercised.
Systems/Procedures : interfacing systems or procedures must be invoked.

VIII. RESULTS AND CONCLUSION

As health care services are important part of our society, automating these services lessen the burden on humans and eases the measuring process. Also the transparency of this system helps patients to trust it. When threshold value is reached, the alarm system that consists of buzzer and LED alerts the doctors and he can act more quickly. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure.

The GSM technology helps the server to update the patient data on website. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors. The biometric information of the patient which is stored and published online can be given to scientists and researchers of medical fields to analyze the value and find patterns or for other research work. To simplify the hardware and reduce wiring we can use wireless sensors.

Advantages:

- Reduces the need of Caretakers.
- Cuts the cost of extra Health Care Services.
- Integrates a lot of sensors.
- Reduces the number of data transfer protocol.
- No wired connections required.
- Time saving, Continuous and efficient monitoring.

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