5.3.1 Smart health

The healthcare monitoring systems has emerged as one of the most vital system and became technology oriented from the past decade. Humans are facing a problem of unexpected death due to various illness which is because of lack of medical care to the patients at right time. The primary goal was to develop a reliable patient monitoring system using IoT so that the healthcare professionals can monitor their patients, who are either hospitalized or at home using an IoT based integrated healthcare system with the view of ensuring patients are cared for better.

A mobile device based wireless healthcare monitoring system was developed which can provide real time online information about physiological conditions of a patient mainly consists of sensors, the data acquisition unit, microcontroller (i.e., Arduino), and programmed with a software (i.e., JAVA). The patient's temperature, heart beat rate, EEG data are monitored, displayed and stored by the system and sent to the doctor's mobile containing the application. Thus, IoT based patient monitoring system effectively monitor patient's health status and save life on time.

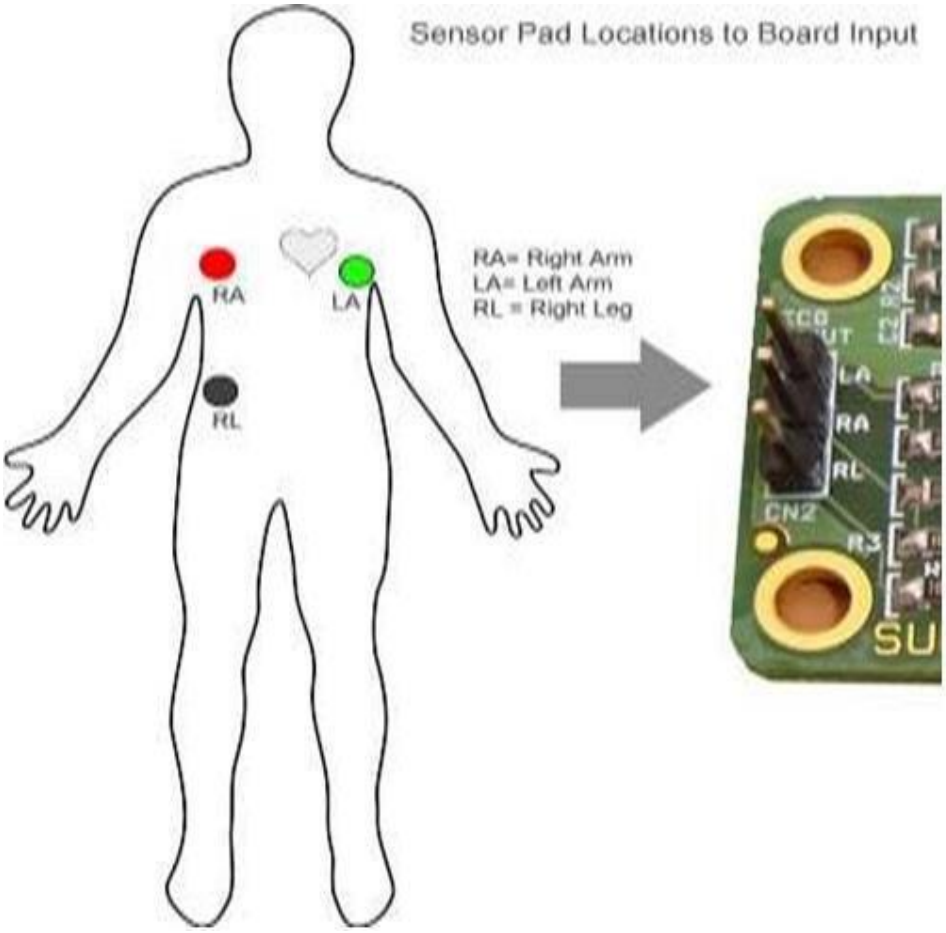
INTRODUCTION

The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings. Likewise, countless ordinary users are being served from the advantages of the M-Health (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health.

According to the constitutions of World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. As we are truly inspired by this, we attempt to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses internet to update the doctors so that they can help in case of any issues at the earliest preventing death rates.

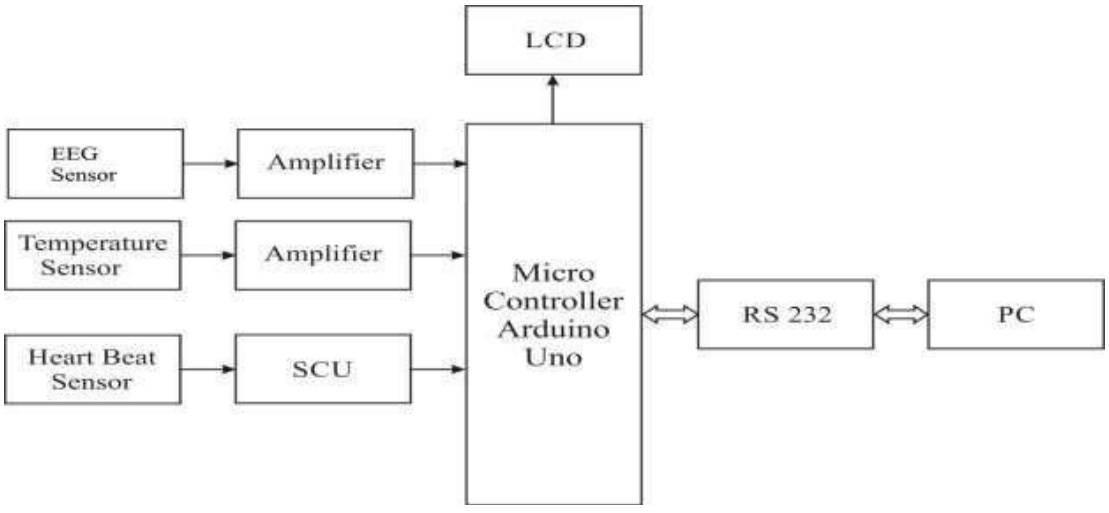
Signal Conditioning Unit

This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

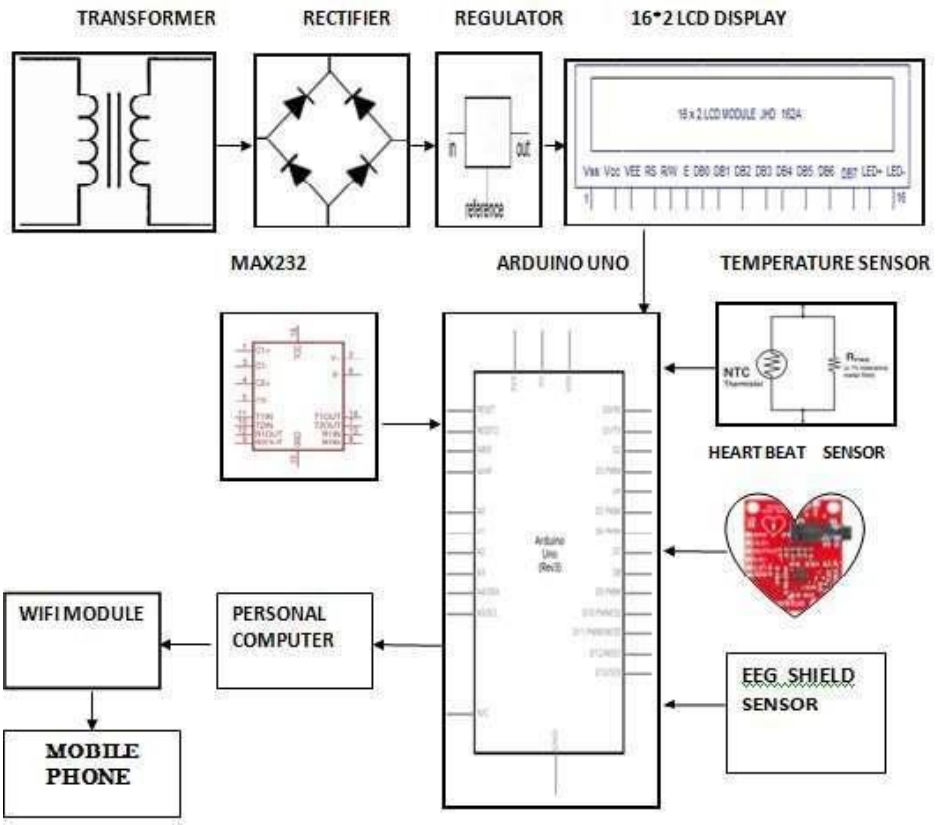


Position of Sensor Pads Input

Block Diagram



Block diagram of sensors connected with the PC



Block diagram of Health monitoring system

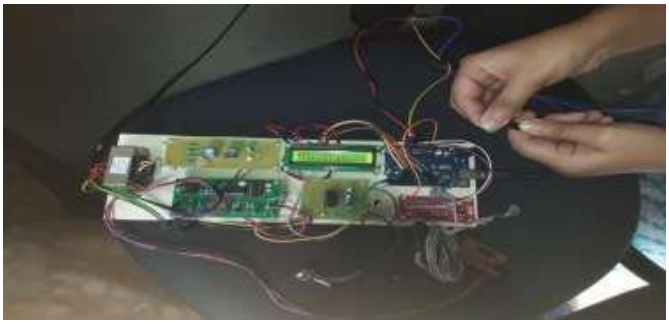
Operating Mechanism

STEP 1: The Heartbeat sensor is fixed to the patient's finger. This contains an IR sensor in it .Every pumping we get pulse from that sensor. This sensor output is given to the arduino viaSignal conditioning unit for amplification

Heart beat sensor

STEP 2

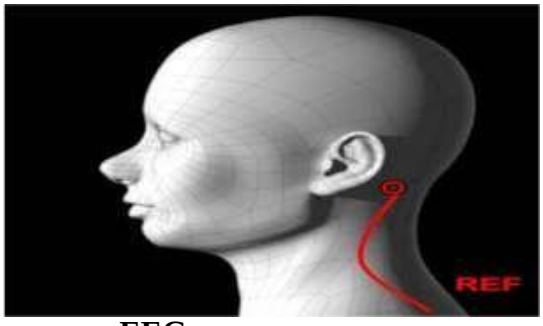
NTC type thermistor is used as a temperature sensor. This temperature sensor output variesbased on the temperature, this output is also given to arduino.



Temperature sensor

STEP 3

EEG sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily and connected to arduino.



EEG sensor

Step 4

All these values are transferred to PC via RS 232 and by using the URL,it is transferred to the mobile app created.

Output in LCD

Output in the Mobile Application:

The output is displayed in the form of string in a particular interval of time. The application is very simple as it just displays the analog values followed by a statement describing the kind of value displayed.

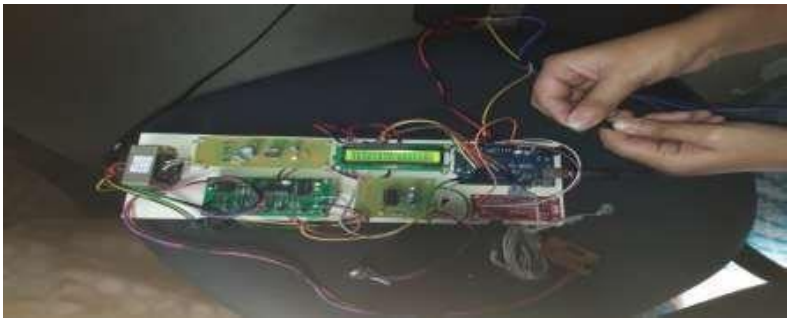
Output displayed in the mobile application device

Testing and findings health care unit

The Patient Health Monitoring System developed is tested using various persons with normal to abnormal health conditions. The various testing and findings producing results with minimal error rate and the observations are listed below.

Temperature Findings

The NC type thermistor used is programmed to display the value at room temperature for demo purposes with minimal error of + or – 5.



5.3.2 Environment monitoring and surveillance

IoT environmental monitoring is a process that uses Internet of Things (IoT) technology to collect data about the environment, such as air quality, temperature, and humidity levels. This data can then be analysed to better understand the indoor and outdoor environment and make informed decisions about how to reduce the impact of negative aspects of the local environment on the business. Alternatively, it can be used to change business activities to help protect the planet or the local community.

These IoT-based systems can be used to detect issues in the environment that are largely invisible, normalised or taken for granted. Allowing businesses to take action by reducing their negative environmental footprint and protecting employees, visitors and the community at large.

IoT connectivity plays a crucial role in Environmental Monitoring by enabling the collection and transmission of real-time data from various sensors and devices. IoT devices such as air quality monitors, water quality sensors, and weather stations are commonly used to monitor environmental parameters. These devices utilise specific connectivity technologies such as GSM, 4G LTE, LoRa, SigFox, and NB-IoT to ensure that data is efficiently transmitted to the cloud for analysis. This real-time data allows for better decision-making, early detection of environmental issues, and ultimately helps in the conservation and protection of our natural resources. With IoT connectivity, environmental monitoring becomes more efficient, accurate, and sustainable.

IoT environmental monitoring relies on individual devices and IoT ecosystems, IoT network, IoT monitoring tool(s) and applications, IoT device monitoring and IoT device management systems, remote monitoring equipment and analytics. The technical complexity of IoT for intelligent IoT monitoring is the requirement for interfacing of a variety of products, systems and protocols. To utilise the scalability and performance benefits of IoT for centralised control and intelligent end monitoring requires the engagement with IoT experts and IoT services as well as engineering the best form of IoT traffic utilization to avoid system failures.

There are four critical components for IoT-based environmental monitoring to support vital insights and decision-making:

1) Observation (Monitor the Environment and Collect Data):

The first step in the environmental monitoring process is to observe and collect data. This involves using sensors or other IoT devices to measure factors such as air quality, temperature, and humidity levels.

These connected IoT devices gather data about the environment and transmit it to a central hub. From here, the data can be reviewed in real-time or used for further analysis off line. Often these systems produce unexpected results and temporal variances. For example, high CO2 levels when offices are highly populated could explain drowsiness or loss of concentration. This can also apply to public spaces such as bars and restaurants where invisible environmental factors may be making the consumer experience uncomfortable.

2) Analysis (Measure Data):

The next step is to analyse the data collected by IoT devices. This includes looking at trends over time, identifying areas of concern, and any correlations between environmental variables, time of day, behaviours and the relationships between indoor and outdoor metrics. IoT sensing devices pick out key points of the data that indicate everything from chemical and water leaks to air pollution levels. This data analysis can help businesses measure

their environmental footprint and make informed decisions about how to reduce their environmental impact.
For some businesses, this can be relatively benign or related to levels of comfort for workers, whereas others are related to safety. For example, monitoring systems placed in drains can be on the lookout for external pollutants such as diesel, oil, and paints that can stress the environment or harm livestock, fisheries or members of the public.

3) Storage (Catalogue Data):

Once the data has been analysed, it needs to be stored so that it can be accessed in the future. IoT environmental monitoring systems make this easy by storing the data in a secure cloud-based database, allowing businesses to access the data whenever they need it and analyse how their environmental impact is changing over time.
Global databases, such as the Microsoft Planetary Computer, catalogue enormous quantities of environmental data from around the world – although not every cloud database is that large.

4) Action (Provide Actionable Insights From the Data and Analysis):

Finally, businesses need to be able to take action based on the data that has been gathered and analysed.
IoT-enabled environmental monitoring systems can provide insights into how businesses can best reduce their environmental impact, such as by using renewable energy sources or introducing water conservation measures.
These actionable insights may involve changing operational processes, implementing new technologies, or even making changes to their overall business strategy.

There are a number of benefits associated with using an IoT-based environmental monitoring system, including:

- **Improved understanding of the environment via data**: With real-time data feeds being supplied by remotely deployed IoT sensors, businesses and organisations can better understand and quantify the environment. From here, targeted actions can be taken to reduce environmental impact or to spot problems, such as excessive CO2, noise or airborne chemicals as they occur.

- **Improved efficiency**: With real-time data, organisations can identify and address any problems long before they become more serious. By employing warning alarms, businesses can be more reactive and proactive. This can result in a better working environment, cost savings and less downtime.

- **Increased sustainability:** IoT environmental monitoring systems help organisations identify areas where they can reduce their areas of environmental stress for employees and stakeholders, thus helping them be more sustainable in the long term.

- **Business Growth**: Companies often need to comply with environmental standards in order to assure their customers that they are a progressive organisation whose values chime and adhere to their own policies and direction of travel. Producing evidence-based systems and results can provide greater surety that measures and controls are in place, fitting both the contexts of the business and its (or its customers) environmental concerns.