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Robotic Patient Monitoring and Medicine Delivery

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***Abstract* – In this project, I propose a robot with some functionality of providing medicine as well as to measure the vital parameters (Heart rate,Blood Pressure, Temperature) of the patient. We can attain the locomotion procedure of the robot using the principle of Radio-frequency identification (RFID) that automatically identifies and tracks tags attached to the objects. The movement and finding the path to patient location is done through a line follower and with RFID tag. Line following method is used to identify the path with help of two infrared sensors. The robot will move towards the patient's room by following a non-reflective line and use RFID cards to identify the patient's room number. Using the Medicine box, the medicine delivery is made possible to the patients. Relevant box will be open based on the RFID reader. All the measured parameters will be stored to the cloud using the application of the Internet of Thinking (IOT).If the read values varied from threshold, then an alert message will be sent to doctors through GSM Module.**

***Keywords* – Medicine delivery, IoT, Healthcare, RFID, Data**

I. INTRODUCTION

In recent years, the healthcare industry has shown rapid growth and has been a major contributor to revenue and employment. A few years ago, the diagnosis of diseases and abnormality in the human body was only being possible after having a physical analysis in the hospital. Most of the patients had to stay in the hospital throughout their treatment period. This resulted in an increased healthcare cost and also strained the healthcare facility at rural and remote locations. The technological advancement that has been achieved through these years has now allowed the diagnosis of various diseases and health monitoring using miniaturized devices like smartwatches. The use of such communication services in conjunction with the rapidly growing technologies (e.g., machine learning, big data analysis, Internet of things (IoT), wireless sensing, mobile computing, and cloud computing) has improved the accessibility of the healthcare facilities.

IoT has not only enhanced the independence but also diversified the ability of the human to interact with the external environment. IoT, with help of futuristic protocol and algorithms, became a major contributor to global communication. It connects a large number of devices, wireless sensors, home appliances, and electronic devices to the Internet. The IoT devices have been integrated with other physical devices to monitor and exchange information using different communication protocols such as Bluetooth, Zigbee,and so on.Additionally, environmental information such as temperature, humidity, date, and time can also be recorded. These data help in making meaningful and precise inferences on the health conditions of the patients.

The framework of the IoT that is applied for healthcare applications aids to integrate the advantages of IoT technology and cloud computing with the field of medicine. It also lays out the protocols for the transmission of the patient's data from numerous sensors and medical devices to a given healthcare network. The topology of an H-IoT is the arrangement of different components of an IoT healthcare system/network that are coherently connected in a healthcare environment. A basic system contains mainly three components such as publisher, broker, and subscriber. The publisher represents a network of connected sensors and other medical devices that may work individually or simultaneously to record the patient's vital information.Since the topology for an depends on the healthcare demand and application, it is hard to suggest a universal structure for IoT. Numerous structural changes have been adopted in the past for an IoT system. It is crucial to list out all associated activities related to the desired health application while designing a new IoT-based healthcare system for real-time patient monitoring. The success of the IoT system depends on how it is satisfying the requirements of healthcare providers. Since each disease needs a complex procedure of healthcare activities, the topology must follow the medical rules and steps in the diagnosis procedure.

II. LITERATURE SURVEY

The synchronization between IoT and robotics, It talks about the technologies in IoT that would benefit the robotics domain. The advent of Cloud Robotics and its role in aiding robot functions like sensing, manipulation, and mobility.IoT-aided robotic applications are discussed in various domains like health-care, military, industrial plants and rescue operations. This concludes by

considering the use case of an Intelligent Transportation System endowed by an IoT-inspired architecture.The introduction of Robots and IoT made the industries and firms fully smart automated and digitalize [1]. In other perspective, robots were also serving medical sectors since many years successfully in heart surgeries, fighting cancer cells etc. and making the footprints for further research and developments. An attempt is made to highlight the methods and applications of Robots & IoT in large extent in medical and societal areas to safeguard from corona virus [2].The path to a mature development of IoT-aided robotics applications requires several pivotal issues to be solved, design methodologies to be consolidated, and strong architectural choices to be discussed, In particular, the present contribution is four-folded. First, it provides a solid state of the art on the main topics related to IoT-aided robotics services: communication networks, robotics applications in distributed and pervasive environments, semantic-oriented approaches to consensus, and network security [3]. In this paper, an idea to improve the current status of health care worldwide through automation and robotics has been propounded. Health Care & proper monitoring is the most integral part of medication as it is the recovery stage of the patient [4].

The comprehensive requirements for updating the healthcare system, this presents a novel system framework and designed a IoT robot which based on cloud technology and Internet of Things. The system based on multi-core embedded system,communication protocol, and cloud technology [5].The experimental results show that the well performance and feasibility of the system.The study in recent advancements in technology and the availability of the Internet make it possible to connect various devices that can communicate with each other and share data. It discusses a new semantic model for patients' e-Health. The model named as makes use of layers; the sensor layer, the network layer, the Internet layer and the services layer. All layers cooperate with each other effectively and efficiently to provide a platform for accessing patients' health data using smart phones [6].

The paper presents [7], finding the path using line following method which identifies the track with the help of two infrared proximity sensor and using cards identifies the room number of the patient. It can also monitor the pressure and temperature levels of the patient and record it in the hospital patient database by incorporating a pressure and temperature sensor in it which is an added advantage in this model. This shows that it provide stable and reliable system and keeps the manufacturing cost low.The performance analysis of scheduling multiple robots for hospital logistics. A fleet of autonomous mobile robots are used in the hospital for the delivery service [8]. To increase the efficiency of using multiple robots, an appropriate task allocation algorithm is required. The indoor service robot which has the capabilities to follow human commands and handle emergency is designed and implemented. A location algorithm of the robot based on the wireless sensor network is proposed. Stability of the proposed home monitoring system in longtime monitoring tasks is tested [9].Automatically classifying affective and informative. Various websites today provide medical information and this information can either be affective or informative, contains information which are facts and information which are opinions from a fellow patient, doctor or nurse who try to analyze the given query and give an opinion [10].

III. PROJECT DESCRIPTION

The robot delivers the medicine to the patient and checks the important parameters of the patient such as temperature, heart rate, SpO2 and blood pressure without the involvement of humans or by avoiding the direct contact of hospital staff with the patients. By using the reference parameters which are given to the system, will compare with the measured parameters. Then the recorded parameters data will be sent to the doctors through the IOT platform. The movement and finding the path to patient location is done through a line follower and with RFID tag. The medical staff will be aware if there is abnormality, through alert message using GSM module.

1.Block Diagram:

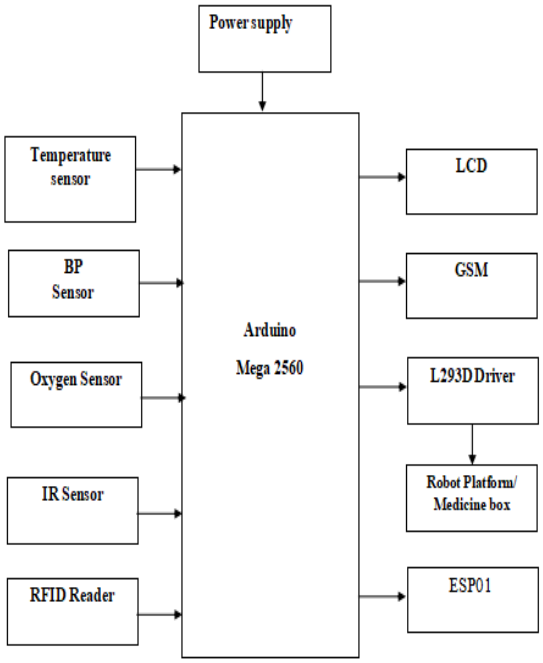

Fig.1. Block Diagram

2. System Architecture:

The project consists of an Arduino mega 2560 as the central part. All the other peripherals for the delivering and parameter measurements are connected to this

Arduino mega. The temperature sensor, blood pressure sensor and heart and SpO2 sensors are connected for parameter measurement. For obstacle detection, obstacle sensor IR is used. RFID reader for the path recognition, node MCU and GSM module for the transferring of measured parameters value are connected. Motor drivers are connected for the locomotion and vending purpose namely double BTS 7960 and L293D. The power supply and medicine box provided for the robot functioning.

3. Flow Chart:

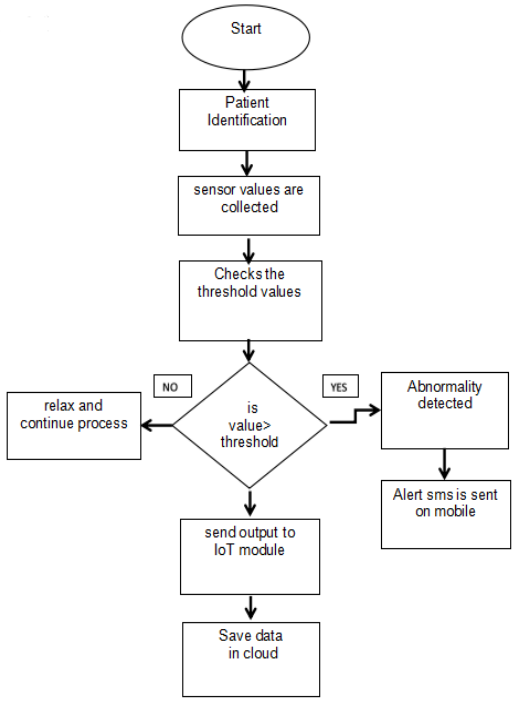

Fig.2. Flow Chart

The robot starts to move by the line follower in that we use the IR transmitter and receiver. The robot moves by a 12 volt dc motor and it is controlled by the Double BTS7960 motor driver.The line following robot follows a line and it can detect this coloured line with the help of IR proximity sensors and send signals to Arduino Mega. This IR sensor works like a diode, it consists of a transmitter and receiver. The transmitter transmits the light and the receiver receives it. When the robot changes position from the line the transmitted light is not received by the receiver. Then the motor will stop. In that condition while the receiver is not receiving then the motor moves two steps to right or to left to get back to the line while when the receiver receives the light then again moves. The 775 DC motors are driven by the double BTS 7960 motor driver.

When it reaches in front of the patient room RFID is detected. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.When the room opens the robot will move inside the room and reach near to the patient bed. First medicine vending occurs. This is done by the dc motor with motor driver l293d. The medicine falls into a box placed,then vending motor stop and vending also stops.

After Delay, the process of vital patient monitoring starts. The parameters monitoring are temperature, Blood pressure, heart rate and SpO2. The temperature is measured using LM35 temperature sensor and digital blood pressure sensor is used to measure pressure. MAX30100 sensor module is used to measure both heart rate and SpO2. The three parameters temperature, SpO2 and heart rate is measured. After this, small delay reading of the blood pressure is taken. All the values read are sent to IOT Module which is a Microcontroller having an inbuilt WiFi driver. It is configured with local WiFi. An IP address is provided and the patient ID and parameters are uploaded to this address. In IOT Module the receiver also has this ID and it checks the ID and compares. After comparing if the ID matches the read parameters are stored and upload it in the cloud. The read values are compared using a threshold and if the value varies from threshold a message is sent to the doctor through the GSM module. After the process, the robot will get back to the Main floor and move forward to the next room.After completing all rooms, the robot gets back to the staffing room.

IV. DESIGN AND IMPLEMENTATION

The proposed Patient monitoring and Medicine delivery system consists of following components Microcontroller, Sensors, IoT Module &GSM

1. Arduino MEGA 2560:

The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for robotics projects. This gives your projects plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform. This document explains how to connect your Mega2560 board to the computer and upload your first sketch.

The Arduino Mega is a Microcontroller board based on the ATmega1280 (data sheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UART (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the Microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

Fig.3. Arduino MEGA 2560

Features:
1. Microcontroller- ATmega1280
2. Operating Voltage 5V
3. Input Voltage 7-12V
4. Digital I/O Pins 54 (of which 15 provide PWM output)
5. Analog Input Pins 16
6. Flash Memory 128 KB of which 4 KB used by boot loader
7. Clock Speed16 MHz
8. 1 USB port and power adapter

2. Driver Circuit (L293D)

L293D IC generally comes as a standard 16-pin DIP (dual-in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 Microcontroller pins (if you do not use enable pins) It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

In a single l293d chip there two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch

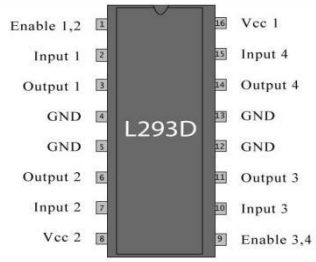

Fig.4. Driver CircuitL293D.

3. Temperature Sensor

Temperature is the most-measured process variable in industrial automation.Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications. A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of environmental temperature

Features:
1. Calibrated directly in Celsius (centigrade)
2. 0.50 C Ensured accuracy (at +250 C)
3. Suitable for remote applications
4. Operate from 4 to 30 V

4. SPO2 SENSOR

Pulse oximeter is a simple, relatively cheap and non-invasive technique to monitor oxygenation. It monitors the percentage of haemoglobin that is oxygen-saturated. Oxygen saturation should always be above 95%, although in those with long-standing respiratory disease or antibiotic congenital heart disease, it may be lower, corresponding to disease severity. The Oxyhaemoglobin dissociation curve becomes sharply steep below about 90%, reflecting the more rapid desaturation that occurs with diminishing oxygen partial pressure PaO2 .
On most machines the default low oxygen saturation alarm setting is 90%.Pulse oximeter does not provide information on the oxygen content of the blood or on ventilation. Thus care is needed in the presence of anaemia and in patients developing respiratory failure due to carbon dioxide retention, for example.

5.RFID Reader and Tag

The reader, functions similarly to a bar-code scanner; however, while a bar-code scanner uses a laser beam to scan the bar-code, an RFID scanner uses electromagnetic waves. To transmit these waves, the scanner uses an antenna that transmits a signal, communicating with the tags antenna. The tags antenna receives data from the scanner and transmits its particular chip information to the scanner The data on the chip is usually stored in one of two types of memory. The most common is Read-Only Memory (ROM); as its name suggests, read-only memory cannot be altered once programmed onto the chip during the manufacturing process. The second type of memory is Read/Write Memory; though it is also programmed during the manufacturing process, it can later be altered by certain devices RFID tag is a small device which stores and sends data to RFID reader. They are categorized in two types – active tag and passive tag. Active tags are those which contain an internal battery and do not require

power from the reader. Typically active tags have a longer distance range than passive tags. Passive tags are smaller and lighter in size than the active tags. They do not contain an internal battery and thus depend on RFID reader for operating power and certainly have a low range limited up to few meters.

6.ESP01

ESP01 is the name of an infamous WiFi module that is a system on a chip (SoC) developed by Espressif Systems, a company based in Shanghai. Originally used with Arduino boards to WiFi-enable hardware projects, it soon became a cheap standalone Arduino-compatible development board. It can function in complete autonomy, without an additional Microcontroller like Arduino board for example. This MCU(Microcontroller unit) can be used to control and monitor engineered systems and products, sensor data logging and more. All of this makes it the perfect piece of hardware for connected home automation projects. It comes in many shapes and forms, with the NodeMCU (with the newest ESP01-E12 chip) being the most popular development board among them.

Fig.5.ESP01

7.GSM Module

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

V. SOFTWARE IMPLEMENTATION

1. Arduino IDE:

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

Sketching is a common term for writing a programme or piece of code in the Arduino IDE. To upload the sketch created in the Arduino IDE software, we must connect the Arduino board with the IDE. The sketch has the ". ino" file extension.

VI. RESULTS AND DISCUSSION

The features mainly the robot movement, medicine vending and patient parameter monitoring by simulating the operations.An attachment of a containing temperature, pulse rate and blood pressure sensors on platform measure the respective parameters. All this data is send or transmitted to the monitoring desk through IoT for data. The read values are compared using a threshold and if the value varies from threshold a message is sent to the doctor through the GSM module.

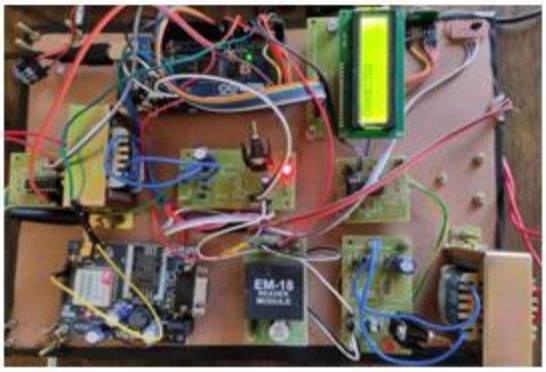

Fig 6 Interface of all modules

Fig 7 Robot Movement

Fig 8Patients identification

Fig 9Patient Temperature Parameter

Fig 10 Patient BP Parameter

Fig. 11Patient Oxygen levels

The read values are compared using a threshold and if the value varies from threshold a message is sent to the doctor through the GSM module.Which will help to get immediate attention to the patient.

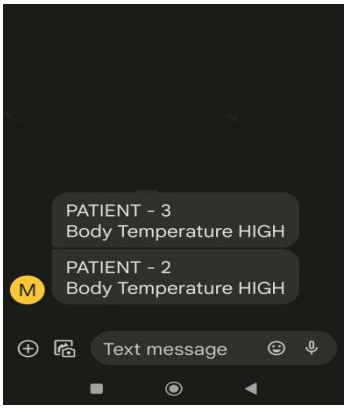

Fig 12 Alert send through GSM module

VII. CONCLUSION

IOT is a combination of various technologies that empower a diverse range of appliances, devices and objects to interact and communicate with each other using different networking technologies. The Internet of Things has made the lives of the human being straightforward and comfortable. It has made the lives of the people very convenient.Whereas on the other hand with the increased use of the Internet of Things the treat for security and safety has also increase. So we should be careful while providing the details on the Internet platform. However, we can see a lot of necessary steps are being taken but still keeping your data safe with you is essential.So far, much of the information found on the Internet is supplied by human beings. In case of IOT smart objects provide the information. There exist a wide variety of applications based on IOT, including healthcare, which is the primary focus of this work. Healthcare systems makes use of interconnected smart devices to establish an IOT network for healthcare analysis, patient monitoring and automatically identifying situations where a physician involvement is needed.This research helps to reduce human to human contact in hospitals and thus prevents the doctors and medical staff from getting affected by Corona virus. The time of both patients and doctors is saved.

VIII. FUTURE WORK

Future we can have an intelligent system which could perform problem solving tasks such as diagnosing the patient in the doctor's absence and if anything suspicious is detected it would provide required solution. The robot can be so designed that it can monitor as many patients admitted to the particular ward. The database of the hospital can be linked with robot to track and register the entry and exit of patients. Robotics, the medicinal robotics market is going to increase exponentially in the coming years. There is a steep rise in the production and development of mobile medicinal as well as service robots and one of the major reasons is the corona virus outbreak. Robots like can be supported with Artificial Intelligence and computer vision so that they can cater to the patients in a more sensitive way. Voice recognition system including text to speech and speech to text could be implemented and the ability to talk to patients, make phone calls to their knows over the internet could be made possible by making them smart by connecting it to the internet and cloud

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