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Voice Recognition in IoT for Monitoring Health Parameters

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Abstract

This project explores the design challenges faced in implementing voice-Recognition in IoT devices for health care, as well as the emerging applications that are reshaping the landscape of healthcare delivery. In recent years, the intersection of voice-recognition in Internet of Things (IoT) devices and healthcare has shown immense promise in revolutionizing patient care and wellness management. These devices, equipped with advanced natural language processing (NLP) capabilities, offer seamless interaction between users and their healthcare environments. This project help us remote health caring of patients at home is increasing with the popularity of various nature of mobile devices that has developed to enable remotely caring. The cloud as well as IoT (Internet of Things) and the mobile technologies make it easier to monitor the patient's health conditions by sharing the health information to health care teams such as doctors, nurses and specialist.

Keywords: Voice recognition, IoT devices, Healthcare, Natural Language (NLP), patient Care, Remote healthcare, Health information sharing.

1. Introduction

In the traditional method, doctors are central to health check-ups, but the process involves extensive time for registration, scheduling appointments, and conducting the check-up, with reports generated afterward. This lengthy process often leads working individuals to either ignore or postpone their check-ups. However, modern approaches aim to streamline this process, reducing time consumption and making it more convenient for individuals to prioritize their health assessments.

Voice-recognition IoT (Internet of Things) devices have significantly transformed multiple sectors, particularly healthcare, through their user-friendly and intuitive interfaces. These devices utilize advanced voice recognition technology, allowing seamless interaction without the requirement of physical input methods such as keyboards or touchscreens. In the healthcare domain, they offer vast opportunities to elevate patient care, enhance accessibility, and optimize workflows for both patients and healthcare professionals.

In our system, we monitor patients' vital signs such as blood pressure, temperature, and heart rate using sensors. These sensors collect data from either the patient, their doctors, or their caretakers. The collected data is then sent to an Arduino device and subsequently transmitted to a server. The data is stored in a database and can be accessed through a website that is restricted to authorized personnel only. This setup ensures that only those with proper authorization can view the patient's status. Traditional healthcare systems often struggle to provide timely treatment during emergencies, underscoring the necessity for improved solutions. IoT technology in healthcare can play a pivotal role in predicting risks beforehand, making it an invaluable tool for addressing this issue. Hypertension, a prevalent yet severe condition, stands out as a leading cause of cardiac and stroke-related fatalities.

2. Literature Survey

This paper proposes a secure system for transmitting patients' monitored data in modern healthcare, leveraging wearable devices and the cloud of things. The system consists of two main stages: storage and data retrieval. In the storage stage, data is stored and updated for future use, while in the data retrieval stage, data is retrieved from the cloud. The wearable device worn by the patient continuously updates their records, with more frequent updates during emergencies. Data from the device can be transmitted to a phone via Bluetooth or NFC, and then to the cloud server using GSM and 3G connections. The system ensures secure and private transmission of healthcare data, enhancing patient care and privacy.

In a cloud server setup, each patient is assigned a unique address, ensuring accurate authentication and access to their data for necessary requests. The evolution of telemonitoring systems via Wireless Body Area Networks (WBAN) addresses the growing demand for home-based mobile health and personalized medicine. This paper utilizes Zigbee technology within WBANs due to its ability to meet the guaranteed delay requirements essential for effective health telemonitoring systems.

Hamid Al-Hamadi and Ing-Ray Chen propose a health IoT protocol that incorporates trust considerations, including risk classification, reliability trust, and loss of health probability, to aid decision-making. They conduct a comparative analysis between this trust-based protocol and standard baseline protocols to assess feasibility. This concept involves implementing automatic electronic medical records to standardize processes. They also present a real-world scenario demonstrating smart autonomous hospital management facilitated by IoT technology.

3. Existing Method

The Existing system in a hospital, either the nurse or the doctor has to move physically from one person to another for health check. In any critical situations cannot be found easily unless the nurse or doctor checks the person’s health at that moment. This may be a strain for the doctors to take care of a lot number of people in the hospital. We can see in now-days-hospitals patients are using sensor bands. In the existing system the sensors are been working continuously. The sensors are used to collect the diagnosis results and transfer them to the micro controller. Microcontroller makes the collected data to transfer to the cloud through transmitter via Wifi or Bluetooth. In cloud it stores the data and it sends the data to Patient Monitor through receiver via Bluetooth or Wifi. Patient Monitor it will produce the Graph of the diagnosis results. The acknowledgement will send to Patient Monitor, it will produce the output.

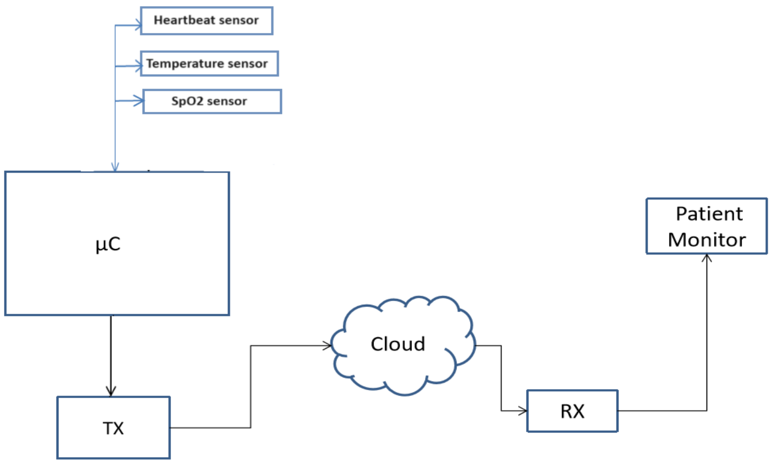

Figure 1: *Block Diagram*

4. Proposed System

Voice-recognition devices provide a simple interface also to patients recovering at home and to the elderly for controlling various functions in homecare or assisted-living settings, including remote health monitoring, preventive and diagnostic smart home, home-care robotics, intelligent pharmaceutical packages that improve medication compliance and smart bandages and stitches that provide information about the healing progress Voice-activated devices facilitate access to telemedicine services and pro- vide support to people with hearing or speech difficulties. Finally, real-time speech recognition improves the communication of people with neurodegenerative diseases and speech disorders.

This paper presents the design challenges and emerging applications of a voice recognition in IoT device tailored for healthcare environments. The device incorporates a range of components including Arduino microcontroller, Bluetooth communication module, pulse oximeter, temperature sensor, LCD display, and integrates with the IoT platform Ubidots for data visualization and analysis.

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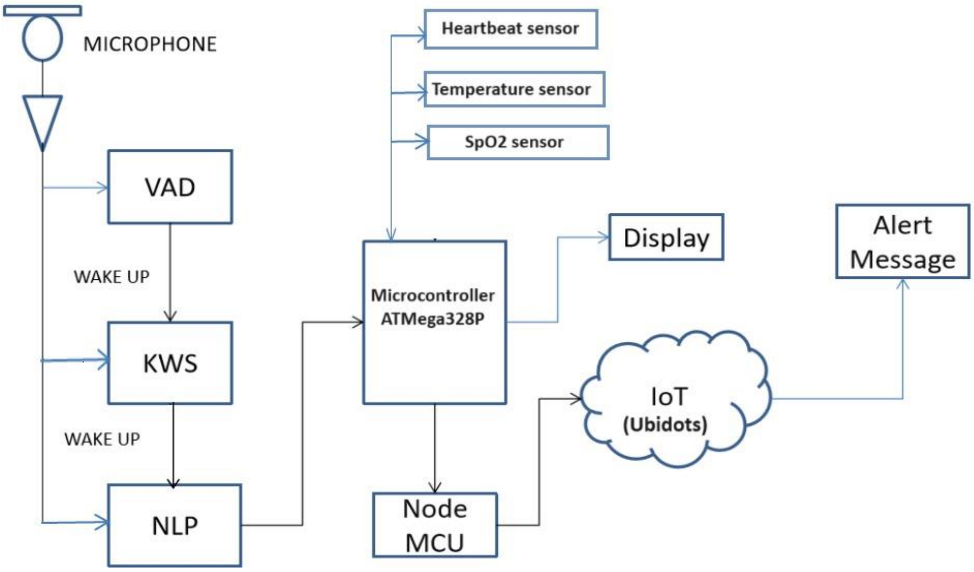

Figure 2: *Proposed Block Diagram*

In the above block diagram 4.1 shown that the Microphone captures the user's voice commands and convert in to electrical signals. VAD analyses the incoming audio signals to detect periods of speech, filtering out background noise and silence. KWS identifies specific keywords or phrases within the user speech, such as "scan". NLP interprets the user's speech beyond simple keywords, allowing for more complex commands and interactions. It understands the intent behind the user's words and processes them accordingly. The device communicates with a mobile phone via Bluetooth. The Bluetooth module in the mobile phone establishes a connection with the Microcontroller device, enabling data exchange. After that sensors can be activated a user/patient can put the fingure in the different sensors. Sensors are used to collect health related data such as heart beat, temperature, SPo2. The microcontroller processes the incoming data from sensors, interprets voice commands through VAD, KWS, and NLP, and controls the device's functions accordingly. It also manages the communication with the mobile phone via Bluetooth and display output in the LCD.A microcontroller board based on the ESP8266 Wi-Fi module. It enables Wi-Fi connectivity for the IoT device, allowing data transmission to platforms (ubidots).IoT stores the data and it is represented the output in graphical form. Once the acknowledgement completed it will send to Email in message format.

5. System Description

5.1 Arduino Uno

The Arduino Uno is a microcontroller board in context of the ATmega328. It has 14 electronic data/yield pins (of which 6 can be utilized as PWM yields), 6 clear data sources, a 16 MHz stylish resonator, a USB association, a power jack, an ICSP header, and a reset get. It contains everything foreseen that would help the microcontroller; just interface it to a PC with a USB association or power it with an AC-to-DC connector or battery to begin**.** Arduino is a model

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stage (open-source) in light of an easy to-use hardware and programming. It incorporates a circuit board, which can be modified (suggested as a microcontroller) and a possible programming called Arduino IDE (Integrated Development Environment), which is worn to casing and exchange the PC code to the physical board. The key sections are: Arduino sheets can read fundamental or pushed data signals from different sensors and change it into a yield, for instance, starting a motor, turning LED on/off, join to the dull and diverse obvious exercises.

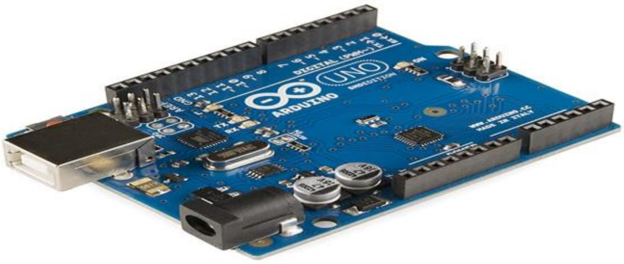

Figure 3: *Arduino Uno*

5.2 AT Mega 328P-PU with Arduino loader

The name says everything on this one. An Atmega328 in DIP bundle, pre-stacked with the Arduino (16MHz) Boot loader. This will engage you to utilize Arduino code in your especially presented connects without using a genuine Arduino board. To get this chip working with Arduino IDE, you will require an outside 16MHz significant stone or resonator, a 5V supply, and a serial association. On the off chance that you are not content with doing this, we propose acquiring the Arduino Due milanove board that has these merged with the board.

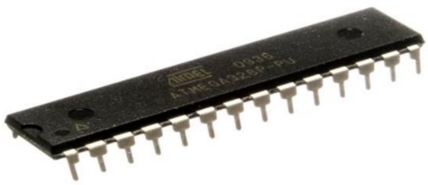

Figure 4: *Atmega328P-PU*

5.3 Node MCU

NodeMCU ESP8266 Wi-Fi Module: NodeMCU is an open-source development board and firmware based in the widely used ESP8266 -12E Wi-Fi module. It allows you to program the ESP8266 Wi-Fi module with the simple and powerful LUA programming language or Arduino IDE.

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Figure 5: *Node MCU*

5.4 Pulse Oximeter and Heart rate sensor:

The MAX30100 is a coordinated heartbeat oximetry and pulse screen sensor arrangement. It joins two LEDs, a photo detector, enhanced optics. The MAX30100 works from 1.8V and 3.3V power supplies and can be shut down through programming with unimportant backup current, allowing the power supply to stay associated consistently.

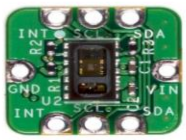

Figure 6: *pulse Oximeter (max30100)*

5.5 Temperature/Humidity Sensor (DHT-11)

The DHT-11 temperature and humidity sensor is used to monitor the temperature and humidity of the atmosphere. It utilizes a capacitive humidity sensor and a thermistor to measure the surrounding air and generates a digital signal on the data pin. The DHT-11 calculates relative humidity by measuring the electrical resistance between two electrodes. The sensor module includes a temperature and humidity sensor complex with a calibrated digital signal output. It is commonly used to measure body temperature, especially maternal temperature, more accurately than using a thermistor. During pregnancy, a woman's body temperature can change due to increased metabolism, elevated levels of hormones such as progesterone, increased workload on the body due to extra weight as the pregnancy progresses, and the processing of fetal nutrients and waste products. Additionally, increased peripheral circulation in pregnant women leads to the dissipation of heat from the body.

Figure 7: *Temperature sensor*

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5.6 LCD Display

LCD stands for liquid crystal display, which is used to show the status of an application, displaying values, debugging a program, etc. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. In the microcontroller LCD we can see it will display the please wear the sensor. The patient/user can put the figure in the sensors then sensors collect the data and it will give to the microcontroller. Microcontroller process the data and it will display output in the LCD for example temperature, pulse oximeter, heartbeat.

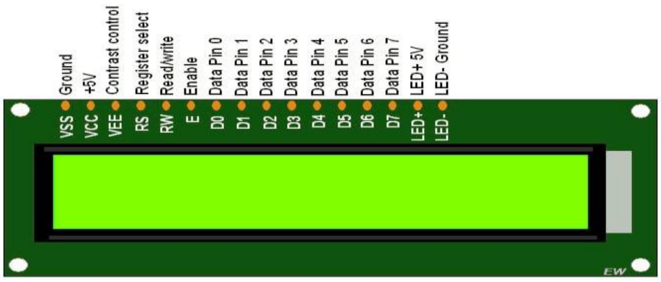

Figure 8: *16X2 Liquid Crystal Display*

6. Result

The process begins by powering up the hardware kit, followed by opening the Arduino Bluetooth app on a mobile device. Using the app's microphone feature, a keyword like "scan" is spoken, which is recognized by the Keyword Spotting (KWS) algorithm, activating the sensors. The microcontroller's LCD then displays a message instructing the patient/user to wear the sensor. Once the sensor is worn, it collects data and sends it to the microcontroller for processing. The processed data, such as temperature, pulse oximeter readings, and heart rate, is then displayed on the LCD.

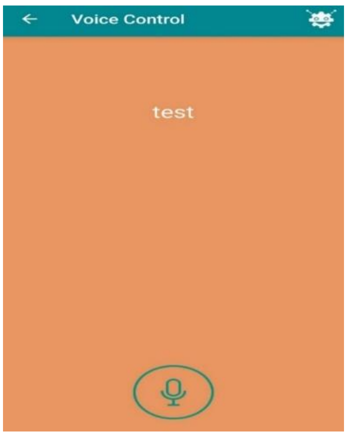

Figure 9: *Input process through voice Commands using Keyword*.

The above fig 6.1 shows Firstly, we can give power supply to the hardware kit then it will start. We can open the Arduino Bluetooth App in the mobile. In that app through the

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microphone we can give the input through voice commands for example we given input as "test". The KWS identify the keyword and sensors are activated**.**

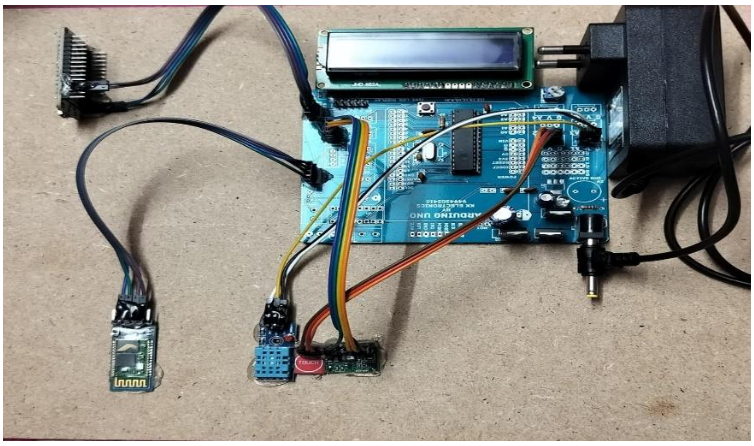

Figure 10: *Hardware Kit*

This is a picture of the project "Voice Recognition in IoT for Monitoring Health parameters" under construction. For this model we are using patient/user check their health condition. This is the complete model of presenting the project on we are working.

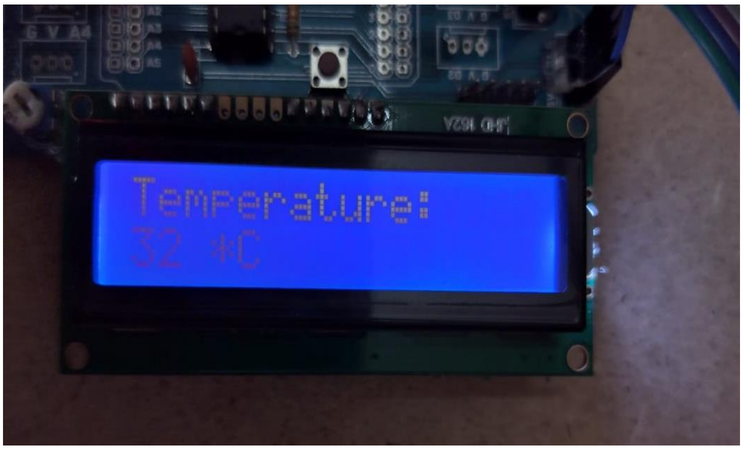

Figure 11: *Result in Display*

In the microcontroller LCD we can see it will display the please wear the sensor. The patient/user can put the figure in the sensors then sensors collect the data and it will give to the microcontroller. Microcontroller process the data and it will display output in the LCD for example temperature, pulse oximeter, heartbeat.

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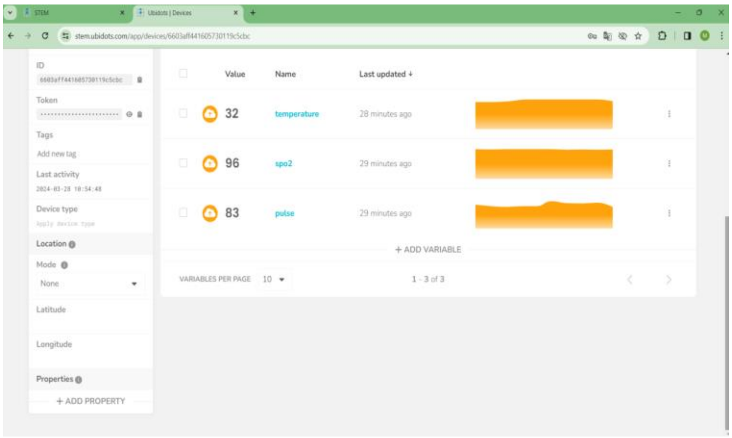

Figure 12: *Diagnosis Results in IoT (Ubidots).*

Figure 6.4 & 6.5 shows The Arduino Uno transfers data to the NodeMCU, which uploads the entire program to Ubidots using IoT. All data is then transferred to Ubidots through the NodeMCU, and the output is displayed on the website. If graphical representation is desired, the output can be displayed on a graph.

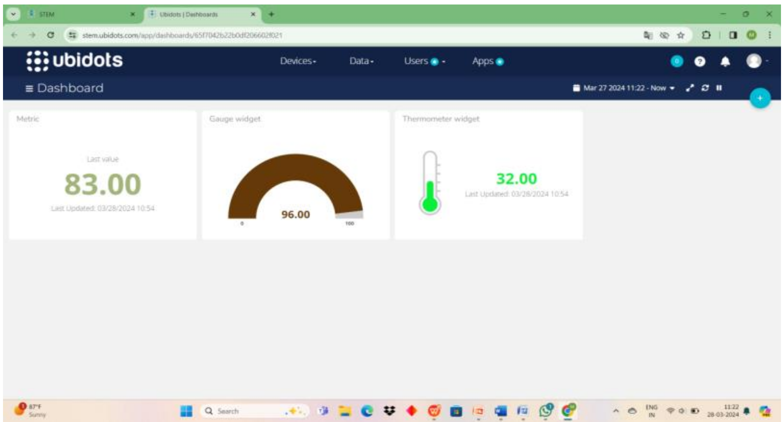

Figure 13: *Diagnosis Results with Graphical Representation in IoT*

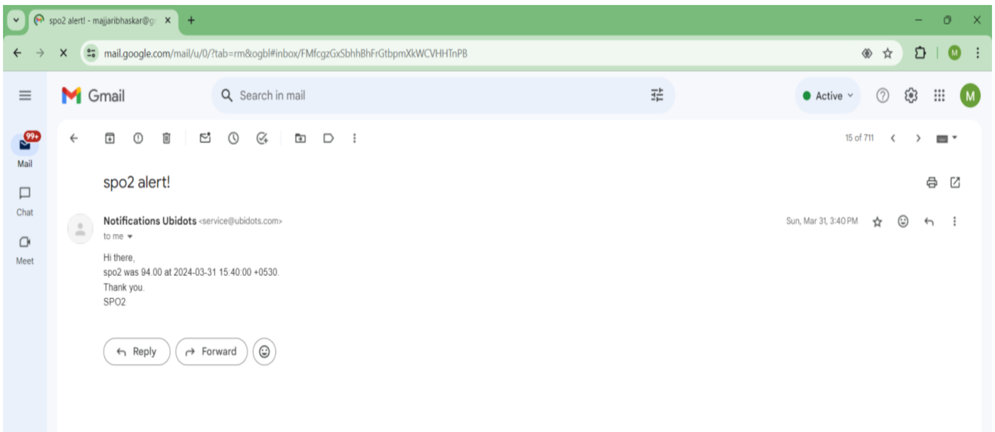

Figure 14: *Message Alert through Gmail.*

The output of the system can be viewed on various devices such as computers, laptops or mobiles phones. Users can access the data on the UBI DOTS open-source platform by logging in with the User. This allows them to monitor and analyze real-time readings from the sensors. The collected data of the user will be displayed and user can be get notified though the E-mail.

7. Advantages & Applications

7.1 Advantages

- IOT Monitoring proves really helpful when we need to monitor & record and keep track of changes in the health parameters of the patient over a period of time.
- Hospital stays are minimized due to Remote Patient Monitoring.
- Hospital visits for normal routine check-ups are minimized.
- Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining the records on printed papers kept in the files.
- In this project, a system for 24x7 human health monitoring is designed and implemented.

7.2 Applications

- IOT Healthcare is the most demanding field in the medical area. This project is for, elderly people in our home.
- For the senior citizen living alone or living with 1 or 2 members.
- This project really proves helpful when family members need to go out for some emergency work.
- Disable patients can use this project.
- Disable patients who find it really difficult to go to doctors on a daily basis or for those patients who need continuous monitoring from the doctor.

8. Conclusion & Future Scope

8.1 Conclusion

A voice recognition in IoT healthcare faces challenges but also offers exciting opportunities. By carefully selecting hardware, developing firmware, and integrating with cloud platforms, the device can overcome hurdles like data acquisition, secure communication, power usage, and user privacy. Once these challenges are tackled, the device can be used for various healthcare applications. It allows patients to easily access health information and enables remote monitoring for healthcare professionals to intervene quickly. With pulse oximetry and temperature sensing, it detects health issues early, leading to better outcomes. An LCD display provides immediate feedback for users. The device uses Ubidots as a central hub for data aggregation and analysis, allowing healthcare providers to track trends and make informed decisions. Integration with electronic health records ensures seamless data exchange. In summary, the voice-activated IoT device is a significant advancement in healthcare, promising to improve patient care and empower both patients and healthcare providers. With further refinement and adoption, it could bring positive changes to healthcare, enhancing access, efficiency, and quality of care.

8.2 Future Scope

In our system, we'll monitor patients individually and also keep an eye on entire ward or patient rooms remotely using Wi-Fi. We're adding a person fall detection feature, particularly helpful for older individuals. We plan to upgrade both hardware and software in the future. On the software side, we'll enhance the website to automatically display patient details like name, date, and ECG readings in a user-friendly manner. Additionally, we'll update and upload the apps to the Play Store for easy download and installation on mobile phones.

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