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A DATA DRIVEN APPROACH THROUGH IOMT BASED PATIENT HEALTHCARE MONITORING SYSTEM

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SUMMARY

The current circumstances underscore the pressing need to accelerate the adoption of Internet of Things platforms in realm of the medical field to improve the health of mankind. Given the present challenges, I propose the development of an Advancing healthcare monitoring system built on the foundation of Internet of Medical Things (IOMT). Advancing patients healthcare IOMT system serves as a communication conduit between patients and doctors, facilitated by the IoMT platform. This platform utilizes various medical sensors connected to a server through technologies such as WiFi and Bluetooth. The data collected and stored in the server is then leveraged to analyse patients' health conditions, guiding subsequent treatment protocols. In this proposed system, the microcontroller serves as an intermediary interface between the sensors and the server. This cutting-edge technology enables remote patient monitoring, eliminating the need for physical presence. Within the prototype, patients' summaries and information is supplied using an online platform. Through the adoption of Advancing Healthcare through Data-Driven IOMT Patient Monitoring, lives can be safeguarded from critical conditions, underscoring the vital importance of embracing such advanced technologies in healthcare.

Key words: *IOMT, sensors, wi-fi, medicine, healthcare.*

INTRODUCTION

The global healthcare industry has faced significant challenges due to the ongoing pandemic, profoundly impacting people's lives worldwide. This situation underscores the urgent need for advancements in healthcare through the integration of cutting-edge technology. The IoT appears as a promising solution, enabling the connection of physical objects to exchange data seamlessly [1]. IoT has revolutionized various sectors, including medicine, where it enables data collection from patients, real-time health monitoring, and supports research endeavors. In response to the growing adoption of IoT in healthcare, here we introduce Internet of Medical Things (IOMT) platform which connects diverse health devices to medical-care systems, fostering communication and data analysis to derive optimal solutions based on acquired data.

Utilizing IOMT streamlines data analysis, offering enhanced accuracy compared to traditional methods. The current climate underscores people's openness to IOMT-based solutions, particularly in remote conditions where physical attendance is challenging. IOMT presents healthcare providers with a significant opportunity to expand their global market reach [2]. In today's daily lives, medical gadgets such as smartwatches, fitness bands, and wearables have become ubiquitous, facilitating real-time health monitoring. These applications are made possible by the advanced features inherent in IOMT [3]. Projections indicate substantial growth in the global healthcare market with IOMT, estimated to reach 332.67 billion dollars by 2027. To facilitate communication and data transmission in IOMT-based gadgets, various methods such as Bluetooth and Wi-Fi are available, simplifying connectivity [4].

Our proposal focuses on online healthcare monitoring, enabling patients to virtually communicate with doctors. Wearables equipped with various sensors are affixed to the patient's body, collecting data that is then stored and monitored on a server. We propose the integration of five different sensors to monitor patient conditions comprehensively: temperature sensors for temperature monitoring, blood pressure sensors for measuring blood pressure, pulse sensors for heart rate monitoring, pulse oximeter sensors for oxygen saturation calculation, and humidity sensors. Through advanced communication technology, these sensors connect to the server, facilitating continuous patient data monitoring and analysis.

EXISTING SYSTEM

Advancing Healthcare through IOMT Patient Monitoring is also known E-Medicine, telemedicine or telehealth, combines cutting-edge therapeutic treatments using internet connectivity for offering distant medical treatment. Patients can access such offerings through web-based portals, including e-consultations and diagnosis followed by treatment. The origins of telemedicine date back to the late 1950s when scholars like Wittson pioneered two-way television systems for healthcare, while Jutra's team established remote radiology [5]. These early efforts paved the way for the integration of electronics and communication technology in medicine, giving rise to telemedicine. Telemedicine has evolved through different stages of development [14].

The first stage, spanning from the late 1960s to the 1980s, saw limited growth due to resource constraints. However, progress accelerated in the following stage, from the 1980s to the early 1990s, with improvements in medical facilities and technology [7]. During this period, medical images were transmitted over longer distances, and consultations occurred via data networks [8]. The third generation, starting in the early 1990s, marked significant advancements, as telemedicine became accessible through public communication systems, enabling services to be delivered via desktop computers [9]. Presently, there's a rapid expansion in e-medicine, driven by cutting-edge IoT solutions are used across the healthcare industry [6, 15]. Today, various therapeutic devices are available across the market, seamlessly integrated into daily life through communication technology. For instance, smartwatches monitor pulse rates and other vital parameters. These stages highlight the development and widespread adoption of e-medicine over time [11, 16].

PROPOSED SYSTEM

The physician's the online platform and patient's the online platform are two separate web-based interfaces included in the suggested method. Data sourced from the patient platform via input and output devices such as monitors, keyboards, printers, scanners, and wearables affixed over the organs of the victim as illustrated in figure 1. In the physician's platform, received data is utilized for patient monitoring, prescription delivery, and advisory services, facilitated through similar input and output devices.

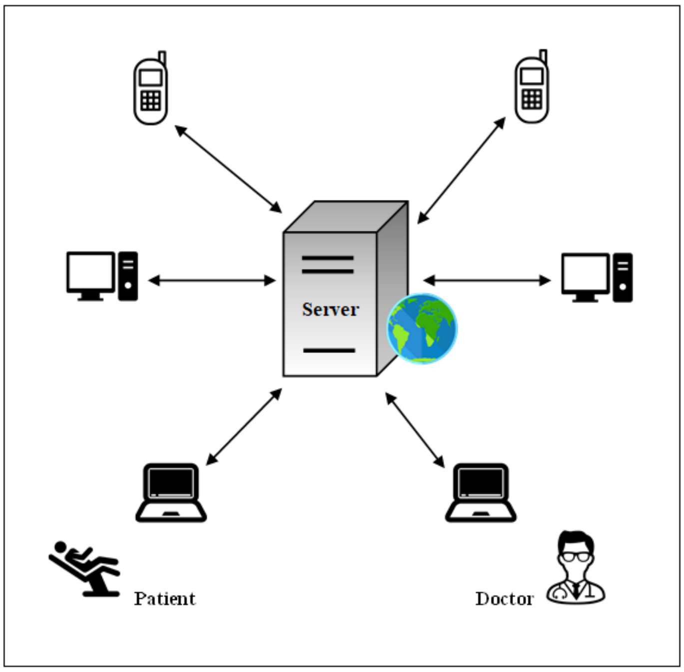

Figure 1. Network Architecture

Data processing is conducted through an SQL server, allowing for efficient storage and retrieval of large datasets. Python was chosen as the primary programming language due to its inherent support for web applications and a vast array of libraries, particularly in image processing and computer vision [12]. The image processing capabilities of Python are particularly valuable in the healthcare industry, complementing its compatibility with various databases, including SQL server [10]. This integration enables seamless data exchange between the client and doctor portals, accommodating the transfer of complex information such as previous prescriptions, X-rays, bills, and chat transcripts [13]. With separate databases for clients and doctors, the system offers multiple channels for patient-doctor connectivity. The database structure is organized as tables comprising rows and columns. Rows delineate ongoing sessions (e.g., session 1, session 2, etc.), while columns contain patient details such as token numbers, names, ages, and identification proofs.

A status bar is implemented to indicate the doctor's online availability; an active status signifies availability, while an inactive status denotes offline status. Using the dialog window, sufferers can acquire notifications about the physician's appointment sessions. This enables for quick communications through token numbers which are specific for every patient, resulting in shorter delays. Python is employed for developing the complete network structure, influencing its innovative features to guarantee the network operates smoothly and efficiently.

The proposed system offers schematics as graphical tools in both physicians and patient platforms to increase understanding, guaranteeing uniqueness as well as precision with depiction. Whenever patient is recurring patient, information system is consulted to get their prior health histories at the moment of meeting initiation, and detectors are employed to determine client's present fitness condition. In case that the individual's condition is novel, data will be taken straight through their devices.

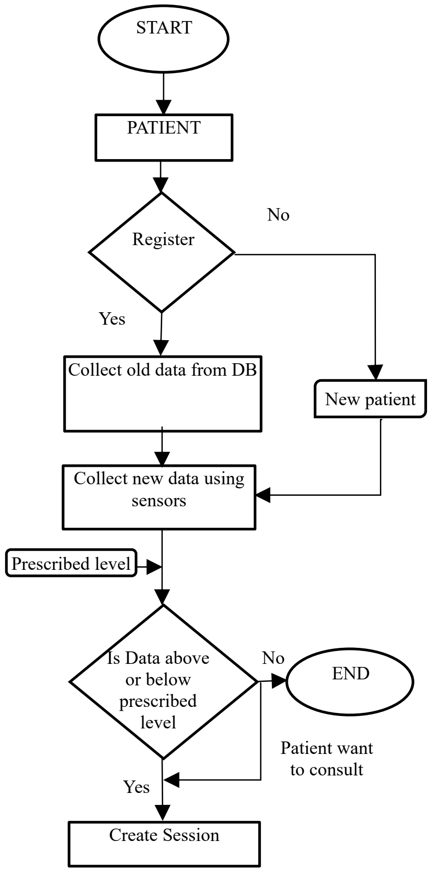

Figure 2. Patient’s Portal Flowchart

In figure 2, the victim's gateway connects the physician's gateway, which in turn acquires information of patient gateway. Whenever a physician answers the call, patient together with physician can communicate via messaging window. After doing an evaluation, the physician uses the physician's gateway to examine the data and prescribe a course of therapies as shown in figure 3.

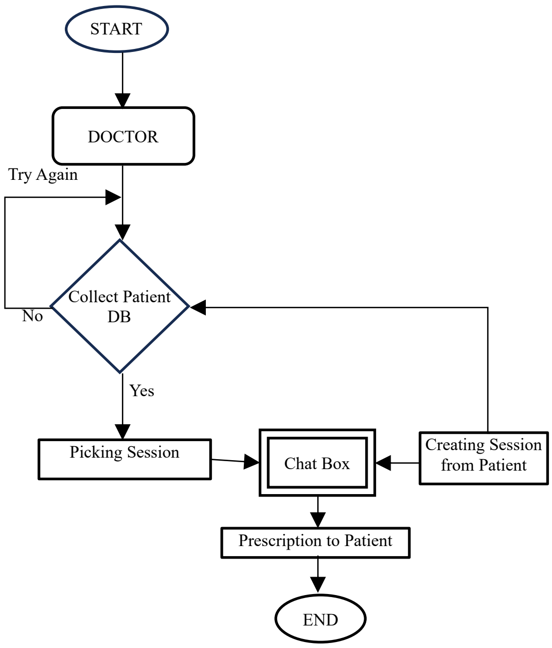

Figure 3. Doctor’s Portal Flowchart

IMPLEMENTATION AND WORKING

The following section demonstrates how to deploy IOMT for building a health surveillance platform. Implementation consists of a Node MCU chip including USB connections, external power supply, as well as integrated GPIO connections as shown in figure 4. These GPIO connectors are used for linking a variety of sensors to measure pulse and oxygen levels. Both Wi-Fi and Bluetooth modules are employed to ease connectivity because of their improved connection features. The advanced functions that Wi-Fi and Bluetooth offer in their connectivity space justify their use.

The initial parameters to be monitored are oxygen condensation and pulse level, both recorded using pulse oximetry. Clinical standards dictate oxygen saturation readings ideally fall within the range of 95% to 100%. Readings below 90% may necessitate supplemental oxygen through devices like medical ventilators. Heart rate, or pulse rate, indicates the rate of pulsation per minute, with typical rate ranging from 60 to 100 per minute. These readings are captured using the MAX30100 sensor, communicating via I2C protocol. Following this, temperature and humidity are measured by DHT22 which incorporates a specialized NTC sensor for thermal monitoring.

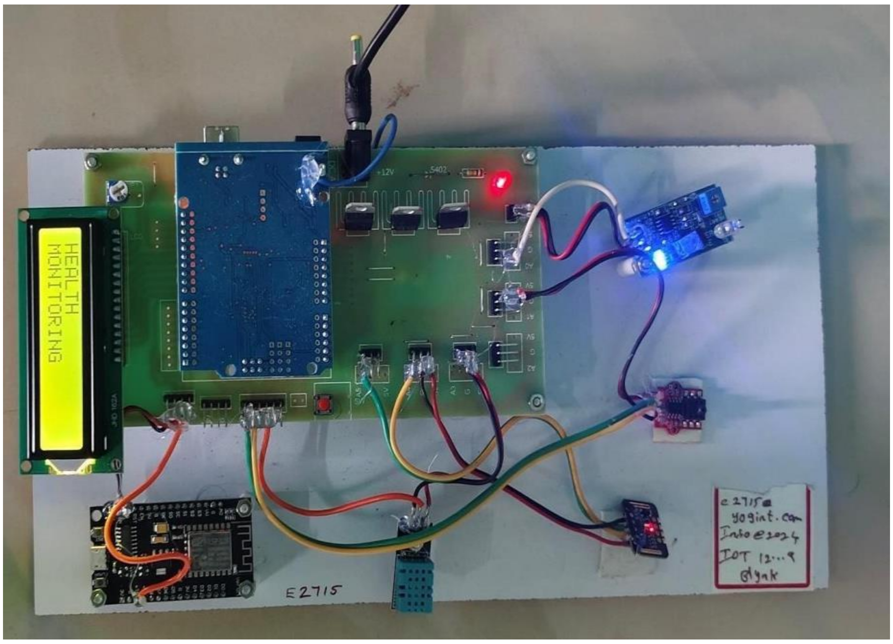

Figure 4. Hardware Configuration of the Proposed System

DHT22 operates within a voltage range of 3 V to 5 V. Finally, pressure of blood is measured using a specific blood pressure sensor within 258 mmHg limit. All these five sensors are connected to Arduino using Wi-Fi and Bluetooth communication technologies. The HM10 Bluetooth module operates at a frequency of 2.4 GHz. All devices are linked to the microcontroller, enabling data transmission via Wi-Fi module. These data are monitored and accessed using laptops or phones through a web server. Sensor data is stored on a central server, allowing doctors to monitor and access it as needed. Additionally, in emergencies, doctors can be called for assistance.

RESULTS AND DISCUSSION

In this advanced data driven patient surveillance framework, dualistic distinct methods tailored to specific needs. Here, comparative analysis between Bluetooth and Wi-Fi is presented from a technical standpoint. Bluetooth and Wi-Fi are among the most commonly utilized technologies in real-time applications.

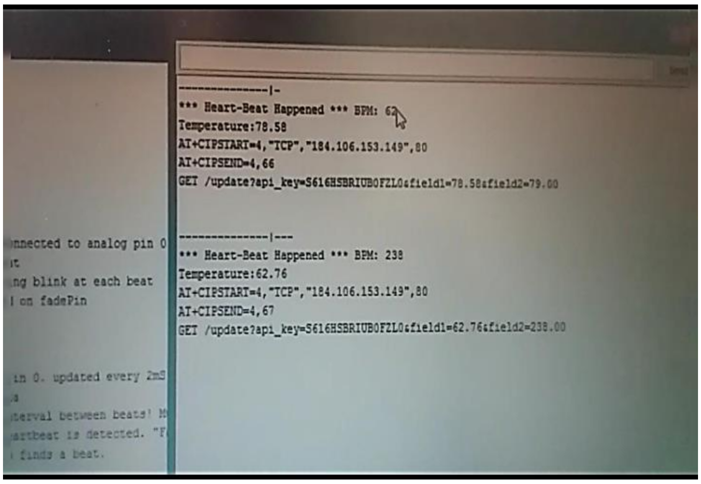

Figure 5. Serial Monitor of Patient 1

Bluetooth was initially developed to replace RS-232 data cables, catering to short-range communication within a span of 5 meters and working at a frequency of 2.602 GHz to 2.68 GHz. On the other hand, Wi-Fi conforming to IEEE specifications. Wi-Fi is predominantly employed in computer networks. In recent times, Wi-Fi has become ubiquitous, incorporated into nearly every communication-capable device. ML models can continuously analyze streaming data from IoMT devices and provide alerts or notifications to healthcare providers and patients in case of any abnormalities or critical conditions as illustrated in figure 5 and 6.

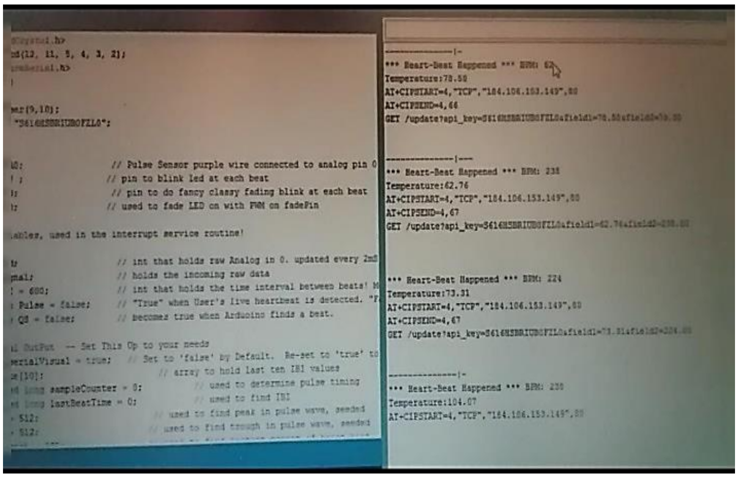

Figure 6. Serial Monitor of Patient 2

By integrating Python and ML into a Healthcare Monitoring System based on IoMT, healthcare providers can achieve more efficient and personalized patient care, early detection of health issues, and ultimately improve patient outcomes. Additionally, the use of these technologies can lead to better resource allocation and cost savings in healthcare delivery.

CONCLUSION

Utilizing the Advanced Data-Driven Healthcare Monitoring System platform via IOMT not only saves crucial time for patients but also reduces maintenance costs. Through this platform, individuals can participate virtually without the need for physical presence, accessing an online gateway. Patients connect sessions according to their state of wellness, receiving medical advice from doctors. Additionally, the system can automatically summon emergency services based on the patient's health status, potentially saving lives. The proposed framed is designed to be accessible, anybody shall navigate the gateway efficiently.

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