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Unmanned Defence Vehicle

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ABSTRACT: This paper presents the design, development, and performance of an Unmanned Defence Vehicle (UDV). Aimed at enhancing modern security and-fence operations through advance automation, mobility surveillance, and Artificial Intelligence (AI). The vehicle is designed to operate ever in dangerous and defined surroundings, reducing mortal trouble while perfecting functional effectiveness.

The operation of artificial intelligence in the development of new technologies has significantly contributed to the technological revolution in both the service and greedy sectors. In just two decades, there has been a multi-fold increase in the number of countries involved in invention programmes predicated on the use of artificial intelligence, particularly reflected in the military sector. We are witnessing a race in artificial intelligence development.

In this modern INDIA, public security has come rough and tough day by day due to some factors like Terrorism, nasalism etc and we are losing our legionnaires day by day. Hence to avoid that loss there is a need of donation of electronics and dispatches in Indian service and defence sector. An unmanned Defence vehicle (UDV) is a vehicle that operates while in contact with the WIFI an on- board mortal presence.

The system incorporates the real time live video surveillance, enabling continuous monitoring of sensitive areas. Its remote mobility system allows smooth navigation across dynamic terrains, icing effective command, surveillance, and response to security risks. The vehicle can be control through a web- predicated interface, allowing motorists to manoeuvre it effectively from a safe position.

The Unmanned Defence Vehicle is equipped with a comprehensive suite of security sensors for intrusion discovery, environmental monitoring, and trouble identification, furnishing moment cautions through GSM communication. The integration of AI predicated face discovery enhances situation- al awareness by distinguishing between sanctioned and unauthorized individualities. The system also integrates an MQ- 2 gas and bank sensor for detecting dangerous feasts analogous as LPG, methane, bank, and carbon monoxide, enhancing environmental safety and early trouble discovery in dangerous zones.

This design emphasizes the community between attack and software factors, including sensor networks, motorized mobility systems, communication modules, and intelligent algorithms. The proposed system demonstrates the eventuality of Unmanned Defence Vehicles as reliable, intelligent, and scalable results for service, artificial, and motherland security operations, contributing significantly to the fields of robotics, automation, and defence technology.

KEYWORDS: Unmanned Defence Vehicle (UDV), Remote Surveillance, Face Detection, GPS Tracking, GSM cautions, MQ- 2 Gas Detector, Artificial Intelligence

I. INTRODUCTION

The development of Unmanned defence System represents a significant advancement in ultramodern security and military technology. This design focuses on designing a multifunctional Unmanned defence Vehicle able of enhancing surveillance, safety, and remote operation in high- trouble surroundings. The system integrates multiple modules, each addressing a specific functional demand. An overview of the crucial modules is given below

1. Surveillance and Vision Module: This module enables real time monitoring of the girding terrain using a camera module connected to a Pi. Live videotape streaming allows drivers to observe conditioning ever, icing nonstop situational mindfulness. Face discovery algorithms are used to identify known and unknown individualities, strengthening security measures.

2. Mobility and Navigation Module: To perform command and surveillance tasks, the vehicle is equipped with motorized bus, motor motorists, and control algorithms. The system enables smooth movement across different terrains while responding directly to remote commands.

3. Security and Monitoring Module: This module integrates detectors and GSM communication to descry unauthorized access and suspicious exertion. Real- time cautions are generated to inform authorized personnels, icing prompt response to pitfalls.

4. Gas and Bank Discovery Module: This module integrates an MQ- 2 gas detector to measure the attention of dangerous feasts similar as LPG, methane, bank, and carbon monoxide. The detector continuously monitors air quality and displays the gas attention values in real time on the monitoring interface. This data allows the driver to manually assess environmental conditions and take applicable action when abnormal gas situations are observed. The module enhances situational mindfulness in dangerous surroundings similar as artificial shops, military zones, and disaster- affected areas.

5. Integrated AI Module: Artificial Intelligence forms the core of intelligent decision timber. The AI module processes visual data for face recognition and assists in Automated trouble identification, making the system adaptive and effective.

The generality of artificial intelligence (AI) was first used by the American mathematician and computer scientist John McCarthy. He introduced it as a training discipline in 1956 at a conference at Dartmouth College in the United States. McCarthy states that AI is “the wisdom and engineering of making intelligent machines, especially intelligent computer programs. It's related to the analogous task of using computers to understand mortal intelligence, but AI does n't have to confine itself to styles that are biologically observable”

This applies to both logistic points developed by logistic subunits at colorful situations of command as well as formed force convoys. force chains organised by logistic subunits at each politic position are particularly exposed to the impact of the adversary. In previous results, the organiser of the logistic system did n't organise structures to carry out the force protection of logistic points and convoys carrying inventories to colors in agreement with the delivery plan. thus, there's a need to fill this gap with new technologies developed in recent times and used by NATO armies, vicelike unmanned upstanding vehicles. The problem in this case will be selection of a specific class UAV at colourful politic situations.

In current times, an outgrowth of dropped sizes and weights concentrated charges and amplified functionalities of colourful detectors and bias. The Unmanned Aerial Vehicles are attracting precipitously general trendy varied variety of internal cessions

II. PROBLEM STATEMENT

Design an Unmanned Defence Vehicle capable of performing surveillance and security task in hazardous environments such as border areas, military zones, industrial plants, and restricted regions to improve human safety and operational efficiency. The system should detect intrusions, monitor environmental threats, and provide real-time alerts. Environ-

mental threats such as gas leakage, smoke, or toxic emissions must also be detected to prevent accidental hazards and ensure safety in sensitive and restricted areas.

The vehicle Must support remote navigation, live surveillance, and intelligent threat detection to reduce dependency on human presence in dangerous situations.

III. OBJECTIVE OF PROJECT

Develop a remote surveillance system: The project aims to design a system that provides live video streaming and real-time monitoring of sensitive areas. This enables security personnel to observe and analyse threats without being physically present at the location.

Mobility Capabilities for Defence Operations: The objective is to equip the vehicle with a motorized mobility system that allows smooth movement, remote navigation, and precise control in various terrains and environments.

Integrate a Security and Alert System: The system incorporates GSM based alert mechanism and intelligent detection techniques to notify authorities immediately upon detecting unauthorized activity or threats.

Implement Artificial Intelligence for Intelligent monitoring: AI Based face detection and decision making enhanced the systems capability to differentiate between authorized and unauthorized individuals, enabling proactive security responses.

Detect hazardous gases and smoke: To integrate an MQ-2 gas sensor that continuously monitors the environment for gas leaks, smoke, or toxic emissions and provides instant GSM alerts to authorities for timely action.

IV. FUTURE SCOPE

1. **Military and Border surveillance:** Deployment in high-risk border zones for continuous monitoring. The system can perform real-time surveillance and reconnaissance in sensitive military areas, reducing the need for human patrols and improving situational awareness while ensuring the safety of defence personnel.
2. **Advanced Mobility:** Future versions may support rough terrains, stairs climbing, or autonomous navigation. Enhancements such as improved suspension systems, terrain-adaptive wheels, obstacle detection, and GPS-assisted navigation can increase operational efficiency and allow the vehicle to function in complex environments.
3. **Real-Time Communication:** Integration with commands centres for instant data sharing and alerts. Secure communication channels can enable live video streaming, sensor data transmission, and coordinated control between multiple vehicles and central command units.
4. **Disaster response:** Use inn fire, chemical leaks, or disaster-hit zones to collect information safely. The vehicle can operate in hazardous conditions to gather environmental data, visual evidence, and location details, assisting rescue teams in making informed decisions without risking human lives.
5. **AI safety and Cybersecurity:** Strong encryption and secure data handling mechanism. Future upgrades may include encrypted data transmission, secure authentication, and AI-based threat detection to protect sensitive information and prevent unauthorized system access.
6. **Weaponized Defence System:** Controlled integration of advanced defence mechanisms under authorization. With strict ethical guidelines and permissions, defence tools such as automated or non-lethal response systems may be integrated to enhance threat neutralization while maintaining safety controls.

V. EXISTING SYSTEM

Conventional Surveillance Systems:

Traditional CCTV and security cameras provide limited static monitoring and require continuous human supervision. These systems are fixed to a specific location and cannot respond dynamically to threats or cover large or changing areas effectively.

Remotely Operated Vehicles (ROVs):

Some defence robots provide remote-controlled mobility for inspection and reconnaissance tasks but often lack intelligent detection capabilities, advanced decision-making, and integrated alert mechanisms, limiting their effectiveness in complex security environments.

Security Monitoring Systems:

Systems such as motion sensors, infrared detectors, and alarm systems can generate alerts when abnormal activity is detected, but they lack mobility and real-time visual feedback, making it difficult to verify threats or assess situations accurately.

AI Based Surveillance Tools:

Existing AI-based surveillance tools focus on specific tasks such as face recognition or motion analysis but are usually standalone solutions. These tools are not integrated into a unified unmanned defence platform that combines mobility, real-time monitoring, and multi-sensor data processing.

Gas Detection Systems:

Standalone gas detection systems are commonly used in industrial and safety applications to identify hazardous gases. However, they lack mobility, real-time video support, and integration with defence surveillance platforms, limiting their usefulness in dynamic or high-risk operational environments.

VI. LIMITATION

System Integration Complexity:

Integrating surveillance, mobility, communication, sensor modules, and artificial intelligence into a single unified platform is technically challenging. Proper synchronization between hardware and software components is required to ensure reliable performance, which increases design complexity and development effort.

Power Management:

Continuous operation of the system requires efficient battery management to avoid frequent recharging and unexpected shutdowns. Power consumption increases due to multiple components such as cameras, processors, sensors, and communication modules, making energy optimization a critical challenge.

Navigation Constraints:

Operating in uneven terrains, narrow paths, or hostile environments requires precise motor control, stable mechanical design, and robust hardware. Environmental obstacles and unpredictable ground conditions can affect vehicle movement and overall system reliability.

High Development Cost:

The use of advanced sensors, processing units, motor drivers, communication modules, and mechanical components increases the overall development cost. Additionally, testing, calibration, and maintenance further add to the system expenses.

Data Security Risks:

Unauthorized access to surveillance data and communication channels poses serious security concerns. Without strong encryption and authentication mechanisms, sensitive information may be vulnerable to cyber threats and data breaches.

Gas Sensor Sensitivity Variations:

The accuracy of the MQ-2 gas sensor can be affected by environmental conditions such as humidity, temperature, and air flow. Proper calibration and periodic maintenance are required to ensure reliable gas concentration readings in real-world operating environments.

VII. IMPLEMENTATION

Live Surveillance System: A camera module provides real time video streaming to the operator, enabling continuous visual monitoring of the surrounding environment. This live feed helps in identifying suspicious activities and supports effective decision-making from a remote and safe location.

Mobility System: DC motors controlled by an Arduino microcontroller and motor driver circuits allow precise and dependable vehicle movement. The mobility system supports forward, backward, left, and right navigation, enabling the vehicle to operate efficiently across different terrains.

Security And Alert System: A GSM module is used to send instant SMS alerts during suspicious activities or security breaches. This alert mechanism ensures that authorized personnel are immediately informed, allowing timely response and enhanced security.

Integrated AI Systems: AI-based face detection improves threat identification and monitoring accuracy by distinguishing between authorized and unauthorized individuals. The intelligent processing of visual data enhances situational awareness and strengthens overall surveillance capability.

Gas and Bank Monitoring System: The MQ-2 gas detector is connected with the regulator to continuously cover the attention of gases such as LPG, methane, bank, and carbon monoxide. The sensed gas values are displayed in real time on the monitoring interface, enabling the operator to observe environmental conditions, detect abnormal gas situations, and take appropriate manual action when required.

Mobility System: DC motors controlled by an Arduino microcontroller and motor driver circuits allow precise and reliable vehicle movement. The mobility system supports forward, backward, left, and right navigation, enabling the vehicle to operate efficiently across different terrains.

Security And Alert System: A GSM module is used to send instant SMS alerts during suspicious activities or security breaches. This alert mechanism ensures that authorized personnel are immediately informed, allowing timely response and enhanced security.

Integrated AI Systems: AI-based face detection improves threat identification and monitoring accuracy by distinguishing between authorized and unauthorized individuals. The intelligent processing of visual data enhances situational awareness and strengthens overall surveillance capability.

Gas and Smoke Monitoring System: The MQ-2 gas sensor is interfaced with the controller to continuously monitor the concentration of gases such as LPG, methane, smoke, and carbon monoxide. The sensed gas values are displayed in real time on the monitoring interface, enabling the operator to observe environmental conditions, detect abnormal gas levels, and take appropriate manual action when required.

VIII. CIRCUIT OF THE UNMANNED DEFENCE VEHICLE PROJECT USING ARDUINO AND RASPBERRY PI:

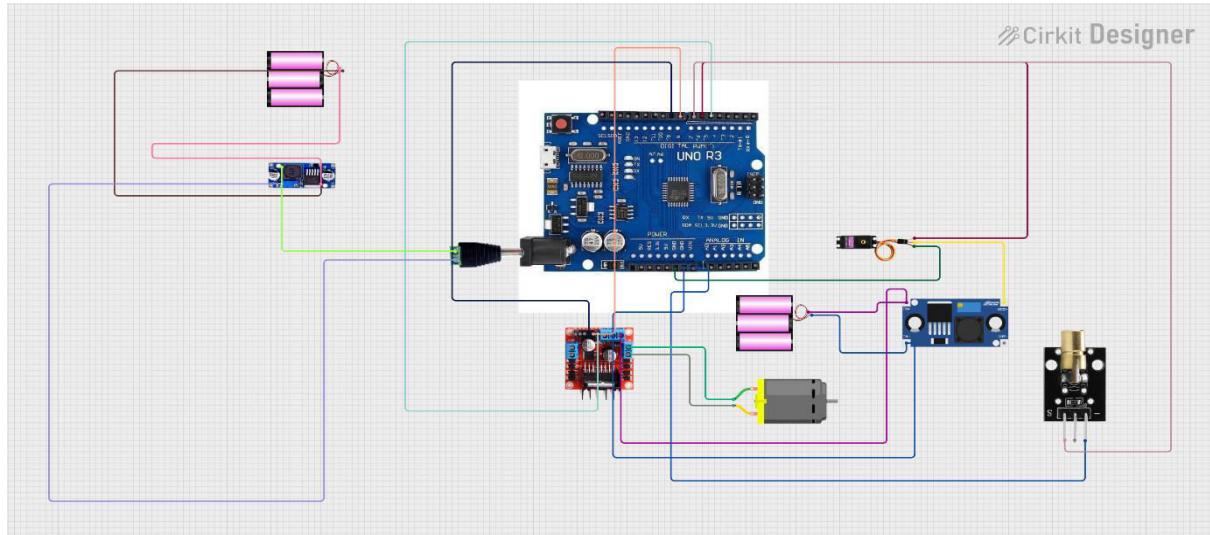


Fig.1 Gun Mechanism

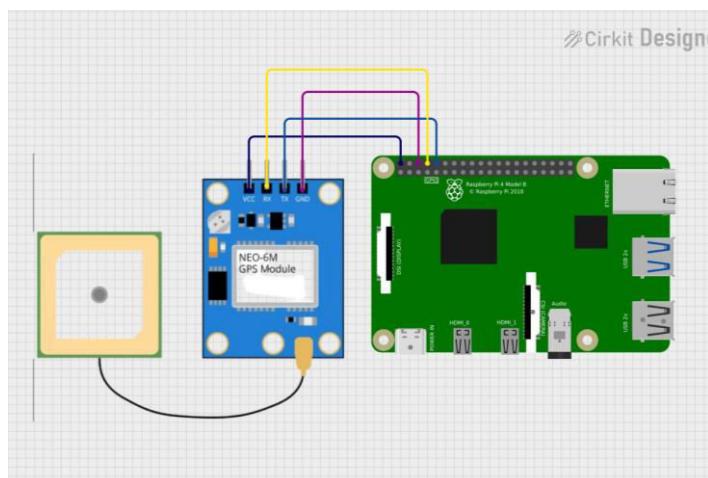


Fig.2 GPS Module

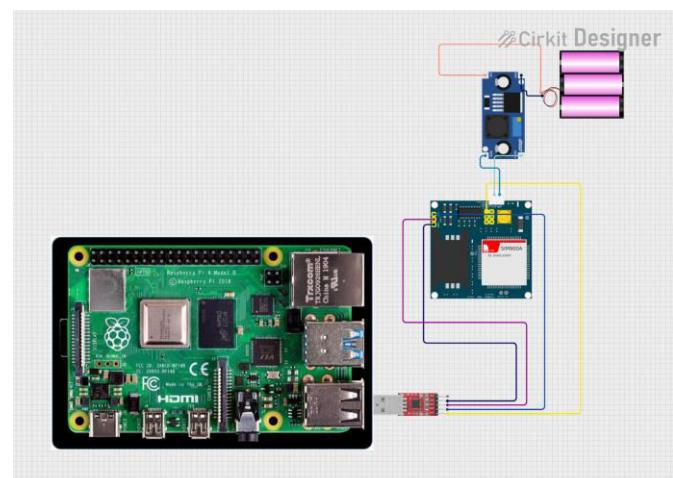


Fig.3 GSM Module

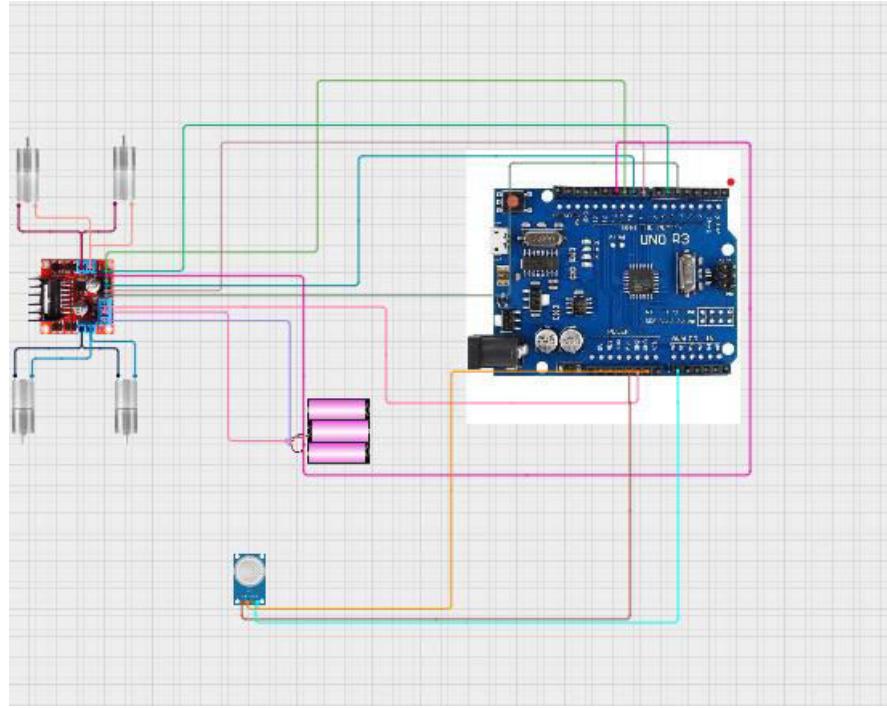


Fig.4 Motor and Gas Sensor

IX. CONCLUSION

The development of the **Unmanned Defence Vehicle** successfully demonstrates the effective integration of remote surveillance, intelligent mobility, security monitoring, and artificial intelligence into a single unified platform. The system significantly minimizes human risk by enabling remote operation in hazardous and restricted environments while maximizing operational efficiency. Features such as live video monitoring, GPS-based location tracking, GSM communication, and AI-based face detection collectively enhance the system's ability to detect, monitor, and respond to potential security threats in real time. This project highlights the growing importance of unmanned systems in modern defence and security applications, offering a scalable, intelligent, and reliable solution for advanced surveillance challenges.

Furthermore, the proposed system proves to be cost-effective, flexible, and adaptable to a wide range of real-world environments including border regions, military zones, industrial facilities, and restricted areas. The implementation of a web-based control interface allows operators to manage the vehicle from remote locations, thereby improving situational awareness and reducing response time during critical situations. The modular design of the system supports future enhancements such as advanced artificial intelligence analytics, improved autonomous navigation, and controlled weapon automation. Overall, this project lays a strong foundation for next-generation autonomous defence systems and contributes significantly to the advancement of smart, secure, and efficient surveillance technologies.

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