# Multi-Role Unmanned Ground Vehicle for Bomb Detection and Surveillance

**Dhanasekar. J, Sengottuvel. P, V.Priya**

***Abstract*: *Nowadays the world is very insecure due to various problems like terrorism , natural disasters , emergency health situations and surveillance. Valuable lives are being lost in various situation due to human negligence when carrying out rescue or emergency operations. Even though when our security forces are tireless working to save us everyday , we still have problem to entirely secure ourselves in different situation. To counter these issues we propose a project. Our project is a multi-role capable unmanned ground vehicle. It has three key aspects the modular design , robotic arm and surveillance The current types of unmanned ground vehicles are designed for doing only one specific task like handling a bomb or only carrying payloads but our unmanned ground vehicle is designed to undertake multiple tasks. When required the unmanned ground vehicle can be fitted with a robotic arm , metal detector or storage compartment for carrying supplies and even wireless camera for surveillance .The operations to be performed are done using two control methods RF control and through microcontroller chips. By implementing a mix of modular design, simple and cheap circuitry we can develop an effective and reliable multi-role capable unmanned ground vehicles.***

***Keywords* : *Multi-role, Modular design, RF Control, Microcontroller Chip***

## I. INTRODUCTION

An unmanned ground vehicle (UGV) is a vehicle that works while in contact with the ground and without an introduced human closeness. UGVs can be used for certain applications where it may be seriously planned, perilous, or hard to have a human overseer present. Generally, the vehicle will have a ton of sensors to watch the earth, and will either self rulingly choose decisions about its direct or pass the information to a human chairman at an other region who will control the vehicle through teleoperation. The UGV is the land-based accomplice to unmanned ethereal vehicles and remotely worked submerged vehicles. Unmanned mechanical self-rule are overall successfully created for both customary resident and military use to play out a combination of dull, smudged, and unsafe activities[10] .

**Revised Manuscript Received on August 22, 2019.**

**Dhanasekar.J**, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, Tamilnadu, India.
Email: Jdhanasekar81@gmail.com
**Sengottuvel. P**, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, Tamilnadu, India.
Email: hodmechatronics@bharathuniv.ac.in
**V.Priya**, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, Tamilnadu, India.
Email: priyaygna14@gmail.com

## II. DESIGN

The entire design was done using the Autodesk inventor professional software[9]. Other than just design we also did analysis of the unmanned ground vehicle base to know how much load it can carry. So as to effectively use the unmanned ground vehicle.

### A. Steps to a complete design

1. Physically measure and know the dimension of the parts if not mentioned by the seller.
2. Create each part individually in the Autodesk inventor software using the dimension noted.
3. Assemble all the parts created in the assembly section.
4. Render the entire assembly
5. The other things that can be done are assembly video , 2D layout of the project and 3D rendering of the images.

### B. Software rendered design

Our idea of unmanned ground vehicle is to make it easily swappable in terms of the payload it will carry like the robotic arm, emergency supplies etc[8].

So we have designed the robotic arm to swappable

We just added clamps and screws so that we can remove and replace with a storage compartment easily. Other unmanned ground vehicles don't have that flexible design.

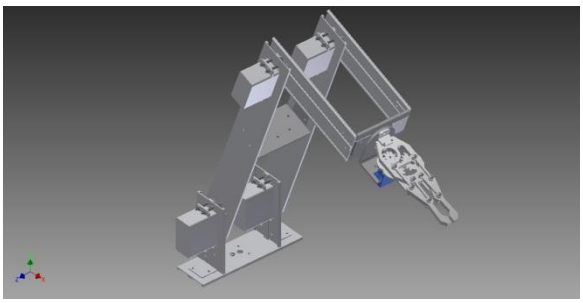

Figure -1 Robotic Arm Setup

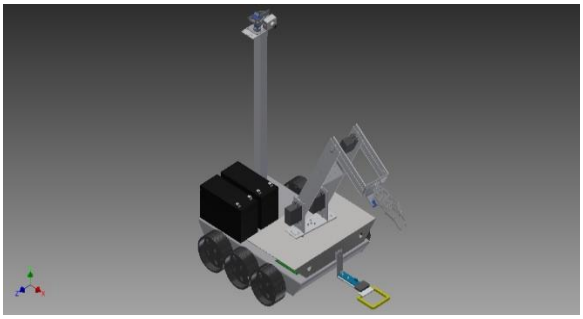

Figure – 2 Rover and Arm setup

The above images shows the modular robotic arm setup . The bottom part is easily removable so you can remove the robotic arm setup from the unmanned ground vehicle and then replace with storage compartment if you want. The below image shows the unmanned ground vehicle with the storage compartment[7].

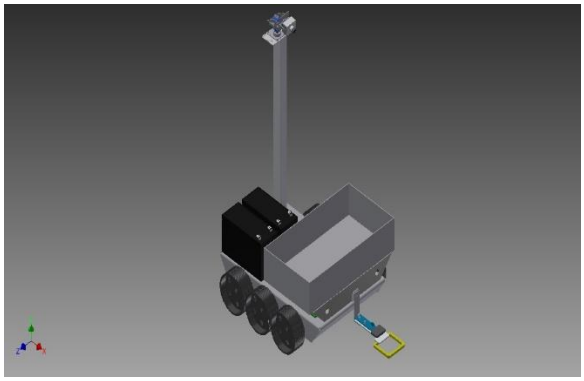

Figure 3 – Rover and Storage Compartment Setup

The computer design of the unmanned ground vehicle is done. The parts that placed on the unmanned ground vehicle are batterie12v, camera tower , robotic arm or storage compartment , circuitry All the parts are placed as shown in the images.

### *C. Design analysis*

The entire design work is done using the autodesk inventor software[6]. We have performed the Von Misses stress test . The test was done on the chassis with the two batteries and the storage compartment which comprise of nearly the entire load of the unmanned ground vehicle. Doing this analysis we understand the stress acting on the unmanned ground vehicle is safe to carry a load of 6kg of cargo.

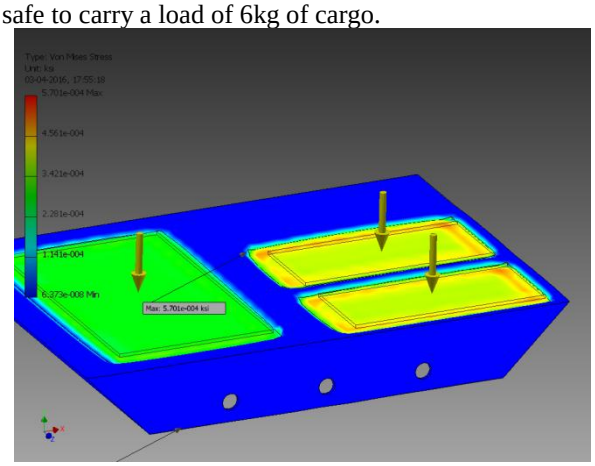

Figure 4- Von Misses Stress analysis

The below images shows the layout of the unmanned ground vehicle with the robotic arm.

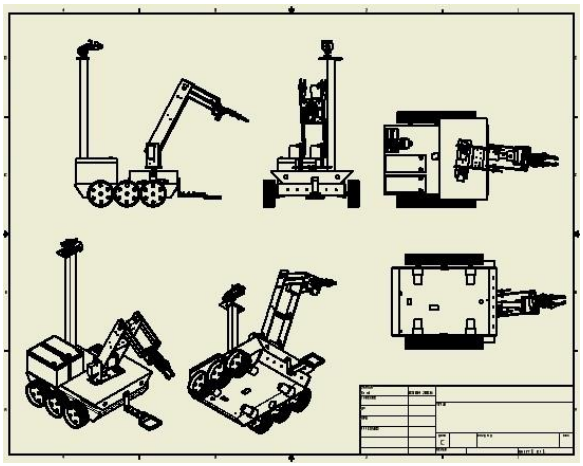

Figure 5 - Layout of UGV with arm setup

With this the whole design and analysis process is done. This shows the design for such type of unmanned ground vehicle with interchangeable configuration is feasible and can be created.

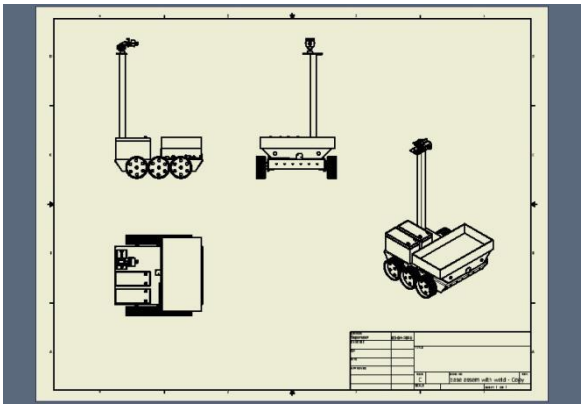

Figure 6 - Layout of UGV with storage compartment

## III. CONTROL SYSTEM

### A. Unmanned Ground Vehicle Control

HT12E is an encoder coordinated circuit of 212 arrangement of encoders. They are combined with 212 arrangement of decoders for use in remote control framework applications. It is basically utilized in interfacing RF and infrared circuits. The picked pair of encoder/decoder ought to have same number of addresses and information group.

Basically, HT12E changes over the parallel contributions to sequential yield. It encodes the 12 piece parallel information into sequential for transmission through a RF transmitter[5]. These 12 bits are separated into 8 location bits and 4 information bits.

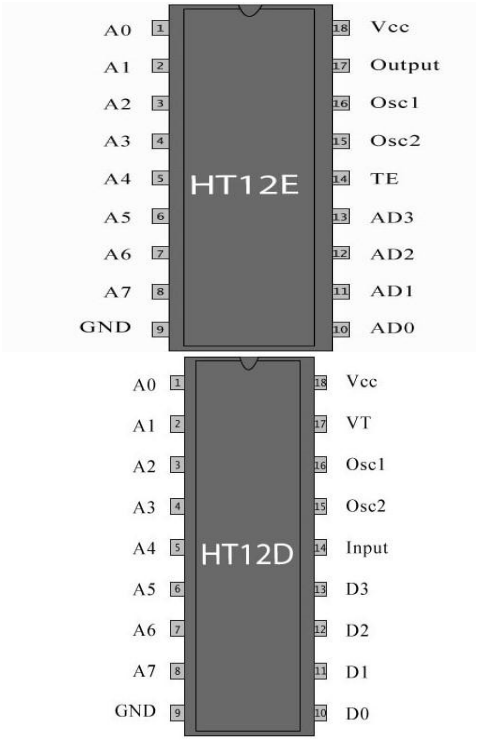


Figure - 7 Encoder and Decoder chip

HT12D is a decoder coordinated circuit. This arrangement of decoders are principally utilized for remote control framework applications, similar to criminal caution, vehicle entryway controller, security framework and so forth. It is for the most part given to interface RF and infrared circuits. They are combined with 212 arrangement of encoders. The picked pair of encoder/decoder ought to have same number of addresses and information design[4].

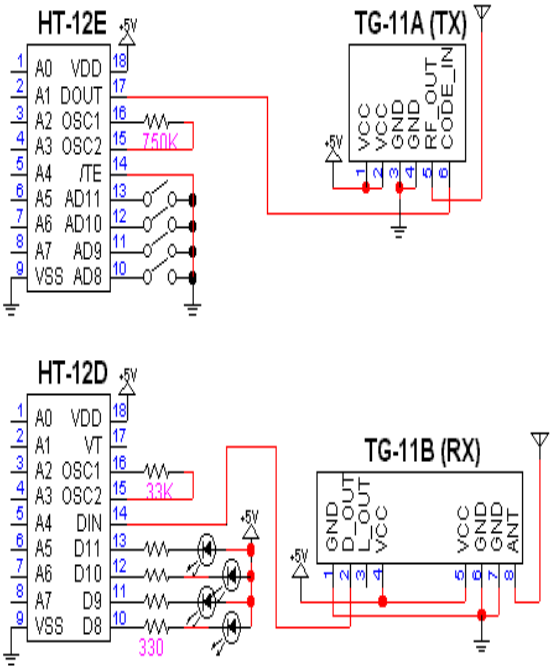


Figure - 8 UGV Control circuit diagram

From the circuit diagram it is clear how the connection are given. Once it is given our control system for the unmanned ground vehicle is done.

**B. Servo control**

The arm is connected by a total of six servos as mentioned earlier. Of these six , one servo is at the bottom which is responsible for the overall 180 degree rotation of the entire robotic arm structure then two pairs of servo motor have the same signal are connected at the lower and upper part of the bottom link and finally the fifth servo remaining is connected to the gripper at the upper link which control the opening and closing of the gripper[3]. The lower and upper link are responsible for the arm extension movements. Now we are complete with placement of the servos at its destined points. Now each servo has three wires which are colored as orange, red, black and each of these wires represent signal , positive , ground respectively . Now all these servo are connected to the servo control board . So how do we control a servo motor. We program the IC when programmed when we change the resistance a certain value is generated which varies from 0-1023 for 0-180 degree rotation which is programmed and the IC knows for angle for the generated resistance value . Hence using this we can precisely control the movement of a servo motor[2]. When the IC is coupled with a wireless transceiver or a any wireless mode of communication , here we have used Bluetooth we can effectively control the servo wirelessly . Using the open source servo controlling software platform we can control these servo from the computer equipped with a Bluetooth . So in this way we control all the servo's equipped in the unmanned ground vehicle.

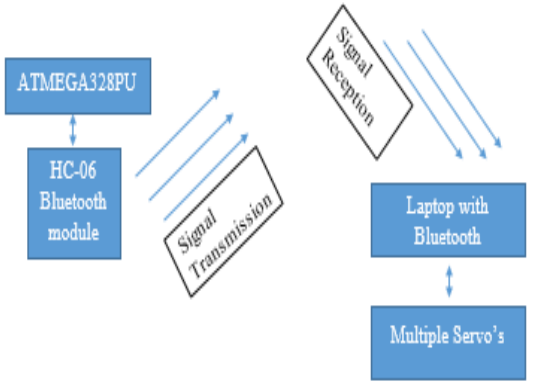


Figure 9 - Servo control system block diagram

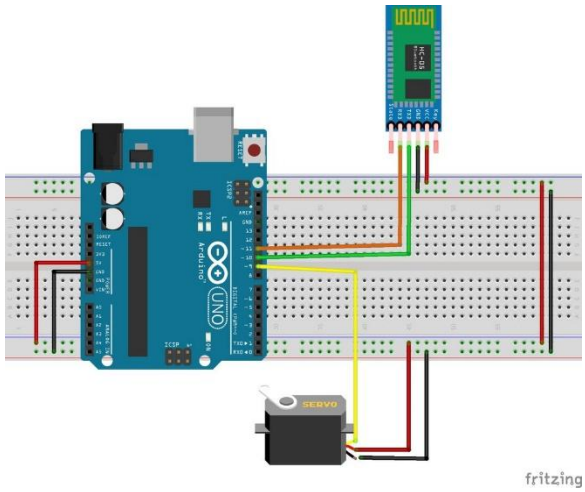


Figure 10- Single servo circuit diagram

The above images shows the circuit diagram for one of the servo in similar way multiple

servo are connected and controlled via open source computer software. This completes the servo control mechanism.

## IV. APPLICATION

The application of the use of unmmaned ground vehicle are immense some of the real applications of the vehicle are as follows

1. Bomb detection and handling

2. Surveillance

3. Light Cargo handling

4. Multi-role capacity

5. Disaster situations

## V. CONCLUSION

This project work demonstrates the use of unmanned ground vehicle designed for multi-role capabilities like the robotic arm for handling objects , metal detector to detect bombs, storage compartment for transporting valuable supplies, surveillance etc. Though the initial cost is high the operational safety and operation success rate is high. The unmanned systems is a game changing technology that everyone is betting the future to be filled with unmanned systems. We have already seen a lot of unmanned systems coming into our social lives like the drones and this is just the beginning of a new revolution our day to day lives[1]. This project sets a example of the current trend of the use of unmanned system in the military space.

## REFERENCES


1. Dhanasekar, J., Sengottuvel, P. & Palanikumar, K. 2019, "Implementation of effective fuel saving methodology for turbines using air drag in vehicles", *Materials Today: Proceedings*, pp. 421
2. Kumar, S.S., Kumar, K.S.R. & Kumar, N. 2018, "Experimental evaluation of magnetorheological damper characteristics for vibration analysis", *International Journal of Vehicle Structures and Systems*, vol. 10, no. 1, pp. 30-34.
3. Dhamodaran, K., Adikesavana, P., Shankar, P.P. & Gowtham, S. 2018, "Conceptual development of flapping wing for unmanned aerial vehicles: Technical note", *International Journal of Vehicle Structures and Systems*, vol. 10, no. 1, pp. 43-45.
4. Karthikeyan, S., Raman Balasubramanian, S.R., Ramesh, B., Raghul, S. & Sathish Kumar, S. 2019, "The automatic solar tracker chronicles", *International Journal of Recent Technology and Engineering*, vol. 8, no. 1, pp. 312-315.
5. Hema, R., Sundararajan, M. & Balaji, S. 2019, "Smartphone control robot with automatic firing gun", *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 9 Special Issue 3, pp. 625-627.
6. Balambica, V., Deepak, V. & Kumar, S. 2019, "Design and efficiency of an asymmetric gear", *International Journal of Mechanical and Production Engineering Research and Development*, vol. 9, no. 3, pp. 223-230.
7. Saravana, S., Balaji, S., Arulselvi, S. & John Paul Praveen, A. 2019, "Reliable power quality monitoring and protection system", *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 9 Special Issue 3, pp. 644-645.
8. Bycil, V.J. & Wiselin, M.C.J. 2019, "Modeling and analysis of vibration energy harvesting system using piezo stack", *International Journal of Mechanical and Production Engineering Research and Development*, vol. 9, no. Special Issue 1, pp. 523-533.
9. Sripada, A., Warrier, A., Kapoor, A., Gaur, H. & Hemalatha, B. 2018, "Dynamic lateral balance of humanoid robots on unstable surfaces", *International Conference on Electrical, Electronics, Communication Computer Technologies and Optimization Techniques, ICEECCOT 2017*, pp. 539.
10. Mahalakshmi, V. & Vijayaragavan, S.P. 2019, "PV based power electronic converters for high voltage DC applications", *International Journal of Recent Technology and Engineering*, vol. 7, no. 6, pp. 670-674.


## AUTHORS PROFILE

**Dhanasekar.J** Assistant Professor, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, India.

**Sengottuvel P** HOD, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, India.

**V.Priya** Assistant Professor, Department of Mechatronics, Bharath Institute of Higher Education and Research, Chennai, India.