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IoT-Based Smart ICU for Intensive Care

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Abstract:*Intensive Care Unit or ICU is where the patients who are critically ill and admitted for treatment. For such critical conditions the Doctors need to have an all-time update patient's health related parameters like their blood pressure, heart pulse, temperature Asthma, Environment and saline is full or not. Doing manually is too tedious a task and also for multiple patients it becomes close to impossible. For this type of situations this IoT based system can bring about an automation that can keep the doctors updated all time over the network. IoT Based ICU Monitoring System is an Arduino based system which collects patients' information with the help of few sensors. The sensors which are networked, either worn on the patient's body or embedded in our living environments, change the gathering of data inductive of our physical and psychological state. Internet of Things (IoT) based smart health monitoring system is a patient monitoring system in which a patient can be monitored 24 hours. In the present world, Health monitoring systems are one of the most notable applications of IoT. In ICU, patient monitoring is critical and most important activity, as small delay in decision related to patients' treatment may cause permanent disability or even death. We are proposing IOT based system, which can help to fast communication and identifying emergency and initiate communication with doctors and also helps to initiate proactive and quick treatment.*

Keywords: Pulse-Sensor, Temperature-sensor, Arduino Uno, Load Cell, Buzzer, Button.

I. INTRODUCTION

The rapid development of Internet of things (IoT) technology makes it possible for connecting various smart objects together through the Internet and providing more data interoperability methods for application purpose. Recent research shows more potential applications of IoT in information intensive industrial sectors such as healthcare services. IOT in healthcare is the key player in providing better medical facilities to the patients and facilitates the doctors and hospitals as well. Now, IoT is one of the buildings blocks that is considered to be used for developing smart system for healthcare services. "Objects" connected to the internet are highlighted to cross 20 billion in the upcoming smart Technology. Over a billion "smart products" connected to the internet, recently IoT is about networking of physical objects and these physical objects are embedded to exchange data in between the IoT components and sense surrounding environments in which they are operating. In environments like hospital and clean room, precise environment control is paramount in meeting your objectives of patient and product safety.

Medical field is the backbone of any country. Medical field technology places a big role when it comes to patient care. Technology is big when it comes to giving the patient the best type of quality care when they are in the hospital. In the old days doctors or nurses would just communicate with patient manually which causes mistakes. Now with the electronic health systems those mistakes are drastically declining. Statistics have shown that using the electronic health systems has lowered nursing mistakes as well as improved patient care. Electronic health care systems are changing rapidly the market is globalized, society is concerned with medical issues, missing of patient data from records, too much.

The work developed in this paper focuses on the study of the development of intelligent health care system. Health monitoring is the major problem in the today's world. Due to lack of proper health monitoring system, patient suffer from serious health issues. There are lots of IoT devices now a days to monitor the patient over internet. Health experts are also taking advantage of these smart devices to keep an eye on their patients in the hospital. In the papers are the patient's body and environment monitoring. The sensors attached to the patient's body (body monitoring) are the Pulse sensor, Temperature sensor and Load Cell.

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The sensors deployed in the patient's environment (environment monitoring) capture data from temperature, light, humidity, Saline, Heart Rate, in environments like hospital and clean room, precise environment control. IOT based ICU monitoring system which records the patient's heart beat rate, body temperature, blood pressure and also send an alert whenever those readings go beyond critical values.

II.LITERATURE SURVEY

1)Surya Deekshith Gupta et.al. Describes about the system design for Healthcare on IoT using Raspberry Pi. In this System, the combination of Raspberry Pi and GSM module are used to observe different ECG mechanisms which are monitored to know the type of cardiac illness by using python coding algorithms. The result of heart beat data is automatically updated in website database using MySQLdv module. Wi-Fi updates can also be accessed using USB 2.0 port which consists of an Ethernet port for network connection.

2)Emre Oner Tartan et.al. Demonstrates an android application for geo-location-based health monitoring consultancy using alarm system. It includes real time remote monitoring of heart rate, geo-location tracking of a patient, decision making for different alarm situations in the smart phones and providing consultancy modules with the health experts to get advice. The prototype framework is equipped with Arduino Uno board and a wireless transmission of sensor data (GPS sensor and pulse sensor) to the smart phone via Bluetooth HC-05module through USB cable. The internet connection over cellular networks is based on 3G / 4G wireless technologies.

3)Ahn et al. implemented a system for measuring the physiological signals in sitting position such as ECG and BCG by using a smart chair that senses the non-constrained bio-signals and can be monitored using a monitoring system such as the one they had developed providing a classic example of the application of IOT in healthcare.

4)Almotiri et al. proposed a system of m-health that uses mobile devices to collect real-time data from patients in and store it on network servers connected to internet enabling access only to a certain specific client. This data can be used for the medical diagnosis of patients and is achieved by using several wearable devices and body sensor network.

5)Banerjee et al. proposed a pulse rate detection system based on a noninvasive technique. The proposed system used plethysmography process and correspondingly displayed the output digitally that made it a real-time monitoring device. The method has proved as reliable for the patient compared to other invasive techniques.

III.PROPOSED SYSTEM

To develop an IOT based application to monitor patient in ICU. It is high-level that IoT -based ICU patient monitoring. This project describes about the modern health care system known as Smart ICU. It is an IOT technology along with sensors for health monitoring. Doctors and the nurses have to attend different patients every day, so they won't be able to concentrate on one patient throughout the day. During this period the patient in the ICU might get critical and because of the medical personas absence the patient might die too. So, to overcome such cases the Smart ICU comes handy. It will show all the patient's parameters and the doctor can check it from anywhere. With this technology being adapted the doctors will be at ease and so the communication problem with the doctor and the patient will also be solved. The doctor will be able to track the patients anytime and from the hospital.

Features:

1)Saves time
2)Easy to Access
3)Improve Efficiency
4)Cost effective and easily manageable
5)Increased Data Security and Retrieve ability
6)Easy to access the system anywhere and anytime
7)Minimize the waiting time for patients during an emergency

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Design Concept and Block Diagram:

A.Arduino UNO:

The Arduino is an open-source hardware and software that can make a user to do effective operation in it. The Arduino is a microcontroller. These microcontroller devices help in sensing and controlling the objects in the real-time situations and environment. These boards are available cheaper in the market. There are a number of inventions performed in it and still it is going on. A developer can send a set of instructions to the microcontroller. All Arduino boards are open-source, empowering users to build them independently, and ultimately adapt them to their particular needs. Arduino/Genuino Uno board consists of an ATmega328P microcontroller chip. It has 14 digital input-output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. The ATmega328 on the Arduino Uno comes programmed with a boot loader that allows uploading new code.

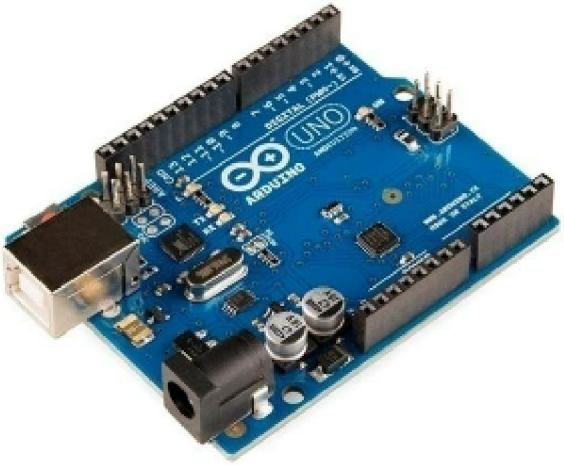

Figure: Arduino UNO

•Sensors:

The sensor is placed on the patient body for medical data generation. The main job of the sensors is to send regular updates about patient medical status to the nearest gateway in an encrypted format. At the same time, the sensors need to sign the data before sending to gateway using Sign Data() module. During the signing process, it includes data hash code, timestamp and sensor pseudo-ID to the actual data.

A.Temperature Sensor:

Temperature Sensor is a fundamental, cheap digital temperature along with humidity sensor which utilizes a thermistor and capacitive humidity sensor to quantify district air furthermore lets out a digital signal on data pin and it does not need any analog input pins (Interface BMP180 Pressure & Temperature Sensor with Arduino)

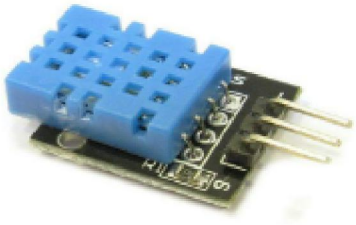

Figure: Temperature Sensor

B.Pulse Sensor:

A pulse wave is the change in the volume of a blood vessel that occurs when the heart pumps blood, and a detector that monitors this volume change is called a pulse sensor.

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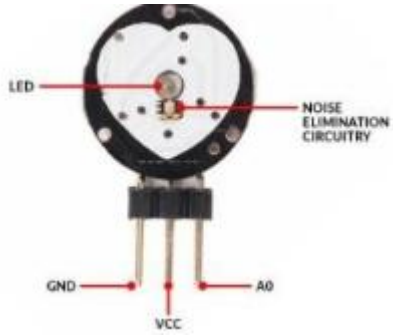

Figure: Pulse Sensor

C.LOAD CELL:

A load cell is a force sensing module - a carefully designed metal structure, with small elements called strain gauges mounted in precise locations on the structure. Load cells are designed to measure a specific force, and ignore other forces being applied. The electrical signal output by the load cell is very small and requires specialized amplification.

Figure: LOAD CELL

D.BUZZER:

In our project the buzzer is used for beep sound indicating the entry of wrong password.

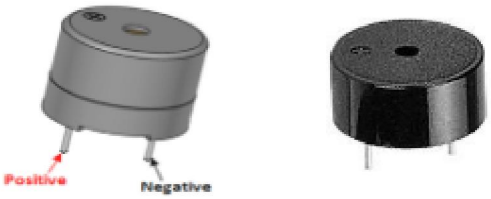

Figure: Buzzer

E.BUTTON:

Press button to activate buzzer.

Figure: Button

F.LCD:

Liquid Crystal Display, which we are using in our project is 16*2 LCD. This display consists of 16 columns and 2 rows. This is programmed using the library <LiquidCrystal.h>. LCD will display sensors values can also be visualized on the display screen of LCD for doctors.

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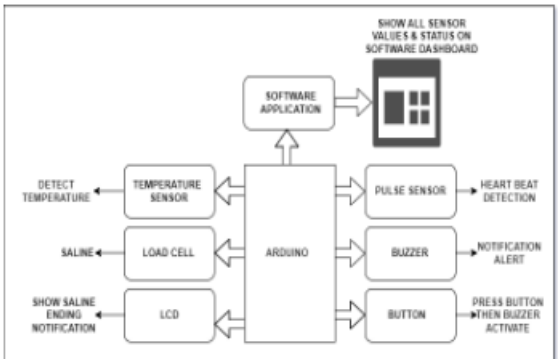
Figure: LCD

Block Diagram:



IV.APPLICATIONS

•Hospitals

V. CONCLUSION

Smart ICU system based on IOT technology, low cost, portable, energy efficient has given satisfactory results. The system makes the use of sensors along with Pulse sensor, Temperature Sensor, Load Cell. The body parameters of a person sensed by the sensors are sent to the cloud with the help of Wi-Fi shield and the sensor details are displayed for doctors. For such critical conditions the doctors need to have an all-time update patient's health related parameters like their blood pressure, heart pulse and temperature. In this way IOT Based ICU Patient Monitoring System that helps in monitoring ICU Patients without any manual intervention. IoT (Internet of Things) based ICU (Intensive Care Unit) patient monitoring system may be a system, which measures the patient vital sign, pulse rate and temperature constantly who is admit in ICU. After measuring, this technique also sends this data to dedicated IOT system. Where every respective doctor could easily see their respective patient data all the time from anywhere. This system is less costly and more precise as compared to the other systems. Patient health parameter dataset are stored. So, it is more beneficial than maintaining the records on printed papers kept in files.

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