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IOT Based Health Monitoring System

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Abstract: *The health monitoring system has become popular these days due to uniqueness and diversified usage in the medical field. Everyday many lives are affected because the diseases are not timely and properly diagnosed so we didn't get a chance to provide medical help. To deal with these types of situations, this system will help to monitor a patient's certain parameters and predict the patient's condition from time to time. This system is user friendly and reduces the human efforts. This system puts forward a wise patient health monitoring system that uses sensors to trace patient health and uses internet to intimate their loved ones or concerned doctors in case of any emergency. The controller is additionally connected with a buzzer to alert the caretaker regarding variation in detector output. The sensors are connected to a microcontroller to trace the status of the patient which in turn is interfaced with LCD display furthermore as wireless local area network association so as to transmit alerts. If the system detects any changes in patient pulse rate or BP, the system automatically sends an alert to the doctor regarding the patient status over IoT and additionally shows the details of heartbeat, BP and temperature of patient, live over the cloud. So IoT based patient health monitoring system effectively uses internet to watch patient health status and save lives on time. For this reason, fast conditional medication may be simply done by this technique. This system is easy to setup and is capable of high performance and time to time response.*

Keywords: Internet of Things, Embedded System, Patient Health Monitoring, Sensors, Microcontroller

I. INTRODUCTION

Internet of Things (IOT) based smart health monitoring system will help to measure various health-related parameters like body temperature, pulse, Humidity etc. which will help to predict diseases. System will consist of an website which will help to monitor patient's health and also data can be shared with a particular doctor if required by URL. This system can be implemented at our home or old age homes to keep the track of an individual's health also for the daily health check-up of people working at electricity boards and public transport at the time of reporting or exit. This system can also be helpful to monitor the health of mine workers and people working at the merchant navy and to monitor the patients in the hospital who are kept under observation in the hardware part PCB package is used to develop a compact system, sensors for measuring health-related parameters like temperature, heart rate, Humidity. This system is specially designed for heart patients and senior citizens who cannot go for regular health check-ups. data from sensors will be further sent to the Cloud server using the machine learning algorithm that will predict different diseases considering those measured parameters.

Today internet has become one among the vital components of our daily life. It is modified to methodologies how individuals live, work, play and learn. Internet serves as a tool for several purposes like education, finance, business, industries, recreation, social networking, shopping and etc. Future new mega trend of internet is IoT. Visualising a world wherever several objects will sense, communicate and share data over a personal net protocol or public networks can be done through IoT. The interconnected objects collect the data at regular intervals, analyse and initiate needed action, providing associate intelligent networks for analysing, designing and decision making [1]. This is the world of Internet of Things. IoT is mostly thought about as connecting object to the internet and victimisation that affiliates for management of these objects or remote watching. But definition of IoT is creating a brilliant invisible network which may be detected, controlled and programmed [3]. The products developed based on IoT include embedded technology that permits them to exchange information, with one another or the internet and it is assessed that 8-50 billion devices are connected by 2020. Since these devices come online, they provide better life style, create safer and more engaged communities and revolutionised healthcare. In low and middle economical gain countries, there is more and more growing range of individuals

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with persistent diseases because of totally different risk factors like nutrient imbalance and physical inactivity. According to WHO report, 4.9million individuals die from carcinoma from the consumption of snuff, over weight a pair of 2.6million, 4.4million for increased cholesterol and 7.1million for high pressure[1]. Chronic diseases are extremely variable in their symptom, evolution and treatment. Some, if not monitored and treated early, will end the patient's life. For several years the standard measure of Temp, pressure level and heart beat was calculated in specialised health centres. Due to the technological development, there is a great variety of running sensors giving important signs such as blood pressure cuff, glucometer and pulse monitor together with electrocardiogram, which permits the patient to take their vital signs daily. The readings taken daily are sent to doctors and enable them to suggest the medicine and physical exercise routine that enable them to improve the quality of life and overcome such disease. Internet of Things applied to the care and watching of patients is more and more common within the health sector, seeking to boost the standard of life of individuals. The Arduino is a programmable device that can sense and interact with its environment. The combination of Internet of Thing with Arduino is the new approach of introducing IoT in healthcare monitoring system of patient. The entire concept of IoT stands on sensor, gateway and wireless network that modify user to communicate and access the information. IoT offer more guarantee within the health awareness. As a saying goes "Health is wealth" it's exponentially crucial to form utilisation of innovation for better well-being[4]. Microcontroller collects the information from the sensor and transfers it to the IoT website.

II. LITERATURE SURVEY

A number of reviews were done in the past as part of research papers/technical reports on iot based Health Monitoring System.

(1) First System Here, researcher designed health monitoring system using ATmega8 microcontroller with Wireless Body Area Sensor Network (WBASN). In this work, the sensors which are used here are Temperature sensor, Blood pressure sensor, Heart beat sensor. These sensors are placed on the human body which helps to monitor the health condition without disturbing the daily schedule of the patient and these health-related parameters are then forwarded to physician's server using long range wireless technology GSM. Health monitoring system consists of sensors, microcontroller, LCD display and GSM modem to transmit or receive health related data to or from the doctor. Similarly, at the hospital the same GSM modem is used. Hence, GSM modem helps in the establishment of a network between patient's server and doctor's server. LCD (Liquid Crystal Display) display is provided to show the instant result to the patient. Here researcher used LM34 as temperature sensor, IR LED and red LED is used for heart rate monitoring and Pressure transducer or the sensor based on piezo-electrical material is used to measure the systolic BP and diastolic BP. Microcontroller reads data as given by the temperature sensor, blood pressure sensor and heart rate sensor and processing it gives the output in the form of digital and it gets directly displayed on LCD or it gets transmitted to the doctor's server through GSM modem. This system gives exact and instant results with high accuracy which gets directly displayed on LCD. It takes max 4-5 sec to monitor the doctor's server using GSM wireless technology. This system takes a small amount of time to know the health condition of the patient and then delivers the report to the doctor.

(2) Second System using the same system, health parameters are sended by using RFID reader, Bluetooth, GSM and UMTS. This system gives facility to monitor the blood pressure of patients. The health parameter directly sends to the doctor using GSM and UTMS. Here, a video guide is used. This video guide feature serves the patients age and his blood pressure correctly. This system consists of three parts: Touchpad, remote server and reading of the Tag ID and BPM. For reading the Tag ID and BPM, use a microcontroller unit (MCU) as a kernel. The client touchpad receives the blood pressure measurement (BPM) data of a RFID through Bluetooth. Client touchpad sends the data to the health parameter. Also, these health parameters are directly sent to remote data centers and remote data centers to the doctor using GSM and UMTS wireless technology. Data gets transmitted in the form of the packets. This system helps to store previous data. Similarly, it takes less time to monitor the blood pressure of the patient.

(3) Third System shows the blood pressure monitoring system using microcontroller. This system includes a motor control unit, Microcontroller ATmega328, LCD display. The pressure sensor is directly connected to the cuff, which is inflated or deflated via a motor and valve. ON and OFF switches of the motor are controlled by the microcontroller at the correct time. Due to changes in the ON and OFF switches of the motor, the wrist cuff gets inflated and deflated, this pressure is measured by the pressure sensor. Pressure sensor generates the health parameter in the analog sensor. The processing of analog sensors is done with the help of the microcontroller and gives digital output which is displayed on the LCD or on the personal

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computer using RS232. Magneto resistive RAM (MRAM) stores the value of systolic and diastolic blood pressure and is directly connected to the microcontroller. Similarly, there is no need to pump the cuff by hand, all the system is controlled by the microcontroller. It is not required to calculate or observe blood pressure manually. Time consumption is very less compared to the old system.

Ananda Mohan Ghosh et al. [4] has proposed a health monitoring system for managing the hospital to allow family members and consultant doctors to remotely monitoring the patient's health condition through the internet with E-health sensor shield kit interface kit. But it does not send any notification such as email and SMS alert to the respective family members and doctors.

P Kumar et al. [5] has proposed a patient monitoring healthcare system which is controlled by a raspberry pi such as the heartbeat rate, respiration level, and temperature and body movement of the patient is monitored and data is collected by using sensors and displayed it on the screen using the putty software. However, it does not provide the alarm notification for insisting the family members or doctors give the prescribed drugs to the patient which is included in our proposed solution.

Sarfraz Fayaz Khan [6] has demonstrated a useful patient's healthcare monitoring system with the help of IoT and RFID tags. But it does not contain preventive measures concerning the patient health condition by controlling the appliances and providing the prescribed drugs to the patient which is included in our paper.

Freddy Jimenez et al. [7] have considered only on monitoring the patient's health condition and sending the necessary information and notification to doctors, family members. Moreover, it does not contain the appliance control, which is included in our project; it only focused on Monitoring and provides notification to the respective people on time.

III. PROPOSED SYSTEM

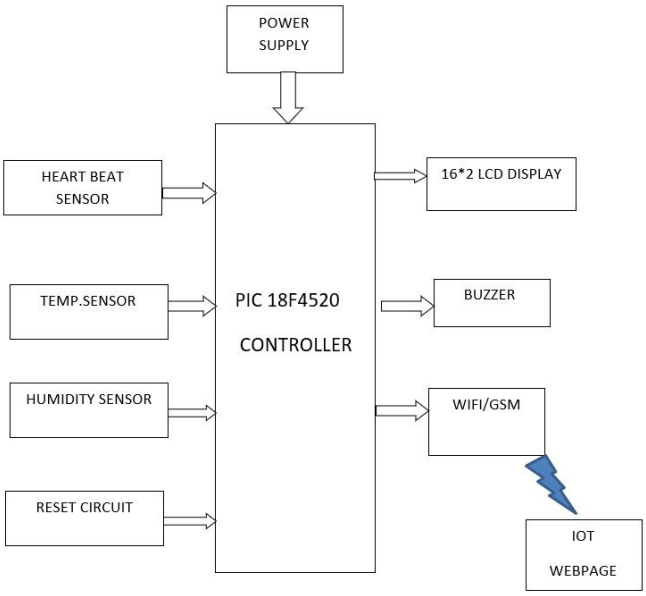

Figure 1: Block Diagram

The IoT plays a major role in the automation process. The system which we prefer to develop would not only help in monitoring the health of the patient when he is in bed but also when he is out of bed. The main idea of the system is to transmit the information through the webpage to continuous monitoring of the patient over internet. Such a system would continually detect the important body parameters like temperature, pulse rate and would compare it against predetermined range set and if these values cross the specific limit, it would immediately alert the doctor. In this system microcontroller is used to transmit the data. It is connected to IoT which provides information to doctor or caretaker. The data of the patient's health is stored in the cloud. The doctor can easily access the patient's health anytime from anywhere. An LCD and buzzer is also connected to the microcontroller for the patients to view their health status live. In case of emergency, it would

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automatically alert the doctor and relative of the patient via SMS. In such case the patient will get rapid medical help and also would save time and energy of the relatives, who cannot be near the patient all the time.

3.1 PIC 18f4520 Microcontroller

1. Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF
2. Divided into 256-byte banks
3. There are total of F banks
4. Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bits
5. Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
6. Program memory stores the program and also static data in the system.
7. On-chip External
8. On-chip program memory is either PROM or EEPROM.
9. The PROM version is called OTP (one-time programmable) (PIC18C) The EEPROM version is called Flash memory (PIC18F).
10. Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000

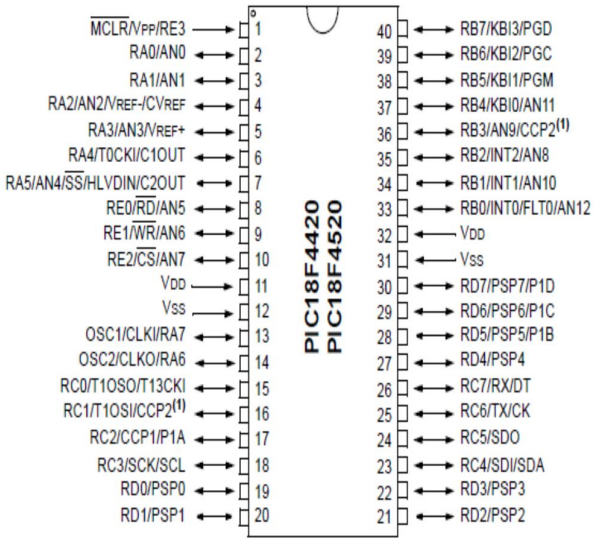

Figure 1: PIC16f690

3.2 Humidity Sensor

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low-cost humidity and temperature sensor which provides high reliability and long-term stability. uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and outputs a digital signal on the data pin (no analog input pins needed).

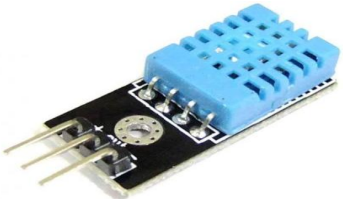

Figure 3: Humidity Sensor

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It's very simple to use, and libraries and sample codes are available for Arduino and Raspberry Pi. This module makes is easy to connect the DHT11 sensor to an Arduino or microcontroller as includes the pull up resistor required to use the sensor. Only three connections are required to be made to use the sensor - Vcc, Gnd and Output.It has high reliability and excellent long-term stability, thanks to the exclusive digital signal acquisition technique and temperature & humidity sensing technology.

3.3 GSM Module (SIM800)

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

A. Features of SIM800A

- Bands: GSM 850MHz, EGSM 900MHz, DCS 1800MHz, PCS 1900MHz
- GPRS class 2/10
- Control via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT command set)
- Supply voltage 3.4-4.4V
- Coding schemes: CS-1, CS-2, CS-3, CS-4 Tx power: Class 4 (2W), Class 1 (1W)
- Small package: 23 * 23 * 3mm
- Low power: down to 1mA in sleep mode.

Figure 4: GSM Module

3.4 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

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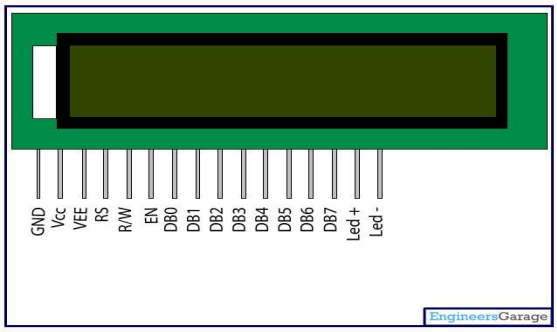

Figure 5: LCD Display

3.5 Heart Beat Sensor

The Green Easy Pulse Sensor Heart Beat Sensor HRM2511E is a DIY pulse sensor that is designed for hobbyists and educational applications, It is used to illustrate the principle of phot plethysmography (PPG), PPG is a non-invasive technique for detecting the cardio-vascular pulse wave from a fingertip. The Easy Pulse Sensor uses a transmission mode PPG probe (HRM-2511E) sensor.

This Sensor uses an infrared light source to illuminate the finger on one side, and On the other side of the sensor there is a photodetector that measures small variations in the transmitted light intensity due to changes in blood volume inside the tissue.

- The onboard components & instrumentation provide a clean and filtered analog PPG waveform.
- The on-board LED also indicates the digital pulse output.
- The analog and digital signals are both synchronous with the heartbeat.

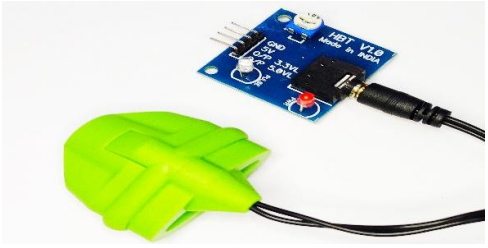

Figure 5: Heart Beat sensor

3.6 Temp Sensor

Outputs 10mV per Degree that can also be read directly on mustimeter or read in to microcontroller. For example, at 30-degree celcius it will output 300mV at linear scale. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35D is rated to operate over a 0° to +100°C temperature range.

3.7 IOT

Internet of Things (IoT) is a network of physical objects or people called “things” that are embedded with software, electronics, network, and sensors that allows these objects to collect and exchange data. The goal of IoT is to extend to internet connectivity from standard devices like computer, mobile, tablet to relatively dumb devices like a toaster. IoT makes virtually everything “smart,” by improving aspects of our life with the power of data collection, AI algorithm, and networks.

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The thing in IoT can also be a person with a diabetes monitor implant, an animal with tracking devices, etc ThingSpeak is IoT Cloud platform where you can send sensor data to the cloud. You can also analyze and visualize your data with MATLAB or other software, including making your own applications. The ThingSpeak service is operated by MathWorks. In order to sign up for ThingSpeak, you must create a new MathWorks Account or log in to your existing MathWorks Account.

IV. CONCLUSION

With the wide use of internet, this work is concentrated to execute the internet technology to establish a system which would communicate through internet for better health. Internet of Things rules the whole world in various fields, mainly in health care sectors. Hence the present work is done to design an Internet of Things based smart patient health tracking system using an PIC16F690 microcontroller. In this, pulse rate sensor is used to detect the heart beat and temperature sensor to read the temperature and sends the data to the cloud using internet. This information is also sent to the LCD display, so patient can easily know their health status. During critical situations to alert the doctor, the warning message is sent to the doctor's phone and at the same time buzzer turns to alert the care taker. The doctor can view the sent data by logging the specific website or IP address. Hence continuous patient monitoring system is designed.

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