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IOT Based Smart Healthcare System

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Abstract: *IOT is an emerging technology and it is important to explore its applications. One of the sector where IOT technology is widely used is in healthcare. Hence, the main aim of this paper is to design a IOT system which provide better facilities for patients and easy and fast diagnosis for doctors. This IOT system helps remote monitoring of patients even in the rural areas where there is no access of internet or any kind of mobile network. Following system uses LoRa based technology for transmission of readings and also web based applications such as google spreadsheet for recording the readings. This remote monitoring system (RMS) consists majorly of an sender node (SN) and an receiving node (RN) for remote diagnostics. Proposed system can show real time medical readings to patients as well as transmit this readings to doctors with the help of LoRa technology. This IOT system consists of various components such as Arduino uno R3, NodeMCU, and the work collaboratively to make this remote monitoring possible.*

Keywords: Internet of things; IOT technologies; IOT applications; Remote Monitoring

I. INTRODUCTION

Various devices interconnected through the network form an IOT system. This proposed system in hardware terms consists of two nodes. One is sender node and other one is receiving node. Sender node consists of Arduino uno R3 with and LM35 temperature sensor and pulse sensor. Also an SX1278 LoRa module is interfaced with this Arduino On the other hand receiving unit consists of NodeMCU interfaced with same LoRa Module. For display of information, both units are equipped with 128x64 OLED display. First at sender node, readings are taken from patients such as body temperature readings and pulse readings. This readings are transmitted to receiver node via LoRa Module. These readings are received on the receiving node through same LoRa module. This helps doctor to monitor real time readings of patient. Also with the help of ESP8266 Wifi modulethis readings are recorded on a web based service called google spreadsheet. Hence real time monitoring is possible with the help of this system. Also recording of this readings is done for various purposes such as comparing previous and new readings. This is very helpful for patients in remote areas where there is no facility of wifi and the areas which are distant from mobile networks. This system can establish communication up to 10 km thanks to LoRa technology. We have used lora module here because it has best fit for transmitting data over long range. Also this system serves the purpose of less availability of hospitals where the patients are not able to find any hospitals nearby. Also there is no requirement for standing in queue for long time. This medical readings can be taken anytime and from anywhere. If the doctor is not available for checking real time readings he can access spreadsheet for tracing the readings. Readings in spreadsheet are stored with date and timestamp so the doctor does not have to worry when the patient has taken these readings. Various sender nodes can be given patients and all this sender nodes can be managed though a single receiving node. This system also solves the problem of limited availability of devices at hospitals. This system saves the time and cost which is required from patients to visit the hospital. This system takes healthcare procedure to a next level with the help of IOT technology. Also management of data is made easy with the help of this system as the readings of the patient can be accessed through any device thanks to google spreadsheet web service.

II. LITERATURE SURVEY

Paper No.1
Title : Smart Healthcare Monitoring using IoT
Year of publication : 2018

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Authors : Shubham Banka, Isha Madan, S.S. Saranya
Keywords: Internet of Things, IoT in Healthcare, Patient Monitoring, Raspberry Pi, Smart Health Monitoring
Various integration of sensors to a microcontroller devices such as temperature sensor and heartrate sensor and collecting this readings from this various medical related IOT Sensors.

Paper No. 2
Title : IoT based Smart Healthcare Monitoring Systems: A Literature Review
Year of publication : 2020
Authors : R. Alekya, Neelima Devi Boddeti, K. Salomi Monica, Dr.R. Prabha, Dr.V. Venkatesh.
Collecting the reading through various microcontroller based IOT devices and sending this readings over web based services for easy management and record of readings.

III. HARDWARE REQUIREMENTS AND SPECIFICATIONS

1. Arduino UNO R3

Arduino UNO is based on the ATmega328P microcontroller. It is easy to use compared to other boards such as Arduino Mega boards. Arduino UNO includes 6 pin analog input, 14 digital pin, USB connector, power jack and ICSP (In-Circuit Serial Programming) header.

2. LM35 Temperature Sensor

The LM35 device has an advantage over conventional thermometers that measure in Kelvin because the user does not need to extract a constant voltage from the output to obtain a simple Celsius value. The LM35 instrument provides ±¼°C accuracy at room temperature and ±¾°C accuracy over the entire temperature range of -55°C to 150°C, without external calibration or correction

3. Pulse Sensor

The Heart Rate Sensor has three pins: VCC, GND, and an analog pin.It can be used by students, artists, athletes, manufacturers, and business and mobile phone developers who need to easily connect their heartbeat data to their work in real time. The element is a combination of optical amplifier circuit and noise cancellation sensor circuit..

4. SX1278 LoRa module

The SX1278 LoRa module is used for long distance communication. It is a low cost RF front-end transceiver module based on Semtech's SX1278. This module is appropriate for a variety of tiny data applications because to the high sensitivity of LoRa modulation (-136dBm) and high power output of 20dBm.

5. NodeMCU

On a low-cost SoC called the ESP8266, NodeMCU (Node Microcontroller Unit) offers a software and hardware development environment..Espressif systems is the manufacturer of NodeMCU.

6. 128x64 OLED Display

This display is 124 x 64 pixels, so you may be able to fit some text or images depending on the physical size of the screen. This module allows you to control OLED messages over I2C. The module uses the SSD1306 OLED driver that contains a pump switch in the capacitor to generate more electricity needed to power the OLEDs on the screen.

IV. SOFTWARE REQUIREMENTS

1. Arduino IDE

The Arduino Integrated Development Environment (IDE) is used to communicate directly with Arduino hardware. It creates programs called sketches with extension .ino. Programs can be uploaded directly to Arduino board through Arduino IDE.

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2. Google Sheets

Google Sheets is an web based application by google. Also it has a mobile application which is compatible with various operating systems and is compatible with excel format.Real time data is updated on this sheets.

V. PROJECT IMPLEMENTATION

1. Arduino

Various sensors are attached to Arduino uno board such as LM35 temperature sensor and pulse sensor. LM35 temperature sensor is attached to analog pin A0 of Arduino board. Pulse sensor is attached to analog pin A1 of Arduino board. The Arduino board is programmed in such a way that first the body temperature readings are taken from patient. Similarly at the same time, pulse sensor readings are taken from pulse sensor. The readings taken are beats per minute. After taking both of these readings, these readings are displayed on a 128x64 OLED display. Simultaneously these readings are sent over LoRa module through packets in string format. Readings are taken consequently after 10 seconds but this frequency can be changed according to the need.

2. NodeMCU (ESP8266)

Ra module (SX1278) is interfaced with NodeMCU which receives the packets sent through the LoRa module attached to Arduino board. This LoRa module receives the readings sent through Arduino board. This received readings are displayed on the 128x64 OLED display interfaced with NodeMCU in real time. Also this readings are transmitted to automated spreadsheet by google. In this spreadsheet first column is date which is automated through apps script by google. Second column is timestamp where sheet can note the timestamp at what the readings were taken. This column is also automated. Third column is body temperature where all the readings taken from LM35 temperature sensors are stored . Last column is pulse sensor Beats per minute (BPM) readings where all the readings received from pulse sensor are stored. All these columns are updated automatically once the readings are received on the NodeMCU board. Thanks to google's apps script which updates readings automatically on spreadsheet. This script is deployed as an web application whose permissions are set such as anyone can update the script with the help of URL which is generated through the apps script. Here google spreadsheet acts as cloud to store information of readings. These readings can be accessed through the URL on any browser or mobile application. One of the main advantage of google spreadsheet is that readings get updated in real time and other advantage is its accessibility. Anyone with google account can access the readings if accessibility of spreadsheet is set to everyone. Also all this readings can be exported to a excel sheet with the help of spreadsheet. Following we can see system architecture of our IOT System.

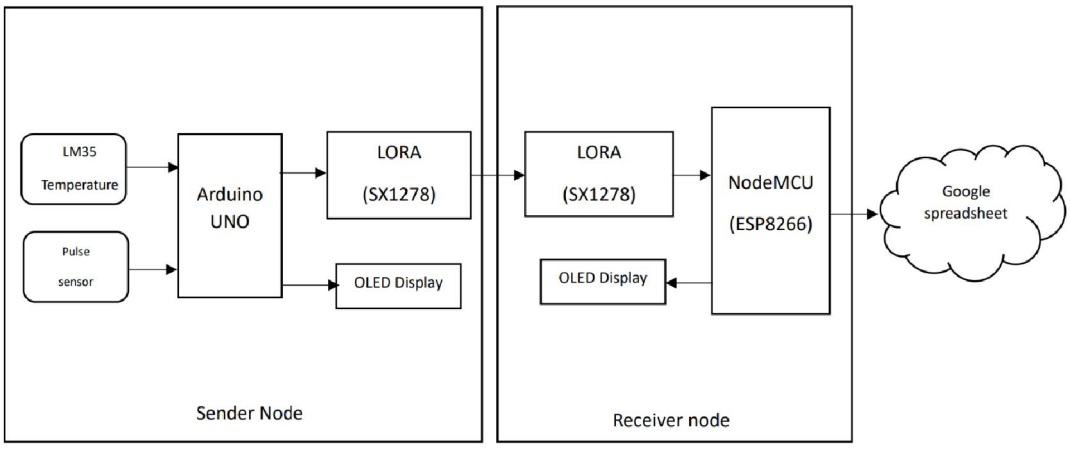

Fig. 1. System Architecture

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VI. WORKFLOW

Step 1 – Set up Arduino board
Making pin connections of both sensors,display and LoRa module according to requirements of system.

Step 2 – Programming Arduino board
Installing Arduino IDE for uploading programs on Arduino board. Program the Arduino board such that it takes readings from temperature sensor and pulse sensor and display readings on OLED display. At the same time, transmit these readings through the LoRa module attached to the board.

Step 3 -- Setting up NodeMCU Board
Interfacing LoRa module and OLED Display with NodeMCU board and setting up pin connections according to the reqirement.

Step 4 – Programming NodeMCU board
Programming the NodeMCU Board such that it receives readings from Arduino board and displays it on OLED display. Also connect this this board Wifi to make a HTTPS GET request for execution of an URL for posting this readingson web based service called google spreadsheet.

Step 5 – Set up google spreadsheet
Set up google spreadsheet such that it takes readings from NodeMCU board and display it on the sheet with date and timestamp. Program the spreadsheet with the help of apps script by google so that it automatically update the readings on the spreadsheet.

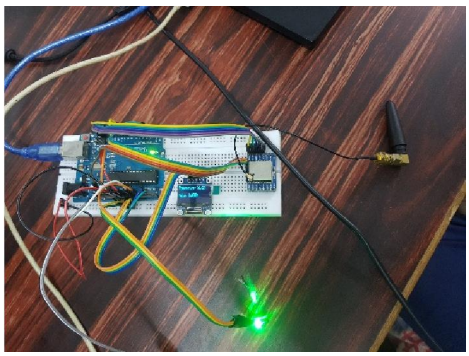

Fig. 2. Sender Node

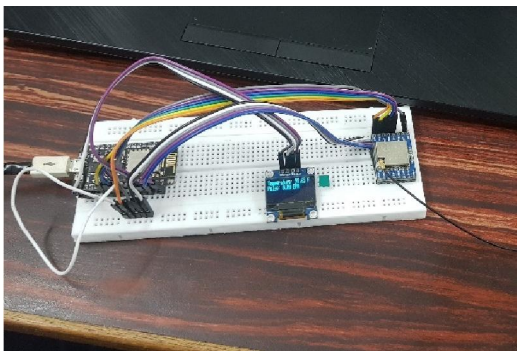

Fig. 3. Receiver Node

Readings
File Edit View Insert Format Data Tools Extensions Help

	A	B	C	D
1	Date	Time	Temperature	Heartrate
2	06/05/2023	23:18:08	96	89
3	06/05/2023	23:20:13	96	83
4	07/05/2023	23:22:43	98	82.9
5	07/05/2023	23:24:29	98	85.7
6	14/05/2023	11:12:31	96	87.9
7	14/05/2023	11:20:47	96	87
8	15/05/2023	19:18:22	97.6	87.2
9	15/05/2023	19:18:27	96.62	85.4
10	18/05/2023	01:41:23	96.62	84.93
11	18/05/2023	01:50:33	96.62	85.5
12	18/05/2023	01:50:43	96.67	83.38
13	18/05/2023	01:50:54	97.6	82.29
14	18/05/2023	01:51:02	97.58	85.12
15	18/05/2023	01:51:13	97.65	83.6
16	18/05/2023	01:51:29	97.6	84.31
17	18/05/2023	01:51:36	97.65	83.96
18	18/05/2023	01:51:45	97.6	84.31
19	18/05/2023	01:51:53	97.65	85.33
20	18/05/2023	01:52:04	97.62	87.82
21	18/05/2023	01:52:13	97.65	85.29

Fig. 4. Spreadsheet

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VII. CONCLUSION AND FUTURE SCOPE

There are many lives that are affected due to lack of proper treatment on time. This device helps tracking medical information in real time and can help patients in emergency medical conditions.Also this medical information is stored in proper web based service so that the information can be managed and accessed anytime. Also in future there are various advancements pending on the system such as various medical sensors are yet to be attached on the system. One emergency switch is to be attached to attached at sender node so that if patient needs any emergency. Also many more software side implementation such as disease prediction based on medical readings and many more advancements are to be implemented in the future. These advancements will help in wide range of patients in rural areas or remote areas where there are limited medical facilities. Also safety is one of the important parameters hence the current system is secure enough but in safety, privacy users private data will be secured and maintained properly throughout the operation of the system.

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