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Bluetooth-Controlled Chassis with Obstacle Avoidance and Environment Monitoring

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Abstract:. This paper gives a holistic answer to the challenges in robotics; specifically, how to navigate a robot, make it aware of its environment and let it interact with humans. The approach shall be to implement a Bluetooth-controlled chassis fitted with advanced sensors such as ultrasonic for obstacle-avoidance, pollution monitoring through MQ-135 gas sensor, sound detection using KY-037 microphone, temperature/humidity sensing with DHT11 and flame detection by Flame sensor. For accurate user control and real-time environmental monitoring, the system is powered by an Arduino microcontroller and a NodeMCU module. In addition to this, it is integrated into the Blink app for better interaction with users. This fusion of technologies resolves not only immediate issues but also lays the foundation for future developments in robotics and environmental intelligence. Consequently, this system ushers in a new era of responsive, versatile and environmentally sensitive intelligent robots.

Index terms: Arduino, ADS1115, Bluetooth-Controlled Chassis, Environment Monitoring, NodeMCU.

I.INTRODUCTION

The robotic systems are constantly changing to suit different applications, calling for progress in navigation, environmental consciousness and user interaction. It thus presents the development of a complete solution based on a Bluetooth con-trolled chassis. The chassis incorporates some advanced sensors such as; ultra-sonic for obstacle avoidance, MQ-135 gas sensor for gas monitoring, KY-037 microphone sensor for sound detection, DHT11 temperature/humidity sensor and Flame sensor for fire detection. This combination of these sensors with an Arduino microcontroller and a NodeMCU module provides a system that not only enhances user control precision but also allows real-time environmental monitoring. Moreover, incorporation of Blink app establishes an intuitive interface that ensures seamless user interactions.

This paper presents the key components, methodology, and significance of this integrated robotic system. By converging technologies, the proposed solution not only overcomes immediate challenges but also lays the groundwork for continuous innovation in the fields of robotics and environmental intelligence. This work represents a paradigm shift, offering a responsive, versatile, and environ-mentally conscious intelligent robotic solution poised to shape the future of robotic platforms.

II.LITERATURE REVIEW

Chen et al. [1], conducted research on frangible internet-based WSN's for real time monitoring of indoor environments, which quantify various parameters. Deshmukh et al. [2] developed an IoT system for measuring air and noise pollution as a cheaper alternative to collect remote data. Joshi et al. [3], developed an industry based IoT smart sensor network for real time monitoring of air and noise pollution levels. Singh et al. [4] designed an IoT that simultaneously measures air and sound pollutants for real-time readings. Pal et al. [5], designed an IoT based air pollution monitoring system that gives alerts and displays pollution levels on LCD and web. Saha et al. [6], designed the system specifically to monitor AQI in real-time and Noise Intensity contributing towards literature aimed at controlling pollution. Alam et al. [7], developed a low-cost environmental monitoring system: gas, sound, temperature, dust sensors, web-connected for efficient pollution analysis. Sinchana et al. [8], designed a unique preventive action real-time IOT pollution detection monitors using Arduino board with sensors. Pudugosula et al. [9], introduce a new design of smart kitchen safety system with sensors, Arduino UNO, Wi-Fi, and relay for real time hazard detection increasing safety measure. Chaudhry et al. [10], designed a cost-effective voice-controlled robot system which was constructed using an Android app and Arduino board. On the other hand, Zohari et al. [11], designed a weather monitoring system using Blynk for real-time data collection and visualization purposes. In another case, Choodarathnakara et al. [12], proposed IoT based real time air and noise pollution monitoring system. Kumar et al. [13], work however developed an IOT system for real time tracking, analytics and alerting of pollution levels in the environments. Li et al. [14], fabricated mobile robot local path avoidance enhanced with YOLO-v3 by ROS based obstacle avoidance Recently Xu et al. [15], suggested that this problem could be addressed through designing synthesizing and fabricating Ro-bot navigation design via w heeled Arduino based system with infrared tracking as well as obstacle avoidance. Newly Cornelius et al. [16], presented an IoT-based air and sound monitoring system detects pollution, alerts authorities for timely intervention and control. Recently Janeera et al. [17], developed And IoT-based system monitors and alerts authorities on noise and air pollution levels. Haque et al. [18], on the other hand, crafted Automated microcontroller-based systems monitors air & sound pollution, give alerts in addition to remotely notifying parties. Recently, Sonawane et al. [19] developed an IoT-based system for monitoring both air quality and noise pollution. Recently, Song et al. [20] created a fuzzy control-based multi-sensor obstacle avoidance system for robots. Cheng et al. [21] recently created a modular wireless video automobile equipped with Bluetooth, Wi-Fi camera, GPS, obstacle avoidance, and an anti-theft alert. Very Dash et al. [22] have created a system that uses ultrasonic sensors and an AT-mega328 to efficiently avoid obstacles in a robotic vehicle. Botero-Valencia et al. [23] recently announced plans to create a tiny, low-cost pollution assessment station equipped with several sensors, Wi-Fi, and solar power.

Unlike previous research, which frequently focuses on isolated components of robotic or environmental systems, this effort integrates precise human control, real-time environmental monitoring, and user-friendly interaction via the Blink app. The combination of many technologies not only addresses present challenges, but also lays the framework for future innovation in robotics and environmental intelligence. This particular convergence establishes the project as a paradigm shift, providing a responsive, adaptable, and environmentally conscious intelligent robotic system that will greatly contribute to the growth of robotic platforms in terms of functionality and user engagement.

III.METHODOLOGY

1.1 Block Diagram

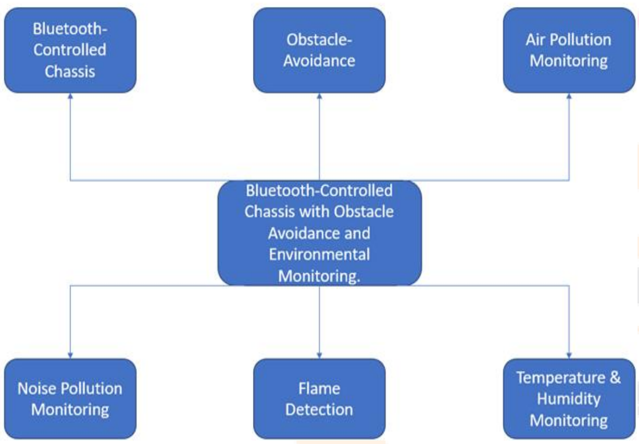

Figure 1. Block Diagram of Actual System.

1.2 Components

Bluetooth Controlled Chassis with Obstacle Avoidance: Arduino, HC-05 Bluetooth Module, 12V DC motor, L298N Motor Driver, HC-SR 04 Ultrasonic Sensor, Servo Motor, 12V Battery.

Environment Monitoring: NodeMCU, ADS1115 module, MQ-135 Gas Sensor, KY-037 Sound sensor, DHT11 Humidity/Temperature sensor, Flame sensor, 16*2 LCD, I2C module.

1.3 Working:

Bluetooth-Controlled Chassis:
Users can send and receive commands wirelessly via Bluetooth. The Arduino microcontroller reads these signals and converts them into motor commands for navigation.

Obstacle Avoidance:

Bluetooth-controlled obstacle avoidance system uses ultrasonic sensors. When an obstruction is spotted, signals instruct the Arduino microcontroller to change motor commands, directing the chassis away for safe navigation.

Environment Monitoring:

NodeMCU: Collect data from sensors and navigate to Blynk app.
MQ-135 Gas sensor: Detects various gases like LPG, CO, and smoke.
KY-037 Sound sensor: Monitors noise levels.
DHT11 Temperature/ Humidity sensor: Measures ambient temperature and humidity.
Flame sensor: Detect presence of fire or flame.

Display on LCD:

The NodeMCU takes sensor readings and communicates over I2C to show the data directly on an LCD screen, avoiding the need for an additional Arduino microcontroller.

Data Transmission to Blink App:

The NodeMCU collects sensor data and uses the Blynk IoT platform to establish a connection with the Blynk application. The NodeMCU delivers real-time sensor readings to the Blynk app over Wi-Fi, allowing for remote monitoring and con-trol. Users can easily access and visualize collected data on their cellphones us-ing the Blynk app interface.

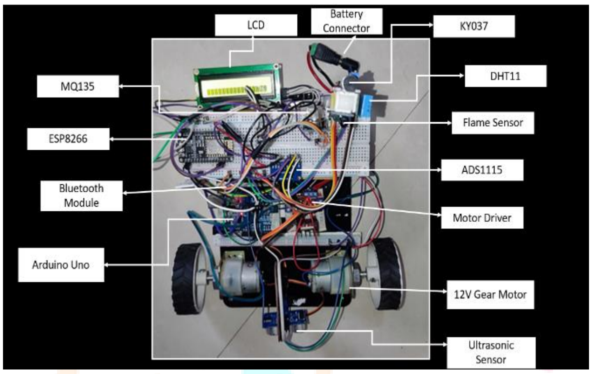

Figure 3. Bluetooth Controlled Chassis with Obstacle Avoidance.

IV.RESULTS AND DISCUSSION

Actual Model of System:

Figure 2 depicts the integrated system, which consists of a Bluetooth-controlled chassis with ultrasonic obstacle avoidance and environmental monitoring com-ponents such as MQ-135, KY-037, and DHT11 sensors. The schematic demonstrates the seamless interface enabled by Arduino and NodeMCU, resulting in precise user control and real-time data collecting. The integration with the Blink app improves user interaction, representing a significant development responsive and environmentally sensitive robotic platforms.

Prototype of Bluetooth Controlled Chassis with Obstacle Avoidance:

Figure 3 displays the Bluetooth-controlled chassis with obstacle avoidance, demonstrating the incorporation of ultrasonic sensors for improved navigation capabilities. The design emphasizes critical components, like the Bluetooth interface and obstacle detection system, which contribute to the system's responsive and intelligent robotic movement.

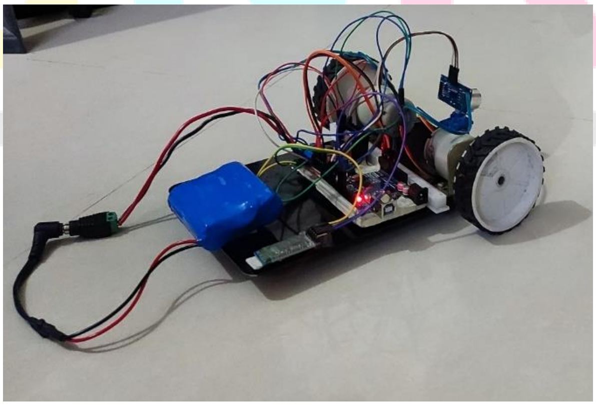

Figure 2 Actual Working Model of System.

Prototype of Environment Monitoring System:

Figure 4. Environment Monitoring System.

Figure 4 depicts the environment monitoring system, which includes an ESP8266, an ADS1115 module, and a suite of sensors such as MQ-135, KY-037, DHT11, and a flame sensor. The system's comprehensive architecture is demonstrated, which allows for real-time data collecting and LCD display of many environmental parameters.

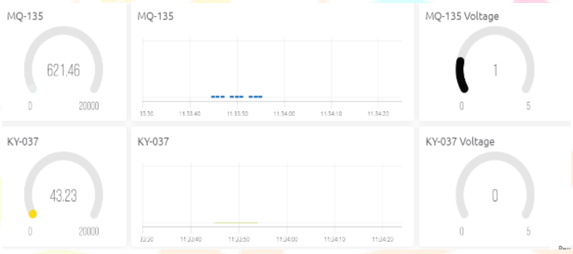

Figure 5 shows real-time sensor readings on an LCD panel, which provide a visual depiction of environmental conditions. This display serves as an important interface for users to monitor and evaluate data generated by the sensor array in the environmental monitoring system.

Graphical Representation with Blynk App

Figure 6 shows the connection of the Blynk app with the robotic system, which provides a simple interface for real-time control and monitoring. The diagram displays bidirectional connection between the NodeMCU module and the Blynk app, highlighting the integrated system's interactive and user-friendly nature.

Figure 5. LCD Displaying Real time sensors reading.

CONCLUSION

Figure 6. Real-Time Sensors reading Displaying on Blynk App.

This project presents a novel way for addressing issues in robotic systems by seamlessly combining modern technologies for navigation, environmental moni-toring, and human interface. The Bluetooth-controlled chassis, along with a di-versified sensor array and the Blink app interface, is a watershed moment in re-sponsive, adaptable, and environmentally conscientious intelligent robotics. The combination of Arduino and NodeMCU technology addresses present challenges while also laying the framework for future innovation in robotics and environ-mental intelligence. With precise human control and real-time monitoring, this technology has the potential to greatly develop intelligent robotic systems. Future initiatives may investigate increasing the sensor suite, improving autonomy, and applying machine learning for adaptive decision-making, further pushing the frontiers of functionality and environmental adaptation.

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