Self Controlled Robot for Military Purpose

Mr. Umakant R .Gaulkar Miss. Shivani A. shirbhate Prof. P. G. Kaushik Prof. S. A. Mishra

***Abstract* — Even though there are many command controlled robots, there is a rise for self-controlled robot especially for military purposes which is generally called as "Unmanned Ground Vehicle (UGV)". These robots are used to augment the soldiers' capability in an open terrain. In the last decade, enormous efforts are put in developing robots for war fields and extensive research is carried out in various parts of the world. This motivation helped us to build a prototype self-controlled robot (called as UGV) to undertake missions like border patrol, surveillance and in active combat both as a standalone unit (automatic) as well as in coordination with human soldiers (manual). Similarly, command controlled mode, we use another specific mode called, self-control mode or automatic mode. In this mode, UGV has maneuvered automatically and it capable of traveling from one point to another point without human navigation commands. It uses GPS, magnetic compass and adjusts strategies based on surroundings using path planning and obstacle detection algorithms. The complete setup and working of the self-controlled mode UGV is discussed in the paper.**

I. INTRODUCTION

Nowadays the use of military robots for the various purpose has increased tremendously. Due to increase in its demand, it has created opportunities to develop efficient robots. The need for self-controlled robots is due to the terrorism and insurgency problems faced by the people and soldiers. Huge investments are made by nations for the research of new defense systems which are capable of safeguarding citizens from terrorist threats; one such is an unmanned ground vehicle (UGV). This has led to the development of prototype self-controlled unmanned ground vehicle (UGV) to undertake missions like border patrol, surveillance and in active combat both as a standalone unit (automatic) as well as in coordination with human soldiers (manual).

To make it clear, a vehicle that operates on ground remotely with or without human presence for giving navigation commands and decision making is called as an unmanned ground vehicle (UGV). In this paper, it is considered self-decision making and self-navigation (autonomous mode) UGV based on GPS coordinates, magnetic compass, path planning and obstacle detection algorithms. One of the motivations for this paper is the Foster-Miller TALON robot and DRDO Daksh robot and Foster-Miller TALON robot is a small military robot designed for missions that can travel through sand, water as well as climb stairs. Different types of TALON robots are regular TALON, Special Operations TALON (SOTAL), SWORDS TALON and HAZMAT TALON. On the other hand, Daksh is a remote controlled robot used in locating and destroying hazardous objects safely. It is powered electrically by a battery. The primary role is to recover improvised explosive devices (IEDs). It has an X-ray machine to locate IEDs, it has a shotgun to open locked doors, and it can scan cars for explosives. Daksh can also climb stair cases, negotiate steep slopes and navigate through narrow corridors.

So, Foster-Miller TALON robot and DRDO Daksh motivated us to develop self-control mode unmanned ground vehicle for military purposes. Our aim is to develop prototype UGV to undertake missions like border patrolling and surveillance on its own (automatically and self-control). So, in this paper, I explain the setup and design of the unmanned ground vehicle which will be controlled by it using GPS, magnetic compass, path planning, and obstacle detection algorithms.

II. SELF CONTROL MODE

The aim of this mode is to enable autonomous functioning of the unmanned ground vehicle without human supervision. To accomplish this operation navigation technology such as GPS, the magnetic compass is used to provide the onboard system enough data to operate as a self-navigated system. Other technologies like Infra-red sensors are used in our prototype to provide functional obstacle avoiding capabilities which augment the autonomous operation.

The main tasks of the self-control mode are:

UGV is capable of traveling from point A to point B without human navigation commands. Adjust strategies based on surroundings using path planning and obstacle detection algorithms. For these tasks to be performed, both path planning and obstacle detection algorithms need to be designed carefully.

The block diagram of command control mode for operating an unmanned ground vehicle is shown in the figure below. The role of each block in the diagram are explained in detail

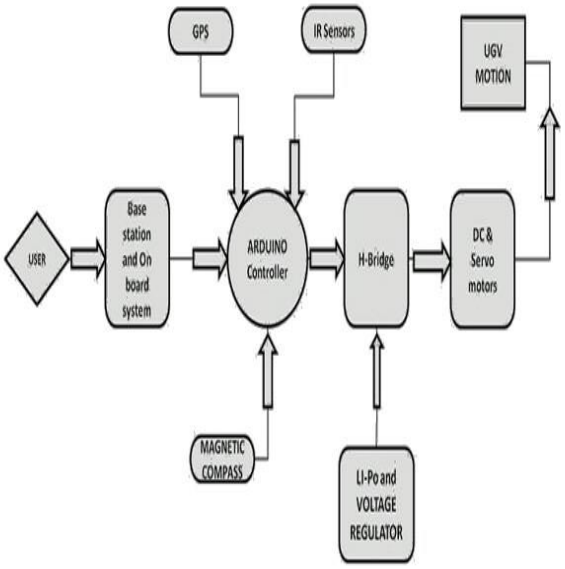

Fig. 1. Block diagram for the self-control mode.

III. BLOCK DIAGRAM EXPLANATION:

Base station: It's a computer system located at a remote place away from the UGV which controls it using the keyboard, mouse for mode control, movement & live video feedback for monitoring the environment.

4G Internet: It's communication medium for the system to system interaction so it is used to control the UGV wirelessly.

Onboard system: A computer system placed on the UGV which receives the commands and send it to the control Unit.

Camera: An image capturing device which provides the video required for UGV vision.

Control Unit: It's the Arduino microcontroller which sreceives signals from the user and other sensors and performs tasks such as UGV movement.

GPS Unit: A navigation system used for obtaining location.

Compass: To acquire the direction to which the UGV is facing.

IR sensors: Infrared Sensors used in the obstacle avoidance mechanism incorporated into the autonomous mode.

Servo motor: It is used to control the direction turn of the UGV and the 2 axis movement of the turret.
DC motor: It is used mainly for the UGV movement. Li-PO Battery and voltage regulator: It is used to provide the power source supplying the entire UGV with voltage regulation to provide optimum power ratings.

Wireless modem: Zig-Bee to provide wireless data transfer for the arm con mode.

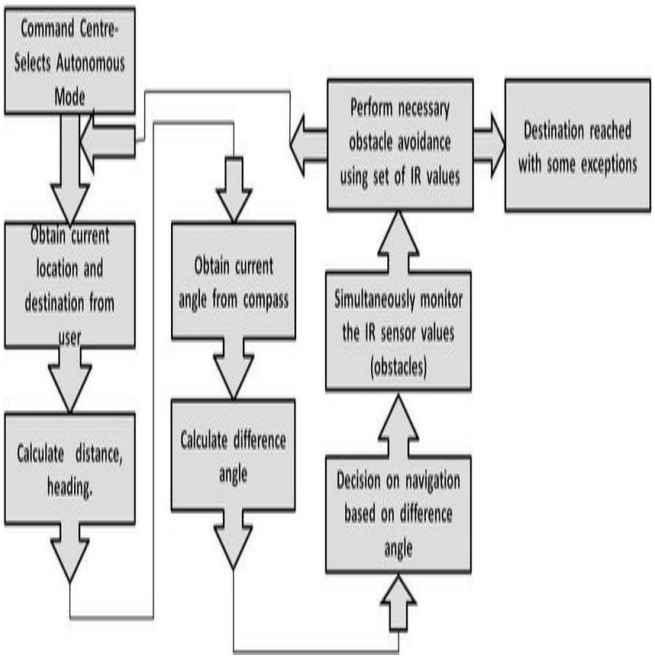

Fig 2. Flow chart for the self-control mode.

Arduino microcontroller
Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.
H-Bridge
It allows DC motor to drive in any direction.
It converts DC-DC, DC-AC, AC-AC.
FTDI chip
It is USB to serial converter chip which allow arduino to communicate with computer through USB port.

IV. Algorithm Design For Self-Control Mode

The algorithm design for self-control mode is easy and straight forward. We considered two important algorithms:
Path planning and obstacle detection algorithms for the UGV to navigate automatically. First, a user obtains the current GPS coordinates and the heading reading from the compass for the UGV. Then the destination coordinates are acquired from the user. Angles are calculated by which the UGV orients with the desired direction using simple trigonometric functions. The calculated angle provides the UGV movement control signals. The UGV navigates itself to the desired location based on the IR sensors values which are obtained with respect to the obstacles. Path planning algorithms are used to decide the path. Obstacle avoiding algorithm is also included, which makes sure, the unmanned ground vehicle avoids obstacles while doing a task at hand in the most efficient manner based on the IR sensors values which are obtained with respect to the obstacles. At the base station, a user obtains the GPS coordinates continuously from the UGV. Destination coordinates are given by the user. Based on the path planning and obstacle detection algorithm, UGV navigates automatically. The obstacle detection algorithm work based are given in below tables. The flow chart of self-control mode for operating unmanned ground vehicle is shown in figure 2.

Table 1. Obstacle Detection Algorithm Codes For Left Side-0

IR(L)	IR(M)	IR(R)	Operations performed
0	0	0	No obstacles
0	0	1	Left and up
0	1	0	Random [Right or left and up]
0	1	1	Left and up

Table 1. Obstacle Detection Algorithm Codes For Left Side-1.

IR(L)	IR(M)	IR(R)	Operations performed
1	0	0	Right and left
1	0	1	Up
1	1	0	Right and up
1	1	1	Random [Right or left and down]

V. Advantages

It is very easy to operate. It consumes chart for power. It is user friendly. And a single equipment is used as an multiple purpose. When extended further in the hardware section, numerous application can be added.

VI. Applications

It is use for military reconnaissance mission, wireless security & surveillance in hot spots, search and rescue operations. It is use in hazardous environment without human supervision.

VII. Conclusion and Future Works

A prototype UGV capable of being controlled automatically using GPS, magnetic compass, path planning, and obstacle planning algorithms discuss here. Similarly, command controlled mode, we used another the self-control mode called, self-control mode or automatic mode. In this mode, UGV has manoeuvred automatically and it capable of adjusting strategies based on surroundings using path planning and obstacle detection algorithms. The complete setup and working of the self-control mode UGV narrow corridors in the paper. We strongly feel, automatic robots using GPS can be maneuvered for military purposes which need to be operated outdoors. This UGV can undertake missions like border patrol, surveillance and in active combat both as a standalone unit as well as in coordination with human soldiers. Our future work is on developing arm controlled mode (gesture controlled) along with command control mode and automatic mode.

Fig. 5. Prototype Unmanned Ground Vehicle

ACKNOWLEDGMENT

Authors wish to thanks J.D.I.E.T College of Engineering and Technology, Yavatmal, Maharashtra, India. Also like to pay gratitude towards Head of Department, Electronics and telecommunications Engineering and Principal of J.D.I.E.T College of Engineering and Technology, Yavatmal, Maharashtra, India for their valuable support and encouragement

REFERENCES

1. Http://en.Wikipedia.Org/wiki/unmanned ground vehicle
2. Http://www.Army-guide.Com/eng/product1795.Html
3. Http://theasiandefence.Blogspot.Co.Uk/2009/08/bomb-disposal-robot-Daksh-for-indian.Html. S. Kumar and P. Awasthi, "navigation architecture for autonomous surveillance rover."
4. http://theasiandefence.blogspot.co.uk/2009/08/bomb-disposal-robot-Daksh-for-indian.html
5. International Journal For Technological Research In Engineering Volume 1, Issue 10, June-2014 "Self Controlled Robot For Military "
6. https://www.researchgate.net/publication/27