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Design and Development of Robotic Vehicle to Assist Patients in Isolation Ward

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Abstract

In the wake of the Contagious diseases, the need for innovative solutions to support patient care in isolation wards has become increasingly crucial. This paper presents the design and development of a robotic vehicle aimed at assisting patients in isolation ward. One can control the car from a safe distance to avoid contact of the patient. Additionally, the robotic vehicle incorporates a sanitizing booth to ensure hygienic conditions within the isolation environment. The control interface for the robotic vehicle is facilitated through a Blynk mobile application, providing real-time observing and managing capabilities to healthcare professionals. This endeavor not only tackles the challenges of patient care in isolation wards but also adds to the advancement of robotics in healthcare settings.

Keywords: *Contagious diseases; Robotic vehicle; Isolation ward; Blynk App.*

1. Introduction

The global healthcare landscape has witnessed unprecedented challenges in recent times, particularly in managing infectious diseases such as COVID-19 ensuring effective care for patients in isolation wards is crucial. To address this, we present a groundbreaking project focused on designing and developing a robotic vehicle tailored to support patients in isolation settings. By leveraging modern technology such as DC motors, a camera system, a buzzer, a power supply, a DFX Player for audio, an ultrasonic sensor, a Blynk mobile app, and an ESP32 module, our project aims to revolutionize patient care within isolation wards. Our robotic vehicle serves as a versatile assistant within isolation wards, equipped with essential features to aid patient care. With agile DC motors enabling smooth mobility, the vehicle able to traverse the ward effectively. The integrated camera system allows real-time monitoring of patients, while a buzzer provides audible cues for communication. A reliable power supply ensures continuous operation, and the DFX Player enables playback of important audio instructions and alerts, enhancing patient management. Incorporating cutting-edge sensor technology, our robotic vehicle enhances safety and efficiency within the isolation ward environment. An ultrasonic sensor is essential to detecting obstacles, ensuring the vehicle moves safely and autonomously. Furthermore, the integration of an ESP32 module enables seamless wireless communication, facilitating remote control via the user-friendly Blynk mobile app. Additionally, our project integrates a sanitizing booth to maintain high hygiene standards within the isolation ward, demonstrating our commitment to comprehensive patient care.

2. Literature Survey

To complete the undertaking in proper manner, a literature survey is of great help. Many techniques are being consistently proposed through various researches and are presented in many both domestic and foreign conferences and released in various journals. This section presents best techniques that are taken from various research publications that are

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best suited for the proposed design. [1] This paper proposed a robotic vehicle for isolation ward. This system consists of totally five motors. Four motors are used for movement of robotic vehicle and fifth motor is used for lifting the tray. The vehicle can be controlled from the distance of around ten meters. It successfully facilitates seamless interaction between the robotic vehicle, healthcare professionals, and patients. [2] The paper designed and Simulated a Service Robot for Covid-19 Isolation Wards. The model comprises of 3 basic mechanisms that include the delivery mechanism, the chassis of the mobile robot, and the sanitization mechanism to disinfect the boxes after each delivery. The system successfully helps in minimizing distance of travel which helps in lowering the delivery time to ensure the freshness of food items and medicines. [3] In this paper they developed a Cost-effective Disinfection Robot Using UVC Radiation. The framework is cost effective, portable UV the automated system is suitable for any type of floor and is operated by Bluetooth technology. The motors consume less power, it is capable of sterilizing the room or small objects without being physically present within in the space. This paper proposed a Andal's Covid-19 is [4] served by Medical Robot assistance (AMIRA) patients. AMIRA is an AGV that has the necessary sensors, controllers, and actuators for it to operate properly. It can help stop the virus from spreading by at least mini missing direct contact between the medical staff and COVID patients.[5] This paper designed a Hospital Application Automatically Guided Vehicle. This prototype includes an automatic guided vehicle for carrying medicines, real-time monitoring of patients, and dumping of waste. The model is intended to work either in automatic or in manual mode. S. [6] This essay suggested a IoT Based Smart Delivering Robot for Isolation Ward. The model measures heart and SpO2 rate by placing the finger tips in pulse oximeter. The two rates thus measured able to be managed by Arduino Nano board. The robot can lower person to person interaction which bring down risk additionally spreading of infection. [7] This paper designed a vehicle ventilation system ESP32 Node MCU being used for remote monitoring. The vehicle ventilation system utilized microcontroller based on the MCU Node ESP8266, connected to sensors additionally the vehicle accessories. It was connected to Wi-Fi in order to store the sensed data in a cloud server. Vehicle ventilation system monitors indoor temperature. microcontroller was able to manage the vehicle power window remote. [8] This paper designed a of robotic vehicle through we bots for isolated covid19 patients. The robot is designed with simple structure with a little hollow top to carry some necessary goods. It's a four-wheel vehicle. The system is capable of transporting a payload of 8kgs. [9] This essay suggested a Sister Robots for food and medicine carriers. The different components of Sister V.2 Robot are metal framework, shaft, motor and camera. They are multi-purpose robots designed to reduce nurses from COVID19 suspected/infected patient. [10,11] This paper designed and execution of Healthcare Assistive Robot. A health care assistive robot is intended to assist the bed ridden patient by delivering the medicines to the patient on time. The robot is also designed to assist the patient based on his/her requests.

3. Methodology

A robot is an electromechanical machine that is managed by computer program for various operations. [12] The vehicle able to be managed from a safe distance to avoid contact of the patient. The system which we designed consist of two major functions, such as viewing the patient through camera and the other is delivering the sufficient things to the patient. DC motors are used to move the vehicle Right, Left, Forward and Reverse. To serve the food and drugs one tray is provided in the vehicle. During serving the food and drugs it is required to change the height of the tray as per the convenience of the individual. The block schematic for robotic vehicle is displayed in Figure 1 The initial stage involved defining the requirements and specifications of the robotic vehicle according to the requirements of patients and healthcare professionals in isolation wards. Through literature review, key characteristics like mobility, communication, and hygiene measures were identified. The selection of components including DC motors, a camera system, a buzzer, a power

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supply, a DFX Player for audio, an ultrasonic sensor, a Blynk mobile app, and an ESP32 module was guided by their suitability for the intended functionalities.[13] Furthermore, the incorporation of a sanitizing booth was conceptualized to address hygiene concerns within the isolation ward environment. with the conceptual framework established, the next stage involved the physical realization of the robotic vehicle. Using a modular approach, each component was individually tested and integrated into the vehicle platform. DC motors were configured for locomotion, while the camera system was mounted for visual monitoring. The buzzer and DFX Player were connected to provide audio feedback and instructions. The ultrasonic sensor was installed for obstacle detection, ensuring safe navigation within the ward. The Blynk mobile app was configured to enable remote control and monitoring, facilitated by the ESP32 module. Additionally, the sanitizing booth was integrated into the vehicle's design to provide a comprehensive solution for maintaining hygiene standards.

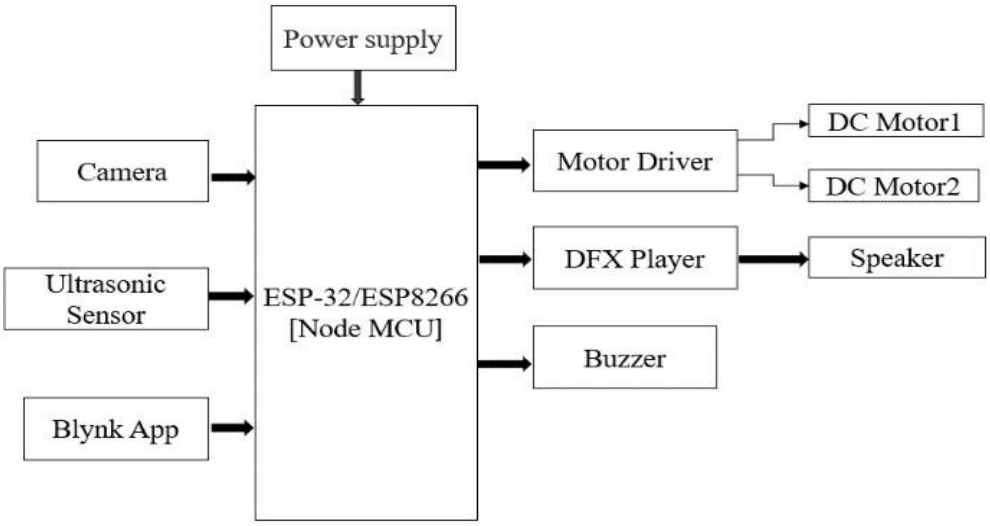

Figure 1 Block Diagram of Robotic Vehicle

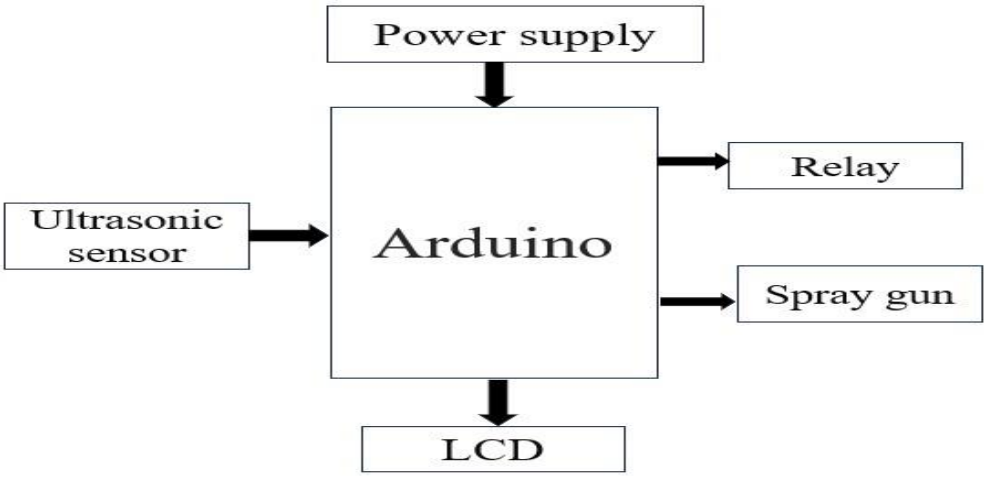

Figure 2 Block Schematic of Sanitizing Booth

The final stage of the methodology involved rigorous testing and validation of the robotic vehicle prototype. Functional testing was conducted to evaluate the effectiveness of individual components additionally the overall system integration. Feedback from healthcare professionals and end-

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users was solicited to determine any areas that require improvement and refinement.[14] Through iterative testing and optimization, the final robotic vehicle prototype was validated for deployment in isolation ward environments, showcasing its potential to enhance patient treatment as well as support healthcare personnel in challenging circumstances show in Figure 2.

4. Flowchart

The Flowchart illustrates the sequential steps involved in the operation of a robotic vehicle to assist patients in an isolation ward, from initialization and task planning to navigation, task execution, and return to base. The steps involve initializing the robotic vehicle's systems, including powering on the vehicle, initializing sensors, and performing any self-tests or diagnostic checks.[15] Based on input from the healthcare staff or pre-defined tasks, the robotic vehicle plans its talks for assisting patients in the isolation ward. Upon reaching the designated location, the robotic vehicle executes its assigned tasks. This may involve delivering medication to a patient. Once all tasks are completed or if no further tasks are assigned, the robotic vehicle navigates back to Sanitizing Booth. Then the flowchart ends, indicating the completion of the process in Figure 3.

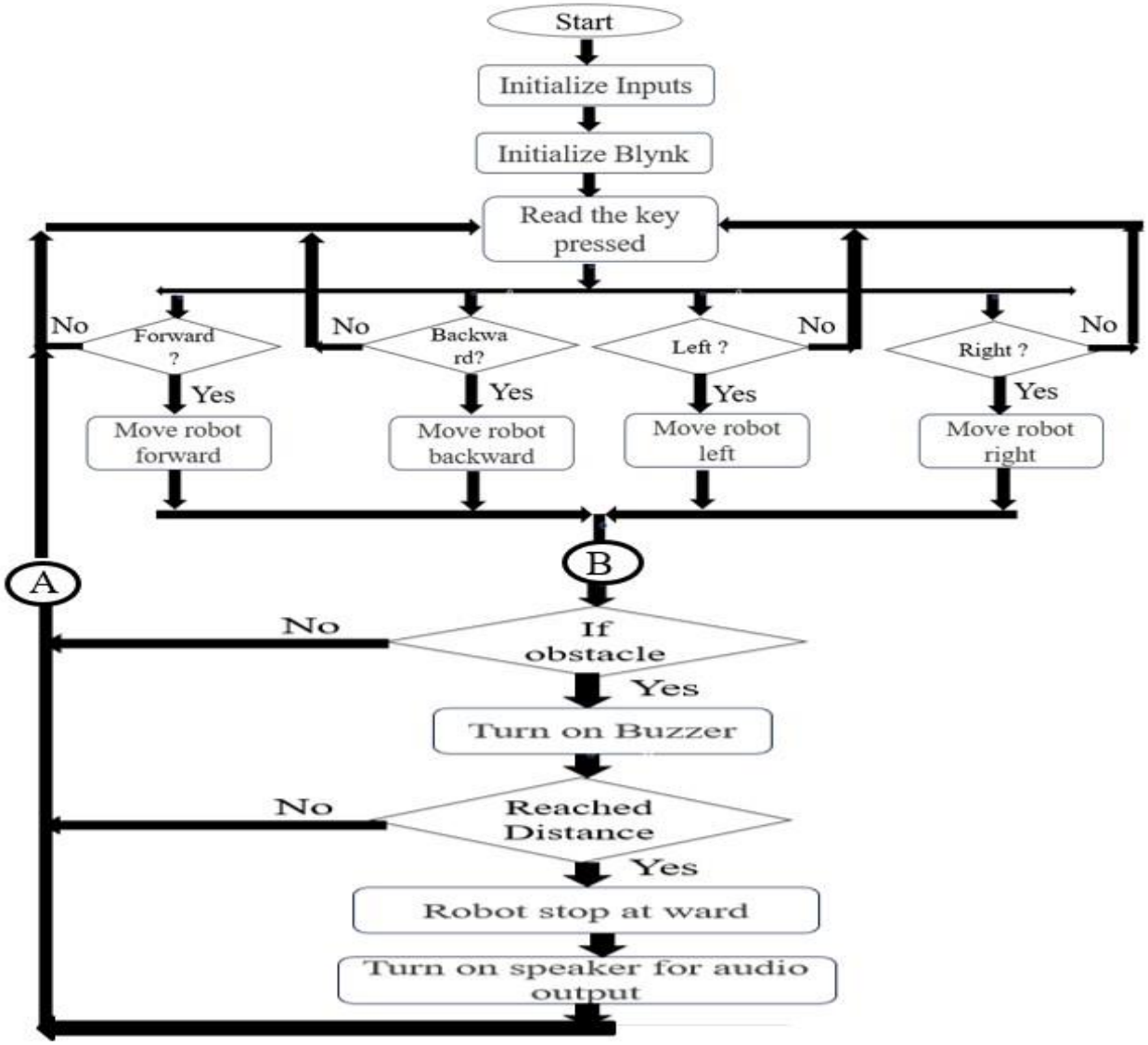

Figure 3 Flowchart of Robot Vehicle

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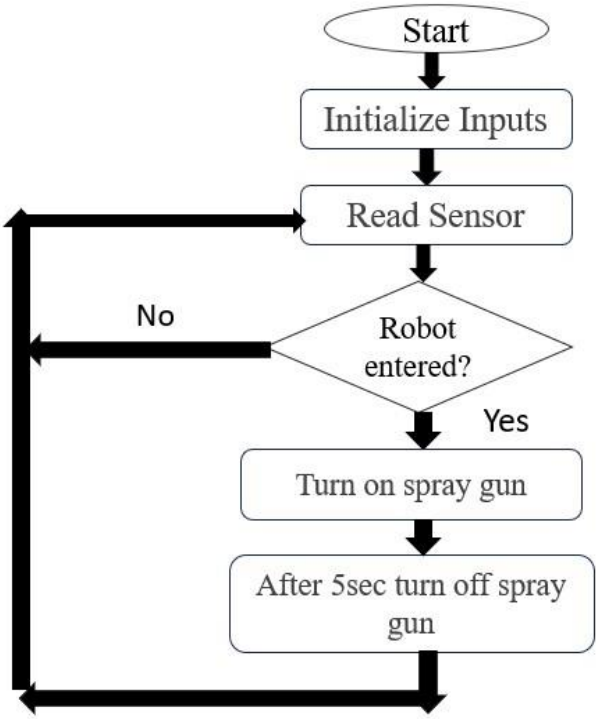

Figure 4 Flowchart of Sanitizing Booth

The flowchart illustrates the sequential steps involved in the operation of a sanitizing booth. It highlights the automated characteristics of the process, with sensors detecting the presence of individuals to initiate and complete the sanitization process effectively. The flowchart begins with the start symbol, indicating the initiation of the sanitization process. Sensors detect the presence of individuals inside the booth. This step guarantees that the sanitization process is initiated only when individuals are present. Once individuals are detected inside the booth, the sanitization process begins. This may involve activating disinfectant sprayer. The booth sprays disinfectant solution or sanitizing agents over the robotic vehicle. After completing the disinfection process, the robot can exist sanitizing booth. The flowchart ends, indicating the completion of the sanitization process in Figure 4.

5. Results and Discussion

A top-view image illustrating the design and development of the Robotic Vehicle to help Patients with Isolation Ward, showcasing its intricate features. Additionally, a top-view depiction of the sanitizing booth underscores the project's comprehensive approach to infection control within healthcare settings.

Figure 5 Top View of The Robot

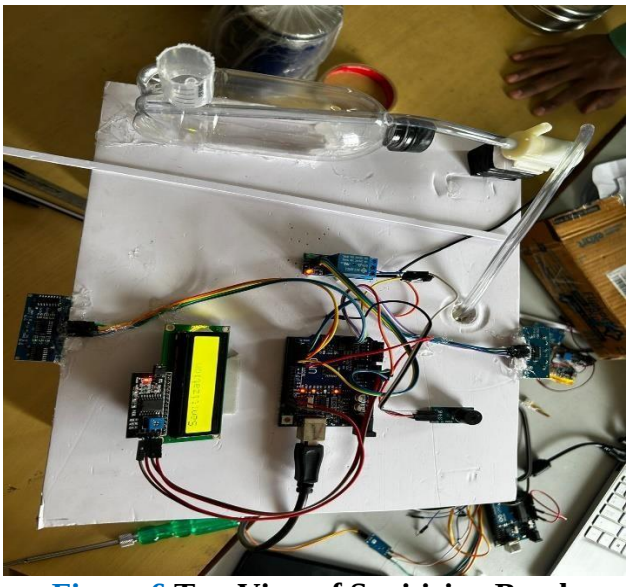

Figure 6 Top View of Sanitizing Booth

This visual representation encapsulates the innovative solution's potential for revolutionizing patient treatment as well as safety protocols in isolation wards, contributing significantly to healthcare robotics research show in Figure 5 &6.

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Figure 7 Movement of Robot Towards the Left Side

Figure 8 Movement of Robot Towards the Right Side

The above images capture the movement of the Robotic Vehicle to help Patients with Isolation Ward, demonstrating its agile navigation capabilities with left and right turns. These dynamic visuals highlight the versatility of the robotic vehicle in navigating through complex environments within isolation wards. The incorporation of such imagery underscores the project's contribution to advancing robotics for healthcare applications, providing an understanding of its possible effects on patient care and safety in Figure 7&8.

Figure 9 Monitoring of The Robot Using Blynk App

The figure showcases the integration of a Blynk app for monitoring the Robotic Vehicle to help Patients with Isolation Ward, providing real-time insights into its operations. Through the Blynk app interface, medical experts can keep an eye on the robot's status, ensuring efficient delivery of supplies and adherence to safety protocols within isolation wards. This visual representation underscores the project's innovation in leveraging IoT technology for enhanced healthcare logistics and patient care in Figure 9.

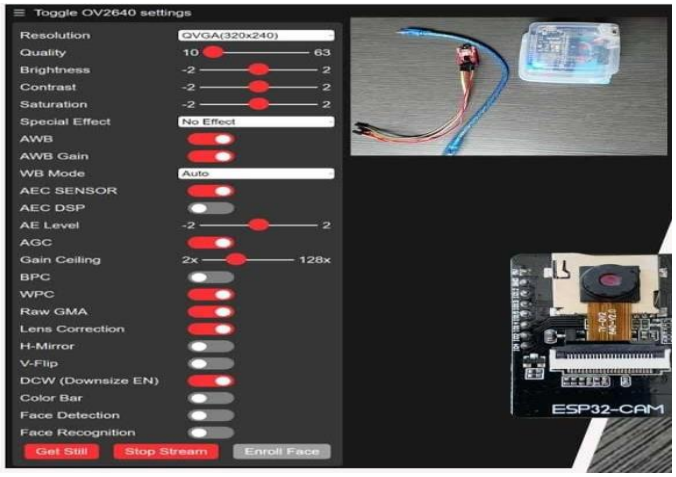

Figure 10 Video Streaming of ESP32-CAM

The figure represents the features a snapshot of the project's implementation of ESP32 camera video streaming, showcasing real-time visual monitoring

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capabilities for the Robotic Vehicle to Assist Patients in Isolation Ward in Figure 10. This integration highlights the project's advancement in leveraging IoT technology to enhance surveillance and patient care within healthcare settings.

6. Future Scope

This project holds significant potential for future advancement. The robotic vehicle is used to assist patients in isolation ward which brings potential to healthcare staff, improve patient monitoring, and provide timely assistance. Our work has minimized the following issues. Some of them include: spreading of infectious disease, direct contact between healthcare providers and potentially infectious patients, risk of contamination and potential exposure.

Conclusion

The project is design and development of a Robotic Vehicle to Assist Patients in Isolation Ward, tasked with delivering food and medicine to patients afflicted with infectious diseases, marks a significant breakthrough in healthcare logistics and infection control. By leveraging robotics to automate the delivery process, this innovative solution minimizes direct human contact, thereby reducing the possibility of disease transmission and ensuring the safety of both patients and healthcare workers. Moreover, the incorporation of a sanitization mechanism to cleanse the robot upon exiting the isolation ward adds an extra layer of protection, mitigating the possibility for cross-contamination and reinforcing the hygiene protocols crucial for containing infectious outbreaks within healthcare facilities.

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