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Design and Implementation of Advanced Real Time Patient Health Monitoring System Using Iot

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***Abstract*: The Real-Time Patient Health Monitoring System Using IOT is a ground breaking designed to address the need for continuous and remote health monitoring of individuals. In an era where healthcare is becoming increasingly digitized and patient-centric, this system leverages the Internet of Things (IOT) technology to provide real-time health data collection, analysis, and alerts. The system integrates various sensors such as heart beat, temperature sensors, breathing, SPO2, patient sleep or standby position by MEMS are the sensors to continuously collect vital health data from individuals. Data collected by the sensors is transmitted securely to a centralized server or cloud-based platform via IOT communication protocols like Thing speak, MQTT or HTTP. The System uses Raspberry pi board with Pi camera to monitor the patient. This includes anomaly detection, 0 trend analysis, and predictive modelling to identify potential health issues. If any critical health parameter deviates from the normal range or if predefined health thresholds are crossed, the system generates real time alerts and notifications. These alerts can be sent to healthcare providers, caregivers, and the individuals themselves via mobile apps or SMS. A user-friendly mobile or web application provides individuals with access to their health data, historical trends, and personalized recommendations for maintaining their well-being. The system is designed to be scalable, allowing for the addition of new sensors or features to accommodate evolving healthcare needs. Healthcare professionals can remotely monitor the health status of patients. It empowers individuals to take control of their health and enables healthcare providers to deliver more personalized and effective care.**

***Keywords*: IOT, SPO2, MEMS, SMS, MQTT, HTTP.**

1.INTRODUCTION

Now a day's aged and people are suffering from at least one deceases and health conscious and increasing. And in hospital difficulty occurs in taking care of that patients. Body Sensor community gives very massive portability to sufferers to discover abnormalities in affected person and used to keep away from essential conditions and offers right remedy on time. Hence, IoT idea used and sensor are linked to human frame with nicely controlled wi-fi network. For measurement heart beat rate, Temperature etc. can be monitored by sensors. In this system, we are using sensor to detect biological parameters and it processes along with controller and that each one hardware aspect is included with software program gadget to show records to consumer and consumer can capping a position manage gadget. The net has grown especially due to its accessibility to everyone.

IoT health screening aids in disease spread prevention as well as accurate evaluation of health status, regardless location of the doctor furthermore it is facilitating continuous health condition monitoring. The Remote Healthcare Monitoring association allows sufferers to be discovered outdoor of conventional clinic environments (for example, at home), and will increase get admission to human sources places of work even as reducing costs. Health care companies can screen patients' fitness reputation the usage of some of vital fitness parameters. Due to important fitness problems, sure humans with persistent sicknesses require non-stop monitoring. These parameters include heart rate, body temperature, spo2, respiratory rate, and patient position. Most of these health parameters can now be tracked using electronic devices with precise sensors thanks to advancements in medical technology. These parameters may be tracked remotely because of trends in communique technology, especially the internet, making IoT healthcare monitoring possible

2.RESEARCH AND BACKGROUND

The development of a Real time Patient Health Monitoring System using raspberry pi with various sensors and communication modules is presented in this project. The system aims to monitor crucial health parameters of patients and provide alerts and visual feedbacks for better care and management. The system integrates a respiratory sensor, heartbeat sensor, MEMS sensor for movement detection, temperature sensor, for Wi-Fi connectivity, GSM module for SMS alerts, and a buzzer for audible alerts. The respiratory sensor continuously measures the patient's respiration, while the heartbeat sensor captures the heart rate. The MEMS sensor detects the patient's movement, enabling the system to assess physical mobility. The temperature sensor monitors body temperature fluctuations for detecting fever or hypothermia. The pulse-Oximeter sensor monitors oxygen for patient. All sensor data is processed and logged by the raspberry pi microcontroller. The facilitates seamless communication between the raspberry pi and a designated web server via Wi-

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Fi. The web server acts as a central repository for storing and analyzing patient health data. This allows healthcare professionals and caregivers to remotely access the data and track the patient's health trends and status over time. In case of abnormal readings or critical health events, the system triggers alerts using the GSM module to send SMS notifications to the concerned parties, ensuring immediate attention. creating awareness of a potential health issue

2.1RELATED WORKS:

Design Health care system using Raspberry Pi and ESP32N. Qunoo, Fuad Ali Published in International Journal of… 17 February 2020Medicine, Computer Science, Engineering

The cognizance of this paper is to put into effect a smart fitness care device primarily based totally on net of thing (IOT) for the size of the critical symptoms and symptoms like pulse rate, Temperature, spo2, ECG, using (ESP32 div package v1) for wi-fi wearable sensor controller and raspberry pi three as a server. With the device proposed, the health practitioner can shop paintings time to go to the sufferers that accountable approximately them and any enables tracking the large wide variety of sufferers. The WI-FI generation is applied as a verbal exchange device to permit transmission the facts remotely. The information of affected person is dispatched to the net server to be saved withinside the database and look at the information at the net web page everywhere and each time the usage of smart gadgets and alert the health practitioner to any ordinary state. This paintings with the wise fitness care device offer a green clinical service, via way of means of gathering and recording the informant that consist of coronary heart rate, ECG, temperature and spo2 that enable the physician to reveal his affected person with flexibility and confidence.

An IoT-based Real-Time Remote Health Monitoring System Sakil Ahammed, Nazmul Hassan, +1 author A. T. Touchily Islam Published in International journal of… 25 June 2021Medicine, Engineering, Environmental Science

In this paper the proposed system is a real-time patient health monitoring system in which a patient's heart rate, peripheral oxygen saturation (SpO2) and body temperature can be monitored remotely, 24 hours in a day, to make it affordable, easy and accessible patients from rural areas. Nowadays, most of the elder people get heart failure because they are not aware in their present-day coronary heart fee whilst resting or doing a little activity. Body temperature needs to be monitored remotely, even in the rural areas for diseases like COVID-19. IoT technology enables these facilities eliminating limitations of current healthcare system. The purpose of this paper is to broaden a faraway fitness tracking machine that may be made with domestically to be had sensors with a purpose to make it affordable, easy and accessible patients from rural areas. The proposed machine is a real-time affected person fitness tracking machine wherein an affected person's coronary heart rate, peripheral oxygen saturation (SpO2) and frame temperature may be monitored remotely, 24 hours in a day. This IoT primarily based totally faraway viewing of the statistics allows a health practitioner or mum or dad to screen a patient's fitness circumstance far from clinic grounds.

IoT-Based Smart Health Monitoring System for COVID-19 Vanetta Bhardwaj, Rajat Joshi, Anshul Gaur Published in SN Computer Science 20 January 2022Medicine, Computer Science, Engineering, Environmental Science

In this paper the maximum relative error in the measurement of heart rate, patient body temperature and SPO2 was found to be 2.89%, 3.03%, 1.05%, respectively, which was comparable to the commercials health monitoring system. With the graduation of the COVID-19 pandemic, social distancing and quarantine are getting crucial practices withinside the world. IoT fitness tracking structures save you common visits to docs and conferences among sufferers and clinical professionals. However, many people require ordinary fitness tracking and commentary via scientific staff. In this proposed work, we've got taken gain of the generation to make sufferers lifestyles less difficult for in advance analysis and treatment. A clever fitness tracking gadget is being evolved the usage of Internet of Things (IoT) generation that's able to tracking blood pressure, coronary heart rate, oxygen level, and temperature of a person. This machine is beneficial for rural regions or villages wherein close by clinics may be in contact with metropolis hospitals approximately their affected person fitness conditions. However, if any adjustments arise in a patient's fitness primarily based totally on well-known values, then the IoT machine will alert the medical doctor or physician accordingly.

3.METHODOLOGY:

3.1 EXISTING SYSTEM:

In the traditional approach to patient health monitoring, healthcare professionals typically rely on periodic manual measurements of vital signs, such as respiratory rate, heart rate, and body temperature. This method has several disadvantages that hinder its effectiveness:

1. Limited Data Collection: Manual measurements only provide snapshots of the patient's health status at specific times. Vital health parameters can fluctuate rapidly, and critical health events might go undetected between measurements.
2. Lack of Real-time Monitoring: Continuous monitoring of patients becomes impractical with manual methods. This can lead to delays in identifying potential health issues, which may result in adverse outcomes or prolonged recovery times.
3. Dependency on Healthcare Facilities: Traditional methods require patients to be physically present at healthcare facilities for measurements. This restricts mobility and may not be suitable for patients who need constant monitoring or those in remote areas.
4. Inconvenience to Patients: Frequent manual measurements can be uncomfortable and distressing for patients, leading to anxiety and reduced compliance with the monitoring process.

3.2 PROPOSED SYSTEM

To address the limitations of traditional methods, we propose an advanced Real time Patient Health Monitoring System that integrates various sensors and an embedded system. The benefits of this technique are as follows:

1. Continuous Data Collection: The embedded system continuously gathers real-time data from multiple sensors, providing a comprehensive view of the patient's health status. This continuous monitoring enables early detection of any abnormal trends or critical health events.

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2. Seamless Remote Monitoring: With the integration of web server connectivity, healthcare professionals can remotely access patient data anytime and from anywhere. This allows for proactive interventions and personalized care, even for patients in distant locations.
3. Patient-Centric Design: The system is designed to be patient-friendly, reducing discomfort and anxiety associated with frequent manual measurements. The LCD display provides patients with real-time feedback, empowering them to take an active role in their health management.
4. Timely Alerts: In case of any deviations from normal health parameters, the system triggers immediate alerts through the GSM module. This ensures that caregivers and medical personnel are promptly notified, enabling rapid response and timely interventions.
5. Enhanced Data Analysis: By storing patient data on a centralized web server, the proposed method allows for sophisticated data analysis and trend identification. This can lead to better insights into the patient's health patterns and support evidence-based decision-making and live video by IP camera.

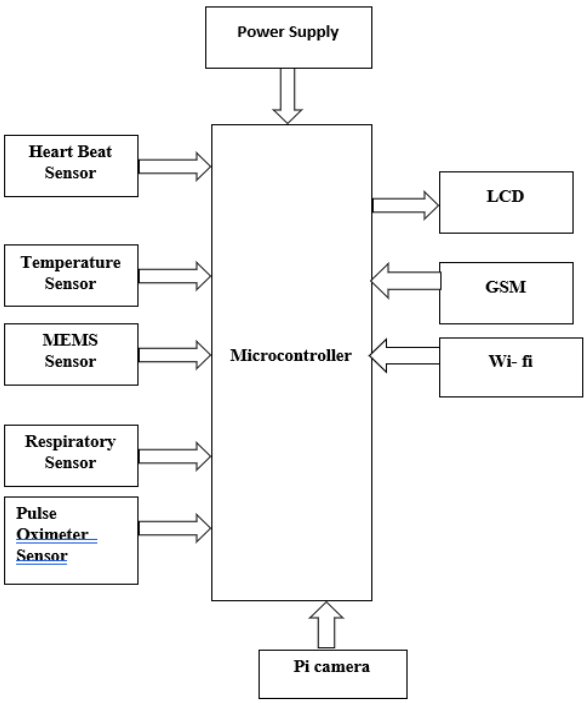

FIG: 3.1 BLOCK DIAGRAM

4. IMPLEMENTATION:

4.1 HARDWARE COMPONENTS:

Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation with the intention of teaching basic computer science to school students and every other person interested in computer hardware, programming and DIY-Do-it Yourself projects. The Raspberry Pi is manufactured in three board configurations through licensed manufacturing deals with Newark element 14(Premier Farnell), RS Components and Ego man. These companies sell the Raspberry Pi online. Ego man produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pi's by their red coloring and lack of FCC/CE marks. The hardware is the equal throughout all manufacturers. The Raspberry Pi has a Broadcom BCM2835 device on a chip (SoC), which incorporates an ARM1176JZF-S seven hundred MHz processor, Video Core IV GPU and changed into initially shipped with 256 megabytes of RAM, later upgraded (Model B & Model B+) to 512 MB. It does now no longer encompass an integrated tough disk or solid-country drive; however, it makes use of an SD card for booting and chronic storage, with the Model B+ the use of a MicroSD.

A 16x2 LCD display is a vital module this is commonly applied in diverse devices and circuits. These modules greater than seven sections and different multi fragment LEDs are liked. The motives being: LCDs are affordable; efficaciously programmable; don't have any restrict of displaying superb or even custom characters (in no way like in seven fragments), movements, etc. A 16x2 LCD implies sixteen characters may be proven in line with line and a pair of such strains exist. Each individual is proven in a lattice of 5x7 pixels on this LCD. There are registers on this LCD, particularly Command and Data.
Heartbeat Sensor is a digital tool this is used to degree the coronary heart charge i.e. speeds of the heartbeat. Monitoring frame temperature, coronary heart fee and blood strain are the primary matters that we do with a purpose to maintain us healthy. In order to degree the frame temperature, we use thermometers and a sphygmomanometer to reveal the Arterial Pressure or Blood Pressure. Heart Rate may be monitored in ways: one manner is to manually test the heartbeat both at wrists or neck and the opposite manner is to apply a Heartbeat Sensor. The DS18B20 is one kind of temperature sensor and its components 9-bit to 12-bit readings of temperature. These values display the temperature of a specific device. The conversation of this sensor may be accomplished via a one-twine bus protocol which makes use of one records line to talk with an internal microprocessor. Additionally, this sensor receives the strength deliver at once from the facts line in order that the want for an outside strength deliver may be eliminated. The programs of the DS18B20 temperature sensor consist of commercial structures, patron products, structures which can be touchy thermally, thermostatic controls, and thermometers.
The MEMS accelerometers can be divided into two important micro system architectures: piezo resistive and capacitive. Even alevin though each of those styles of accelerometers own inner evidence hundreds which can be excited with the aid of using acceleration, the variations of those architectures lie withinside the transduction mechanism that is used to the motion correlation of the inner evidence mass to accelerate. The Capacitive accelerometers own a differential capacitor whose stability is disrupted with the aid of using the evidence mass

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movement. Piezo resistive accelerometers commonly rely on inducing, which attach the proof mass to the sensor which is used for identification of the movement of the mass.

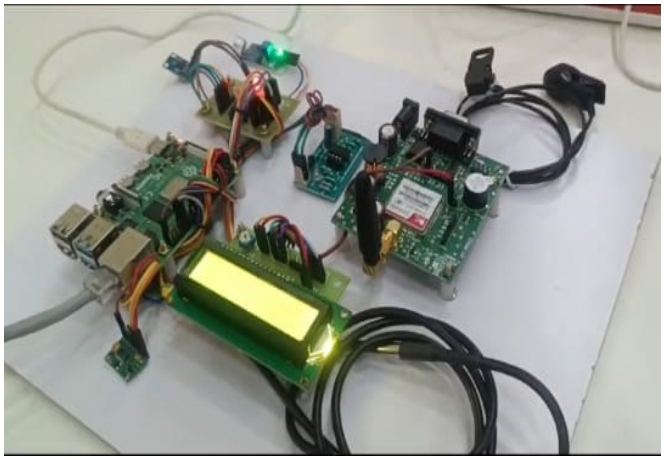

FIG: 4.1 CIRCUIT OF THE HARDWARE

A respiratory sensor is a device that monitors and measures various parameters related to the respiratory system. These sensors are used in medical, research, and sometimes fitness applications to gather information about an individual's breathing patterns and respiratory function. The data collected by respiratory sensors can provide valuable insights into a person's health, help diagnose respiratory conditions, and monitor the effectiveness of treatments.

The module functions the MAX30100 – a modern, included pulse oximeter and coronary heart price sensor IC, from Analog Devices. It combines LEDs, a photodetector, optimized optics, and low-noise analogy sign processing to come across pulse oximetry (SpO2) and coronary heart rate (HR) signals. On the right, the MAX30100 has LEDs – a RED and an IR LED. And at the left is a completely touchy photodetector. The concept is which you shine an unmarried LED at a time, detecting the quantity of mild shining returned on the detector, and, primarily based totally at the signature, you can measure blood oxygen level and heart rate.

A GSM modem also can be a general GSM cell tele cell smartphone with the proper cable and software program motive force to hook up with a serial port or USB port to your computer. GSM modem is typically ideal to a GSM cellular phone. The GSM modem has extensive variety of packages in transaction terminals, deliver chain management, safety packages, climate stations and GPRS mode far off statistics logging. It calls for a SIM (Subscriber Identity Module) card similar to cell telephones to spark off communique with the network. Also, they've IMEI (International Mobile Equipment Identity) range much like cellular telephones for his or her identification. A GSM/GPRS MODEM can carry out the subsequent operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The ESP8266 is connectivity to your projects. The module can work both as an Access point (can The ESP8266 is a very user-friendly and low-cost device to provide internet create hotspot) and as a station (can hook up with Wi-Fi), as a result it is able to effortlessly fetch facts and add it to the net making the Internet of Things as clean as possible. It also can fetch information from the net the usage of APIs for this reason your challenge ought to get admission to any records this is to be had at the net, as a result making it smarter.

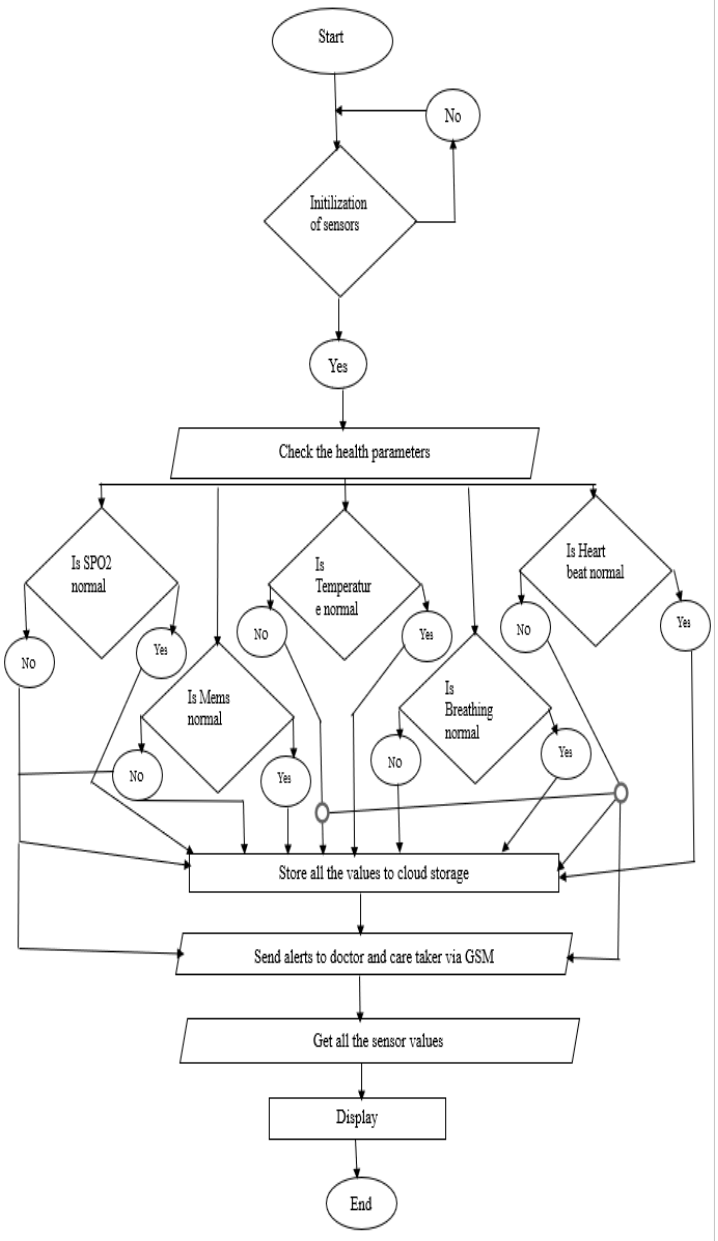

FIG: 4.2 FLOW CHART

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4.2 SOFTWARE REQUIREMENTS:

PYTHON:

Developments in information and communication have brought about the advent of the Internet of Things (IoT). Internet of Things enables more physical sensors/devices to collect data via the internet and provides further methods of data connectivity. Nowadays IoT has affected every part of our life, including health care, smart city, transport, and many more. The health monitoring system was described in this research to offer sufficient patients' health status in real-time to the clinicians remotely. Monitoring the precise state of the patient in the absence of the doctor was developed for effective health purposes. The system collects patient information including Spo2, heart rate and body temperature, in addition to providing patient location information in emergency situation with SMS alert notification in case of presence abnormal health parameters value. The system also includes a cross platform mobile application as graphic user interface for both clinicians and patients. The physical presence of patients and clinicians may be avoided by implementing the suggested system in healthcare management, and the condition of patients with any abnormal parameters can be monitored Remotely for powerful intervention, permitting docs to make life-saving selections on the proper time.

5. RESULTS AND DISCUSSION

FIG: 5.1.1 MEMS SENSOR OUTPUT

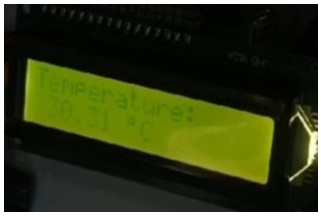

FIG: 5.1.2 TEMPERATURE SENSOR

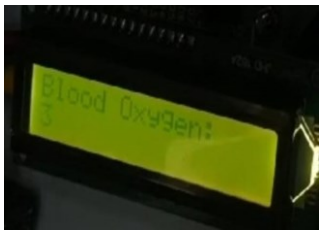

FIG: 5.1.3 PULSE OXIMETER OUTPUT

FIG: 5,1.4 HEART BEAT SENSOR OUTPUT

FIG: 5.1 OUTPUT OF THE HARDWARE

PROCESS FOR SENDING MESSAGE:

1. When any health parameter crosses the threshold value then LCD shows us the patient need assistance message.
2. Messages or Alerts will be sent to the Doctor and Care taker mobiles.

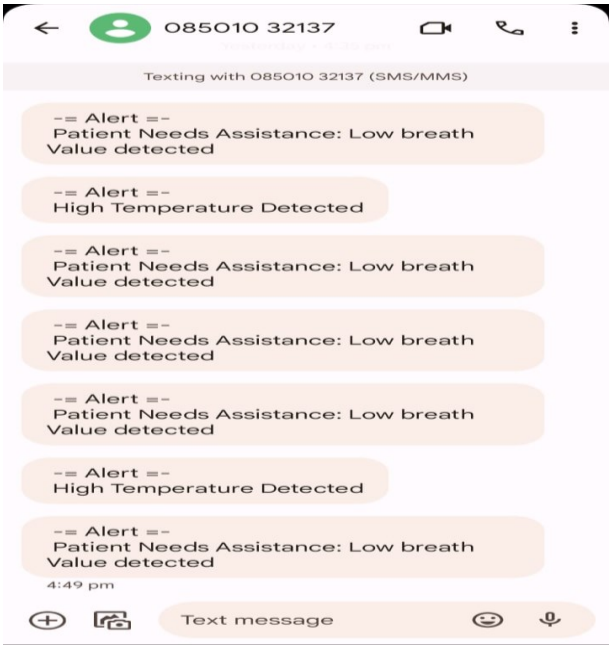

FIG: 5.2 ALERT'S IN DOCTOR'S MOBILE

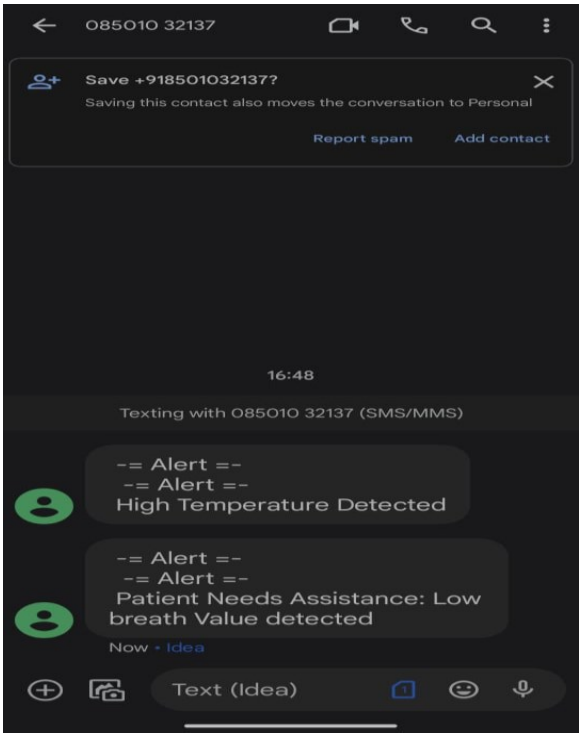

FIG: 5.3 ALERT'S IN CARETAKER'S MOBILE

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Table: 5.1 Table

SL NO	Type of Sensor	Abnormal value	Normal value
1	Mem's sensor	>1400	1400
2	Pulse Oximeter sensor	Oxygen level in the blood	Oxygen level in the blood
3	Temperature sensor	>30	30
4	Heart beat sensor	>100	up to 90
5	Respiratory sensor	Exhale/Inhale	Exhale/Inhale

In MEMS sensor, when X Exceeds the threshold value i.e. 1400, patient needs food and Y crosses the threshold value patient needs water.

6. CONCLUSION:

Developments in information and communication have brought about the advent of the Internet of Things (IoT). Internet of Things enables more physical sensors/devices to collect data via the internet and provides further methods of data connectivity. Nowadays IoT has affected every part of our life, including health care, smart city, transport, and many more. The health monitoring system was described in this research to offer sufficient patients' health status in real-time to the clinicians remotely. Monitoring the precise state of the patient in the absence of the doctor was developed for effective health purposes. The system collects patient information including Spo2, heart rate and body temperature, in addition to providing patient location information in emergency situation with SMS alert notification in case of presence abnormal health parameters value. The system also includes a cross platform mobile application as graphic user interface for both clinicians and patients. The physical presence of patients and clinicians may be avoided by implementing the suggested system in healthcare management, and the condition of patients with chronic diseases can be monitored Remotely for powerful intervention, permitting docs to make life-saving selections on the proper time.

FUTURE ENHANCEMENT:

According to the provision of sensors or improvement in biomedical fashion extra parameter may be sensed and monitored if you want to appreciably enhance the performance of the wi-fi tracking gadget in biomedical field. A graphical LCD may be used to show a graph of price of extrude of fitness parameters over time. The whole health monitoring system which we have framed can be integrated. This will assist the sufferers to without problems bring this tool with them anyplace they go. In addition, with medical application we can use our system in industrial and agricultural application by using sensors like humidity sensors, fertility check sensors, etc.

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