Special Issue of First International Conference on Advancements in Engineering, Management, Science & Technology (ICEMST 2021)

Weapon Detection System in Remotely Operated ASV

Muniyandy Elangovan[1], B. Yuvan Siddarth[2], R Govindram Uduupa[3], R. Vigneshwar[4]
[1]Professor, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Tamil Nadu, India.
[234]Department of Mechanical Engineering, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Tamil Nadu, India.
muniyandy.e@gmail.com[1]

Abstract

High tensions within states or across borders are quite common nowadays. Protection of human resources i.e., soldiers is as important as the protection of national resources. It is a visible fact that the causality rate among the defense forces during a crisis is relatively higher. That is the reason why a majority of Governmental organizations of various nations are stressing the concepts of Automation. ROV or Remotely Operated Vehicle, a concept of automation, is playing a very vital role in almost all the advancements in this technologically developed society. Present work, one complete Armored Safety Vehicle (ASV) was designed with more featured to accommodate sensors for detection and coding are developed o detect the weapon using the image processing techniques. There is a special wheel design is introduced which is safe for easy and quick movement of a vehicle. From commercial vehicles to exploring the deepest trenches, ROV's have been a substantial tool for developmental prospects. It was tested for one image file and worked well. It is integrated with Machine Learning and image processing concepts to automatically come up with solutions based on the inputs. These concepts when used in defense vehicles not only increase efficiency but also reduces the casualty rate during a crisis.

Keywords: Automation, Modelling, Remotely-Operated Vehicle (ROV), Machine Learning, Image Processing

1. Introduction

The two major areas that have been continually evolving along with human civilization are transport and technology [1-3]. Initially, man invented wheels. He attached it for locomotion to a cart and then motorized it for comfort. Today, the need for automated vehicles with autonomous features is the need of the hour in the 21st century. So, they're computerizing it for robotics at the moment and energy estimation [4-6]. One of the most critical industries of a country is defence. They protect the country's territorial dignity and sovereignty. This automation is now strongly requested by the defence industries, as border disputes have been constant for a while now [7-9]. ROV is one of the implementations of this automation [10-13]. For the defense, the vehicle must have the features to attack the opponent and same time to easily identify the weapons from a longer distance. Safety is an important factor while designing the defence vehicle.

1.1 Remotely Operated Vehicle

For reconnaissance, surveillance and other combat-related objectives, the Internet of Military Stuff (IoMT) is the use of IoT technology in the military domain. It is highly inspired by the future possibilities of urban warfare and requires the use of cameras, ammunition, tanks, robotics, human-wearable biometrics, and other battlefield-relevant smart technologies. The IoT-based operation will help in the control of the vehicle from a remote location [14].

1.2 Armored Security Vehicle

Armored Safety Vehicle (ASV) also known as Advanced Safety Vehicle are used in military operations to transport militants and weapons to a battlefield [15]. These vehicles when fitted with weapons are considered combatant vehicles. The combatant vehicles such as the M1117 Guardian developed by Textron Systems are used in defence operations in the United States of America.

2. Design

The ASV is designed in such a way that it can withstand multiple explosions while protecting the soldiers present inside. The unique hull design with oblique faces can withstand impact more effectively than vertical faces. The designed vehicle can accommodate about 10 to 15 people inside. The vehicle is provided with radar to detect incoming threats. The front LED wide lamp provides sufficient brightness to travel in rough terrains. The vehicle is also provided with a grapple system to sustain the vehicle on steep slopes. The front windshield is bulletproof one-sided mirror glass which helps the user to monitor the environment from inside while nothing can be seen inside from outside. The complete vehicle is modeled using commercial software and it is shown in Figures 1 and 2. The vehicle can be only operated by a single person in case of system malfunction. The vehicle is provided with an autonomous turret system with two barrels of 50cal

each. The wheel is designed to provide mobility even after severe explosions near/on tires. For this case, we have increased the size of the rim such that the vehicle can move using rims as well. It is shown in figure 3.

2.1 Mechanism

The design is not provided with a suspension system as it can cause immobility in case of under-vehicle explosions. The vehicle is powered by electric motors provided on each wheel. These motors are provided by battery modules. The battery module is made up of individual lithium-ion cells. A single module can accommodate about 1000 lithium-ion cells. The default power source is 7 modules and can be increased up to 12 modules. The weapon detection system is used to differentiate military personal from terrorists. The military personals are provided with unique IR id tags which are used to differentiate them. A camera is provided in the turret system for weapon detection. The turret can be rotated up to 270 deg with elevation up to 15-20 deg. When a weapon is detected, if it is a terrorist the weapon system gets activated and eliminates them. For the weapon detection algorithm, we will be using YOLO object detection where will be training datasets for different weapon cases. The accuracy of the detection is based on the training of datasets.
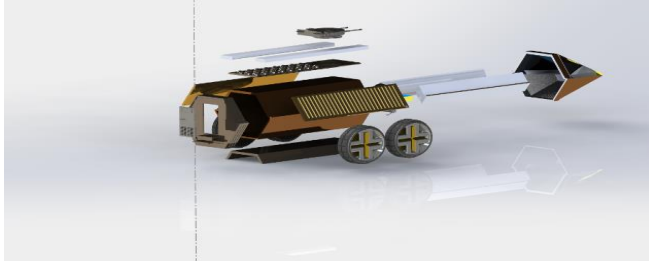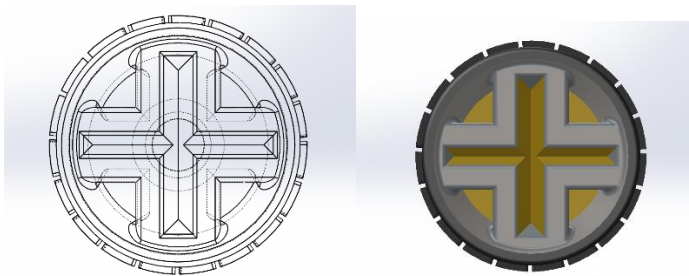

Fig.1. Exploded View

Fig.2. Design of ASV
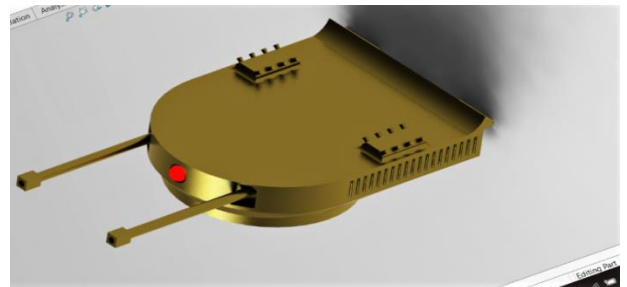

Fig.3. Illustration of Modified Wheel

2.2 Weapon Detection Algorithm

In any detection system, there are sensors to identify the object and a camera to capture the environment. The captured images are to be sent for analysis as an image processing technique.

Fig.4. Illustration of Turret

2.3 Program Code used in Detection under Image Processing

Chapter one
clone darknet repo
!git clone https://github.com/AlexeyAB/darknet

```
# change makefile to have GPU and OPENCV
enabled
%cd darknet
!sed -1 's/OPENCV=0/OPENCV=1/' Makefile
!sed -1 's/GPU=0/GPU=1/' Makefile
!sed -1 's/CUDNN=0/CUDNN=1/' Makefile
# verify CUDA
!/usr/local/cuda/bin/nvcc —version
#make darknet (build)
! make
# get yolov3 pretrained coco dataset weights
!wget
https://pjreddie.com/media/files/yolov3.weights
#define helper functions
Def inShow(path):
        Import cv2
        Import matplotlib.pyplot as plt
        %matplotlob inline

        image  cv2.imread(path)
        height, width = image, shape[:2]
        resized_image =
cv2.resize(image,(3*width, 3*height),
interpolation = cv2.INTER_CUBIC)

fig= plt.gcf()
fig.set_size_inches(18, 10)
plt.axis("off")
plt.imshow(cv2.cvtColor(resized_image,
cv2.COLOUR_BGR2RGB))
plt.show()

#use this to upload files
def upload():
        from google.colab import files
        uploaded – files.upload()
        for name, data in uploaded, items():
        with open(name, 'wb') as f:
                f.write(data)
                print ('saved file', name)
# use this to download a file
def download (path):
from google.colab import files
fiels.download (path)
# run draknet detection
!./darknet detect cfg/yolov3.cfg yolov3.weights
data/weapon.jpg
#show image our helper function
imShow('predictions.jpg')
```
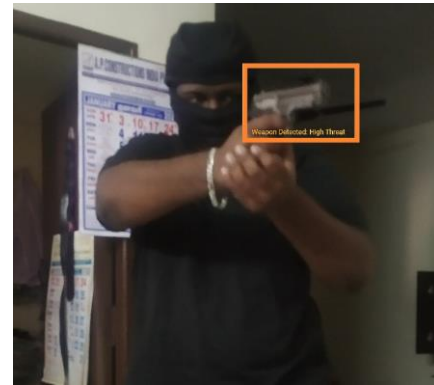

Fig.5. Weapon Detection Result

Similarly, using the sensors, it can identify the object. Based on the earlier experience, program coding is developed for the image processing and object detection system. From figure 5, it is image processing is done and it can capture that there is a weapon, and this information help to make proper safety and for the next action.

Conclusion:

Nowadays in countries or around borders, high tensions are very common. Security of human capital, i.e. the safety of troops, is as important as national property security. The fact that the causality rate is comparatively higher among the security powers during a crisis is apparent. It is quite substantial that the casualty rate must be low for a good military ally. In this analysis, a complete ASV vehicle is designed with all necessary parts. A special effort is spent on designing a wheel. A programing is developed to do image processing to detect weapons. These statistics and figures demonstrate the nation's resilience and the security sector's performance. The definition of ROV, therefore, is an important instrument for achieving this. ROV vehicles need minimum to no human intervention, making them very powerful in defense sectors to decrease the causality rate. The final design was arrived at after doing many analyses based on wind and the size of the vehicle. With these studies and modeling, a suitable and safe vehicle can be designed for defense application.

References

Journals

[1].Cameron, Lori. "Internet of Things Meets the Military and Battlefield: Connecting Gear and Biometric Wearables for an IoMT and IoT". IEEE Computer Society. Retrieved 31 October 2019.

[2]. M117 Armored Security Vehicle Data Sheet." Textron Marine and Land Systems, 17 May 2011. Web. Retrieved 1 Aug 2012.

[3]. John Pike. "M1117 Armored Security Vehicle (ASV)". Retrieved 13 February 2015.

[4]. Muniyandy Elangovan, A.T. Ravichandran, and S. Prabhukumar "Need of Energy Audit in everyday LIFE", International Research Journal on Advanced Science Hub, 2020, Volume 2, Issue 11, Pages 6-11.

[5]. Mihai Dimian, Luc Chassagne, Petru Andrei, and Pu Li - Smart Technologies for Vehicle Safety and Driver Assistance, April 2019

[6]. T Balaji, Muniyandy Elangovan and S Sankar Ram, "The Design of an Unmanned Aerial Vehicle" Research Journal of Nervous System, Volume 04 Issue S(5), November 2020.

[7]. Rohit Kumar Tiwari, Gyanendra K. Verma - A Computer Vision-based Framework for Visual Gun Detection using SURF, 2016

[8]. Felipe Jiménez et al., - Advanced Driver Assistance System for Road Environments to Improve Safety and Efficiency, 2016.

[9]. Muniyandy Elangovan, "Hydrodynamic Energy Devices to Improve the Efficiency of Propulsion System in AUVs" International Research Journal on Advanced Science Hub, 2020, Volume 2, Issue 11, Pages 18-22.

[10]. Romano Capocci 1,*, Gerard Dooly 1, Edin Omerdić 1, Joseph Coleman 1, Thomas Newe 2 and Daniel Toal, "Inspection-Class Remotely Operated Vehicles – A Review", Journal of Marine Science and Engineering · March 2017 DOI: 10.3390/jmse5010013

Chapter in a Book

[11]. H. V. Jansen, N. R. Tas, and J. W. Berenschot, "Encyclopedia of Nanoscience and Nanotechnology", Edited H. S. Nalwa, American Scientific Publishers, Los Angeles, vol. 5,(2004), pp.163-275.11.4.

[12]. Vincent Boulaunin, "The Impact of Artificial Intelligence on Strategic Stability and Nuclear Risk" Volume I, Euro-Atlantic Perspectives, May 2019.

Conference Proceedings

[13]. Ramakrishnan and M, Muniyandy ELANGOVAN" IOT based Pollution Monitoring System", International Conference on Design, Materials, Cryogenics, and Constructions(ICDMC'19).

[14]. J. Kimura and H. Shibasaki, "Recent Advances in Clinical Neurophysiology", Proceedings of the 10th International Congress of EMG and Clinical Neurophysiology, Kyoto, Japan, (1995)October 15-19.

[15]. Nicholas G. Poulter, "Guide to the Technologies of Concealed Weapon and Contraband Imaging and Detection" National Institute of Justice Office of Science and Technology Washington, DC 20531, February 2001