

## DESIGN AND DEVELOPMENT OF SURVEILLANCE – BASED ARMY HELPING UNMANNED GROUND VEHICLE\*

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### ABSTRACT

*The aim of this Project is to design and implement a cost-effective as well as multitasking Potent Military-helping Artificial Intelligence based Prototype of an Unmanned Ground Vehicle (UGV). In this Paper, the salient features of the UGV have been briefly described. This project would be of great significance to the Indian army as such systems are scarce in the country, and would be of great help to tackle sensitive situations where Human intervention is not possible. This UGV is capable of conducting Surveillance, Bomb detection and defusing, Laser targeting, and can be remotely controlled with the help of Bluetooth Module, and Radio Frequency Controller. The major feature of the UGV is that it is self-exploding, in case it gets into unfavorable situations, which makes it highly secure. This UGV will be a perfect solution to major challenges faced in the military sector today.*

### KEYWORDS

Unmanned Ground Vehicle (UGV), Army Helping Vehicle, Surveillance robot, Bluetooth-Controlled robot, Radio Frequency Regulated, Infra-Red Sensors, Arduino-Based, Sensors.

### I.INTRODUCTION

Robots have been invented to make the work of humans easier, and help carry out tasks efficiently within the desirable time period. Today, The robotics sector is the fastest growing sector witnessing significant leaps and bounds, and with each day, more and more advancements are being made, with experts predicting the robots to become increasingly public-facing in the near future..There have been many advances in this field

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since then and robots are being developed and improvised to be able to be used in as many fields as possible like Manufacturing, Health care, Agriculture, Hotel management and Military (in the form of UGV's).

An Unmanned Ground Vehicle (UGV) is a vehicle that operates while in contact with the ground and without an onboard human presence. This type of vehicle is controlled remotely, capable of sensing its environment and navigating from one place to another without any human intervention.[2]

The most important use of UGV is in the Military sector and although some of them have been made and are being used, they still haven't been able to be exploited to their maximum potential. With this project, we aim to solve this problem by creating a cost effective, made in India, multitasking potent AI-based UGV, which will be a solution to all the challenges faced in the Indian Army.

## II.MOTIVATION

The main determination behind this project is to help reduce the struggles faced by Soldiers. This UGV has many dynamic benefits such as Obstacle avoiding, Reaching and Patrolling difficult places, Surveillance (Night vision included), Bomb detection, Bomb Neutralizing, Targeting enemies through laser besides several other features. This UGV can act as an additional support to the soldiers, and would also make the strenuous duties of the Soldiers easier up to a considerable extent. Currently, our Nation is dependent on other countries for procuring defence technologies, but this UGV can be made using our own Indigenous resources, which would help to reduce the cost of making and import duties along with increasing employment in the Nation, it is only a one-time investment for The Government.

## III.LITERATURE SURVEY OF EARLIER ANALOGOUS WORK

There has been an extensive literature review of the pre-existing similar systems, in order to deeply understand the actual mechanism and components involved in making the UGV's, so as to identify what other advancements could be made.

Sr. No.	Title of the Research Paper	Author
1.	Low Cost UGV (Autonomous)	Leckraj Nagowah
2.	D.R.D.O NETRA(Official)	D.R.D.O.

3.	D.R.D.O DAKSH(Official)	D.R.D.O.
4.	Big dog Quadrupled Robot	Marc Raibert
5.	Self-Controlled UGV for army purpose	Santhosh Kumar
6.	Armed Military Robots: Editorial	Peter Asaro
7.	Design and Structural Analysis of a Robotic Arm	Gurudu Rishank Reddy

Their works have been briefly summarized one by one.

The vehicle designed by Leckraj et. al. is able to move autonomously, detects obstacles, reads direction from QR codes. It calculates the shortest path towards its final destination and autonomously moves towards the same. They created a general- purpose low cost Autonomous UGV. Major inspirations for the outer design and components have been taken from this model.[2]

The D.R.D.O NETRA is an ambitious project of the Organization, and is an UAV (Unmanned Aerial Vehicle), the main aim of which is surveillance, for which it uses CCD Camera, the body of it is made up of Carbon fiber and utilizes Quad-Copter to lift up the device and provides it with Vertical Takeoff and landing ability. There have been almost 10 Prototypes of the device before launching the final Device, which were used as testers for High - Altitude Reaching capacity, Temperature tolerance, etc. before clearing the UAV for final Launch. Inspirations for making the UGV light-weight and for the surveillance camera were taken from this model.

The D.R.D.O Daksh is the Country's first completely autonomous UGV designed to be used for Bomb defusing and recovering of the Bomb. The parts utilized in the making of it are maximally Indigenous (around 90%). The robot can be controlled from far away, within a range of 500 meters, via a MCS (Master Controlling Station). It has the ability to lift, scan and destroy or defuse Bombs and Dangerous Materials. It has proper Radio frequency jamming devices within it, which prevents malicious control, and is used, by The Army, The Paramilitary and the Police

to handle sensitive situations. Outer structure, arm design and dynamics, batteries of the UGV were inspired from this ROV.

The Big Dog Quadrupled Robot designed by Marc Raibert et. Al. and team, is a four-legged Robot aimed to be used as a load carrier for carrying heavy ammunitions and equipment (up to 150 Kg), as a helper to the Soldiers. It was developed by Boston Dynamics, in association with the NASA Jet Propulsion Laboratory. It utilizes Hydraulics as the main driving Principle; the pressure of the oil moves the bot. Fast running ability and load carrying capacity motivated the formation of the UGV. [3]

Santhosh Kumar and other co-members designed a UGV capable of being regulated automatically by a GPS System. New technologies like Zigbee and Arduino had been used. It uses Magnetic Compass and adjusts its strategies based on its surroundings using path planning and obstacle detecting algorithms. The destination coordinates are obtained from the user. The features like obstacle detection and avoiding were added in the UGV after getting influenced from this paper.[4]

The thesis written by Gurudu Rishank Reddy explains about the designing and structural analysis of a Robotic Arm. The Mechanical design has been crafted after deep analysis and extensive study, and the functionality, Reliability, Motion Range and speed, Payload, Reach and axes have been described in detail. The process of Design using AutoCAD has been illustrated. Major inspirations for the structural designing were inspired from this thesis, after a few modifications.[1]

#### IV.SOME DETAIL PART OF ROBOTS:

##### i.Body (Chassis) :

Our robot body is made of Reinforced metal chassis combined with geared motor clamp having a smart arrangement of battery that

Sr. No.	Component	Function
1.	Arduino Uno	To control chassis and its wireless operating system.
2.	Arduino Mega	To control Robotic and its PWM operating system.

3.	Servo motors	Movement of arm.
4.	Bluetooth HC-05	Wireless connectivity.
5.	L298N motor driver	To control DC GearMotors.

□ Specifications of electric components

balances the center of mass which directly improves the weight balance of the robot. Chassis' front end & back end have been cut in specific angles, which help the robot to climb slopes. geared DC motors with 6mm shaft. Wheel belt is used for better stability, torque, and grip and also increases surface area of the robot.

ii. Motors:

The 12V DC Motor – 200RPM have been used in the robot. These motors are DC motors with gears through the shaft for obtaining good performance. They also called as Centre shaft DC Geared Motors because their shaft extends through the center of their gearbox. This motor has a voltage range between 5 and 35V DC.

iii. Wheels & Wheel Belt:

The High-quality Track wheels are used in the robot with a pair of 4 cm tracked belt. It fits on geared DC motors with 6mm shaft. Wheel belt is used for better stability, torque, and grip and also increases surface area of the robot

iv. Motor Driver:

L298N motor driver is used in the robot, which can control 2 DC motors with directional and speed control. It can drive motors of 12V with a total DC current of up to 4A.

v. Arduino Uno R3 Development Board:

Arduino Uno R3 is similar to a brain for the robot because it has microprocessor and ATMEGA328 integrated chipset, which can control motor driver, servo motors simultaneously and with integrated RX & TX ports, it also controls Bluetooth HC05 module.

vi. Bluetooth HC05 Module:

HC05 is used in our robot because it has unlimited channel controls and Bluetooth HC05 can be controlled by any Bluetooth enabled device and has voltage operating range between 3.6 to 5V.

vii. 433Mhz Modulator:

This Modulator has an intelligent chipset as it has a variety of controllable frequencies and also has 8 Bit controlling so that we can access up to 64 security patterns that will give connection securely to the robot.

## viii.12 Volt Power Battery:

This Battery is 12 Volt, 2 Amps Rechargeable Lead Acid Battery which will give constant power supply of 12 Volt to the robot.

Sr. No.	Batteries	Type	Function
1.	12v battery[2 A]	Lithium-ion	To operate motor driver and motors
2.	5v battery[3 A]	Lead Acid	To operate Micro controller and servo motors

ix.Arm: The Robotic Arm is used to defuse the bomb which is composed of 3D Printed PLA. It also has specifically calculated space for holding servo motors.

## x.Servo motor:

Basically, servo motor is used in arm for movement of the arm. Here, in this robot, there has been a use of SG90 variant which is very small and has high torque motor. It can rotate up to 180degrees. With perfect fitting it can be used in the arm.

## xi.5 Volt Power Supply:

All servo motors and Bluetooth modules work on constant 5 Volt power supply, for which there has been a use of 5 Volt power module to supply proper voltage and amperes to each motor and the modules.

## xii.Camera:

There has been a use of normal phone camera as a surveillance camera, but Wi-Fi camera or Go-pro cameras can be used for better results. Also, analog cameras can be used having same analog frequency screens.

xiii.Laser diode module:

Basically, laser module has been inbuilt on the robot, because it can point out the situation during suspicious activity. It works on 5mW power and 3 Volts Voltage supply.

xiv.Connecting wires:

In the robot, 3basic types of wires are used for the connection of modules motors to controller (male to male, female to male and female to female). Some normal solder-able wires are also used for wiring purpose. USB cables used for power up and programming the Arduino unoR3 board and jumper wires have been also used for high current norms.

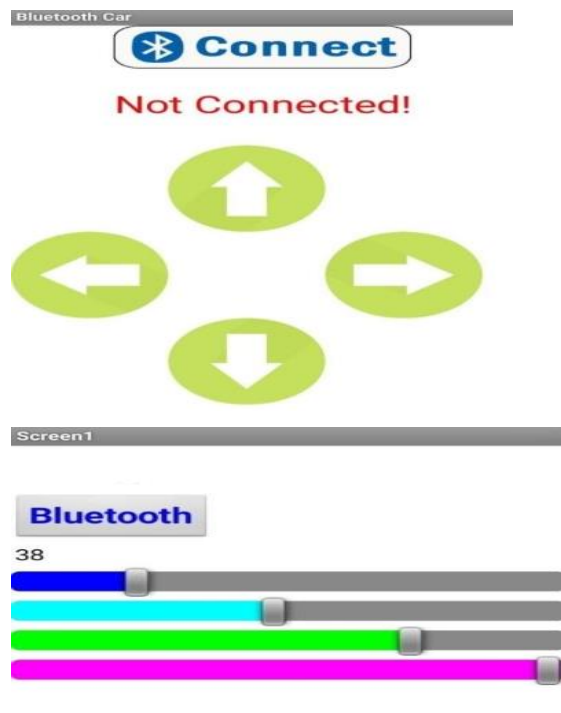
And some basic materials like cable tie for tying up wires, electric tape and heat sink for protecting circuit, Fevi-quick/ M-seal/ Aerolite have been used as adhesives, glue stick for protecting circuits and many types of screws have been used for the robot.

**V.FEATURES:**

i.Bomb detection:

We can detect bomb or explosives using colorimetric test kits. This colorimetric sensor has been mounted on linear Gear box for better performance.

ii.Bomb defusing:



Multi tech 7 alloy steel nippers and micro shears are used for accurate wire cutting. This blade is mounded on the gripper of the robotic arm, with the help of servo motors bomb will be defused.

### **Fig.1.1: UGV Bluetooth controlling system.**

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v.Surveillance with laser guidance: Surveillance is done with the help of Alfred camera. This application also has night vision system and mobile control camera system. Additional laser module has been mounded for better results.[6]

##### **vi.Suicide bombing:**

The Robot has an inbuilt bomb so it can be used. If anyone tampers with the robot, it will explode. Also, we can use it for targeting enemy camp or enemy's base and using it there as a suicide bomber.

vii.In future we can also mount high frequency laser as a weapon, just as Iron Dome.

#### **VI.KEY POINTS:**

i.Our robot can be controlled by multiple ranges of frequencies like 315/433/434/435/866 ASK module with 8-bit DIP switch. So, we can differentiate between the above frequencies as well.

ii.It is portable as well so it can perform best in difficult situations and sensitive areas. Transportation of such robots is also easy so we can transfer robots where they are being needed. On surgical operations, commandos can carry this robot easily.

iii.Manufacturing of such robot is very easy and quite cheap. All parts are used in robots are majorly made in India. In future, we can develop 100% parts of robot in India itself.

iv.There has been a use of high quality of modules, chip set and controllers which perform during extreme heat and in extreme cold also in areas.

v.Broad belt and high torque motors help give better performance of the robot in extreme conditions.

vi. We can also customize the robot for Daily usage work.

## **VII.STRUCTURAL DEVELOPMENT AND ANALYSIS OF ARMY-HELPING UGV.**

### **VII. I SOFTWARE**

The 3D designing of the UGV was done on the software – FUSION360, a very well know software provided by the Adobe group, used for 3d designing and modelling purpose.

### **VII.II DESIGN AND FEATURES**

Designing is a process where your ideas take a shape. Many varieties of design can come to mind at initial stage but you need to be precise with the parameters and specifications you want to add or remove from the model.[1]

Figure 1.1 depicts the 3D design of the UGV with an aim to be used in the army for bomb diffusion and surveillance.

This model is the base and has been made with carbon fibre. Later in the section you will find the model with some metal on it. It has been designed for the whole and sole purpose of military surveillance and bomb diffusion



Fig 1.2.CAD diagram of Abhimanyu, created using Fusion 360..

The body is strong enough to withstand any climate and the arm has sharp forks on it to cut the wires smoothly. The wheels have belt attached to it for smooth movements and to overcome any sort of hurdle. Figure 1.2 shows the image of the arm. It is semi-metallic to keep it light weight and for proper functioning of the UGV.



Fig 1.3 CAD diagram of the Robotic arm.

There are also some internal parts like the power generator, coolers, cylinders which are overall needed for the proper working of the UGV.

The arm has two motors attached at two points for it to bend down and accomplish the task. It also has a camera which is beneficial for the surveillance.

### VII.III PARTS USED IN DESIGN

There are many parts used to build the final model which are made of combination of metals and carbon fibre. The list of all the parts are: -

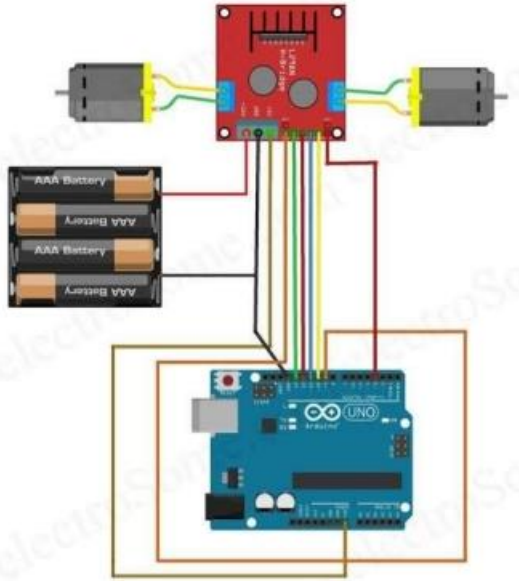
- |               |               |                    |
|---------------|---------------|--------------------|
| 1. Battery    | 2. Chain Tire | 3. Cooling System  |
| 4. Cylinder   | 5. Jaws (6)   | 6. Power Generator |
| 7. Protrusion | 8. Tires      | 9. Turret          |

Below you find the exploded version of the robot through which all the parts can be seen clearly.



Fig 1.4 Dismantled CAD View of Abhimanyu

### VII.IV CIRCUIT DIAGRAM



### **VIII.RESULT AND DISCUSSION**

In our current work we have successfully developed an unmanned ground vehicle (UGV) capable of traveling through difficult terrains even without daylight able to be controlled by mobile using HC05 Bluetooth Module, radio frequency receiver, Arduino, motor driver, servo motors, buttons, batteries, and lights.

### **IX.CONCLUSION**

The team was able to successfully build an Unmanned Ground Vehicle (UGV) Prototype that can be remotely controlled by mobile using HC05 Bluetooth Module, radio frequency receiver, and Arduino. By using HC05, the UGV is capable of been travelling from one place to other place with human controlled interference. The complete set up and working of the UGV is described in the paper. We strongly feel, in near future this human controlled robot using can be used for military purposes which need to be operated outdoor. This UGV can undertake missions like border patrol, surveillance, bomb detecting, bomb defusing, mine detecting, use in hostage situation, and it can also tow as well as in co-ordination with human soldiers.

### **X.ACKNOWLEDGEMENT**

It was a great and an enriching experience for the team to have taken up such an incredible and challenging project, and is extremely grateful to their guide, Prof. Sameer Agrawal, who allowed the team to take up this venture and provided time to time guidance and support, whenever needed. The team is also thankful to the University, for introducing them to such a useful and

practical subject like this, which allows students to get exposed to the procedures followed in the industry since a beginner stage.

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