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Utilization of UGV in Mining Sectors

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Abstract: In various sectors such as defense and mining, existing Unmanned Ground Vehicle (UGV) applications face specific limitations, including the inability to achieve wide- range control and operate in dark environments. To mitigate human risks and reduce human involvement in bomb disposal operations, the need for UGVs has become crucial. In this context, we propose a model/framework that utilizes gas and temperature sensors to detect environmental conditions. Our framework aims to enhance UGV applications by incorporating wide-range Wi-Fi enabled control devices and night mode camera functionality. This enables rapid object detection over a greater distance and emphasizes remote control through a mobile application. As a result, the proposed system automates the process of bomb disposal, thereby reducing human risks involved in such operations.

INTRODUCTION

UGV vehicles possess immense potential as they operate autonomously without requiring an on board human presence. These autonomous vehicles find application in situations where it is deemed risky or inconvenient to involve humans. Equipped with a range of sensors, these prototypes can detect and assess the environment, transmitting the collected data to a human operator stationed at a base. This model has been effectively developed for bomb disposal in monitored areas, significantly reducing the potential for human casualties. Consequently, the utilization of UGVs in mining areas minimizes human intervention and the associated risks faced by individuals.

LITERATURE SURVEY

Topic: Undesirable Release of Toxic and Flammable Gases
Author: Subhash Kumar

Efficiently managing the presence of hazardous gases like carbon monoxide (CO) and methane (CH4) is of utmost importance in underground coal mining. Detecting the exact sources of gas leaks and determining their boundaries are critical for minimizing risks. These proactive measures not only enhance safety but also empower mine management to take timely preventive measures. The features of Undesirable Release of Toxic and Flammable Gases mentioned below The existing gas monitoring practices in underground coal mines have limited capabilities when it comes to localizing gas leakage sources and estimating gas boundaries. To address this issue, an intelligent system based on a gas analyzer-mounted unmanned ground vehicle (UGV) has been proposed. This system aims to achieve the desired goal of accurately identifying the location-specific gas concentration values. These values will be statistically analyzed using the deduced Gaussian Plume gas model specifically designed for underground coal mines. By doing so, the system will be able to determine the gas leakage source, spread boundary, and generate a gas concentration grid map for effective monitoring and mitigation of gas-related hazard

Topic: Proposed an Landmines and Other Explosives.
Author: P. Greeshma Shivani

Proposed an landmines and other explosives are placed in war fields and other populated places which causes injuries and sometimes death to humans and also property loss. There are various types of landmines such as Antitank landmines and Antipersonnel landmines. Antitank landmines and some of the antipersonnel landmines are metal cased so these landmines can be detected using metal detectors. The ideas are Proposed on Landmines and Other Explosives are mentioned below These landmines have to be relocated for diffusion using robotic arms. For identifying the landmine and to relocate them, without human interference, the unmanned remote controlled ground vehicle with attached robotic arm structure and model is proposed in this paper.

This device is a wireless controlled ground vehicleusing RF modules.
The ground vehicle along with the metal detectorand the robotic arm is designed and their workingis explained.
Operations are controlled through Arduino UNO.

Topic: Modifiable Security and Surveillance Vehicle
Author: Prajot P. Kulkarni

In situations where a large building or area has limited security personnel, monitoring becomes challenging and poses risks to both the security personnel and the overall security of the premises. To address this issue, we propose the concept of a modifiable security and surveillance vehicle, as outlined in this paper. The vehicle is designed to be adaptable, allowing it to be equipped with various modules based on specific requirements. In this case, the vehicle is equipped with a module comprising a camera, sensors, and a siren.The sensors on the vehicle detect any movement or activity, prompting the camera to rotate and focus in the direction of the detected object. If any intruder or suspicious activity is detected, appropriate actions can be taken swiftly to mitigate potential risks. The primary objective of this mobile system is to minimize the risks faced by security personnel while effectively covering a significant portion of the area or building with minimal human intervention.

The features of Modifiable Security and Surveillance Vehicle are
The proposed vehicle demonstrates a modifiable nature, making it highly adaptable for various applications in the security, surveillance, and defense sectors. Its mobility as a vehicle allows for efficient movement and operation in different environments.

Topic: Developed a Prototype Unmanned Ground Vehicle (UGV)
Author: Zhiwei Chen

In a high-risk mission, the deployment of an unmanned ground vehicle (UGV) can effectively replace human involvement, particularly in repetitive mechanical transportation tasks within the military.. Additionally, a combination of Lidar (Light Detection and Ranging) and IMU (Inertial Measurement Unit) is utilized to detect and assess the surrounding environment, providing crucial data for effective UGV control and navigation. The implementation Prototype of Unmanned Ground Vehicle (UGV) are The primary focus of this article is centered around the autonomous control of Unmanned Ground Vehicles (UGVs) operating in field environments. It delves into the concepts of path planning and UGV environment optimization technologies, aiming to enhance the capabilities of UGVs in terms of navigation, efficiency, and overall performance

Topic: The availability of various modalities for their remote-control movement can further more upgrade their abilities and the extent of usage
Author: Dr . Maheswaran S

The development and utilization of remote-controlled spy robots have proven to be highly beneficial, especially when they can be operated over larger distances. The automation industry and the robotic world have played a crucial role in shaping and improving human lives The main objective of this paper is to design an automated vehicle for investigative purposes, utilizing advanced technologies such as Wi-Fi. The work done by various modalities for their remote-control movement The robot equipped with a camera is its ability to continuously transmit live video feed. This feature enables real-time monitoring and surveillance, providing valuable visual information for analysis and decision-making.

Topic: Android applications combined with Bluetooth technology are an inseparable pair at this time especially for controlling a robot.
Author: Widodo Budiharto

Developed a Android applications combined with Bluetooth technology are an inseparable pair at this time especially for controlling a robot. A sophisticated military robot is a robot that is needed by the military/police because it can be deployed to the battlefield or the eradication of terrorism that can be controlled remotely. This system is needed to reduce the remaining casualties from the army, and this combat robot system can also be operated at any time with more numbers than regular soldiers and with minimal operator needs. The usage of Android applications combined with Bluetooth technology. We propose a prototype of a tank-based militaryrobot with object detection and tracking and controlling using Android for simulation of shooting the enemy target. We propose an algorithm for controlling the robotusing an HC-05 Bluetooth module. The methods explained, and experimental results were presented

Topic: Low-Cost Control Systems can be Established by Using Arduino.
Author: Rusdianto Roestam, Nur Hadisukmana

The utilization of Arduino as an affordable microcontroller enables the establishment of low-cost control systems, making it a crucial component in the development of inexpensive autonomous vehicles The focus of this paper is the development of a prototype for an autonomous vehicle that offers commercial specified requirements set forth for its intended purpose. The features Low-Cost Control Systems can be Established by Using Arduino. IoT is adopted to allow the car be controlled remotely.

EXISTING SYSTEM

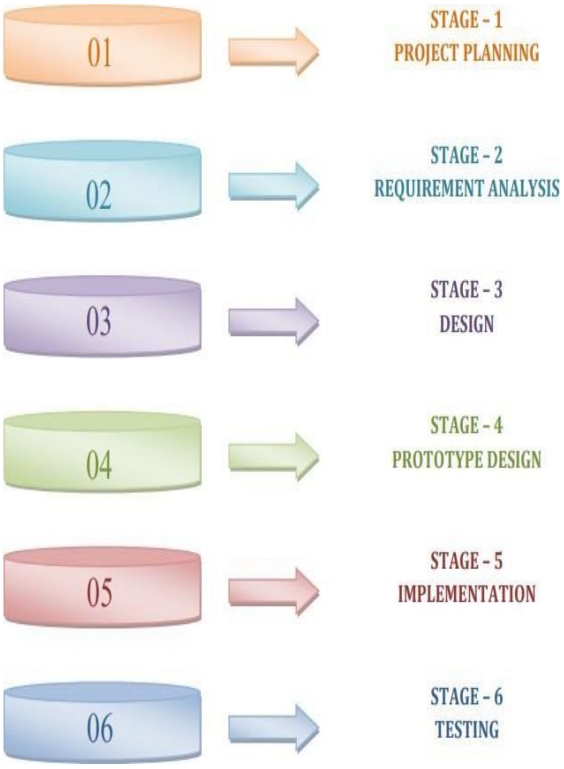
On land, especially off-road, Unmanned Ground Vehicle (UGVs) face difficulties steering away from obstacles and challenges posed by various terrains. Sensors check the surrounding environment without sensing the gaseous particles. If there is any suspicious activity found , the camera is turned in that direction by the servo motor which cannot be operated in night mode.

Many of the UGV were build in Arduino board with lesser range which cannot be controlled by a operator remotely in most of the situations.

PROPOSED SYSTEM

In this work, multifunctional Unmanned Ground Vehicle (UGV) is designed which is controlled using Wi-Fi through mobile Application. A Wi-Fi enabled camera is placed on unmanned ground vehicle for live streaming. LEDs are used for illumination when the vehicle travels in dark places. A mechanism for placement and activation of bombs is deployed. A gas sensor is incorporated for sensing the air quality along with humidity and temperature sensor for checking the surrounding temperature and humidity.

ORGANIZATION OF THE PROJECT



REQUIREMENTS SPECIFICATION

HARDWARE REQUIREMENTS

1. ESP8266 WI-FI MODULE:

The ESP8266 microchip facilitates wireless communication between devices and boasts sufficient on board processing and storage capacity to seamlessly integrate with sensors and other specialized devices.

Fig 3.1.1 : ESP8266 Wi-Fi Module

2. L298N MOTOR DRIVE:

The L298N is a 16-pin integrated circuit (IC) that enables simultaneous control of four gear motors in various directions. It functions by receiving signals from the microprocessor and transmitting corresponding signals to the motors. The IC includes two voltage pins: one is responsible for drawing current to power the L298N itself, while the other is used to provide voltage to the motors for their operation.

Fig 3.1.2 : L298N Motor Driver

3. WI-FI BASED CAMERA:

The camera integrated into the unmanned ground vehicle (UGV) features a resolution of 2.0MP and a wide camera angle of 150 degrees. It is equipped with night vision capabilities that allow clear vision up to a distance of 16 feet in low-light conditions. This camera is Wi-Fi enabled, enabling live streaming of the captured footage. Additionally, it has a motion detection feature that triggers an alert message whenever any motion is detected by the camera.

Fig 3.1.3 : Wi-Fi Based Camera

4. MQ-9 GAS SENSOR:

The MQ9 gas sensor is designed to detect and measure the levels of various gases, including LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide, in the surrounding air. It employs a sensing material that undergoes a resistance change upon exposure to these gases.

Fig 3.1.4 : MQ-9 Gas Sensor

5. DHT11 HUMIDITY AND TEMPERATURE SENSOR:

The DHT11 is an affordable digital sensor designed for accurately measuring temperature and humidity. It is capable of seamlessly interfacing with various microcontrollers, allowing for instant and precise measurements of humidity and temperature. This sensor serves as a convenient device that provides a single measurement for both temperature and humidity, making it an efficient solution for monitoring the environmental conditions of a particular place.

Fig 3.1.5 : DHT11 Sensor

6. SERVO MOTOR:

A servomotor is an electromechanical device that generates torque and controls velocity based on the power supplied to it. It operates by receiving an electric signal, which can be analog or digital, and this signal determines the extent of movement required to achieve the desired final position for the motor's shaft. The servo motor functions within a closed-loop system, where it receives commands for torque and velocity from a servo controller. It utilizes a feedback device to continuously monitor and adjust its performance, ensuring accurate positioning and movement control.

Fig 3.1.6 : Servo Motor

7. RELAY:

A relay is a type of switch that is activated by an electrical signal to establish or interrupt the connection between two circuits. Unlike manual switches, relays are operated electronically, using an electrical signal to control the switching action. They are capable of opening and closing circuits either electromechanically or electronically. In essence, a relay functions as an electromagnetic switch that can be controlled by a relatively small electric current to turn on or off a much larger electric current.

Fig 3.1.7 : Relay

8.LED STRIPS:

LED strips are a series of LEDs arranged in a linear configuration, designed to provide enhanced illumination. They are commonly used as indicators for various purposes. An LED strip light, also referred to as LED tape or ribbon light, consists of a flexible circuit board that houses surface-mounted light-emitting diodes (SMD LEDs) and other associated components. These strips often come with an adhesive backing, making them easy to install in various locations. Initially, strip lights were primarily used for accent lighting, backlighting, task lighting, and decorative lighting applications.

Fig 3.1.8 : LED Strips

SOFTWARE REQUIREMENTS

Operating System: Windows XP/7/8/10 Technology Implemented: Blynk Application
Mobile Application: Android OS Programming Language: C++

SYSTEM DESIGN

PROTOTYPE DESIGN

The utilization of versatile unmanned ground vehicles is prevalent in areas where human presence poses risks to safety. The suggested ground vehicle and its accompanying sensors operate through wireless means. Wireless communication is facilitated by the ESP8266 module, enabling seamless interaction between the vehicle and the sensors via the Blynk

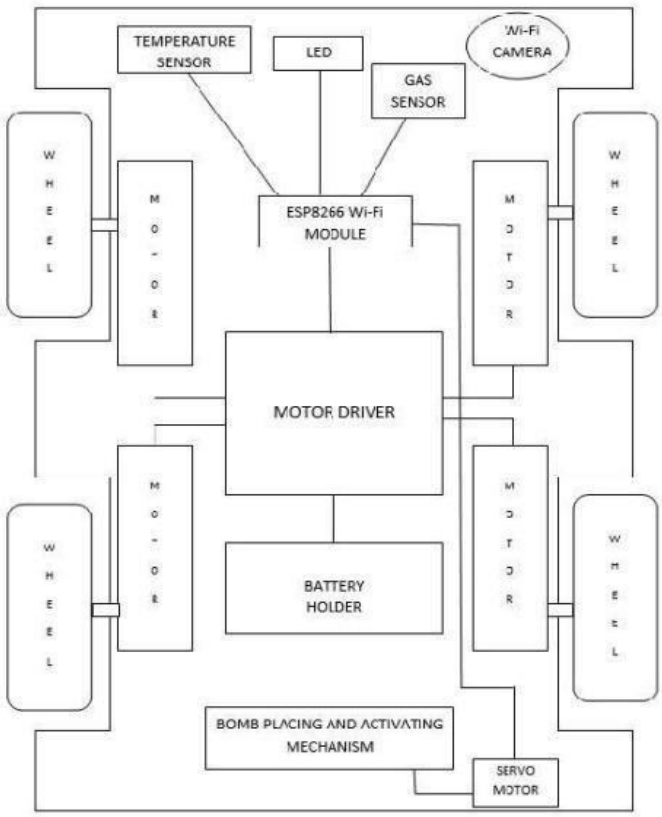
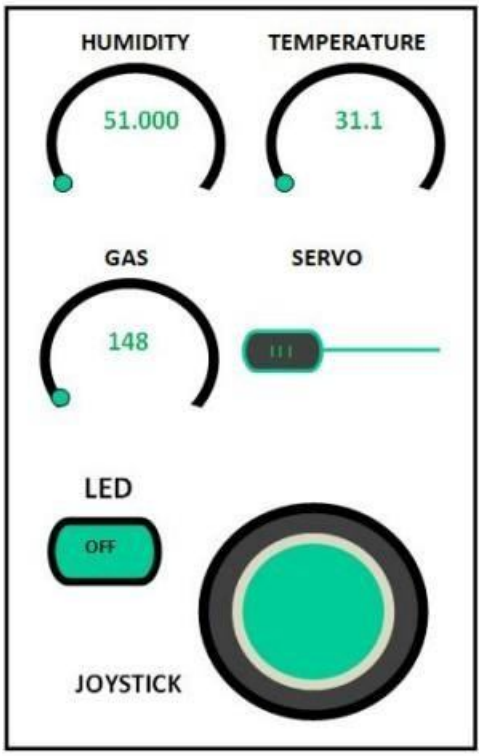


Fig 4.1.1 : Layout of UGV

DESIGN OF MOBILE APPLICATION

The unmanned ground vehicle incorporates the MQ-9 gas sensor, as well as the DHT11 Humidity and Temperature sensors. The gas sensor detects variations in the surrounding air quality and transmits the measured values to a smartphone via the Blynk Application. The temperature sensor monitors the ambient temperature in the vehicle's vicinity, with the corresponding readings displayed on the smartphone through the Blynk Application. Additionally, a servo motor is employed to create a mechanism for the placement and activation of bombs.



RESULTS

Order to create a remote-controlled ground vehicle capable of operating in challenging terrains and extreme environments, the following features have been incorporated: Integration of a camera to provide live video feed of the vehicle's surroundings. Implementation of an illumination system to enhance obstacle detection in low-light conditions. Development of a mechanism for the placement and activation of bombs. Integration of gas, humidity, and temperature sensors to monitor the air quality, humidity In levels, and temperature of the vehicle's surroundings.

DISCUSSION

In modern times, the significance of Unmanned Ground Vehicles (UGVs) in various industries has grown due to their ability to mitigate human casualties. In sectors such as defense and mining, reducing human involvement in bomb deployment has prompted the exploration of several recommendations. This paper proposes a model or framework that utilizes gas and temperature sensors to monitor environmental conditions. The framework incorporates an ESP8266 module and a gas sensor capable of detecting atmospheric gases that may pose a threat to human well-being. When inappropriate gas levels are detected, the system sends notifications to the base station.

CONCLUSION

Following the aforementioned system and algorithm design, the final system design exhibits a straightforward structure, rapid detection speed, uncomplicated operation, and other notable features, all aimed at achieving the desired objectives.

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