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Internet of Things (IoT) Based Smart Health Monitoring System – A Case Study

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Abstract **- A new corona virus has heightened awareness of the need of health care in every country. IoT-based health monitoring systems are the greatest option in this regard. In particular, health care researchers are increasingly interested in the Internet of Things (IoT). Remote health care monitoring has grown at such a rapid pace due to the increasing usage of wearable sensors and smart phones. Even if a doctor is far away, IoT health monitoring can assist prevent the spread of disease and provide an accurate diagnostic of the status of health. Authorized individuals can access this data saved on any IoT platform and diagnose illnesses based on these values obtained from a distance using the suggested remote health monitoring system.**

Keywords: Internet of Things (IoT), health Monitoring, Sensors, Medical Devices

I. INTRODUCTION

Health is always a major concern in every growth the human race is advancing in terms of technology. Like the recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. It is always a better option to monitor these individuals utilising remote health monitoring equipment in regions where the pandemic is widespread. IoT-based health monitoring systems are the current answer [6].

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Using Remote Patient Monitoring, patients can be seen outside of their usual clinical settings (such as their homes). This allows for more access to human services offices while reducing costs. Using sensors to track patient health and the internet to notify loved ones of any concerns, this project's main aim is to create and deploy a smart patient health tracking system. The objective of developing IOT based patient checking framework [7].

In IoT based framework, subtle parts of the patient flourishing can be seen by different clients. The explanation behind this is the information should be checked by IoT application. Medical facilities are often out of reach of the indigenous in remote regions. As a result, monitoring systems are used to minimise health care expenses by lowering physician office visits, hospitalizations, and diagnostic testing procedures, among other things. Everybody's body uses temperature and pulse recognition to assess their health [8-10].

The sensors are connected to a microcontroller, which tracks their state and can send warnings to a remote location.

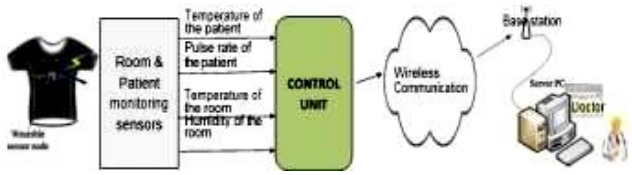

Figure 1.Flow diagram [13]

If the framework detects any abrupt changes in heart rate or body temperature, it notifies the client through IoT and displays subtle aspects of the patient's pulse and temperature in real time on the web. Silent wellness measures may be monitored and saved using an IOT-based monitoring system that leverages the internet [11].

A strong relationship exists between pulse rate and other factors. Health problems are treated only after they have reached the point when their lives are in danger. This might lead to an unnecessary loss of wages. In particular, this is important when an epidemic spreads in a region where doctors cannot access it. A smart sensor that allows patients to be watched from a distance might be a realistic way to prevent the spread of illness [12-13].

In literature study we have studies various details about Health Monitoring System.

S. J. Jung and W. Y. Chung studied the Flexible and scalable patient's health monitoring system in 6LoWPAN. The main advantage of this enabling factor is the combination of some technologies and communications solution. The results of Internet of Things are synergetic activities gathered in various fields of knowledge like telecommunications, informatics and electronics [1].

K. S. Shin and M. J. Mao Kaiser developed a cell phone-based health monitoring system with self-analysis that incorporates IoT, a new paradigm that uses smart objects that are not only capable of collecting information from the environment and interacting with the physical world, but also of being interconnected with each other via the internet to exchange data and information [2].

During her time in university, Cristina Elena Turcua completed a Bachelor of Radio frequency identification, multi-agent systems, and the Internet of Things are being utilised to create and improve people's access to excellent health care services, as well as to optimise the health care process [3].

J.L. Kalju developed a system, which is capable of measuring different physiological parameters and are used to design a system for heart rate reconstruction for rate adaptive pacing [4].

Biomedical sensors made from the integration of sensing materials with integrated circuitry have been tested by Loren Schwiebert, Sandeep Gupta, and Jennifer Weinmann [5].

II. Block Diagram

In this healthcare monitoring system, we use NodeMCU, Arduino's and sensors. These sensors used to monitor the different parameters of patient remotely and also control over medicine dosage is provided.

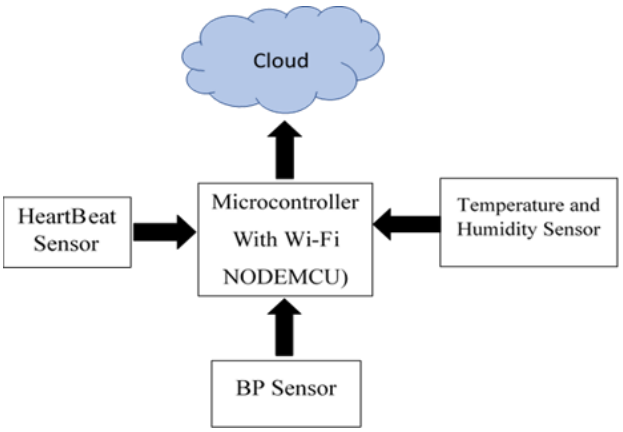

Figure 2. Block Diagram of IoT Based Health Monitoring System

Fig. Block Diagram of IoT Based Health Monitoring System

This system helps doctors to monitor vital parameters like body temperature and humidity, heartbeat, blood pressure, acceleration and saline level of patients in remote areas of hospital as well as he can monitor the patient when he is out of the hospital. If the parameters go to abnormal these system sends alert message to the doctors or it makes a buzzer sound. [28-30]. All these information and communication between doctor and patient is possible only through the android application blynk.[14]. NodeMCU is worked as server which takes the information gathered by Arduino's from sensors and puts complete information on the application created. This system gives the minute-to-

minute update to the doctor. Thus, we can reduce the deaths and can save people more easily [15].

A. Hardware Requirements

- Microcontroller ESP8266-12E
- NodeMcu
- Humidity and Temperature Sensor
- Pulse oximeter MAX30100

B. Software Requirement

- Blynk Android Application

C. Component's Description

1. Microcontroller ESP8266-12E

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espresso Systems.

Figure 3. ESP8266-12E

Ai-Thinker, a third-party producer, introduced the ESP-01 module to western makers in August 2014. Simple TCP/IP connections may be made using microcontrollers by utilising Hayes-style instructions and a Wi-Fi module. At the time, there was little or no English-language documentation on the chip and its instructions [16]. Many hackers were drawn to the module, chip, and software because to its low price and the fact that it had relatively few external components, which suggested that it could be produced in large quantities at a low cost [17].

As an ESP8266 with 1 MiB of built-in flash, the ESP8285 is capable of connecting to Wi-Fi on a single chip. As an all-in-one microcontroller and Wi-Fi development platform, the ESP8266 (ESP-12E) Wi-Fi Development Board is very easy to use to construct projects that employ both Wi-Fi and IoT (Internet of Things) applications ESP8266 Wi-Fi Module chip with ESP-12 SMD footprint is used to build the board [18].

2. NodeMCU

This open-source software and hardware development environment is designed on ESP8266, a relatively low-cost System-on-a-Chip (SoC). All of the essential components of a contemporary computer are included in the espresso systems ESP8266, including a modern operating system and a CPU and RAM [19].

Figure 4. NodeMCU

But the ESP8266 is equally difficult to access and utilize because it's a chip. Powering on the chip or sending a keystroke to its "computer" requires soldering analogue voltage cables to its PINs. Programming it with low-level machine instructions that the chip hardware can understand is another need [20]. For hobbyists, hackers, and students, this degree of integration is a major obstacle when using the ESP8266 as an embedded controller in mass-produced devices, but it's a non-issue when using it in their own IoT projects [21].

3. Humidity & Temperature Sensor

Digital output is generated by the DHT11 Humidity and Temperature Sensor. In addition, the DHT11 can interact with any microcontroller, such as Arduino or Raspberry Pi, and provide immediate feedback [22]. Moisture and temperature sensor DHT11 is a low-cost sensor that offers good reliability and long-term stability. The gadget has four pins and operates on a one-wire protocol. VCC, GND, and a pull-up resistor on the single data line are all you need to connect it to your project [23].

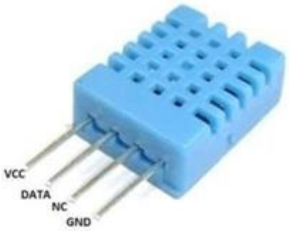

Figure 5. Humidity and Temperature Sensor

4. MAX30100 Pulse Oximeter

Heart-rate monitor system with integrated pulse-oximetry sensor. It detects pulse and heart rate using two LEDs, a photodetector, improved optics, and low-noise analogue signal processing. Because the power supply may be left connected at all times, it runs on both 1.8V and 3.3V power sources and can be shut down by software with little standby current [25].

Figure 6. Pulse Oximeter

5. Blynk Android Application

Apps for iOS and Android let you manage Arduino, Raspberry Pi, and other devices via the Internet with Blynk's Platform. It's a digital dashboard where you may drag and drop widgets to create a graphic interface for your project. To get started, it takes less than five minutes to set everything up [27].

Unlike other boards and shields, Blynk is not bound to any one board or shield. Instead, it supports the hardware of your choosing, allowing you to customize your system. Blynk will get you online and ready for the Internet of Things, regardless of whether your Arduino or Raspberry Pi is connected to the Internet through Wi-Fi, Ethernet, or this new ESP8266 chip [26].

III. Working Algorithm

A sensor for measuring the patient's heart rate is attached to the patient's finger. This device is equipped with an infrared (IR) sensor. This sensor sends us a pulse with every pumping action. Using a Signal Conditioning Unit, this sensor output is amplified and sent to the NodeMCU.

A temperature and humidity sensor, the DHT11, is utilised in Step 2. NodeMCU also receives this temperature and humidity sensor data, which fluctuates dependent on temperature.

A BP sensor measures the patient's blood pressure, and if any abnormalities are detected, the information is transmitted to NodeMCU.

Node MCU receives the information received by the sensors, which is then processed.

A NODE MCU is a WIFI module that gathers sensor data and sends it to a server through the internet.

A mobile application may be used to see the information that is saved on the server (Graphical User Interface).

Physician has remote access to the patient's health information via the mobile app.

- Advantages of System
  1. Better patient experience
  2. Improved disease management
  3. Homecare
  4. Decreased costs
  5. Reduced Errors
- Applications of system
  1. Day-to-day activity monitoring applications
  2. Fall and movement detection applications
  3. Location tracking applications
  4. Medication intake monitoring applications

IV. Output In Mobile Application

The output result of health monitoring is display out in blynk android application in numeric form. The application is very simple as it just displays the numeric values followed by which kind of result it is. It shows the accurate reading of equipment's.

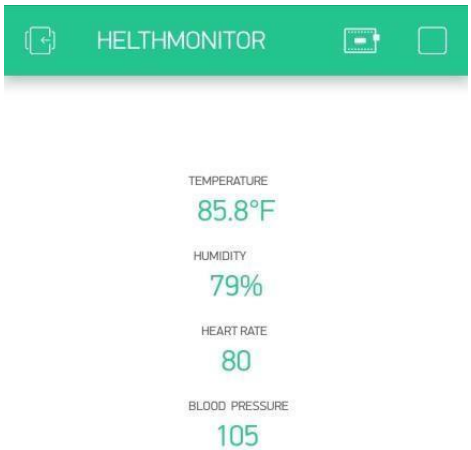

Figure 7. Output Result

V. CONCLUSION

For any remote value tracking, especially in the health area, the Internet of Things is regarded a viable option. For traditional regular tests, hospital stays are shortened, and - most importantly - the health of an individual may be followed and disease diagnosed remotely by any doctor. In this work, a health monitoring system based on the Internet of Things (IoT) is described. In addition to monitoring body temperature and pulse rate, the system also monitored ambient humidity and temperature using sensors, which were presented on a mobile application. Wireless connection is used to transmit these sensor readings to a medical server. These data are then received on a personal smart phone with IoT platform by an authorized individual. From these data, the doctor is able to make a diagnosis of the patient's illness and health status.

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