DESIGN & DEVELOPMENT OF UNMANNED GROUND VEHICLE

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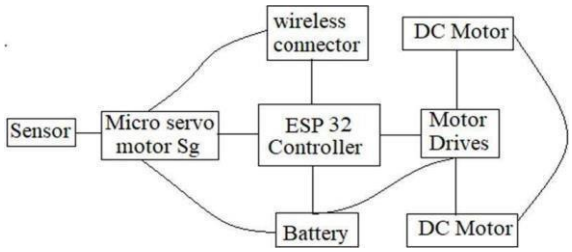
ABSTRACT

An unmanned ground vehicle (UGV) is a vehicle that touches the ground and has the ability to function and perform task without any human on board. Automated vehicles can operate off-road and on-road while navigating, and can be used in military operations such as bomb detection, border patrol, cargo transport, search, rescue, etc. to reduce the danger to the soldiers and to fulfill other tasks. UGVs can be used in many applications where driver presence may be inconvenient, dangerous or impossible. Vehicles typically have a number of sensors that monitor the surroundings and make autonomous decisions about vehicle behavior or communicate information to other operators who will be driving the UGV. These types of vehicles mainly use sensors to monitor their surroundings and automatically make their own decisions in unpredictable situations and unknown information, or they use this information to transmit this information through various means of communication to the operator controlling the UGV when assistance is needed. These UGVs can send visual feedback to ground station operators. We have proposed four main UGV specifications. Metal detectors and robots that search for metal or bombs have fire extinguishers. Camera is used for the scrutiny using wireless technology. The on-board sensors transmit the entire vehicle environment to the driver in the form of signals. The UGV is tasked with patrolling the border between the two areas without human guidance. This function can be achieved by implementing GPS, a magnetic compass, to measure the angle of rotation and correct the course, avoiding obstacles such as mountains, trees and oceans. This route planning strategy is a key program in which the robot acts autonomously. Finally, a warning message and the location (coordinates) are sent from the UGV to this location via GSM and GPS. This robot is an unmanned robot that can be remotely controlled using a transceiver using RF technology.

1.INTRODUCTION

The rapid growth of terrorism in the current environment has laid the groundwork for a growing number of self-directed and regulated robots. All of these incentives have prompted professional researchers to design and work on more efficient and organised robots on the battlefield. This autonomous robot assists civilians and military personnel in emergency situations. For example, these autonomous and unmanned robots could freely work with the military to monitor terrorist activity and could work with the security and police to detect illegitimate, unlawful and many other urban activities. Many countries are unaware of this problem and are currently investing in the development of unmanned robots to protect citizens from thieves. To be accurate, free cars work without human intervention. Executive Intelligence arises from the need to draw personal conclusions and take control. A robot's resolution can be achieved by using GPS in conjunction with a magnetic compass to detect hurdles in its path and using the robot to determine a new path. Unmanned land vehicles are based on two main robotic technologies that are combined and efficiently built. The first is a remote-controlled DRDO Daksh robot that safely detects and destroys dangerous objects. This is achieved through the use of LEDs and an X-ray machine that detects metal. It is also used to destroy explosives by climbing stairs or scanning vehicles. Next is the Fostermiller TALON, it is a water, sand, and tree-climbing robot. All of these features are added along with the control function to create a more efficient multifunctional robot with path planning and obstacle detection capabilities. If this all works out as per the plan, the world will be able to witness a new era of robots and robotic defense systems working to improve society and the world around us. Robots have always helped humans solve many problems easily. Robots are build to work effectively in any environment. It can be used in time-limited environments and in the real world, where sensors and reflectors have special hardness properties. In many situations, a robot is manually controlled to move from one place to another. However, a lot of research is currently being done on these autonomous robots and there are many promising applications of these autonomous robots. An unmanned ground vehicle (UGV) is a vehicle that touches the ground and operates without a human on board. This type of vehicle is remote controlled. At the same time, UGV (Unmanned Ground Vehicle) is a type of vehicle that effectively senses the environment and moves from one target to another without human mediation.

WORKING PRINCIPLE



Wheels are coupled to the DC motors and fixed to the frame with the help of Clamps. Esp32 Camera Module is fixed with Micro Servo Motors and is Connected to Aurdino UNO. Proximity Sensor is connected to Aurdino UNO. DC motors and Micro Servo Motors are connected to the L293D Motor Driver which is attached with Aurdino UNO. Program is inputted in the Aurdino to control the Vehicle and its components as per our requirement. Output from the Aurdino is analysed by L293D driver resulting in working of the DC and servo Motors. When input is given DC motors and servo motors works resulting in movement of Vehicle and Esp32 Camera respectively. When Proximity sensor detects a metal in its range it gives the coordinates of the location to our device with the help of GSM module attached to it.

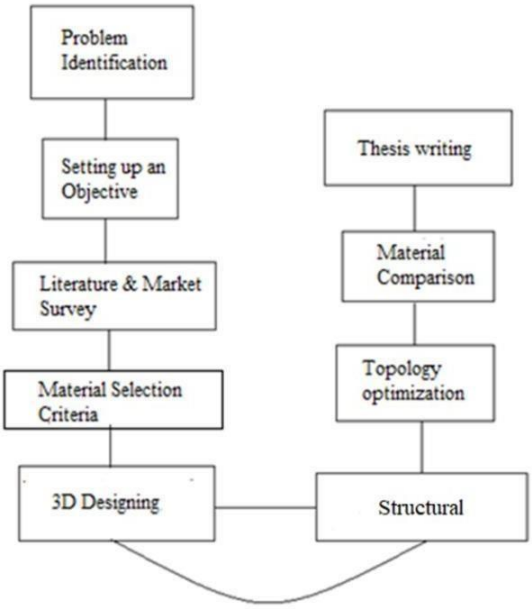
2. PROBLEM STATEMENT

In wars or other military applications conventionally, humans are required to do various hazardous operations like as handling explosives, patrolling enemy lines, surveillance, reconnaissance, and target acquisition. These tasks contribute majorly to fatalities. Thus, an UGV is built to replace humans in dangerous situations.

3. OBJECTIVE

- To study the IEEE journal papers to continue with the project like knowing the components and controller's capacity range and limitation of it.
- To predict the parameters and sizes required to complete the project work. Like assuming lengths calculating bending moment's pneumatic pressure etc.
- To design unmanned ground vehicle using CATIA V5 tool.
- To make market research for purchasing of components.
- To create the required working of vehicle by coding it using controller.
- To fabricate the designed work to test & observe the working

4. METHODOLOGY



The methodology followed during the course of this research work has consisted of the following phases:

PHASE 1:

Work was started with a literature Survey. Search of Research Papers from various articles and Published Journal Papers was conducted. Topic Related Data from the research papers was studied in detailed manner along with standard reference books and academic books. Different Mechanisms were studied which were found to be useful for our project. A Rough 2D sketch of the model was proposed. Final Analysis and Material Selection was done and cost required for the machining and components was estimated.

PHASE 2:

Specifications of all the components were noted and all the necessary Calculations for Failure Analysis were carried out. A 3D model of the UGV was designed using CATIA v5 software. Components required were purchased from the market and Operations were performed. Manufacturing and Assembly was completed. Last stage was Coding which was executed and a working prototype was developed.

5. COMPONENTS USED

Camera Module:

The ESP32 CAM Wi-Fi Module with OV2640 Camera is used for spying. It is a very competitive small size camera module that can operate independently as a minimum system and is widely used in various IoT applications.

Metal Detection Sensor:

NPN Inductive Proximity Sensor development CATIA can be beneficial to OEMs and RM18 DC6-36V (Unshielded) is used to detect a metal object. The detecting distance of the sensor is 8mm. The sensor has 3 wire and NO (Normally open) type output with RED LED indicator.

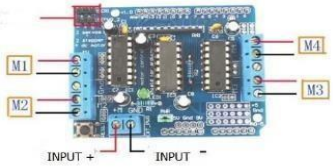
Servo Motor:

Micro Servo Motors are used to control the rotation of Camera module in 360-degree horizontal axis and 180 degrees in vertical axis

Aurdino:

Arduino is an open-source hardware platform consisting of a microcontroller which reads the Input and turn it into an output

Motor Driver:



L293D Motor Driver IC is a small current amplifier which is used to control the set of two DC motors simultaneously in any direction.

Battery:

12 Volts 1.3-amp Sealed Lead Acid Rechargeable Battery is Used to supply Power to the Vehicle. It is Maintenance, Position and Leakage Free.

DC Motors:

DC motors are used to generate the torque by converting Electrical energy into Mechanical energy. The motor transfers the torque to the wheel resulting in the movement of the vehicle.

Solar Panel:

5Wp Solar Panel with Positive Tolerance with Aluminium body is used. It can be used for recharging all 6V-12V devices & batteries. It is used to charge the battery with the abundantly available sunlight.

6. ADVANTAGES

- It is suitable in the rescue and recovery missions.
- It can travel between the way-points without the human navigation assistance.
- We can send it to examine the terrain.
- It can discover many explosives, If the bomb is found and cannot be successfully defused, UGVs can be used to detonate the explosive.

7. DISADVANTAGES

- One of the most popular errors with the remote controlled UGV is the lagging of it, and during this time the UGV is capable of moving too far to the left, leaving it to fall of the cliff, It can be detected by the enemy troops, or even be blown up by a mine.
- Bandwidth always be the problem with the wireless solutions and even some wired solutions, causing for the slow reaction time for the controller to the actual UGV, bandwidth will remain an issue because it is shared with many other UGVs.

UGVs are not a reliable as the human, many of these vehicles are stealthy vehicles that are not capable of detecting where the enemy soldiers are, and even developing the detailed description of the enemy household and the autonomous robots still require regular maintenance as all machines.

8. DESIGN AND SPECIFICATION

1. Design of Support

Area of rectangular

We had taken a teak wood frame which is available in the market of thickness 4 mm and length, width according to requirement.

Thickness = 4 MM

W = 200 MM

L = 250 MM

The total surface area of the rectangular prism is given by:

A = 2(l b+ b h+ l h)

=2((250* 200) + (200 * 4) + (250 * 4))

=103600mm^2

Mass = 0.127Kg=0.127 * 9.81 =1.24587 N

From CATIA V5 software

@Area = 103600mm^2

Moment of Inertia ICM

= 1 /12 x M (w^2 x l^2)

= 1 /12 x 1.245 (200^2 x 250^2)

= 10634.375Nmm^2

Force = Total load from CATIA

= 2.827 x 9.81

= 27.73 N

Solar panel + Columns =2.5 kg = 24.525N

Total weight = 28 + 25 = 53 N

FOS = 1.5 = 53 x 1.5 = 79.5N = 80 N

Perpendicular Distance = 250/2 = 125mm

M = 80 x 125 = 5625 N mm^2

M = 10000 Nmm^2

I = 10634.375 mm^2

Y = Distance of the layer at which the bending stress is consider = 4/2 = 2 mm

Sigma b = M x Y / (I)

= 10000 x 2 / (10634.375)

= 1.88N/mm^2

Wood Plywood 13.8 Ultimate Yield Strength

Hence Design is Safe.

Moto selection on total pay load of component Selection Motor

Total weight on the frame = 50 N + 2 Litres Water

= 70 N + 19.62 N = 90 N

= 100N

No. of wheels 4

Load is distributed into 4 wheels

Actual load = total load / no. of wheels

= 100 / 4 = 25 N

Diameter of inside hole of a wheel 100 mm

Torque = ½ Force x Diameter

= ½ x 25 x 10 mm

= 125 N mm = 0.125 Nm

Diameter = Diameter of wheel (d = 70 mm) standard available in market, internal diameter (d =10 mm)

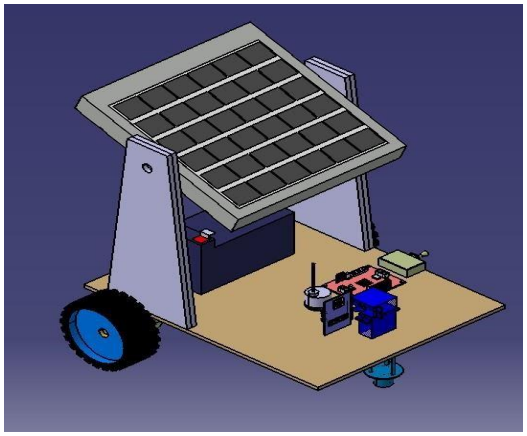
Force = total force including all components (25) at each wheel

SELECTION OF SERVO MOTOR

- Tower Pro SG90 Servo - 9 gms Mini/Micro Servo Motor
- This micro servo motors are used to control the rotation of camera module in 360-degree horizontal axis & 180 degree in vertical axis.
- Torque = ½ X Force X Diameter
- Weight of camera = 40 grams
- Force = 0.04 kg x 9.81 = 0.3924 N
- Diameter of shaft = 2mm
  = ½ x 0.3924 x 2mm
- Required torque = 0.3924 Nmm^2

9. DESIGN

CATIA V5 software is used for creating a 3-D design of our prototype.



Several countries are significantly spending on the R&D of unmanned ground systems to overcome the challenges that are associated with such systems.
Reliability of the systems and the need for improvement in the power supply to UGVs are
some of the prominent challenges for the manufacturers of UGVs.

10. FUTURE SCOPE

The market for the unmanned ground vehicle is anticipated to register a CAGR of over 8% during the forecast period.

There is a growing use of UGVs to carry counterinsurgency and combat operations. This is primarily to reduce human casualties in such situations. Increasing demand for UGVs for ISR missions. Demand for UGVs is also increasing for commercial applications, such as in the oil and gas sector, firefighting, and agriculture.

11. CONCLUSION

The design and fabrication of the Unmanned Ground Vehicle was successful completed. The Prototype was thoroughly tested with different codes to operate in a straightforward way. The issue of Power requirement was successfully dealt with an addition of Solar Panel. The Model was tested to collect the data, detect the metal objects and discover the coordinates form the surrounding.

12. REFERENCES

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