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# Robonav:Smart Mobile Controlled Autonomous Robot

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## ABSTRACT

The advancement of robotics and automation has led to the development of intelligent autonomous systems capable of performing complex tasks with minimal human intervention. RoboNav is a smart, mobile-controlled autonomous robot designed for versatile applications, including surveillance, logistics, and assistance in industrial and domestic environments. By leveraging IoT connectivity, AI-driven navigation, and real-time remote control, RoboNav ensures efficient and precise movement in dynamic environments. Equipped with sensors such as LiDAR, ultrasonic, and computer vision cameras, RoboNav can detect obstacles, map surroundings, and navigate autonomously while adapting to changing conditions. Users can control the robot remotely via a mobile application, enabling real-time monitoring and command execution. Machine learning algorithms enhance RoboNav's decision-making capabilities, allowing it to optimize routes, recognize objects, and interact intelligently with its environment.

By combining autonomy with remote accessibility, RoboNav enhances efficiency, reduces operational risks, and expands the possibilities for smart robotic applications. Its integration into various sectors contributes to automation, safety, and productivity, making it a valuable asset in modern technological ecosystems.

## INTRODUCTION

Dynamic technological development has been observed in the world for a long time, especially in the field of robotics. It already has a significant impact on people's everyday lives, especially in terms of replacing human work with activities carried out by machines. This phenomenon is particularly visible in industry [1-3], but it can also be found more often in the area of services.

Most of the robots used in the world are fully autonomous constructions that are able to perform monotonous inspection works on their own and act as autonomous platforms for fleet management and control of intra-logistic processes [4]. Nevertheless, such designs are also widely used in the military sphere. Using them provides the opportunity to carry out reconnaissance, support and combat operations in dangerous or inaccessible terrain. It is extremely important for humans, as not involving human resources in tasks that are dangerous to human life or health increases the chance of survival or at least minimizing any damage to the health. The use of highly advanced sensory devices in modern robots allows the use of perceptual abilities that are much more accurate and reliable compared to human organs – especially senses such as vision and hearing [5]. The resistance of robots to an environment dangerous for humans is particularly visible in tasks related with space exploration, where unmanned mobile robots can successfully operate on other planets of our solar system: Sojourner, Spirit, Opportunity, Curiosity and Perseverance [6].

## I. EXISTING SYSTEM

Traditional autonomous robots are typically operated using Fixed programming routines and manual control systems. These often relay on wired connections and specialized Contro l hardware, which can be cumbersome and less flexible. They may use basic sensors and motors but lack integration with mobie technology , limiting their adaptability and ease of use in dynamic environments.

## PROPOSED SYSTEM

In this proposed system a speech recognition module is not required to recognize human voice to control robot. In this system an android application is used to recognize and process human voice which is further converted into text (making use of google speech to text converter). This text is transferred to the robot using Bluetooth. This text is further processed by the microcontroller to control the robot accordingly.

## II. METHODOLOGY

Smart Mobile Controlled Autonomous Robot project using IoT involves a systematic approach that integrates hardware assembly, IoT-based communication, and autonomous control through sensors. The project starts by defining the objectives, which include enabling mobile-based remote control via the internet and implementing autonomous navigation for obstacle avoidance. Suitable components are selected for the task, with NodeMCU (ESP8266) serving as the main controller due to its Wi-Fi capability. Additional components include DC motors for movement, a motor driver module (such as L298N), an ultrasonic sensor for obstacle detection, and a battery pack for power supply.The robot's hardware is assembled by mounting the components on a mobile chassis and connecting them according to a predefined circuit design. The NodeMCU is programmed using the Arduino IDE to control the motors based on input from both the mobile interface and the ultrasonic sensor. An IoT platform such as Blynk, Adafruit IO, or Firebase is used to create a mobile dashboard that allows users to send commands to the robot over Wi-Fi, enabling real-time control from anywhere with internet access.Autonomous behavior is achieved by implementing algorithms that allow the robot to detect and avoid obstacles using data from theultrasonic sensor. The robot switches between manual and autonomous modes based on the input received from the IoT interface. Testing is conducted at various stages to ensure stable connectivity, accurate sensor readings, and reliable motor control. The system is optimized by calibrating sensor sensitivity, adjusting motor speeds, and ensuring efficient power usage. Finally, comprehensive documentation is prepared, covering hardware specifications, wiring diagrams, source code, testing procedures, and usage instructions for future reference and scalability

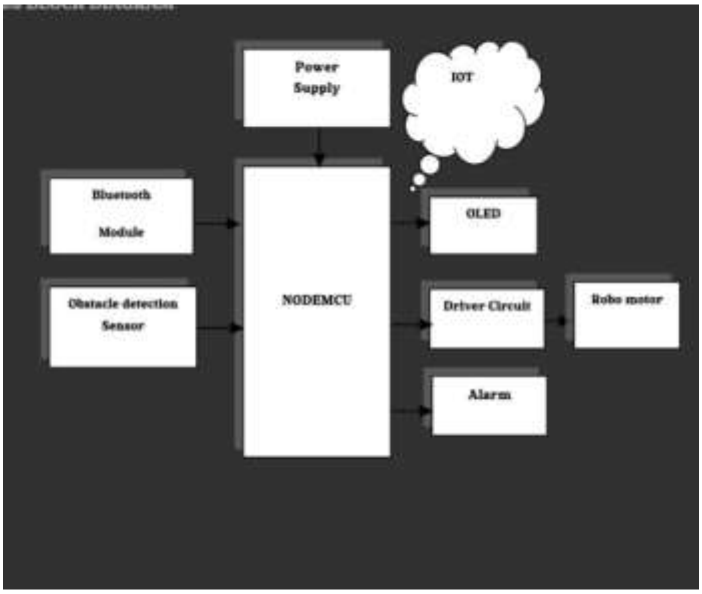


Fig 1:SMART MOBILE CONTROLLED AUTONOMOUS ROBOT

### Applications

1. Surveillance and Security

The robot can be used for remote surveillance in homes, offices, warehouses, and restricted areas. Users can control it via mobile devices and monitor live data, making it useful for security patrols and real-time incident reporting.

2. Disaster Response and Rescue

In hazardous environments such as collapsed buildings, fire zones, or chemical spills, the robot can autonomously navigate and be remotely controlled to search for survivors or assess damage without risking human lives.

3. Smart Home Automation

The robot can perform tasks such as monitoring different rooms delivering small items,or interacting with smart home devices, offering convenience and automation in daily household tasks.

4 . Agricultural Monitoring

It can be deployed in agricultural fields for monitoring crop health, soil conditions, and environmental parameters. The mobile and autonomous features make it ideal for use in large and uneven terrains.

5. Military and Defense Operations

These robots can be used for reconnaissance missions, bomb detection, or remote inspection in combat zones, reducing risk to soldiers while enhancing situational awareness.

6. Industrial Automation

In industries, the robot can assist in monitoring equipment, transporting small components, or inspecting dangerous machinery areas where human access is limited.

## HARDWARE DETAILS

**Power Supply**

The power supply is the backbone of the system. It ensures that all components receive the correct voltage and current. Typically, a Li-ion battery or adapter (5V or 9V) is used, with a voltage regulator (like 7805) to step down to 3.3V or 5V, suitable for components like NodeMCU, sensors, and motors.This also includes power distribution to the motor driver, sensors, and NodeMCU.

**NodeMCU (ESP8266)**

The NodeMCU is a microcontroller with built-in Wi-Fi. It acts as the central processing unit.It receives data from sensors (e.g., obstacle sensor), processes it, and makes decisions like stopping the motor or sending alerts.It also handles communication—both Bluetooth ( via amodule) and Wi-Fi (for IoT).
You can program it using Embedded C.

**Bluetooth Module**

Typically an HC-05 Bluetooth module is used here.This module allows the robot to be controlled via a mobile application. When the user sends a command ("move forward"), it's received by the NodeMCU through this module, which then triggers motor movement.

**Obstacle Detection Sensor**

Commonly IR sensor is used.
The sensor continuously checks for obstacles ahead. If it detects an object within a certain range, it sends a signal to the NodeMCU. NodeMCU then takes action:

**OLED Display**

Usually a small OLED display is used.It displays real-time data like : Obstacle distance Battery level ( if monitored) Robot status (e.g., "Obstacle Ahead", "Moving Forward", "Bluetooth Connected" ) It's useful for debugging and monitoring without needing to connect to a PC.

**IoT (Internet of Things)**

NodeMCU's built-in Wi-Fi allows it to connect to cloud platforms.Popular platforms: ThingSpeak.
Enables:
Remote monitoring (e.g., obstacle logs, movement logs) Remote control via the internetData logging (e.g., distance sensor data)This can extend the robot's functionality from local (Bluetooth) to global access.

**Alarm**

This could be a simple buzzer.It activates under certain conditions like:
Obstacle detection,Unauthorized Bluetooth access System fault (e.g., motor failure) Acts as an auditory feedback for important events.

**Driver Circuit**

Most likely a motor driver IC L293D. NodeMCU outputs low-power control signals; this circuit amplifies them to drive high-power motors.
Controls:
Direction ( forward , backward ) Speed ( via PWM) It isolates the motors from the sensitive NodeMCU pins.

**Robo Motor**

The motors used are DC geared motors or BO motors. These physically move the robot.They respond to control signals from the driver circuit and perform the movement (left,right,forward, reverse).

## SOFTWARE DETAILS

**Embedded System Software:**
The core of the smart mobile controlled autonomous robot lies in its embedded system software, typically programmed using platforms like Arduino IDE, MicroPython, or C++. This software is responsible for interfacing with sensors (such as ultrasonic or IR), controlling motors through PWM signals, and managing communication modules like Bluetooth (HC-05) or Wi-Fi (ESP32). It includes logic for switching between manual and autonomous modes, executing obstacle avoidance, line

e.g.,stops the robot, activatesan alarm,or reroutes the robot.

appropriately to its environment without human intervention.

**Mobile Application and Communication:**
The mobile control interface is developed using tools such as MIT App Inventor, Flutter, or Android Studio, allowing users to control the robot wirelessly through a smartphone. The app typically includes a joystick or button-based interface, a mode selector, and status indicators. Communication between the app and robot is established via Bluetooth or Wi-Fi using serial communication or HTTP protocols. In manual mode, the app sends commands for movement, while in autonomous mode, it can monitor the robot's actions. Advanced setups may include cloud integration for remote control, data logging, or real-time tracking through services like Firebase or MQTT**.**

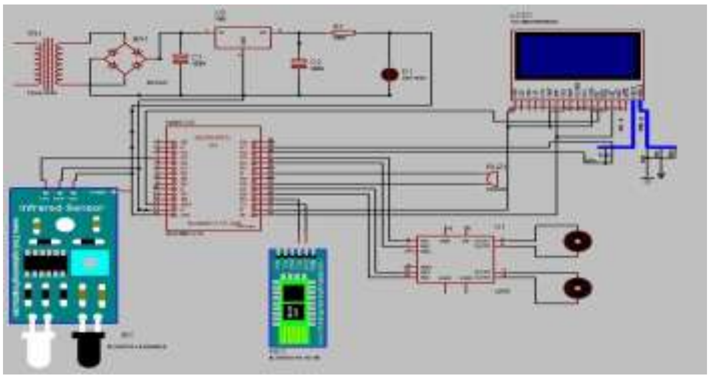

Fig.2 SCHEMATIC DIAGRAM OF SMART MOBILE CONTROLLED AUTONOMOUS ROBOT

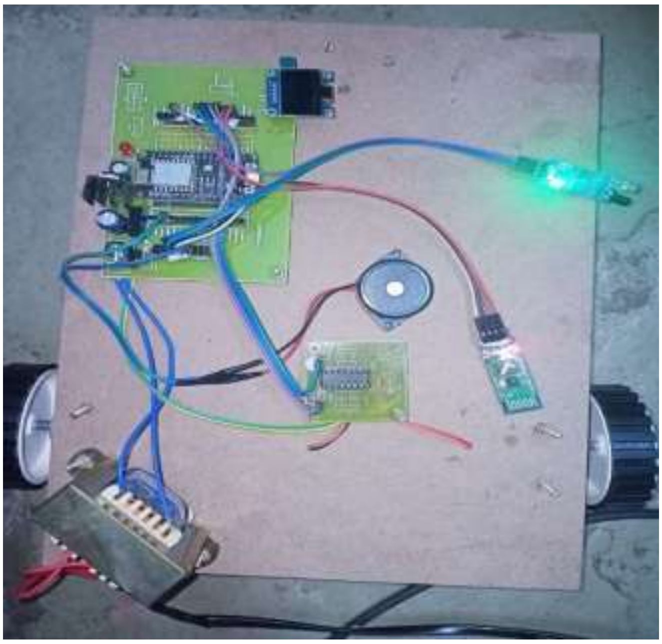

Fig 3: PROTOTYPE OF SMART MOBILE CONTROLLED AUTONOMOUS ROBOT

## CONCLUSION

The RoboNav: Smart Mobile - Controlled Autonomous Robot project successfully demonstrated how embedded systems, wireless communication, and sensor integration can be used to build a reliable, semi-autonomous robotic platform. Designed for real-time operation in dynamic environments , RoboNav combined manual Bluetooth- based control with autonomous obstacle detection and navigation. The use of NodeMCU ( ESP8266 ) as the microcontroller ensured efficient data processing and wireless connectivity. Sensors such as ultrasonic modules and computer vision cameras provided real - time environmental awareness, enabling the robot to make intelligent decisions like avoiding obstacles and rerouting paths. The integration of an OLED display and Bluetooth module enhanced interactivity and user experience.

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