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Smart Health Monitoring System based on Internet of Things

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ABSTRACT

The aim of developing this paper is to employ health-based sensors in a real-time application to monitor a person's heartbeat, temperature and other aspects. Not only to monitor the levels but also to alert if there is any abnormality.

Keywords : Combustor, Numerical Simulation, Velocity Profile, Oxygen Percentage

I. INTRODUCTION

Web of everything or Network of Everything is moreover known as Internet of Things (IoT). At the point when physical items or things are inserted with material science, sensors and programming then the system called IoT is shaped. This system has property to change articles to trade information with the gathering, administrator as well as various associated gadgets upheld the framework of International Telecommunication Union's global Standards Initiative. IoT grants the recognition of articles and controlling them remotely crosswise over existing system framework. In this way a system makes an extension for a great deal of direct mix between the physical world and PC based frameworks. This prompts enhanced precision, strength and monetary benefit.

Technology has always been there to simplify and makes the human life much easier. It affected the various areas of life; the medical field is one of them. It benefits from the technology in different ways; now it is easier to diagnose internal diseases using some digital devices. The healthcare sector is going through a huge change, with digital capabilities changing the way doctors interact with their patients. Nowadays, patients have the tools to view their key vitals themselves and help doctors to have immediate access to patient data on-the-go. In a form of wearable devices e.g. Apple watches.

However, we note that these devices are quite expensive and it is difficult to find these devices used by poor people, who are facing the biggest part of diseases burden. Moreover, most of the existing medical devices are still need some investigations once it comes to the concept of the Internet of Things. The concept of the IOT entails the use of electronic devices that capture or monitor data and are connected to a private or public cloud, enabling them to automatically trigger certain events. Medical data such as blood pressure and heart rate are collected by sensors on peripheral devices; these data are transmitted to healthcare providers or third parties via wireless telecommunication devices.

The data are evaluated for potential problems by a health-care professional and health providers are immediately alerted if a problem is detected. Bluetooth, ZigBee, and Wi-Fi are the common wireless technologies for remote patient monitoring systems. However, their suitability and usability for this task are widely varying. Therefore, there are significant considerations while selecting a technology for IoT medical devices; you need to be aware of what their characteristics for specific requirements.

II. AIM AND SCOPE OF PRESENT INVESTIGATION

The proposed system will help patients in remote places (e.g. home healthcare) and that is not just about monitoring a chronic disease state but about helping prevent patients from getting to that state. By implementing this paper, it will offer an inexpensive system for remotely patient's health monitoring, which can save their lives by giving emergency alert in real-time.

This paper aims to develops a small health care monitoring system FOR patients continuously and reacts based on their current health conditions. This is not about just monitoring any chronic disease state, but it is to design a system of yearly prediction of health so that helping not to be getting any critical chronic disease state. This papers offers an inexpensive system for patient health monitoring from a remote place which alerts the health care professionals. So that can save their lives by giving emergency alerts at real time.

III. EXPERIMENTAL OR MATERIAL AND METHOD SYSTEM DESIGN

IoT is a concept that connects all the devices to the internet and let them communicate with each other over the internet. IoT is a giant network of connected devices – all of which gather and share data about how they are used and the environments in which they are operated.

By doing so, each of your devices will be learning from the experience of other devices, as humans do. IoT is trying to expand the interdependence in human- i.e interact, contribute and collaborate to things. I know this sounds a bit complicated, let's understand this with an example.

A developer submits the application with a document containing the standards, logic, errors & exceptions handled by him to the tester. Again, if there are any issues Tester communicates it back to the Developer. It takes multiple iterations & in this manner a smart application is created.

Similarly, a room temperature sensor gathers the data and send it across the network, which is then used by multiple device sensors to adjust their temperatures accordingly. For example, refrigerator's sensor can gather the data regarding the outside temperature and accordingly adjust the refrigerator's temperature. Similarly, your air conditioners can also adjust its temperature accordingly. This is how devices can interact, contribute & collaborate.

Benefits of IoT

Since IoT allows devices to be controlled remotely across the internet, thus it created opportunities to directly connect & integrate the physical world to the computer-based systems using sensors and internet. The interconnection of these multiple embedded devices will be resulting in automation in nearly all fields and also enabling advanced applications. This is resulting in improved accuracy, efficiency and economic benefit with reduced human intervention. It encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. The Major Benefits of IoT Are:

Improved Customer Engagement

IoT improves customer experience by automating the action. For e.g. any issue in the car will be automatically detected by the sensors. The driver, as well as the manufacturer, will be notified about it. Till the time driver reaches the service station, the manufacturer will make sure that the faulty part is available at the service station.

Technical Optimization

IoT has helped a lot in improving technologies and making them better. The manufacturer can collect data from different car sensors and analyse them to improve their design and make them much more efficient.

Reduced Waste

Our current insights are superficial, but IoT provides real- time information leading to effective decision making & management of resources. For example, if a manufacturer finds fault in multiple engines, he can track the manufacturing plant of those engines and can rectify the issue with manufacturing belt.

Nowadays, we are surrounded by lots of IoT enabled devices which are continuously emitting data and communicating through multiple devices. Moving ahead, let's discuss the required hardware for building an IoT application. We will also look at the IoT devices which we are using in our day to day life.

Healthcare Application

Smartwatches and fitness devices have changed the frequency of health monitoring. People can monitor their own health at regular intervals. Not only this, now if a patient is coming to the hospital by ambulance, by the time he or she reaches the hospital his health report is diagnosed by doctors and the hospital quickly starts the treatment. The data gathered from multiple healthcare applications are now collected and used to analyse different disease and find its cure.

PROPOSED SYSTEM

We have proposed a robust health monitoring system that is intelligent enough to monitor the patient automatically using IOT that collects the status information through these systems

Which would include patient's heart rate, blood pressure and body temperature and sends an emergency alert to patient's doctor with his current status and full medical information. This would help the doctor to monitor his patient from anywhere and also to the patient to send His health status directly without visiting to the hospital

ADVANTAGES

• high speed data transmission
• robust method

BLOCK DIAGRAM

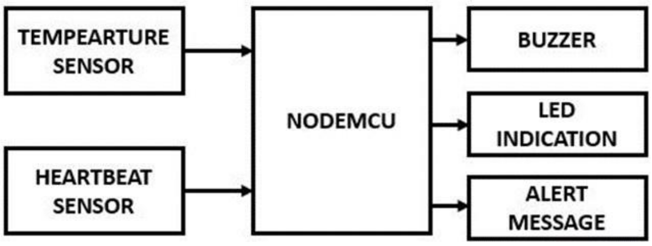

Figure 3.1: block diagram

HARDWARE USED:

Heart beat sensor:

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy. In order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

Figure : 3.2 heart beat sensor

Principle of Heartbeat Sensor

The principle behind the working of the Heartbeat Sensor is Photoplethysmograph. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ.

Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor. With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor.

In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver. Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

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Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor. In this paper, we have designed a Heart Rate Monitor System using Arduino and Heartbeat Sensor. You can find the Principle of Heartbeat Sensor, working of the Heartbeat Sensor and Arduino based Heart Rate Monitoring System using a practical heartbeat Sensor.

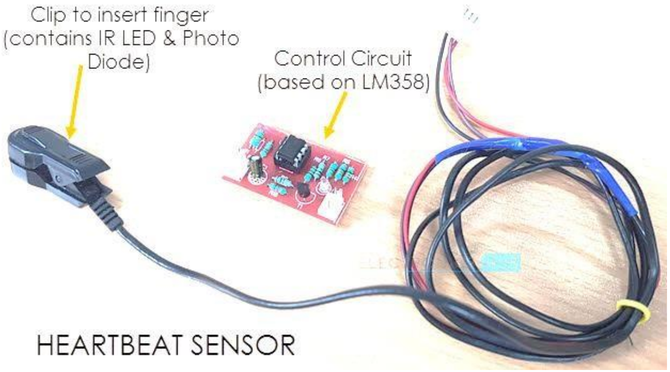

Fig no 3.3 : heart beat sensor module Introduction to Heartbeat Sensor

Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography

But the more easy way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat.

Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute.

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Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

Working of Heartbeat Sensor

A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip.

The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram.

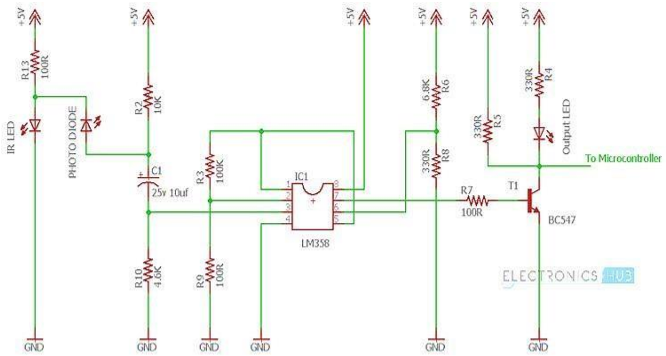

Figure no : 3.4 block diagram heart beat sensor

The above circuit shows the finger type heartbeat sensor, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary.

The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp cats as a non – inverting amplifier with an amplification factor of 1001.

The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino.

The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

Applications of Heart Rate Monitor using Arduino

• A simple paper involving Arduino UNO, 16×2 LCD and Heartbeat Sensor Module is designed here which can calculate the heart rate of a person.

• This paper can be used as an inexpensive alternative to Smart Watches and other expensive Heart Rate Monitors.

Specifications:

Fig no: 3.5 invento pulse rate sensor

Figure 3.6: node MCU

However, as a chip, the ESP8266 is also hard to access and use. You have to solder wires, with the appropriate analog voltage, to its PINs for the simplest tasks such s powering it on or sending a keystroke to the "computer" on the chip.

And, you have to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT papers.
Borrowing a page from the successful playbooks of Arduino or a Raspberry Pi, the NodeMCU paper aims to simplify ESP8266 development. It has two key components.

NODE MCU:

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for IoT papers of all kinds.

Operating Voltage	5V
Flash Memory	4Mb
Processor	L106 32-bit
Processor speed	80-160MHz
RAM	32K + 80K
GPIOs	16
ADC	1, 10-bit

TABLE 3.1 Specification of ESP8266 Node MCU

TEMPERATURE SENSOR

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges.

Temperature is one of the most commonly measured variables and it is therefore not surprising that there are many ways of sensing it.

Temperature sensing can be done either through direct contact with the heating source, or remotely, without direct contact with the source using radiated energy instead. There are a wide variety of temperature sensors on the market today, including Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared, and Semiconductor Sensors.

THERMOCOUPLE

It is a type of temperature sensor, which is made by joining two dissimilar metals at one end. The joined end is referred to as the HOT JUNCTION. The other end of these dissimilar metals is referred to as the COLD END or COLD JUNCTION. The cold junction is actually formed at the last point of thermocouple material. If there is a difference in temperature

between the hot junction and cold junction, a small voltage is created. This voltage is referred to as an EMF (electro-motive force) and can be measured and in turn used to indicate temperature.
The RTD is a temperature sensing device whose resistance changes with temperature. Typically built from platinum, though devices made from nickel or copper are not uncommon, RTDs can take many different shapes like wire wound, thin film. To measure the resistance across an RTD, apply a constant current, measure the resulting voltage, and determine the RTD resistance. RTDs exhibit fairly linear resistance to temperature curves over their operating regions, and any nonlinearity are highly predictable and repeatable.

The PT100 RTD evaluation board uses surface mount RTD to measure temperature. An external 2, 3 or 4-wire PT100 can also be associated with measure temperature in remote areas. The RTDs are biased using a constant current source. So as to reduce self-heat due to power dissipation, the current magnitude is moderately low. The circuit shown in figure is the constant current source uses a reference voltage, one amplifier, and a PNP transistor.

THERMISTORS:

Similar to the RTD, the thermistor is a temperature sensing device whose resistance changes with temperature. Thermistors, however, are made from semiconductor materials. Resistance is determined in the same manner as the RTD, but thermistors exhibit a highly nonlinear resistance vs. temperature curve. Thus, in the thermistors operating range we can see a large resistance change for a very small temperature change. This makes for a highly sensitive device, ideal for set-point applications.

Semiconductor sensors:

They are classified into different types like Voltage output, Current output, Digital output, Resistance output silicon and Diode temperature sensors. Modern semiconductor temperature sensors offer high accuracy and high linearity over an operating range of about 55°C to +150°C. Internal amplifiers can scale the output to convenient values, such as 10mV/°C. They are also useful in cold- junction compensation circuits for wide temperature range thermocouples. A brief details about this type of temperature sensor are given below.

SENSOR ICS

There are a wide variety of temperature sensor ICs that are available to simplify the broadest possible range of temperature monitoring challenges. These silicon temperature sensors differ significantly from the above mentioned types in a couple of important ways. The first is operating temperature range. A temperature sensor IC can operate over the nominal IC temperature range of -55°C to +150°C. The second major difference is functionality.

A silicon temperature sensor is an integrated circuit, and can therefore include extensive signal processing circuitry within the same package as the sensor. There is no need to add compensation circuits for temperature sensor Ics. Some of these are analogue circuits with either voltage or current output. Others combine analogue-sensing circuits with voltage comparators to provide alert functions. Some other sensor ICs combine analogue-sensing circuitry with digital input/output and control registers, making them an ideal solution for microprocessor-based systems.

Digital output sensor usually contains a temperature sensor, analog-to-digital converter (ADC), a two-wire digital interface and registers for controlling the IC's operation. Temperature is continuously measured and can be read at any time. If desired, the host processor can instruct the sensor to monitor temperature and take an output pin high (or low) if temperature exceeds a programmed limit. Lower threshold temperature can also be programmed and the host can be notified when temperature has dropped below this threshold. Thus, digital output sensor can be used for reliable temperature monitoring in microprocessor-based systems.

Above temperature sensor has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature. When the voltage increases then the temperature also rises. We can see this operation by using a diode.

Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need of A/D converters.

An example for a temperature sensor is LM35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 is operates at -55˚ to +120˚C.

Features of LM35 Temperature Sensor:

Calibrated directly in ˚ Celsius (Centigrade)

• Rated for full l –55˚ to +150˚C range
• Suitable for remote applications
• Low cost due to wafer-level trimming
• Operates from 4 to 30 volts
• Low self-heating,
• ±1/4˚C of typical nonlinearity OPERATION OF LM35:

The LM35 can be connected easily in the same way as other integrated circuit temperature sensors. It can be stuck or established to a surface and its temperature will be within around the range of 0.01˚C of the surface temperature.

This presumes that the ambient air temperature is just about the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

The temperature sensors have well known applications in environmental and process control and also in test, measurement and communications. A digital temperature is a sensor, which provides 9-bit temperature readings. Digital temperature sensors offer excellent precise accuracy, these are designed to read from 0°C to 70°C and it is possible to achieve ±0.5°C accuracy. These sensors completely aligned with digital temperature readings in degree Celsius.

BUZZER

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

Figure no : 3.7 buzzer

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz.

LIGHT-EMITTING DIODE (LED)

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers).

Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an infrared-emitting diode (IRED).

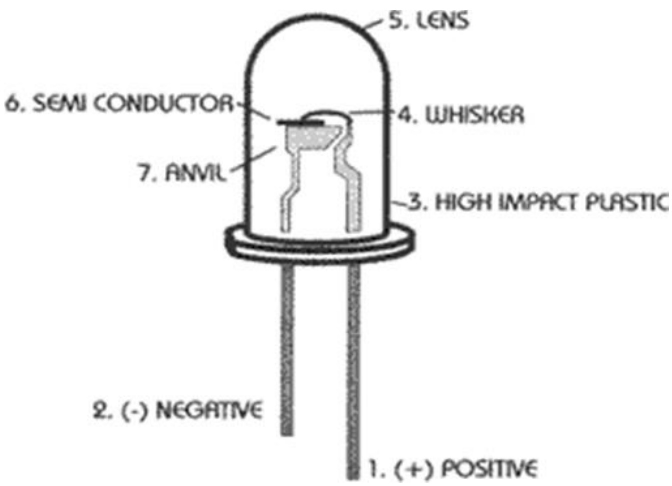

Figure no :3.8 Light emitting diode Benefits of LEDs

• Low power requirement: Most types can be operated with battery power supplies.

• High efficiency: Most of the power supplied to an LED or IRED is converted into radiation in the desired form, with minimal heat production.

• Long life: When properly installed, an LED or IRED can function for decades.

IV. SOFTWARE DESCRIPTION

ARDUINO IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board.

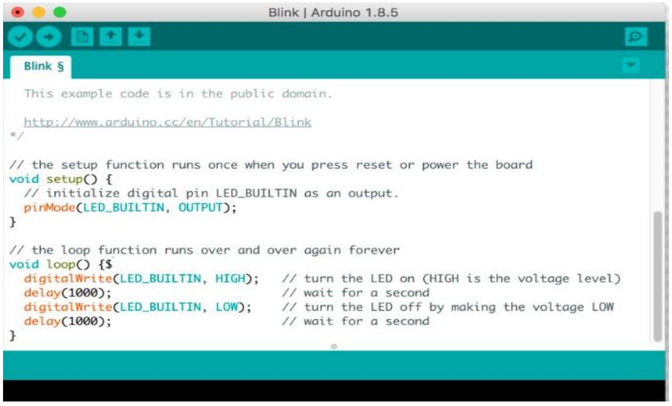

Figure no:4.1 Programming Arduino

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring paper, which provides many common input and output procedures.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution.

The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Real-Time Monitoring System

Data visualization was developed by utilizing JavaScript framework as a monitoring system to present sensor data in real-time. The manager could monitor the status of assembly line process as well as receive the early warning once the abnormal event (fault) is detected in real-time through the proposed system.

The IoT-based sensor devices sent the sensor data to Apache Kafka, then Apache Storm will process the data as well as sent the sensor data and its fault prediction results directly to the monitoring system in real-time, and finally the sensor data and its prediction result are stored into MongoDB. As can be seen, the real-time monitoring system can be easily accessed via a web-browser on a personal computer.

The proposed system presents the sensor data such as temperature, heartbeat and respiration data in real-time. The device ID (IoT-based sensor device) and recorded time was collected and presented for every record. In addition, the hybrid prediction model was used to predict the fault and present the result into real-time monitoring system. The proposed system has been implemented and tested in one of automotive manufacturing in Korea from 1 August 2017 to 31 March 2018. Four IoT-based sensor devices were installed in the manufacturing assembly line and transmitted the sensor data to the remote server every 5 s.

During this testing period, around 19 million records (with approximate size is 3 gigabytes) has been collected.

Arduino IDE:

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino papers can be stand-alone, or they can be communicate with software running on your computer (e.g. Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

1. Open Arduino IDE as shown below

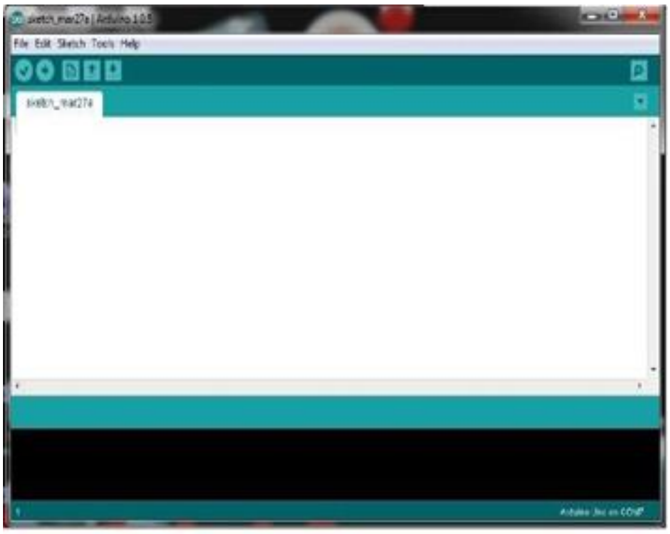

Figure no. 4.2 :Opening Arduino IDE

2. Select the COM Port from tool

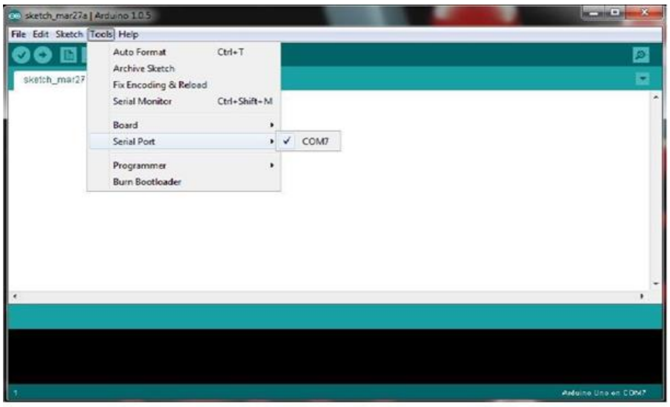

Figure no:4.3 Selecting the COM Port

3. Select the required Arduino board from Tools as shown below

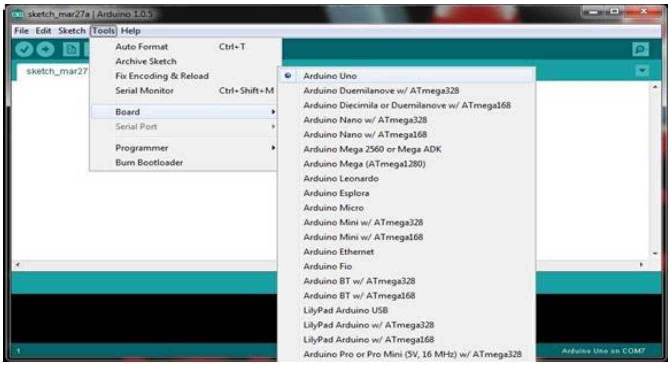

Figure no:4.4 Selecting the required Arduino board

4. Write the sketch in Arduino IDE

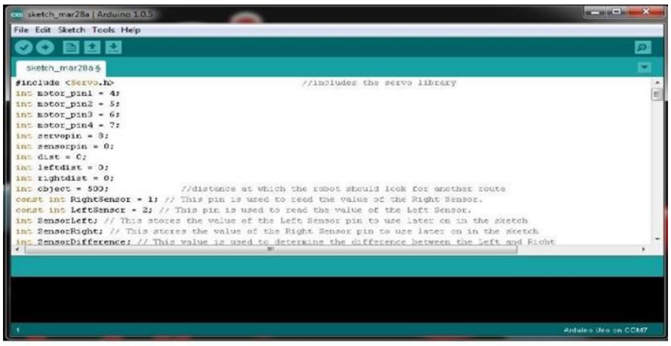

Figure no: 4.5 Sketching a program in Arduino IDE

5. Compile and upload the Sketch to Arduino board

Figure no:4.6 uploading the program sketch to Arduino board

VII. CONCLUSION

In this proposed system a mobile physiological monitoring system is presented, which is able to continuously monitor the patients heartbeat, temperature and other critical parameters in the hospital.

The system does a continuous monitoring and control mechanism to monitor the patient condition and store the patient data's in server using Wi-Fi Module based wireless communication, we also proposed remote health care data acquisition and smart storage system. The Future work of the paper is very essential in order to make the design system more advanced. In the designed system the enhancement would be connecting more sensors to internet which measures various other health parameters and would be beneficial for patient monitoring i.e. connecting all the objects to internet for quick and easy access. Establishing a Wi-Fi mesh type network to increase in the communication range.

II. REFERENCES

[1]. G. Ahn, Y. H. Noh, and D. U. Jeong. Smart chair based on multi heart rate detection system. In 2015 IEEE SENSORS, pages 1–4, Nov 2015.

[2]. S. H. Almotiri, M. A. Khan, and M. A. Alghamdi. Mobile health (m-health) system in the context of iot. In 2016 IEEE 4th

[3]. International Conference on Future Internet of Things and Cloud Workshops (FiCloudW), pages 39–42, Aug 2016.

[4]. T. S. Barger, D. E. Brown, and M. Alwan. Healthstatus monitoring through analysis of behavioral patterns. IEEE Transactions on Systems, Man, and Cybernetics - Part A:

[5]. Systems and Humans, 5(1):22–27, Jan 2005. ISSN 1083-4427.

[6]. I. Chiuchisan, H. N. Costin, and O. Geman. Adopting the internet of things technologies in health care systems. In 2014

[7]. International Conference and Exposition on Electrical and Power Engineering (EPE), pages 532– 535, Oct 2014.

[8]. A. Dwivedi, R. K. Bali, M. A. Belsis, R. N. G. Naguib,P.

[9]. Every, and N. S. Nassar. Towards a practical healthcare

[10]. Information security model for healthcare institutions. In 4th International IEEE EMBS Special Topic Conference on Information Technology Applications in Biomedicine, 2003.