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Design and Development of IoT based Health Monitoring System

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Abstract: ***With prospects for developing technology, patient health monitoring is a significant and quickly expanding topic nowadays. Various designs for patient healthcare monitoring systems have been developed by numerous researchers in accordance with technological advancements. The devices in the suggested business plan, which include web-based sensors and mobile applications, communicate over a network to improve the efficiency of the system designed to record and monitor patient health information. In order to precisely analyze a patient's health status, a health system comprising sensors and monitoring devices has been built. These devices are able to collect medical data from patients and then send alarms via GSM module to specialized doctors. In order to gather health-related data, this project will connect patients via the Internet to an appropriate monitoring system that will improve medication care for both local patients and patients who live in remote areas without hospitals nearby. The devices will be able to record the patient's temperature, heart rate, and the oxygen levels in their blood.***
Keywords: Arduino UNO, LCD Display, Temperature sensor (DS18B20), Accelerometer (ADXL345), Heart Beat sensor (LM358), MAX30100, Flex sensor, GSM module (SIM900A)

I. INTRODUCTION

The worldwide healthcare scene of nowadays is stamped by a compounding rise in constant sicknesses, which are ascribed to components like late onset of liquor and tobacco utilize, tall weight rates, inactive ways of life, and other lifestyle-related propensities. As per the World Wellbeing Organization (WHO), millions of people around the world surrender to afflictions counting tall blood weight, corpulence, and diabetes each year, underscoring the squeezing require for reasonable healthcare mediations. Patients with constant sicknesses require persistent treatment consideration to screen their wellbeing in a sensible way. Crucial signs such as blood oxygen levels, temperature, and heart rate are vital pointers of a patient's wellbeing. Utilizing observing advances that can screen these imperative signs in real-time has gigantic openings for making strides care conveyance and care coordination. There have been noteworthy mechanical progressions in medical field, but the development of the Web of Things (IoT) stands out as a game-changing drive. This presentation gives subtle elements on the genuine advance and powers impelling the headway of Web of Things-based Success Checking Frameworks. Moreover, IoT-driven activities have contributed to the change of healthcare conveyance by empowering farther interviews, customized medicine regimens, and mass thriving organizing exercises. The creation of Web of Things (IoT)-based Success Observing Frameworks basically talks to a fundamental headway in healthcare advance, meaning a commitment to utilizing innovation to advance thriving, modernize care openness, and secure people's capacity to lead superior ways of life.

II. LITERATURE SURVEY

Ananda Mohan Ghosh et al. [1] have created a health monitoring system for running the hospital that will allow family members and consulting doctors to remotely check the patient's state online using an E-health sensor shield kit interface kit. But it doesn't send out email or SMS alerts to the appropriate physicians and family members. A raspberry pi-controlled patient monitoring healthcare system that monitors a patient's temperature, heart rate, breathing level, and movement has been proposed by P Kumar et al. [2]. Data is collected by sensors and shown on the screen by Putty software. However, our recommended approach incorporates an alarm warning system to compel medical professionals or family members to provide the patient the necessary prescription drugs.

Sarfraz Fayaz Khan [3] has used RFID tags and the Internet of Things to create a helpful patient monitoring kit. However, it lacks the preventative actions that our study discusses, such as managing the appliances and giving the patient their prescribed medications.

Only keeping an eye on the patient's health and notifying physicians and family members of any changes have been taken into consideration by Freddy Jimenez et al. [4]. Furthermore, it lacks the appliance control that is a part of our solution; instead, it is solely concerned with monitoring and promptly notifying the appropriate parties. S. Siva [5] et al. have shown how to use the smart hospital system to always have the details about patient's vitals. The spark kit can be used to keep an eye on the patients' health. It takes the patient's temperature and heart rate, sending out an alarm signal if any of the metrics exceed the pre-established threshold.

III. WORKING

A. Block Diagram

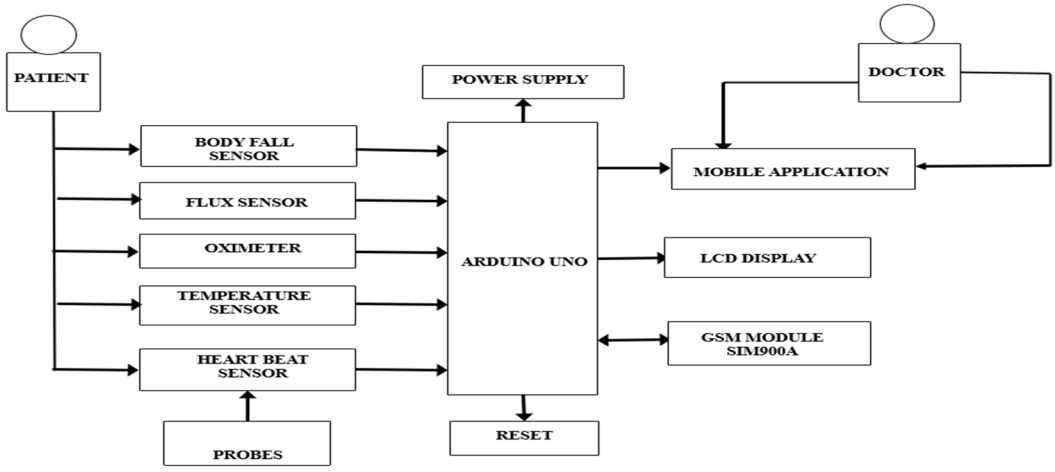

Fig 3.1 System Block Diagram

This project uses the Internet of Things to detect the patient's numerous metrics. In Internet of Things (IoT)-based health monitoring systems, the doctor receives real-time patient data via an internet connection via a GSM or Wi-Fi module. In our present project, we are sending alert calls or messages to the doctor or anybody else who knows the patient using a GSM module. The user can access the details at any moment by having the collected data emailed to any location in the world. Doctors and their loved ones can frequently view patient health data with Internet of Things (IoT) based monitoring equipment. The reason for this is that the data is only accessible via a web page or a laptop address while the impacted person tracking system is based on the Global System for Mobile Speech Communication.

IoT primarily based totally fitness tracking structures have diverse senses. Initially they feel the temperature degree, pulse rate, hand second that's connected with the movement of frame and oxygen degree of the affected person with the assist of temperature sensor, heartbeat sensor, flex sensor, frame fall sensor and oximeter sensor. Whenever any unique fitness parameter is going past an appropriate restrict or any odd scenario arises,an alert is ship to the medical doctor on this proposed system. By which the medical doctor or the caretaker will take right motion right away. The corresponding medical doctor might be notified right away letting them offer the right remedy in time. This is extraordinarily beneficial because the medical doctor will come across the affected person`s fitness parameters definitely through traveling a web internet site or IP address. And nowadays numerous IoT apps also are being developed. So the medical doctor and family will screen or music the affected person`s fitness via Android apps.

IV. HARDWARE COMPNENTS

The hardware components required for this project are:

- Arduino UNO
- Body fall sensor
- Flex sensor
- Oximeter
- Pulse sensor/ Heartbeat sensor
- Temperature sensor
- LCD display
- GSM Module (SIM900A)

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A. Arduino UNO

It is made up of a microcontroller or programmable printed circuit and the free software Arduino IDE (Integrated Development Environment), which is used to write computer code and upload it to the physical board. Computer code is written and loaded onto a physical disc using it.

B. Body Fall Sensor (ADXL345)

ADXL345 measures both static acceleration due to gravity and dynamic acceleration due to movement or impact. The sensors are supplied in a small 3 x 5 x 1 mm 14-pin LGA package. This sensor can be used in many mobile phone applications, such as game consoles, mobile phones, pointing devices, personal navigation systems, hard security devices and industrial and medical instruments.

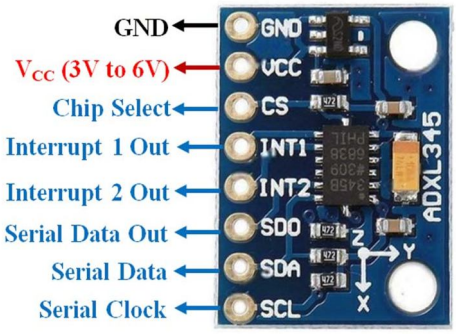

Fig 4.1: Accelerometer (ADXL345)

C. Flex Sensor

A flex sensor, sometimes called a bend sensor, is a cheap, simple-to-install tool used to measure curvature or degree of bending. The flex sensor works similarly to a variable resistor in that its resistance changes as it bends. Its resistance is usually referred to as a flexible potentiometer since it is directly correlated with the degree of bending. These sensors are sometimes referred to as flexible potentiometers and are often found in two-degree bending. These sensors are typically available in two lengths: 2.2″ (5.588 cm) and 4.5″ (11.43 cm).

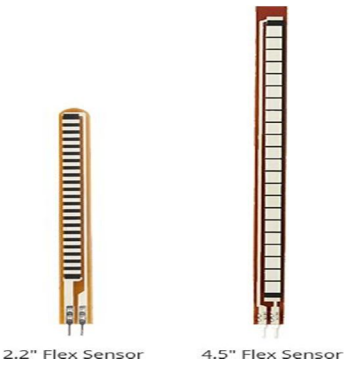

Fig 4.2: Flex sensors of different lengths

D. Oximeter (MAX30100)

A heart-rate screen and a beat oximeter are combined within the sensor arrangement MAX30100. It is an optical sensor that employments a photodetector to degree the absorbance of throbbing blood after two LEDs deliver two diverse light wavelengths: an infrared and a ruddy one. Usually the perfect combination of Driven colors to examined information together with your fingertip. The MAX30100's beat oximetry subsystem is made up of a one of a kind discrete worldly channel, 16-bit sigma delta ADC, and encompassing light cancellation (ALC). Due of its inconceivably moo control utilization, battery-operated frameworks discover it perfect. The MAX30100 works inside the 1.8 to 3.3V supply run. Wearable innovation and restorative observing gadgets can make utilize of it.

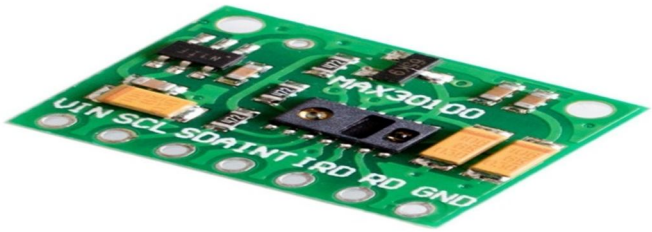

Fig 4.3 : Oximeter(MAX30100)

E. Pulse sensor/ Heartbeat sensor(LM358)

The pulse is the rate at which the heart beats once presently. BPM stands for beats per diminutive. The normal heart rate in people is alluded to as sinus beat. Depending on the requirements of the persistent, the sinus cadence might shift between 50 and 90 beats per miniature and real capacities. Applications for the chip-sized operational speaker LM358 IC incorporate DC pick up pieces, transducer speakers, and ordinary op-amp circuits. An extraordinary operational intensifier that fulfills your needs is the LM358 IC. It's a ordinary demonstrate. It features a source that can oversee up to 20mA per channel and a 3-32V DC supply. Since it can run two particular op-amps off of a single control source, this op-amp is appropriate. It incorporates an 8-pin Plunge bundling.

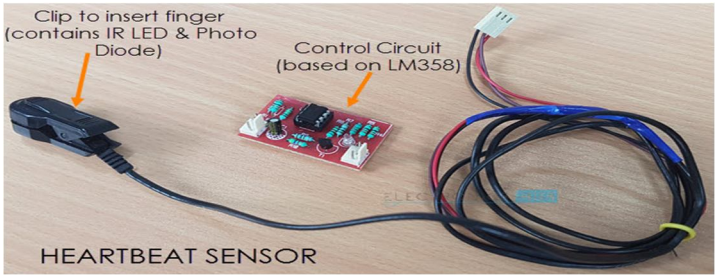

Fig 4.4 : Pulse sensor/ Heartbeat sensor(LM358)

F. Temperature Sensor (DS18B20)

The DS18B20 Digital Temperature Test gives 9–12 bit (flexible) temperature estimations that can be utilized to see the device's temperature. Data is moved to and from the single cable plus ground is all that's required to put through a DS18B20 to a central CPU through a single cable interface. The information line itself has the capacity to studied, compose, and change over temperatures, in this way no other control source is required.

Fig 4.5: Temperature sensor(DS18B20)

G. LCD Display

Due of its two lines and sixteen letters per line, the LCD we utilized is called a 16x2 LCD. Each character is appeared on this LCD as a 5x7 pixel framework. There are 224 particular characters and images that can be shown on the 16x2 shrewdly alphanumeric speck framework display. LCD's are level optical shows that combine polarizers with the light-modulating capabilities of fluid precious stones. Fluid gems utilize a backdrop illumination or reflector to create color or monochrome pictures rather than creating light directly.

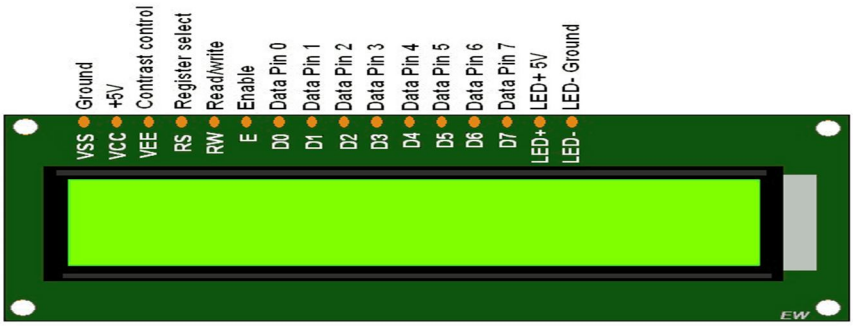

Fig 4.6: LCD Display

H. GSM Module (SIM900A)

The Double Band GSM/GPRS SIM900A modem from SIMCOM is the premise for the SIM900A modem. It employments a recurrence run of 900 to 1800 MHz. Band checking is programmed with the SIM900A. The frequency groups can too be changed with AT commands. The baud rate can be changed from 1200 to 115000 with an AT command. You'll be able interface to the internet via GPRS thanks to the GSM/GPRS Modem's inbuilt TCP/IP stack. The SIM900A is a exceptionally compact and steady remote module.

Fig 4.7: GSM Module(SIM900A**)**

V. RESULTS

We report the findings from our project, "Design and Development of IoT Health Monitoring System," in this part. Actionable data and alarms are produced by the IOT-based Health Monitoring System featuring Temperature sensor, Flex sensor, oximeter, heartbeat sensor, MEMS sensor, LCD display, and GSM connectivity. The testing and implementation phases are the most crucial for the development project.

As a result, we can assess if the result met our expectations. After the system is executed, this is demonstrated. It yielded distinct results for particular sensors. The testing of each sensor yields results in a variety of ways, and it's an effective method. The outcomes show that our project was implemented successfully and functions as intended. We used the temperature, oximeter, pulse rate, accelerometer, heart rate, and flex sensor to assess the patient's health. The patient was able to properly manage their health and make educated decisions thanks to the visual display of the collected data on an LCD interface.

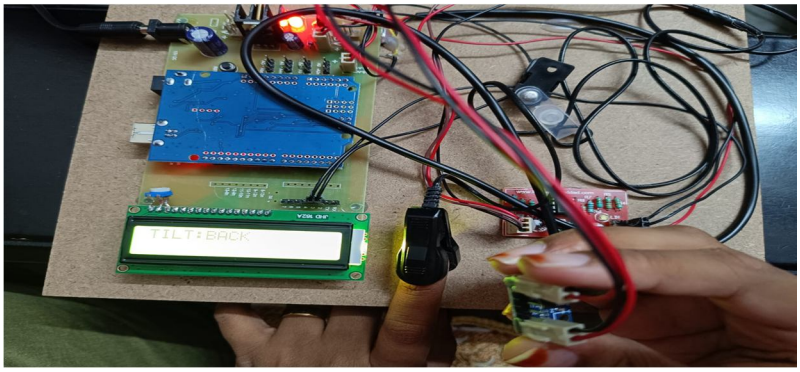

Fig 5.1: Complete setup of the System

A. LCD Display Output

The real-time health parameters of the patient are represented visually by the LCD display. We can keep an eye on the state of the patient's health as well as any changes to its parameters thanks to it. An essential component of the health monitoring system, the LCD display acts as a direct link between the patient and the system, giving them the information they need to make decisions and react proactively to changes**.**

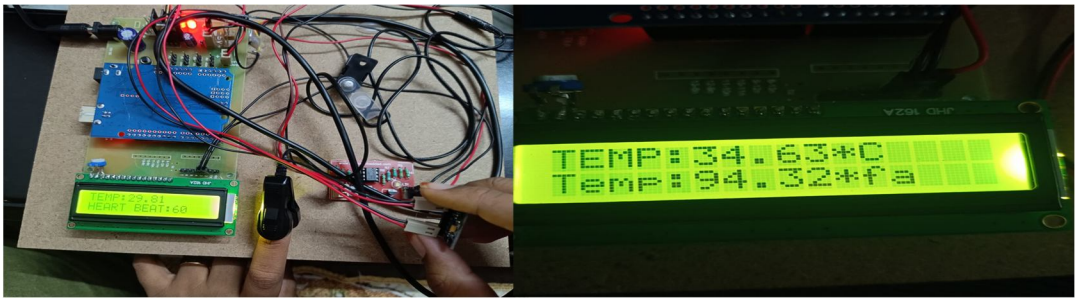

Fig 5.2: Temperature Readings of the patient

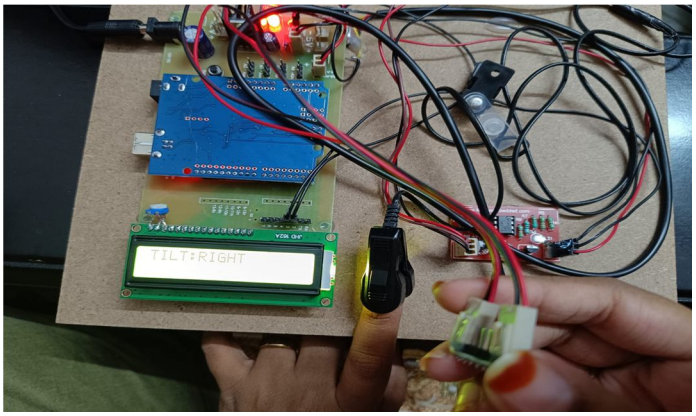

Fig 5.3: Accelerometer Sensor output displayed on LCD

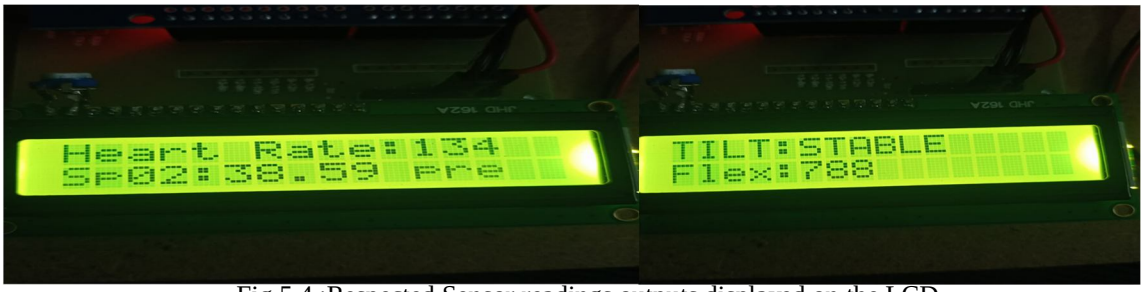

Fig 5.4 :Respected Sensor readings outputs displayed on the LCD

Fig 5.5 :When the flex sensor is bent ,the necessity of the patient is displayed on the LCD

B. Alert Messages via GSM

When sensor values exceed predefined thresholds, the system triggers an alert. The GSM module sends alert messages via SMS to predefined recipients.

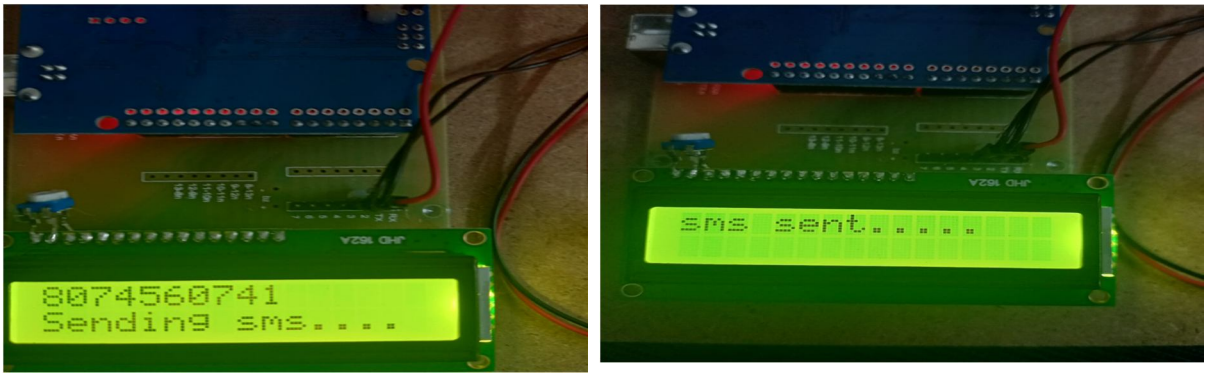

Fig 5.6 Sending alert SMS messages to recipients

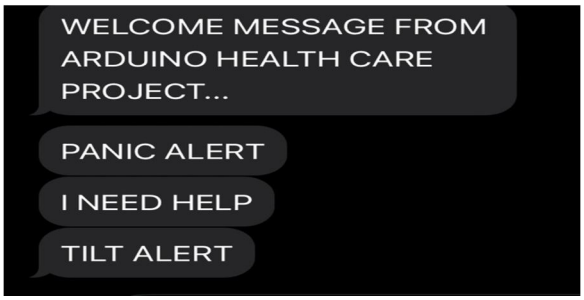

Fig 5.7 Received messages from the patient

Fig 5.8 Calling the doctor if the defined thresholds reached and doctor(Neha Kiran) received calls from the patient

VI. ADVANTAGES AND DISADVANTAGES

A. Advantages

1) Dodge sitting around idly and vitality.

2) A therapeutic emergency can be deflected with the assistance of real-time inaccessible observing through connected IoT gadgets and shrewd notices that can recognize and treat afflictions.

3) Productive healthcare plans can be created by analyzing totaled information gotten from various patients to distinguish wellbeing patterns and designs. This approach makes strides the understanding of populace wellbeing.

B. Disadvantages

1) There may be integration complexity when coordination diverse IoT stages, sensors, and gadgets from diverse producers.

2) Securing understanding security and secrecy requires solid security measures and encryption procedures.

3) Although IoT has the potential to lower healthcare costs within the long run, healing center arrangement and staff preparing costs are significant.

VII. APPLICATIONS

Through the IoT-Based Understanding Wellbeing Observing Framework extend, we are utilizing IoT to monitor a number of quiet parameters. Numerous people can see understanding wellbeing subtle elements within the IoT-based framework. For the client to see this information by means of the app, they only require a useful web association. A GSM module association is required in arrange to run a Web of Things (IoT) based wellbeing checking framework extend. This extend is particularly planned for the elderly in our domestic and for debilitated patients who discover it greatly difficult to visit the specialist on a day by day premise. It is the foremost requesting field within the therapeutic industry. Empower incessant patients' care to be proceeded. Give a stage for unremitting patients to track, screen, and degree their wellbeing. Make information for assessing wellbeing dangers accessible. Follow to ethical quality healthcare methods that run from keeping up clinical records to trading germane information. Patients can counsel with doctors at a remove, sparing time when they visit the clinic.Gathering, assessing, and conveying information in a convenient way.

VIII. CONCLUSIONS

The advent of IoT-based patient health monitoring systems signifies a revolutionary stride in healthcare technology, promising sweeping advancements with profound implications. By harnessing the capabilities of interconnected devices, real-time data collection, and advanced analytics, these systems are poised to redefine patient care paradigms and empower individuals with greater control over their health. This integrated IoT-based healthcare platform holds immense potential for elevating care quality, fostering patient autonomy, and streamlining healthcare delivery processes to be more efficient and personalized. Our work presents a methodological approach to the development of real-time patient health monitoring systems. Leveraging three sensors to measure critical parameters such as heart rate, body movement, and temperature, our system utilizes Arduino microcontrollers to process sensor inputs and make informed decisions based on contextual factors. The resulting data is then promptly displayed on an LCD screen, facilitating immediate access and interpretation of vital health information and also send an SMS or directs a call to the doctor if any of the sensor reaches or exceeds the threshold value using GSM module. Through rigorous testing and validation, our approach has yielded positive outcomes, underscoring its efficacy and potential for widespread adoption.

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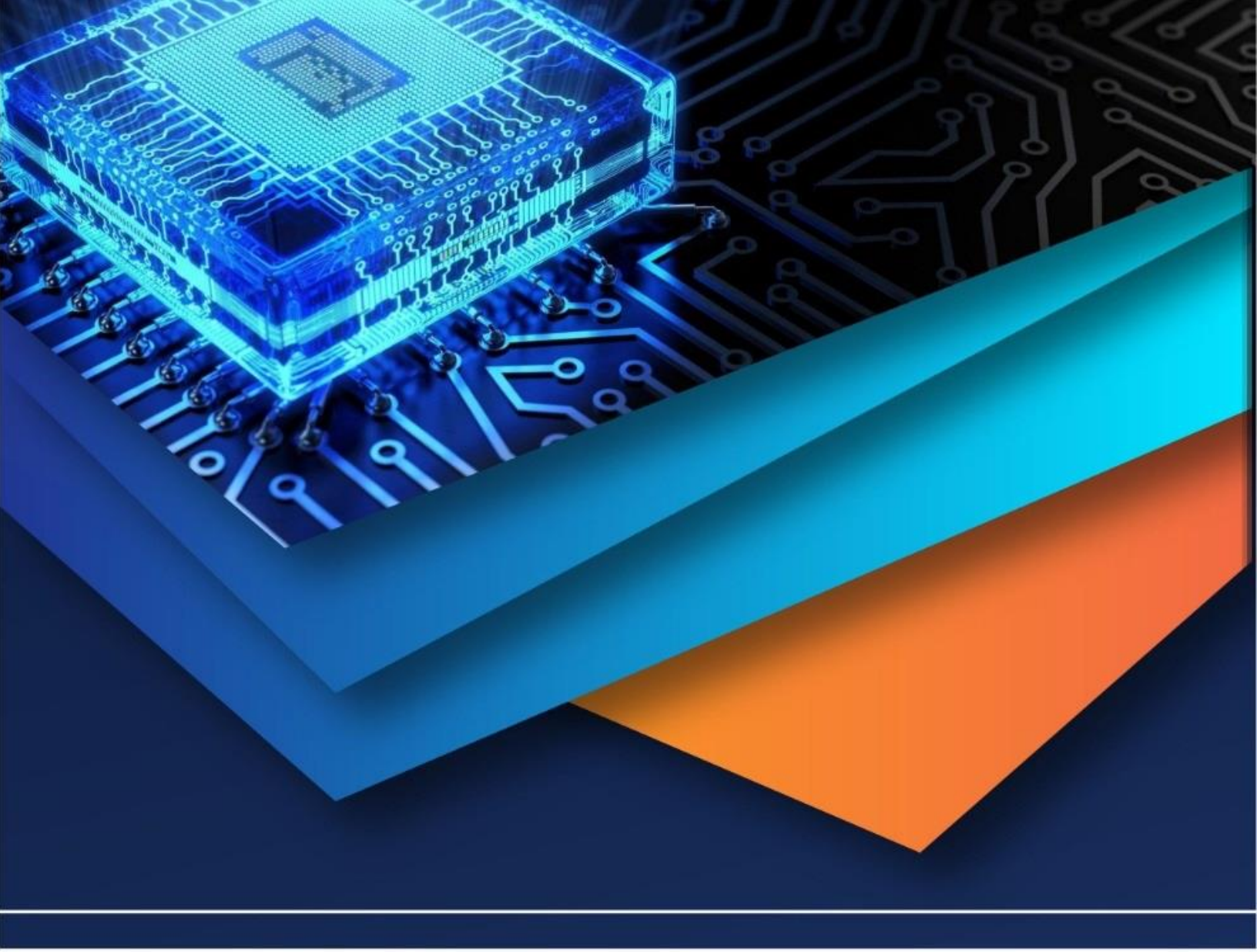

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