IOT BASED DELIVERY ROBOT FOR MEDICAL APPLICATIONS

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ABSTRACT:

This project presents the design and implementation of a smart medicine delivery robot that leverages modern embedded systems and IoT technologies to support healthcare automation. At its core, the robot is powered by the ESP32 microcontroller, which provides seamless integration with the Blynk mobile application via built-in Wi-Fi for remote control and real-time monitoring. Motion control is achieved using the L293D motor driver in conjunction with DC and servo motors, enabling precise navigation and maneuvering. A rechargeable battery system ensures sustained operation, while intelligent power management optimizes energy efficiency. To enhance operational safety, the robot is equipped with obstacle detection sensors to avoid collisions during movement. The development process encompasses hardware assembly, firmware development, mobile app configuration, and extensive testing to ensure reliability and effectiveness. Detailed documentation, including system architecture and wiring diagrams, supports future enhancements and scalability. The resulting system offers a reliable and user-friendly solution for contactless medicine delivery, contributing to safer and more efficient healthcare services.

Index Terms: Medicine Delivery Robot, ESP32, IoT, Blynk App, Healthcare Automation, L293D Motor Driver, Obstacle Detection, Remote Monitoring, Embedded Systems, Smart Healthcare.

1.INTRODUCTION

Nowadays Robotics is a wide spreading area almost in all fields including healthcare. In healthcare applications, IoT robots are involved for surgery, care taking, motion robots and medication robots.Robotic systems have dramatically extended the reach of humans in sensing, interacting, manipulating and remodelling the world around us. Medical robotic devices are designed for entirely different environments and operations relevant to the treatment and prevention of diseases. Under this severe pandemic cause of novel coronavirus or covid-19, hospitals are overcrowded due to an increase in lots of news. Hence the hospital staff are in a great need of support from technology. Robotic healthcare thus finds the best way to support them by providing their superior work and helping them not to have direct contact with the coronavirus positives. Delivering the medicine to the in one ward on a daily basis would take around half to one hour. So to reduce the workload of medical staff, the medicine vending and can be automated. This was the motivation behind developing this project. With the advancement of technology, as the life span of people is expected to increase, it will also lead to increase in population in the older age category. With older age, it becomes a necessity to monitor health accurately for healthy life. Without proper and quality healthcare it is practically impossible for to recover.This has been one of the leading problems in the field of medicine. Nowadays Robotics is a wide spreading area almost in all fields including healthcare. In healthcare applications, an IoT of robots are involved for surgery, care taking, motion robots and medication robots. Robotic systems have dramatically extended the reach of humans in sensing, interacting manipulating and remodeling the world around us.This autonomous robot will be highly beneficial for organizing the medical field. The robot is obedient and highly accurate as it follows the doctor with the aid of ultrasonic sensors. As a result, the hospital only needs a minimal amount of staff to carry out treatment in peace. For the medical system, hygiene is crucial. Since the equipment is kept clean and secure in UV sterilization lockers, the units are also known as autonomous transportable UV sterilization chambers. By using this, doctors may treats without worrying about viruses because they are using clean equipment. Since robots are becoming increasingly intelligent, we have developed voice-activated lockers that open in response to their instructor's commands, making them touchless robots. With the aid of its voice recognition module, this was all accomplished.

Fig: 1.1 Medical Robot

Robots in the medical field execute standard streams of work independently, which decreases the workload on health staff. They also ensure consistency and solve the problem of a shortage of health workers. For example, medical robots can use sanitizers and disinfectants to clean hospital rooms. As a result, medical practitioners can concentrate on caring and other important tasks. Any medical facility has a fair share of unhealthy microorganisms, and medical personnel is susceptible to them. Medical robotics is applicable in controlled and systematic cleaning, which can help decrease the circulation of pathogens and prevent doctors from contracting a health center's infections. Also, specially designed medical robots can help healthcare workers with strenuous jobs like movings, beds, or machines. Prototype manufacturing involves making parts in small quantities for testing, and it occurs in the early manufacturing stages and is most time achievable using 3D printing and CNC machining. For real-time manufacturing, use injection molding process.

2.RELATED WORK

A few research papers related to medical robots have been reviewed and the following references show influence on the design of the smart medical assistant robot. Marcin Zukowski have developed a humanoid medical assistant and companion robot dedicated to children hospitals. They have focused on the robot being able to express emotions and communicate with the children by recognizing their faces and using pictures and text on the chest display to tell stories and present educational videos. The 'Robot' autonomously navigates through hospital rooms and performs simple medical tests like measuring the body temperature or heart rate and sends live video feed to the doctors and nurses. The robot is run using ODROID XU and XU4 with Ubuntu 14.04 operating system and has a dedicated Raspberry Pi 2 computer to animate the robot's eyes. Marcin Zukowski presented the implementation of the temperature measurement system for the medical robotic assistant. They have experimented with MLX90614 infrared thermometer and FLIR Lepton thermal camera and found out that the MLX90614 infrared thermometer cannot be used as the only input source of the system and to get more accurate results, robot would need to come as close as less than 0.3 metres to patients face. To overcome this they created a hybrid system having infrared thermometer along with thermal camera to provide ambient temperature and approximate skin temperature that can be used to detect presence of humans in front of the robot. Kaveh Bakhtiyari, Nils Beckmann and Jürgen Ziegler have proposed a non-invasive contactless Heart Rate Variability (HRV) measurement with Respiratory Sinus Arrhythmia (RSA) correction. They have incorporated Infrared and RGB cameras to measure the heart rate signal, and a 3D Depth sensor has been used to capture the human respiratory signal to correct the calculated HRV with RSA. They have performed correlation analysis by different methods and devices to find an appropriate method for HRV calculations based on the required accuracy and application. Contactless heart rate variability sensors can become an important part of sensors for preliminary health tests. Sachit Mahajan, Prof. Vidhyapathi C.M have designed a medical assistant robot which helps to carry the necessary medical equipment along with them. The robot uses a Pixy image recognition sensor for person detection and ultrasonic sensor for obstacle avoidance.

OBJECTIVE OF PROJECT:

The main objective of the project is to develop a robot that autonomously delivers medications within healthcare facilities, improving overall efficiency in patient care and control the medicine dispensing mechanism also control the robot from anywhere in the world using IOT technology.To implement sensors for obstacle detection and real-time monitoring, ensuring safe navigation within medical environments while providing visibility into the delivery process and track the robot using GPS and alert with voice announcement Live stream the video data over wireless communication.

3.SYSTEM ANALYSIS

Proposed System: The envisioned medicine delivery robot is a sophisticated system that seamlessly integrates cutting-edge components for enhanced functionality. The ESP32 microcontroller, renowned for its versatility, takes center stage as the primary control unit. With built-in Wi-Fi capabilities, the ESP32 establishes a robust connection with the Blynk app, transforming the robot into a remotely controlled device. Motor control is executed with precision using the L293D motor driver, allowing the robot to navigate using DC motors and perform intricate movements through a servo motor. Reliability is a corner stone of the system's design, with a rechargeable battery supplying power and a sophisticated power management system optimizing energy consumption. The Blynk app acts as a versatile command center, empowering users to remotely control the robot and receive critical sensor data. As an extra layer of safety, obstacle detection mechanisms are integrated to prevent collisions, ensuring the robot operates securely in diverse environments. The development process is a meticulous journey that involves the careful setup of hardware components, the crafting of intricate code for motor control and sensor interaction, and the configuration of the Blynk app to provide a seamless user experience. Rigorous testing, including safety assessments, ensures the system's robustness, while ongoing iteration and optimization refine its efficiency and effectiveness.Comprehensive documentation accompanies the development, offering valuable insights into the system architecture, wiring diagrams, and codebase for future reference and continuous improvement. This holistic approach ensures that the medicine delivery robot not only meets but exceeds expectations in delivering healthcare solutions.

4.IMPLEMENTATION

4.1 HARDWARE IMPLEMENTATION

- DC motor

- L293D Motor Driver
- Ultrasonic Sensor
- Rechargable Battery
- Liquid Crystal Display
- Servo Motor
- ARP33A3 Module
- Speaker
- GPS
- ESP32 CAM

4.2 BLOCK DIAGRAM OF THE PROJECT:

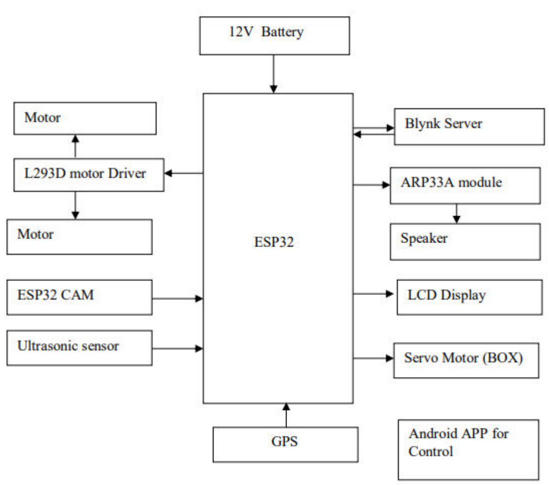

Fig: 4.2 Block Diagram of IOT Based Delivery Robot for Medical Applications

4.3 SCHEMATIC DIAGRAM:

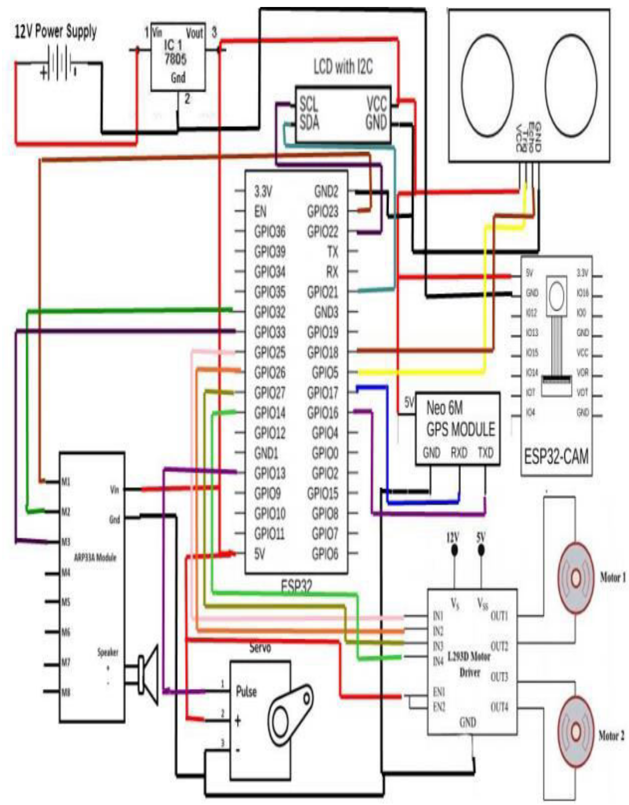

Fig.:4.3 Schematic Diagram

4.4 FLOW CHART :

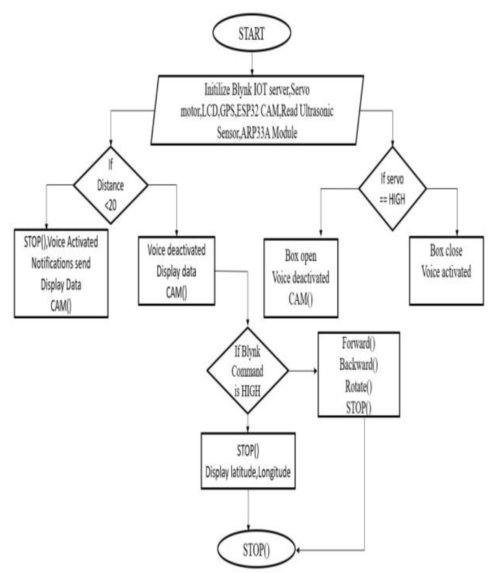

Fig:4.4 Flow Chart

Working Principle: The IoT-based medicine delivery robot operates on the principle of autonomous navigation guided by real-time data from integrated sensors and modules. The heart of the system is the ESP32 microcontroller, which acts as the brain, coordinating inputs from the GPS module, ARP33A sensor, and ultrasonic sensors. When a medicine delivery request is made through the Blynk IoT app, the ESP32 receives the destination coordinates and initiates the navigation process. The GPS and ARP33A module work together to determine the robot's location and generate a path to the patient’s location, while the ultrasonic sensor continuously monitors the surroundings to detect and avoid obstacles. As the robot travels, its environment is monitored in real-time using the ESP32-CAM, which provides a live video feed to healthcare staff through the Blynk mobile app. The LCD display mounted on the robot shows current delivery status, such as the robot's position, delivery progress, and any warnings related to obstructions. The combination of real-time video streaming, live sensor data, and app-based control ensures that the robot can be remotely supervised and managed efficiently, reducing the need for constant human interaction. Upon reaching the destination, the robot activates its servo motor-driven dispensing mechanism, releasing the correct medication to the patient in a controlled and precise manner. Once the delivery is completed, the system sends a confirmation through the app and the robot either returns to its base or awaits the next command. This seamless process ensures safe, timely, and reliable medicine delivery within healthcare environments, reducing staff workload and enhancing overall patient care through automation and smart monitoring.

5.RESULTS

Fig: 5.1 Medicine Dispensing Mechanism.

Fig: 5.2 LCD Displaying Command

Fig: 5.3 Mobile Blynk App

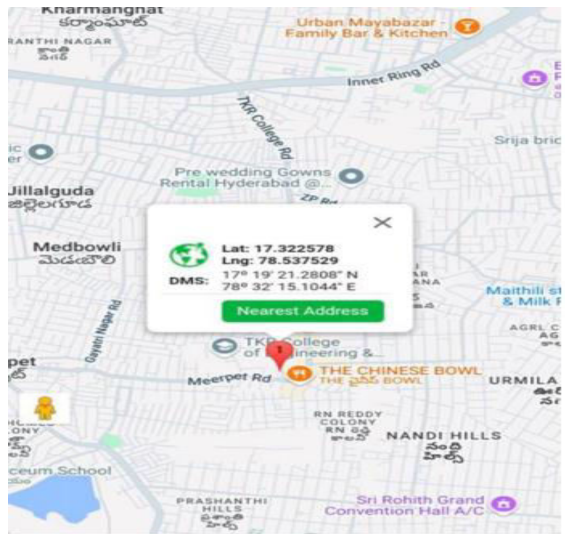

Fig: 5.4 Location Of The Robot

Fig: 5.5 Video Streaming in ESP32 CAM

6.CONCLUSION

The IoT-Based Medicine Delivery Robot is a smart healthcare innovation designed to reduce the workload of medical staff and improve the efficiency of medicine delivery in hospitals. By using components like the ESP32 microcontroller, GPS, ultrasonic sensors, camera, and Blynk IoT platform, the robot can navigate autonomously, avoid obstacles, and deliver medicines safely and on time. It allows healthcare workers to monitor and control the robot remotely through a mobile app, ensuring accurate and reliable service. The implementation of IoT and smart sensing technologies in this context demonstrates significant potential for wider adoption in hospitals and clinics, contributing to the modernization and efficiency of healthcare services.

7.FUTURE SCOPE

- **AI Integration:** Implement AI to improve autonomous navigation, enabling predictiveanalysis for avoiding obstacles and optimizing delivery routes.
- **Enhanced Patient Interaction:** Add features like voice recognition or touchscreens, allowing patients to interact with the robot for feedback and status updates.
- **Battery and Power Optimization:** Integrate solar power or advanced batterymanagement to enhance operational duration.
- **Expansion to Other Healthcare Services:** Extend the robot's capabilities to handleadditional services such as delivering lab reports, sterilization tools, or other medical supplies.

8.REFERENCES

[1] Satale, K., Bhave, T., Chandak, C., & Patil, S. A. (2020). Nursing Robot. International Research Journal of Engineering and Technology (IRJET), 10(5), 352–362.

[2] Lee, M., Ameyama, K., Yamazoe, H., & Lee, J.-H. (2020). Necessity and feasibility of care training assistant robot (CaTARo) as shoulder complex joint with multi-DOF in elderly care education. Robomech Journal, 152, 1739–1744.

[3] Wang, X. V., & Wang, L. (2021). A literature survey of the robotic technologies during the COVID-19 pandemic. Journal of Manufacturing Systems, 31(25), 2772–2777.

[4] Tian, S., Yang, W., Le Grange, J. M., Wang, P., Huang, W., & Ye, Z. (2019). Smart healthcare: making medical care more

intelligent. Global Health Journal, 41, 237–240.

[5] Loh, E. (2018). Medicine and the rise of the robots: a qualitative review of recent advances of artificial intelligence in health. Vol. 5(3), 205–226.

[6] Louis, L. (2016). Working principle of Arduino and using it as a tool for study and research. International Journal of Control, Automation, Communication and Systems (IJCACS), 1, 5.

[7] Chaitanya, K. (2021). Robotic nursing aid. National Science Foundation (NSF), 49, 1–6.

[8] Pandey, A. K., & Gelin, R. (2018). A mass-produced sociable humanoid robot: Pepper: The first machine of its kind. IEEE Robotics & Automation Magazine, 30(1), 35–37.

[9] Nitzan, M., Romem, A., & Koppel, R. (2014). Pulse oximetry: fundamentals and technology update. Medical Devices: Evidence and Research, 95, 160–180.

[10] Kyrarini, M., Lygerakis, F., Rajavenkatanarayanan, A., Sevastopoulos, C., Nambiappan, H. R., Chaitanya, K. K., Babu, A. R., Mathew, J., & Makedon, F. (2021). A survey of robots in healthcare. Technologies, 60(6), 901–911.

[11]. Rajesh. K, M. GopiKrishna, V.R.Rao, P.Pavani, C.Chandrasekhara "Smart Applications using Robotic and Iot Technologies in Fighting against Pandemic Covid19 in Medical and Societal Sectors," International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN. 2278-3075, Volume-9 Issue 7 , 2020.

[12]. Min-soo Kang,Chunhwa Ihm, Jaeyeon Lee, Eun-Hye Choi, Sang Kwang Lee, - "A Study on Object Recognition for Safe Operation of Hospital Logistics Robot Based on IoT, " The Journal of The Institute of Internet, Broadcasting and Communication (IIBC) Vol.17, No.2, pp.141-146,. pISSN 2289-0238, eISSN 2289-0246.Apr. 30, 2017

[13]. Seohyun Jeon , Jaeyeon Lee, "Performance analysis of scheduling multiple robots for hospital logistics" in the proceedings of 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI) 2017.