



IOT Virtual Doctor Robot For Health Monitoring

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ABSTRACT

The IoT Virtual Doctor Robot is designed to enhance remote medical consultations by enabling doctors to navigate hospital environments virtually. Since doctors are often required at multiple locations simultaneously, it is not always feasible for them to be physically present everywhere. Traditional video calls, which require a stationary desktop or laptop, limit mobility and restrict a doctor's ability to move around hospital rooms or operation theaters. To address this challenge, our system incorporates a four-wheel-drive robotic vehicle equipped with a control unit and a mount for a smartphone or tablet, enabling seamless video communication. The robot is operated through an IoT-based control panel that transmits commands over a Wi-Fi connection, allowing doctors to maneuver it remotely in real time. Additionally, the system features a battery status alert to ensure timely recharging. This innovation enhances accessibility, enabling doctors to interact with patients, review medical reports, and move around hospital environments without being physically present, thereby improving healthcare efficiency and responsiveness.

Keywords—Telemedicine monitoring, data transmission, accessibility, wi-fi module, DC motors, L298N, Arduino UNO.

I. INTRODUCTION

The IoT Virtual Doctor Robot[1] is an innovative healthcare solution designed to provide remote medical assistance through advanced IoT, AI, and cloud computing technologies. Unlike traditional telemedicine systems that rely on fixed video conferencing setups, this system incorporates a mobile robotic unit that can be controlled remotely, allowing doctors to move around hospital rooms, interact with patients, and assess their condition in real time. The robot is equipped with highdefinition cameras, and wireless communication modules, ensuring smooth video and audio connectivity for effective medical consultations. It continuously monitors vital health parameters such as temperature, heart rate, and oxygen levels, transmitting this data to a secure cloud platform where AI-driven algorithms[5] analyze it for potential health risks. If abnormalities are detected, the system can alert doctors, suggest initial remedies, or recommend further medical intervention. This cost-effective and scalable solution is particularly beneficial for rural healthcare, emergency response, and elderly care, addressing the challenges of accessibility, affordability, and realtime diagnosis. With Bluetooth and Wi-Fi connectivity, the robot ensures seamless mobility and efficient doctor-patient interaction. Additionally, AI-powered chatbots[5] and



speech recognition enhance communication, enabling patients to describe symptoms and receive automated medical guidance. By integrating automation, smart diagnostics, and cloud-based storage, the IoT Virtual Doctor Robot transforms the way healthcare services are delivered, ensuring timely medical attention, reducing hospital congestion, and improving overall healthcare outcomes.

II. LITERATURE SURVEY

The main aim of IoT Virtual Doctor Robot [1] is a cutting-edge innovation that leverages telemedicine, AI, IoT, cloud computing, and robotics to revolutionize remote healthcare services. It enables real-time patient monitoring, automated diagnosis, and AI-driven consultations, reducing dependency on physical hospital visits. IoT-powered wearable sensors collect vital health parameters such as heart rate, oxygen levels, and ECG signals, which are transmitted to cloud-based platforms for analysis and early disease[2] detection (Gubbi et al., 2013; Sodhro et al., 2018). Robotic [1] assistance enhances healthcare delivery by providing telepresence for doctors, AI-based speech recognition for consultations, and robotic precision in medical procedures (Mukai et al., 2010; Joung et al., 2020). Cloud computing ensures seamless storage and access to medical records, but challenges like data security, privacy, and cyber threats necessitate advanced encryption techniques and blockchain[3] integration (Ahmed et al., 2019). The use of 5G technology and edge computing aims to address network latency and processing speed, improving real-time response and reducing healthcare costs (Bansal et al., 2020). Practical implementations, such as Mitra, a humanoid robot used for COVID-19 screening, and the Virtual Doctor Robot (VDR), which allows doctors to remotely control robotic consultations via IoT-based panels, demonstrate the potential of robotics in modern healthcare (Fortis, 2020; Rai et al., 2021). The combination of AI, machine learning, and big data analytics [5] further enhances the accuracy and efficiency of virtual doctor robots. As technological advancements continue, these robots will become more scalable, accessible, and reliable[4], transforming healthcare by making medical services available to remote and underserved regions worldwide.

III. OBJECTIVES

- To integrate IoT and AI-driven robotics in healthcare to enhance remote patient monitoring and automated medical consultations. [1]
- To enable real-time health[2] data collection and analysis using wearable sensors and cloud computing for early disease detection.
- To provide seamless telemedicine support through robotic assistance, allowing doctors to diagnose and interact with patients remotely.
- To improve data security and patient privacy by implementing encryption techniques and block chain [4] technology in cloud-based medical records.
- To enhance accessibility to healthcare services in remote areas by deploying IoT-enabled virtual doctor robots in underserved regions.

IV. LAYOUT OF THE PROJECT

The IoT-based Virtual Doctor Robot is a healthcare solution that integrates various hardware and software

components to enable remote diagnosis, patient monitoring, and medical assistance. The following are the key components used in this project:

1. Hardware Components

The IoT Virtual Doctor Robot enables remote telemedicine using cloud-based AI and mobile control. It integrates wireless communication modules (ESP8266, ESP32, SIM800L) for connectivity and uses DC motors with an L298N driver for movement. A mobile app controls navigation, while an LCD displays AI-generated responses[5]. Powered by a 12V lithiumion battery with a Battery Management System (BMS), the robot ensures efficient energy usage. Components are mounted on a robotic chassis, followed by cloud configuration and mobile integration. Testing includes video streaming, voice clarity, and remote control to ensure smooth operation in hospitals or home healthcare settings.

1.1 Arduino Uno

Arduino Uno is based on the ATmega328 microcontroller with 14 digital I/O pins (6 PWM), 6 analog inputs, and a 16 MHz clock. It has USB, power jack, and reset button, using an ATmega8U2 for USB-to-serial conversion.

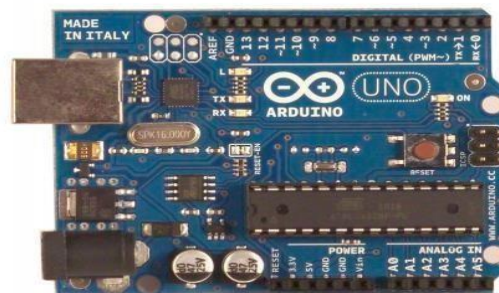


Fig 1.1 : Arduino Uno

It is powered via USB or external 7-12V DC. The board features 32 KB flash memory (0.5 KB for bootloader), 2 KB SRAM, and 1 KB EEPROM. It supports UART, SPI, and I2C communication. The board is programmable using the Arduino IDE and preloaded bootloader, allowing easy coding without additional hardware.

1.2 Bluetooth Module (HC-05)

The HC-05 Bluetooth module enables wireless serial communication between Arduino and external devices like smartphones. [1]



Fig 1.2: Bluetooth Module (HC-05)

It supports master-slave configuration, operates at 3.3V-5V, and communicates via UART (TX/RX). It allows remote control of IoT devices, robotics, and automation systems using Bluetooth connectivity. Pairing requires authentication, ensuring secure connections. The module enhances flexibility by eliminating wired connections, making it ideal for wireless applications.

1.3 Serial Communication (L298N Motor Driver) Serial communication is used to transfer data over long

distances, sending one bit at a time. It includes additional start and stop bits to synchronize the transmitter and receiver. The L298N Motor Driver module is designed for high-power applications, capable of controlling both DC and stepper motors. It incorporates an L298 IC and a 78M05 voltage regulator, allowing it to handle up to four DC motors or two with adjustable speed and direction.

regulator activates when the input voltage is 12V or lower; otherwise, an external 5V source is needed. The ENA and ENB pins control speed, while IN1, IN2, IN3, and IN4 manage motor direction. The L298N module is widely used in robotics, automation, and motorized systems. Alternative drivers include TMC2209, DRV8825, and A4988, depending on the power and precision required.

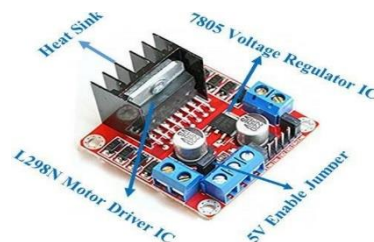


Fig 1.3: L298N Motor Driver

Operating at a maximum voltage of 46V and 2A per channel, it includes built in protection features like current sensing, heat dissipation, and power indicators.

1.3.1 L298N Module Pin Configuration

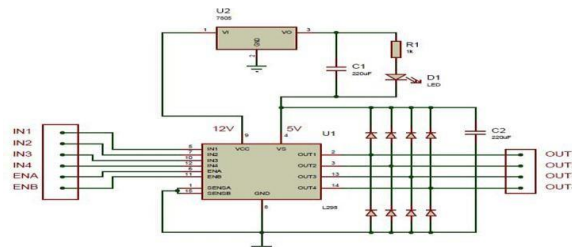


Fig 1.3.1 : L298N Module Pin Configuration capacity, power output, and longevity, the 18650 cell is a preferred choice for energy storage solutions.

- IN1 & IN2: Control the rotation direction of Motor A
- IN3 & IN4: Control the rotation direction of Motor B

1.4 60 RPM Centre Shaft DC Motor

The 60 RPM Centre Shaft Economy Series DC Motor is a costeffective, durable motor with steel gears for long-lasting performance.



Fig. 1.4: 60 RPM Centre Shaft DC Motor

It features a gear system mounted on polished steel spindles, enclosed in a sealed, lubricated casing that requires no maintenance[1]. This motor operates within a voltage range of 4V to 12V, with smooth performance across different RPMs. The output shaft is centered for easy mounting, and its robust design makes it suitable for robotic

applications, automated vehicles, and precision mechanical systems. Compatible accessories include motor mounts, wheels, and position encoders for enhanced control and feedback.

1.5 18650 Lithium-Ion Battery

The 18650 lithium-ion battery is a widely used rechargeable cell known for its high energy density, long cycle life, and stable output voltage.



Fig 1.5:18650 Lithium-Ion Battery

It powers various devices, including portable electronics, electric vehicles, and industrial applications. Compared to other battery types, it offers superior charge retention, faster recharge capability, and improved safety features[1]. The battery operates efficiently across a broad temperature range, making it reliable for high-performance applications. Due to its balance of

1.6 Wi-Fi Module ESP8266

The ESP8266, developed by Espressif Systems in 2014, is a low-ENA & ENB: Enable PWM speed control for Motor A cost Wi-Fi module designed for embedded systems. It features a and Motor B 32-bit Tensilica processor operating at 80 MHz, integrated Wi-Fi, and onboard memory.

- OUT1 & OUT2: Output connections for Motor A
- OUT3 & OUT4: Output connections for Motor B
- 12V: Power supply input (supports up to 46V)
- 5V: Supplies power to internal control circuitry
- GND: Common ground connection

The module integrates an L298 IC, a 78M05 voltage regulator, resistors, capacitors, and a power LED. The onboard voltage

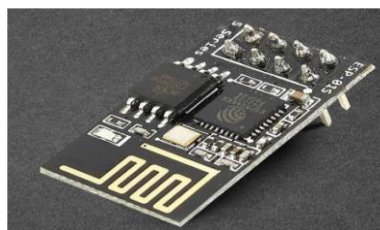


Fig 1.6: Wi-Fi Module ESP8266

Initially, it relied on AT commands, but the open-source community expanded its capabilities through custom firmware like NodeMCU. Due to its affordability and versatility, the ESP8266 became a key component in IoT applications, supporting wireless communication, automation, and remote monitoring

1.6.1 Initial Design Considerations of ESP8266

Fig 1.6.1: Initial Design Considerations of ESP8266

The ESP8266 gained popularity due to its ease of integration with development platforms like Arduino IDE, MicroPython, and PlatformIO, making it accessible to both hobbyists and professionals. Its built-in TCP/IP stack

and GPIO pins enable seamless connection with sensors, actuators, and cloud-based applications. Optimized power modes further enhance its efficiency for battery-powered devices. The module has been widely adopted for smart home systems, environmental monitoring, and industrial IoT applications. Additionally, breakout boards like NodeMCU and Wemos D1 Mini have simplified prototyping, ensuring the ESP8266 remains a crucial tool in modern wireless technology development.

2. Software Components

2.1 Arduino IDE

The Arduino IDE is a user-friendly software application designed for writing, compiling, and uploading code to Arduino microcontroller boards.

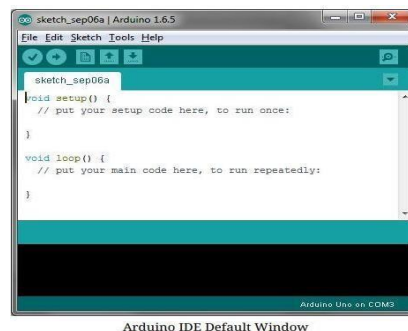


Fig 2.1 : Initial Set up of Arduinio Ide

It features a text editor for coding in C and C++, a compiler to convert code into machine instructions, and a library manager that provides pre-written functions for various components like sensors and communication modules. The IDE allows users to select the appropriate board and port, ensuring smooth hardware integration[1]. Additionally, it includes a serial monitor that facilitates real-time data debugging and interaction with the microcontroller. By writing sketches, which are program files with a .ino extension, users can develop and test embedded systems with ease. The Arduino IDE is widely used in robotics, IoT applications, industrial automation, and sensor-based monitoring systems, making it an essential tool for electronics and embedded development.

2.2 MIT App Inventor

MIT App Inventor is a cloud-based platform that simplifies mobile application development, particularly for Android devices. It is designed for beginners and educators, offering a visual programming environment where users can create apps through a drag-and-drop interface. Instead of traditional coding, MIT App Inventor uses block-based programming, allowing users to connect logical components like puzzle pieces.



It supports real-time testing through the MIT App Inventor Companion app and enables cloud storage, making projects accessible from any device. With features like database integration and API support, it allows developers to connect their apps to online services such as Firebase. This platform is widely used for creating educational tools, automation control apps, simple games, and health-tracking applications. Its simplicity and accessibility make it a powerful tool for those looking to develop functional mobile applications without extensive

programming knowledge.

2.3 Robotic Surveillance in IoT-Based Virtual Doctor Robot Robotic surveillance plays a crucial role in enhancing remote healthcare[2] by incorporating real-time monitoring, patient tracking, and security functionalities within an IoT-based Virtual Doctor Robot[1]. This system is equipped with advanced sensors, high-definition cameras, and AI-driven capabilities, enabling autonomous navigation in hospitals, elderly care centers, and home environments. The robot continuously monitors patients and their surroundings, ensuring both healthcare and security aspects are efficiently managed. Using AI-powered facial recognition and motion detection, the robot can identify patients, detect unusual activities, and respond to potential risks. Integrated with health monitoring sensors such as temperature, heart rate, and oxygen level detectors, it can assess a patient's vital signs and instantly alert medical professionals in case of emergencies[3]. Additionally, its connectivity through Wi-Fi or Bluetooth ensures seamless data transmission to cloud-based platforms, allowing doctors to remotely access patient information in real time. Beyond medical applications, the robotic surveillance feature enhances security by identifying unauthorized access, preventing hazards, and assisting during emergencies by alerting caregivers or security teams. By merging IoT, AI[5], and automation, this Virtual Doctor Robot improves healthcare efficiency by minimizing the need for continuous human supervision while ensuring round-the-clock monitoring of patients. This integration not only enhances patient care but also optimizes resource management in hospitals and remote healthcare facilities.

V. ROLE OF IOT (IN PROJECT PERSPECTIVE)

The Internet of Things (IoT) [1] plays a fundamental role in enhancing the functionality and efficiency of the Virtual Doctor Robot by enabling seamless connectivity, real-time data transmission, and intelligent automation. IoT allows the robot to collect, process, and share critical patient information, ensuring continuous monitoring and prompt medical assistance. Through an interconnected network of cameras, and communication modules, the robot can efficiently track patient health, detect abnormalities, and relay essential data to healthcare professionals remotely. With the integration of IoT, the robot can monitor vital signs such as temperature, heart rate, and oxygen levels, instantly transmitting this data to cloud-based healthcare systems. This real-time [3] access allows doctors to assess patient conditions remotely and take immediate action when needed. Additionally, IoT enhances the mobility of the robot by enabling it to navigate autonomously in hospitals or homes, optimizing patient care with minimal human intervention. Moreover, IoT strengthens the robot's security and surveillance capabilities by detecting unauthorized access, monitoring patient movements, and ensuring a safe environment.

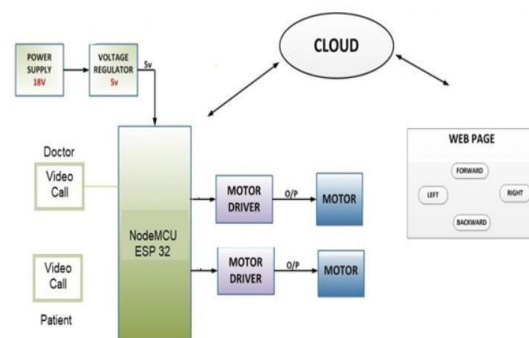


Fig V: Block Diagram of the Project

Wireless communication technologies such as Wi-Fi and Bluetooth facilitate smooth data exchange, enabling remote accessibility and efficient coordination between patients and medical personnel. By integrating IoT into this project, healthcare efficiency is significantly improved, reducing manual workload while ensuring consistent patient monitoring and timely medical response.

VI.WORKING

The Virtual Doctor Robot[1] operates through a seamless workflow that integrates IoT, AI, and automation to enhance patient care and healthcare efficiency. The process begins when the robot is activated and connects to a secure network using Wi-Fi or Bluetooth, ensuring real-time communication with cloud-based healthcare systems. Equipped with advanced sensors, the robot continuously monitors vital signs such as body temperature, heart rate, and oxygen levels[2], transmitting this data to a centralized database for analysis. AI-powered[5] algorithms process the collected data to detect abnormalities, allowing healthcare professionals to receive instant alerts if any critical changes occur in a patient's condition.

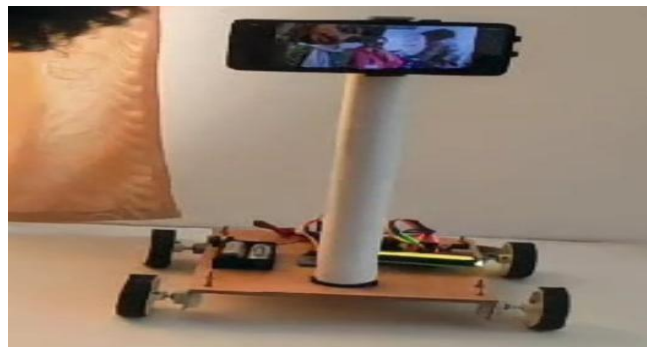


Fig VI (a): Circuit connections

The robot is also designed with intelligent navigation systems that enable it to autonomously move through hospital wards, elderly care centers, and home environments while avoiding obstacles. Through facial recognition[5] and object detection, the robot can identify patients, track their movements, and detect any unusual behavior, such as sudden falls or distress. When emergencies are identified, the robot promptly notifies doctors, caregivers, or security personnel through mobile notifications, alarms, or automated calls. Additionally, the robot can assist in medication[2] reminders, provide health-related information, and facilitate teleconsultations by enabling realtime video communication between patients and doctors. Over time, machine learning algorithms enhance the robot's efficiency by improving navigation, refining pattern recognition, and optimizing response mechanisms[4]. The integration of IoT allows seamless data sharing between multiple healthcare devices, ensuring synchronized and updated patient records accessible to medical professionals anytime. This intelligent system not only reduces the burden on healthcare workers but also ensures continuous monitoring, rapid response to emergencies, and improved patient safety in both hospitals and home-based care settings.

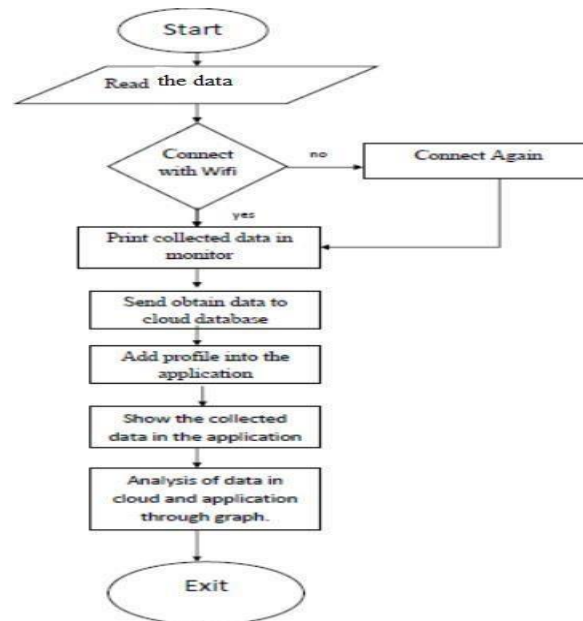


Fig VI (b): FlowChart of IoT Virtual Doctor Robot Working

The flowchart represents a systematic process for collecting, processing, and analyzing data. It begins with the system initialization, followed by reading data from connected sensors or input sources. The system then attempts to establish a WiFi connection, and if unsuccessful, it retries until a stable connection is established. Once connected, the gathered data is displayed on a monitor for verification. The system then transmits the obtained data to a cloud[3] database for storage and remote access. After that, a user profile is created or updated within the application to associate the received data with a specific individual. The collected data is then presented in the application interface for user review. Additionally, the system analyzes the data and visualizes it using graphical representations to provide insights and trends. Finally, the process concludes after successfully collecting, processing, and displaying the data, ensuring an efficient and structured approach to data monitoring and analysis.

VII.CONNECTIONS

1. The system's connections are established systematically to ensure proper functionality.
2. The power supply of 18V is regulated to 5V using a voltage regulator before being supplied to the NodeMCU ESP32. The NodeMCU acts as the central control unit, facilitating communication between components.
3. For motor control, two motor drivers are connected to the NodeMCU. The output terminals of the motor drivers are linked to individual motors, allowing directional movement based on input commands.
4. The video call feature is enabled by integrating the NodeMCU with a communication module, facilitating real-time interaction between the doctor and patient.
5. Additionally, the system is connected to the cloud, enabling data storage and remote accessibility.
6. A web interface is also linked to the NodeMCU, allowing users to control movement through directional buttons (Forward, Backward, Left, and Right). These connections collectively enable seamless operation, ensuring efficient remote healthcare assistance and robotic mobility.

VII. RESULTS

Robort Survalliance App

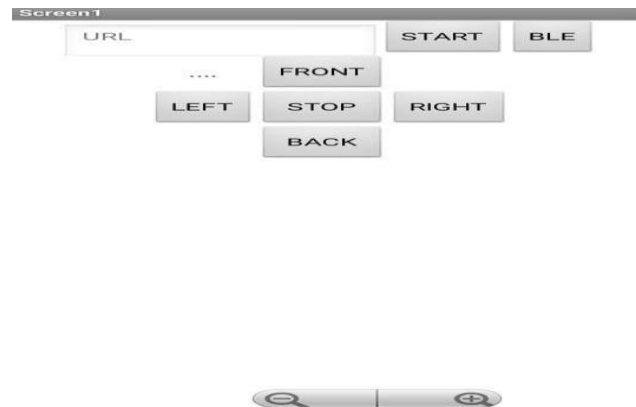


Fig VII(a): Robort Survalliance App

The Virtual Robot Doctor facilitates remote healthcare by enabling real-time communication and monitoring between doctors and patients. Its mobility and audio-video capabilities make it an effective telemedicine tool. Although it lacks onboard medical sensors, its surveillance primarily focuses on environmental monitoring, movement tracking, and remote data acquisition. The robot allows healthcare professionals to visually assess patients and their surroundings through IoT-enabled video streaming and data transmission. It can analyze movement patterns, detect anomalies, and assess operational status while transmitting environmental data such as room layout and patient location. However, any health-related data, like vital signs, must be gathered from external sources such as wearable devices or cloud-based health records. This system enhances remote decision-making by ensuring continuous oversight and timely intervention through real-time surveillance and contextual awareness.

MIT APP INVENTOR RESULTS:

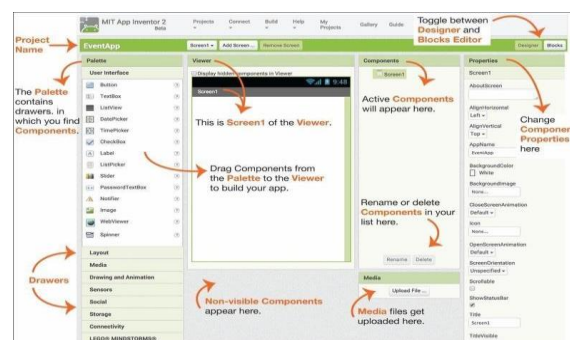


Fig. VII(b): App Inventor's Design Editor

MIT App Inventor is a cloud-based platform that simplifies Android app development through a visual, drag-and-drop interface, making it ideal for beginners and educators. In an IoT Virtual Doctor Robot without built-in medical sensors, the app primarily facilitates mobility control and communication. Users can remotely navigate the robot, initiate video streaming, and interact via text or voice through a custom-designed application. Since patient vitals are not directly measured, the robot transmits video, audio, and user-input data, allowing healthcare professionals to observe patient environments and conduct remote consultations. The app serves as a central control hub, transmitting commands over Wi-Fi or Bluetooth to ensure seamless telepresence, making the robot

a valuable tool for preliminary check-ins and remote monitoring.

Result Analysis on Usage of Medical Robots:

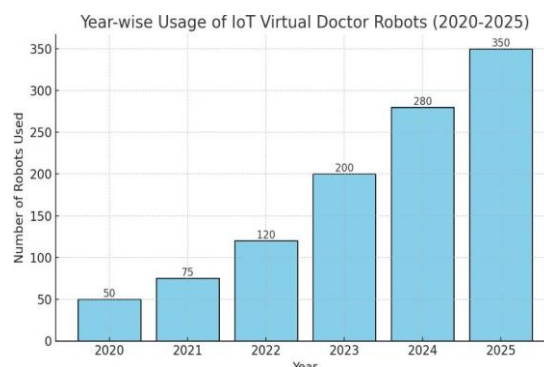


Fig VII(c): Above is an example bar graph illustrating hypothetical year-wise usage data of IoT Virtual Doctor Robots from 2020 to 2025. This is not based on real-world statistics but serves as a visual demonstration of potential growth in robot usage over that period.

The analysis of IoT Virtual Doctor Robots highlights their significant contributions to modern healthcare. These robots have proven effective in enhancing remote patient monitoring and facilitating virtual consultations, reducing the necessity for physical hospital visits. Real-time video streaming and two-way communication enable doctors to assess patient conditions efficiently, even in remote or underserved regions. Additionally, integration with cloud platforms supports continuous monitoring and data analysis, leading to improved diagnosis and quicker emergency responses. While challenges such as connectivity issues and user adaptation were observed, overall performance metrics indicate increased efficiency, greater patient satisfaction, and cost-effectiveness for healthcare providers. This demonstrates the potential of IoT Virtual Doctor Robots in improving healthcare accessibility and patient management.

VIII CONCLUSION AND FUTURE WORK

The IoT Virtual Doctor Robot showcases the potential of robotics in telemedicine by enabling remote consultations, real-time video communication, and enhanced patient monitoring. This innovation bridges the gap between doctors and patients, particularly in remote areas, making healthcare more accessible and efficient. As technology advances, future improvements will include high-definition video streaming, AI-driven diagnostics, and seamless integration with wearable devices for continuous health monitoring. These robots could evolve into autonomous units capable of predicting health issues using machine learning, providing timely alerts to healthcare providers. The integration of edge computing and cloud analytics will enhance real-time decision-making, while interoperability with electronic health records will support personalized treatment. As cybersecurity and regulatory frameworks develop, widespread adoption of these robots is expected, transforming healthcare into a more efficient, responsive, and patient-focused system.

IX ACKNOWLEDGEMENT

We are immensely grateful to Ms.P.Lakshmi Prasanna, Associate Professor of the Department of Internet of Things, for her invaluable guidance and unwavering support in completing this project. We extend our sincere



appreciation for her inspiring assistance throughout our project. We also express our sincere gratitude to all the lab technicians who supported us in every aspect related to our project. We would like to thank our friends and everyone who provided their direct or indirect support in completing our project.

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