IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

REVIEW OF "COMBAT SOLDIER ASSISTANCE ROVER: ENHANCING MILITARY CAPABILITIES WITH UNMANNED GROUND VEHICLES"

[1]Vedant Dusa, [2]Shreyash Raut, [3]Rushikesh Thorat, [4]Prof. Chitralekha Rananaware

[1]Student, [2]Student, [3]Student, [4]Assistant Professor

[1]Department of Instrumentation Engineering,

[1]All India Shri Shivaji Memorial Society Institute of Information Technology, Pune, India

Abstract: The use of robotics technology in counter-terrorism and military operations has become increasingly prominent in recent years. With the development of vehicle automation, sophisticated machines such as unmanned ground vehicles have emerged as efficient and effective tools to aid soldiers in the battlefield. This project proposes the design and implementation of a Combat Soldier Assistance Rover for missions such as border patrol, surveillance, and active combat. Equipped with an automatic weapon, landmine detector, and robotic arm, the rover can inspect suspicious objects and detect and track human movement using computer vision. The remote operator can control the rover wirelessly and receive live video feeds from the camera to assist in the mission. This system aims to reduce military casualties and increase operational efficiency with less human resources required.

Index Terms **- Terrorism, Insurgency, Vehicle automation, Unmanned ground vehicles, Combat Soldier Assistance Rover, Border patrol, Surveillance, Active combat, Automatic weapon, Landmine detector, Robotic arm, Computer vision, Remote operator, Live video feed, Military casualties, Operational efficiency, Human resources.**

I. INTRODUCTION

The problem of terrorism and insurgency is one of the most significant challenges that the world is facing today. Governments and scientists across the globe are working tirelessly to find solutions to these complex issues. With advancements in the field of vehicle automation, sophisticated machines are being employed to handle numerous dangerous and critical counter-terrorist operations. These machines are not only more efficient than humans, but also responsible for saving numerous human lives. Unmanned ground vehicles or robots, in particular, have proved to be incredibly useful for supplementing soldiers on the battlefield. One of the primary advantages of robots is that they can carry out repetitive tasks with speed and precision, making them well-suited for performing routine duties that soldiers would find boring or monotonous. They are also tireless and fearless, capable of avoiding or resisting enemy armaments while executing specific military functions. For instance, the Combat Soldier Assistance Rover has been designed to assist soldiers in various missions, including border patrols, surveillance, and active combat coordination with human soldiers.

The Combat Soldier Assistance Rover is a state-of-the-art robot that can be operated wirelessly, making it possible for a person in a remote location to control its movements. The rover is equipped with an automatic weapon, a landmine detector, and a robotic arm/claw that can inspect suspicious objects such as improvised explosive devices (IEDs). The rover's camera allows for live video feed that enables the remote operator to control the machine manually. Additionally, the rover is designed to detect human movement and track any enemy activity within its range of vision using computer vision technology. The system is operated by a human operator connected to a base station that provides a direct video stream and control over various features using a graphical user interface. The goal of the system is to reduce the number of casualties among soldiers and provide a larger workforce than regular soldiers with fewer operator requirements. In addition to this, the Combat Soldier Assistance Rover can perform specific military functions without exposing human soldiers to danger. The rise of terrorism and insurgency has necessitated innovative solutions, and the development of automated vehicles has brought a new level of efficiency and effectiveness to counter-terrorism efforts. The Combat Soldier Assistance Rover is designed to supplement soldiers on the battlefield while minimizing the risk to human life.

1.1 Background and Context

The Indian Army has developed several advanced gadgets for security purposes. These are some DRDO developed Robots for various military applications:

1. Remotely Operated Vehicle (ROV) DAKSH, which is a flexible device designed to identify and manage improvised explosive tools. It is also useful for surveying and detecting nuclear and chemical infection levels.
2. Unmanned Aerial Vehicle (UAV) 'NETRA', which is a mini UAV that operates on batteries and is equipped with a day camera with zoom for detailed surveillance.
3. Confined Space Remotely Operated Vehicle (CSROV), DAKSH MINI, is a battery-operated tracked vehicle that weighs no more than 100 kg and comes with a multiple-level manipulator arm.
4. Surveillance Remotely Operated Vehicle (SROV), DAKSH-SCOUT, is remotely operated using RF and has several cameras mounted on the platform for real-time viewing.
5. Unexploded Ordnance Handling Robot (UXOR), which is capable of handling, diffusing, and detecting Unexploded Ordnance (UXO).

The development of military robots has brought significant improvements to military technology. These machines are designed to perform tasks that are dangerous or difficult for human personnel. With enhanced surveillance capabilities, military robots provide better situational awareness and faster response times, ultimately contributing to saving human lives and improving the efficiency of military operations. With ongoing advancements in technology, it is expected that the capabilities of military robots will continue to evolve and improve in the future. In the past, there have been several attempts to develop automated vehicles for military use, but these machines were often limited in their capabilities and lacked the necessary features to make them effective on the battlefield. However, with recent advancements in technology, the development of unmanned ground vehicles has become more sophisticated and practical. Previous models of unmanned ground vehicles have been used in a variety of military applications, such as explosive ordinance disposal, reconnaissance, and surveillance. However, these machines often required human intervention to make decisions, limiting their usefulness in certain situations. The Combat Soldier Assistant Rover, on the other hand, has been designed to work in close coordination with human soldiers, supplementing their efforts without replacing them entirely.

What sets the Combat Soldier Assistance Rover apart from previous models is its advanced features and capabilities. For instance, the rover's automatic weapon, landmine detector, and robotic arm/claw enable it to perform tasks that were previously only possible for human soldiers. Additionally, the rover's computer vision technology allows it to detect and track enemy activity, providing real-time information to human operators to make critical decisions. Furthermore, the rover's wireless capabilities make it possible for operators to control the machine remotely, reducing the risk of human casualties. The robot can be operated by a single person, reducing the number of operators required and allowing for more efficient use of resources.

In summary, the Combat Soldier Assistance Rover is a significant improvement over previous models of unmanned ground vehicles. Its advanced features and capabilities make it a valuable asset for soldiers on the battlefield, supplementing their efforts while minimizing the risk of casualties.

II. LITERATURE SURVEY

1. Ivan Culjak, *et al.* [1], talked about how Intel introduced OpenCV, an open-source library for image and video analysis, more than a decade ago. Additionally, numerous programmers have made contributions to the most recent library advancements since then. OpenCV 2, which made major changes to the C++ interface in 2009, was the most recent major change. There are currently more than 2500 optimized algorithms in the library.
2. Mehendale, *et al.* [2], examined about how ESP32 CAM-Based Item Location and Recognizable proof with OpenCV. OpenCV is a widely used open-source image processing library, not only in industry but also in research and development. The cvlib Library is used for object detection in this case. To locate objects, the library employs a pre-trained AI model based on the COCO dataset. The pre-trained model is called YOLOv3. The ESP32 Camera Module, which can be programmed with the FTDI Module, was used for the hardware. For the ESP32 Camera Module, setting up the Arduino IDE is necessary. After uploading the firmware, the object detection and identification component must be completed. Since the object detection script is written in the Python programming language, users will also need to install Python and the necessary libraries. OpenCV is used for object detection and identification in this project.
3. Krishnamachari Marapalli, *et al.* [3] highlighted the significance of robots in carrying out tasks that are either too hazardous for humans or require specific conditions that humans cannot perform. Inspired by this, the developers aimed to design a robot capable of conducting risky tasks like border patrol and surveillance. This robot can be operated with hand gestures and can efficiently travel long distances. The article focuses on integrating various technologies, such as IoT, software, wireless communication, and mobile applications, to create the robot. To detect enemies and obstacles, the robot uses GPS, HC-05 for communication and vehicle tracking, Python/OpenCV for contour tracing, and ESP32 Cam. The developers present a low-cost device that models an Arduino glove to control the RC car, with the gyro sensor (ADXL) measuring the hand's angle to determine the car's direction. The car's movements are tracked with Neo-6m GPS, and data is sent to the cloud for retrieval and mapping. The robot can detect any object within 11 meters of the vehicle and determine its approximate distance. Additionally, a mobile application is designed to enable secondary manual control and collect information about the robot. Overall, the paper focuses on combining various technologies to create a robot capable of performing hazardous tasks with safety features and efficient control.
4. Ashutosh Jain, *et al.* [4], talked about an IOT-based firing system is a manual and automatic system that fires lasers when motion is detected in front of the camera. The platform on which the laser and camera are mounted moves vertically, while the hardware module rotates 360 degrees clockwise. This guarantees protection all around. The python programming language is used throughout the system, and the OpenCV python library is used for motion detection.
5. B. Lakshmi Sharath, *et al.* [5], talked about how landmines are a problem that will never go away. Many landmines have been buried as a result of conflicts and wars in previous centuries, and demining them is a difficult, risky, and time-consuming process. As is typical when a solution is anticipated, it is unacceptable that lives will be lost. Using robots that can solve the problem without harming people, technology opens the way to a scientific approach. Using GPS technology, a robot has been developed to locate these landmines and identify their locations. In addition, in order to assist in locating the precise location

of the landmines, feedback regarding the findings of the latitude and longitude location is sent to the server via Global System for Mobile Communication (GSM) technology. Using the same GSM technology, the feedback can be received on mobile phones to alert the bomb squad member. The robot's camera is used for navigation, allowing it to identify its path of movement and problematic locations by taking an image and using it to function properly. Blast Mines and Fragmentation Mines are two types of anti-personnel landmines that this robot can deal with.

6. Yin Liuliu, *et al.* [6], discussed how during the experiment, they discovered that driving the DC motor directly with a single chip microcomputer control module was extremely challenging. The reason for this is that the single-chip microcomputer control module's causing current is greater than the starting and braking current of the DC motor. We have added a driving module to the control board so that it can transmit a PWM wave signal to drive the DC motor through the I/O port. The driving circuit board can perform the functions of positive and reversal rotation as well as speed adjustment for the DC motor. The integrated level of the L298N module is higher than that of any other driver module in many different driving modules. The L298N model is simple to operate because it can control the DC motor as well as the motor's speed by modulating a PWM wave that is output by the control panel. The L298N model can also protect the motor and circuit when the motor locks with its over-current protection function. Therefore, we drive the DC motor with the L298N driver module.
7. Pertab Rai, *et al.* [7], talked about how surveillance systems have always been an important part of businesses, organizations, homes, and factories. Using the most recent Espressif microcontroller, the ESP32, continuous video is acquired, transmitted through the aforementioned microcontroller's integrated Wi-Fi capabilities, and displayed on the connected SPI TFT Module on the receiving end in the proposed implementation.
8. Tejashree Dhawle, *et al.* [8], discussed about The ideal method for detecting and recognizing a human face employing OpenCV and Python, both components of deep learning, is presented in this research paper. This report describes how, with the help of several OpenCV and Python libraries, deep learning, an essential component of the field of computer science, can be used to identify faces. A proposed system that will assist in real-time face detection will be included in this report. This implementation is usable with a variety of platforms, including smartphones, computers, and software applications.

2.1 Comparative Study

1. Face Detection and Recognition using OpenCV and Python [8]: The platform that will make it possible for users to engage in some form of interaction is known as the graphical user interface (GUI).There are a few drawbacks to this system, such as the cost or lack of funding, the need for high-definition cameras, poor image quality that could limit its effectiveness, the importance of the image's size because it can be difficult to recognize faces in small images, face angles that could reduce the reliability of face recognition, and the need for a lot of storage space for this system to function properly. During image recognition, illumination is very important. The results will significantly change if the lighting conditions change even slightly. The result may be different for the same object depending on whether the lighting is low or high. Face detection also relies heavily on the object's background. Because the factor affecting its performance changes when the locations change, the result might not be the same outside as it is inside. The face as beard, mustache, and accessories (goggles, caps, mask, etc.) are all examples of occlusion. Also hinder a face recognition system's estimation. The distinct expressions of the same person are another important aspect to consider. For the same person, a change in facial expression may result in a different outcome.
2. ESP32 Based Smart Surveillance System [7]: The designed prototype is simple to use for short-range surveillance. Integral Wi-Fi is used by the transmitting and receiving modules to communicate. There are more pins on the ESP32 than ESP8266, and you can choose which pins are for UART, I2C, or SPI by setting the code. The ESP32 chip's multiplexing feature, which lets multiple functions be assigned to the same pin. The ESP32 is more expensive than the ESP8266, although it lacks as many features, it is sufficient for the majority of straightforward DIY IOT projects. Additionally, because it is "older" it receives significantly more software support, making it easier to get assistance. However, it may not have enough pins for your intended use due to some limitations in the GPIO mapping.
3. Application of Drive Circuit Based on L298N in Direct Current Motor Speed Control System [6]: The L239D chip is utilized to amplify the pulse signal, which powers the stepping motor. The operating voltage or drive voltage for the L293D ranges from 4.5V to 36V, while for the L298N, it ranges from 5V to 46V. The L298N's operating voltage lies between 4.7V to 7V, whereas the L293D operates within 4.5V to 5.5V. The maximum output current for the L293D is 600mA through one channel, while the L298N Motor Driver can deliver up to 2A across both channels. The speed control system for the DC motor employs the L298N-based driver circuit module, where the driving module can execute the DC motor and speed control through the generation of current signal and PWM wave by the control panel. The outcomes of the experiments reveal that the driving circuit plays a critical role in maintaining the DC motor's stability. The L293D driver features four independent input/output lines, making it a quadruple half-H driver. Conversely, the L298N driver is a dual full-H driver, which allows only full drives to be employed. The L293D comprises internally added protective diodes against back EMF, while the L298N requires external connections for these diodes. The L293D is suitable for controlling low current-rated motors, while the L298N can manage high current-rated motors.

III. CONCLUSION

The "Combat Soldier Assistance Rover" has the potential to serve as an indispensable tool for military and law enforcement applications. Its wireless control, automatic weapons, landmine detectors, and robotic arms enable it to carry out a variety of missions with high efficiency and safety. The integration of computer vision technology allows it to detect and track human movements and suspicious objects, enhancing its surveillance capabilities. The literature survey provided valuable insights into the current trends and advancements in robotics and image processing, emphasizing the importance of using technologies such as IoT, wireless communication, and mobile applications to develop efficient and safe systems. The use of the L298N driver module and OpenCV library were also highlighted as crucial components in the development and operation of such systems. The development of the "Combat Soldier Assistance Rover" highlights the potential of combining robotics, image processing, and other technologies to create advanced systems capable of supporting and assisting human operators in challenging and hazardous environments.

REFERENCES

[1] Ivan Culjak, David Abram, Tomislav Pribanic, Hrvoje Dzapo, Mario Cifrek. 2012. A brief introduction to OpenCV. IEEE Proceedings of the 35th International Convention MIPRO, 12865556.

[2] Ninad, Mehendale. 2022. Object Detection using ESP 32 CAM. Social Science Research Network (SSRN), 4152378.

[3] Krishnakumar Marapalli, Ashutosh Bansode, Pooja Dundgekar, Nilesh Rathod. 2021. AIGER an Intelligent Vehicle for Military Purpose. IEEE 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 20799978.

[4] Ashutosh Jain, Rachit R B, Dr. Suvarna Nandyal. 2020. IOT-based Firing System. International Journal for Research in Applied Science and Engineering Technology (IJRASET), Volume 8, Issue VIII.

[5] B. Lakshmi Sharath, Lakshmi Sankar S., Aman Dinodiya, Gaurav Kumar Mishra. 2020. Development of Landmine Detection Robot. AIP Conference proceedings 3rd International Conference on Frontiers in Automobile and Mechanical Engineering, 050008.

[6] Yin Liuliu, Wang Fang, Han Sen, Li Yuchen, Sun Hao, Lu Qingjie, Yang Cheng, Wang Quanzhao. 2016. Application of Drive Circuit Based on L298N in Direct Current Motor Speed Control System. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Volume 10153, id. 101530N 7 pp.

[7] Pertab Rai and Murk Rehman. 2022. ESP32 Based Smart Surveillance System. Biomedical Engineering Mehran University of Engineering and Technology, 17640047.

[8] Tejashree Dhawle, Urvashi Ukey, Rakshandha Choudante. 2020. Face Detection and Recognition using OpenCV and Python. International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 10.