

Design of Advanced Computer Controlled GPS Assisted Integrated Unmanned Robotic Ground Vehicle for Defense Operation

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Abstract— The paradigm of GPS based Unmanned Robotic Ground Vehicle administered by the computer in the control room to exercise the defense operation is the lineation of the paper. The paper domain comprises of a self navigating robotic platform as a base on which the surveillance system and the remote triggered for a weapon are fitted. The microcontroller acts as a prime controlling element for the custom built vehicle. The GPS receiver has been interfaced with the vehicle which is capable of receiving information from the GPS satellites and finding out the location of the vehicle in terms of Latitude and longitude coordinates, anywhere on earth. The control room can transmit targeted location information to the robot, in terms of Latitude and longitude data. Once the vehicle receives this data, the microcontroller unit compares the targeted location with the present location and autonomously moves to the desired location. The movement of vehicle is detected by the Passive IR sensor, as the movement is detected the wireless camera is tuned on. Additionally the camera is mounted on a servo pan and tilt mechanism, which moves the camera in a scanning pattern to capture all the visible details around the vehicle. The video is transmitted to a control room, if the presence on enemy is detected the mounted weapon on the vehicle is triggered based on the commands from the control room. The algorithm for the proposed robotic ground vehicle is depicted in the form of pseudo code.

Keywords— Microcontroller, GPS Receiver, PIR Sensor, Wireless Camera, Surveillance, Servo pan mechanism and Weapon system.

I. INTRODUCTION

Terrorism, the new face of nation's fate has exceeded its own state of action. It's time to uproot terrorism instead to face it and to dedicate the brave hearts to the nation. With the advent growth in the field of Robotics in today's scenario is tremendous especially in the areas of nation's security is concerned. As terrorism increasing day by day, its duty of engineer's to curb it through innovation. Since robots become more advanced and sophisticated it can be used to perform the desired tasks where men cannot be in a state to carry out his tasks. With automation and application of electronics in the field of robotics ensures safety for individuals and desired task can be achieved.

This paper aims at designing and demonstrating a prototype of one guided weapon system which drastically reduces the people physically present in the lines of fire. The objective of our work is to decimate the terror activities. In this paper, the methodology adopted to achieve our objective is to build a self powered vehicle with self navigating design; sensing obstacle in the navigation path of the vehicle; to turn ON the wireless camera once the vehicle movement is detected; to transmit the real time video signals to control room and to trigger the weapon if necessary.

II. BACKGROUND

The assault, which drew far-flung execration across the world, commenced on 26th November 2008 and lasted until 29 November, killing at least 173 people and contusing at least 308. The Leopold Cafe, the well-known eatery on Colaba Causeway in South Mumbai, was one of the first places to be assailed. Two aggressors opened fired on the cafe on 26 November night, killing at least 10 people. At least 166 victims and 9 assaulters were killed in the attacks. Among the dead were 28 foreign nationals from 10 countries. It could have been avoided if any robotic force is used instead of the brave martyrs who lost their lives. The occurrence of terrorism serves as a background for the paper.

III. RELATED WORK

The SWORDS robots are used by the US military forces is designed to work in remote locations and is capable of overcoming most of the obstacles, but is quite slow [1]. Security, Robustness and range of the communication link between the remote base station and the vehicle, obstacle avoidance and the real time control of the vehicle are some of the major issues encountered while deploying autonomous vehicles. Smart controlled robotic vehicles like like QinetiQ's MAARS are armed with weapons to shoot insurgents; appendages to disarm bombs and surveillance equipment to search buildings with human intervene.

IV. DESIGN CONSIDERATIONS

The development of Unmanned Robotic Ground Vehicle was divided into three phrases. In first phrase, the vehicle module was instrumented. In second phrase, the computer control module was instrumented. In third phrase, a display unit is set up in the control room.

In the vehicle module section, the microcontroller PIC16F877A is the heart of the entire design. It,s features includes 10-bit, up to 8 channel Analog-to-Digital Converter (A/D); Two analog comparators; Compare is 16-bit, max. Resolution is 200 ns; Synchronous Serial Port (SSP) and Wide operating voltage range (2.0V to 5.5V). The GPS Receiver GMO-101 features include Full implementation of ultra-high performance SiRFstarIII single chip architecture. High tracking sensitivity of -159dBm; Low power consumption of 45mA at full tracking (for USB interface);Small size of 36 (W) x 42 (L) x 15 (H) (mm) with patch antenna of 25x25x4mm.;Built-in backup battery for hot/warm starts and better performance; Firmware upgradeable for future potential performance enhancements and Flexible connector interface and cable length. The PIR sensor features includes Detection range up to 20 feet away; Single bit output; Jumper selects single or continuous trigger output mode; 3-pin SIP header ready for breadboard or through hole project; Small size makes it easy to conceal; Compatible with BASIC Stamp, Propeller, and many other microcontrollers

The computer control module circuit diagram is shown below. The AC source is used, which is fed to the transformer. From the transformer the AC voltage is fed to a rectifier circuit consisting of one or more diodes. The rectifier converts AC voltage to DC voltage. This DC is not steady as from a battery. The regulator circuit is used to give out a very steady voltage. The MAX232 is used which is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. To interface the hardware module to the computer, the RS232 port on the computer is used. The XBee transceiver with the following specifications is used, Indoor/Urban: up to 100' (30 m); Outdoor line-of-sight: up to 300' (100 m); Transmit Power: 1 mW (0 dBm); Receiver Sensitivity: -92 dBm; TX Current: 45 mA (@3.3 V); RX Current: 50 mA (@3.3 V); Power-down Current: < 10 µA.

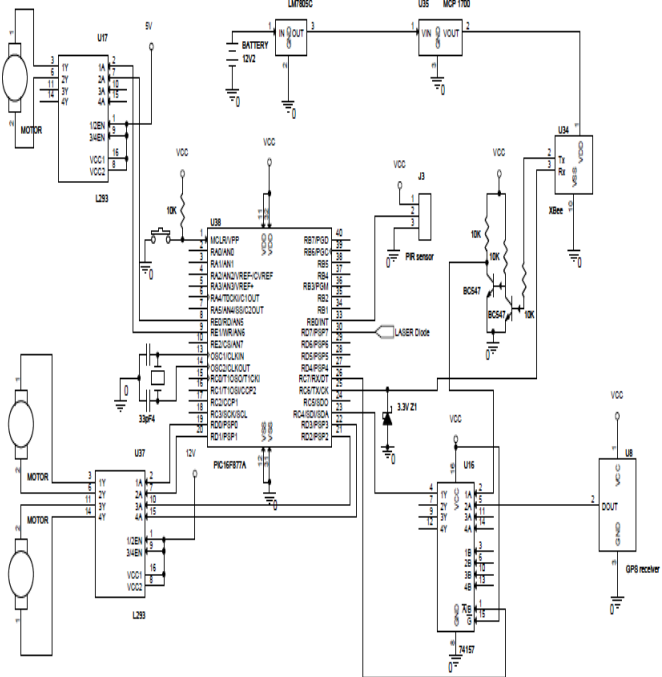


Fig. 1 Circuitry of Robotic Vehicle Module

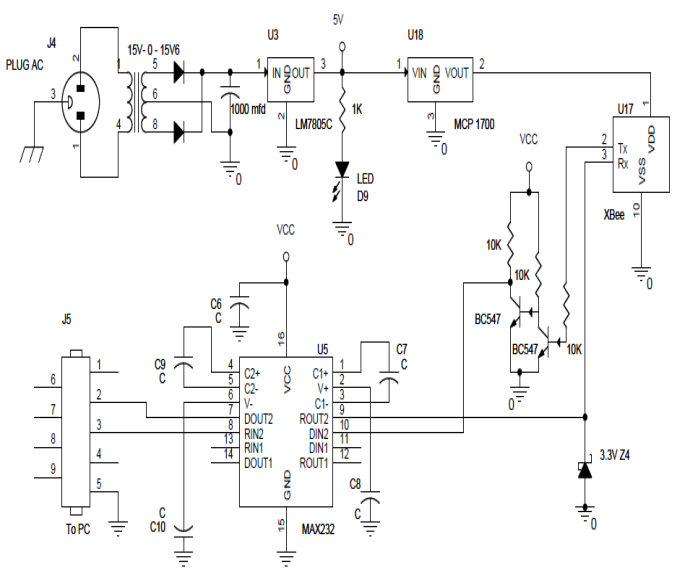


Fig. 2 Circuitry of Computer control module

From the wireless camera mounted on the vehicle, the video signals are transmitted to the control room. The video signals are received by the receiver in control room and displayed. The display devices can be television or projectors to monitor the situation.

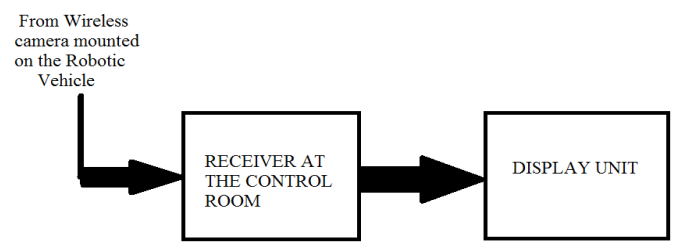


Fig. 3 Block Diagram of Display unit section

V. SYSTEM DESCRIPTION

The commands for the action on the robotic vehicle to be performed are sent only from the control room. The control room module has a XBee transceiver which transmits the command window input to the vehicle. The command window is programmed by means of using Visual Basic 6.0 software.

As the vehicle power supply is turned on the GPS location of the vehicle is shown in command window in terms of Latitude and Longitude. The command window is programmed in a way to show the GPS location of the vehicle even while navigation. The latitude can be incremented or decremented by clicking on the respective icons on the command window. Similarly, the longitude can also be incremented or decremented by clicking on the icons on the command window for the respective navigation of the vehicle. As the desired location of the vehicle is reached, the message DESTINATION REACHED is popped up on the command window. If any kind of obstacle or intruder is been detected the vehicle intimates the control room with message OBSTACLE DETECTED with the location of obstacle in terms of latitude and longitude. Two icons are provided on the command window to rotate the camera clockwise and anti clockwise. An icon FIRE ON is provided to trigger the weapon if necessary. A receiver is kept on the control room to receive the video signals which is been transmitted from the wireless camera mounted on the vehicle. The receiver is connected to a display unit to view the real time video captured by the vehicle camera.

The IR LED proximity sensor is used in the system for the detection obstacle on the path of navigation. The Infrared proximity sensors work by sending out a beam of IR light, and then computing the distance to any nearby objects from characteristics of the returned (reflected) signal which is received by another IR LED. The XBee transceiver is placed on the vehicle which receives all the commands given from the control room. The heart of this vehicle is microcontroller PIC16F877A. Two microcontrollers, IC2 is first microcontroller which acts as master controller which decodes all the commands received from the transmitter and give commands to slave microcontroller1 IC3 and slave2 IC5. Slave2 microcontroller controls the gun and camera movements in up/down, left or right direction. IC6 is driver IC which drives gun and camera motors in two angles. Slave microcontrollers are responsible for executing all the commands received from the master and also generating pulse width modulation pulses for the speed control.

The wireless camera is tuned on once the movement of the vehicle is detected. Wireless camera transmits a video and audio signal to a wireless receiver through a radio band. The images are continuously sent to the receiver display at the

control room. The barrels are mounted on the vehicle which provides the passage for the bullets when fired, the storage of bullets will me in a chamber placed inside the vehicle. The barrel turret is capable to rotate its angle by an angle of 180 degrees. As the terrorists are being viewed on the receiver station display as the wireless camera transmits the digital signal the barrels will start to fire based on the commands from the server station.

VI. ALGORITHM FOR THE PROPOSED SYSTEM

STEP 01 : Start

STEP 02 : Latitude and Longitude data of the vehicle is transmitted to control room to indicate present location of vehicle.

STEP 03 : PIR sensor checks the vehicle movement.

STEP 04 : If the movement is detected, Turn ON the wireless camera.

STEP 05 : Transmit the real-time video signals to control room.

STEP 06 : Navigate the vehicle towards the desired location.

STEP 07 : Location of the vehicle is updated while navigation.

STEP 08 : Check for obstacle in the path of vehicle.

STEP 09 : If obstacle detected intimate the control room and take alternative path else navigate in the prescribed path.

STEP 10 : Intimate the control room when the vehicle reached the target location..

STEP 11 : If desired send commands to fire up using barrel turrets.

VII. EXPERIMENTAL RESULTS

The program for the control room operations has been carried out using Visual Baisc 6.0 software. The visual programming aims at providing the user with an interface that is intuitive and easy to use. In developing such an interface, the programmer employs user-friendly features. The window shown below represents the program code for control room operations.

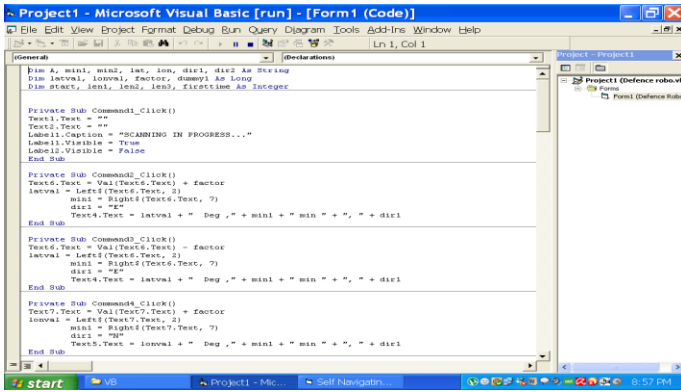


Fig. 4 Screenshot of Program code for control room operations

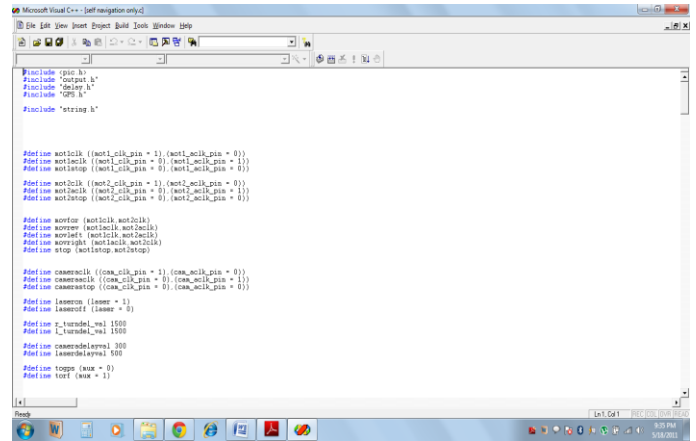


Fig. 6 Screenshot of Microsoft Visual C++ program

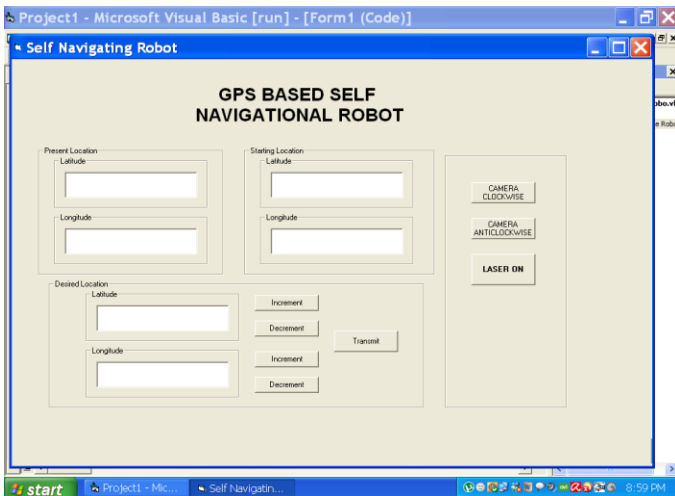


Fig. 5 Screenshot of Command window at control room

The control room command window screenshot is shown above. The present location, desired location and the starting location of the vehicle are shown in the control room command window in terms of latitude and longitude (GPS Locations). The desired location can be allocated by increasing or decreasing the latitude and longitude. The transmit tab is used to transfer the desired location to the robotic vehicle. Once the vehicle reaches the desired location, a message indicating DESTINATION REACHED will be popped up on the command window. If an obstacle is detected, a message OBSTACLE DETECTED will appear on the screen. To move the camera 360 degrees, respective tabs are used. In order to trigger the weapon LASER ON is used. In this vehicle prototype, a laser source is used instead of real time weapon system.

The microcontroller coding have been carried out using Microsoft Visual C++ Software. The screenshot of the coding window is shown below.

The computer in the control room is interfaced to the hardware module in the control room by means of using the USB Port. The XBee transmitter present in the control room module establishes a communication link between the robotic vehicle and the control room. The real time videos are transmitted to the control room by the wireless camera placed on the vehicle. A receiver is used in the control room to capture the signals which can be viewed on the display unit.

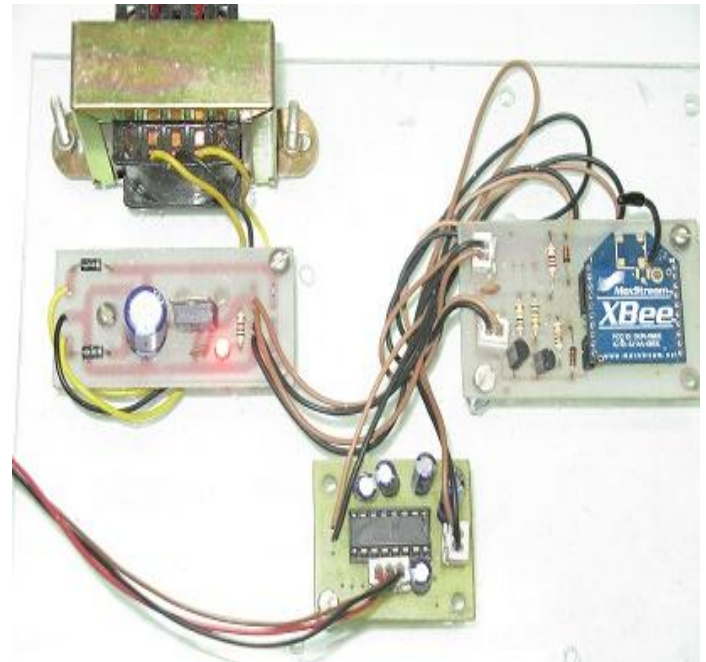


Fig. 7 Control room Transmitter module



Fig. 8 Video receiver unit at control room

Experiments on the robotic vehicle are carried out inside a building. The results of the experiments are as desired. The view of unmanned robotic ground vehicle is shown below.



Fig. 9 Front view of Robotic Vehicle prototype

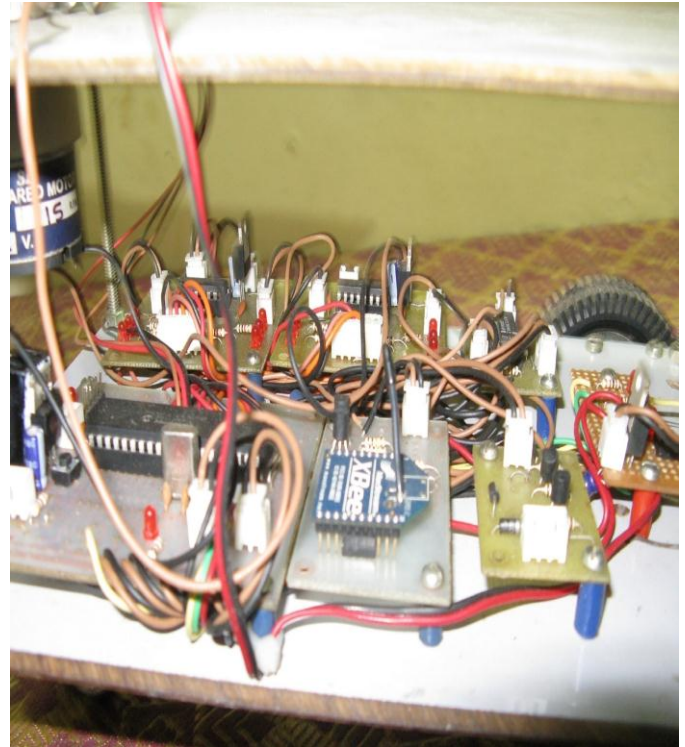


Fig. 10 View of Internal circuitry of the prototype

VIII. FUTURE WORK

The purported system presents the versatile autonomous robotic ground vehicle with reconnaissance action. The vehicle is observed to be capable of navigating over rough terrain and the triggering action holds good. The potential scope to incorporate features with the present design of the vehicle encompasses methods like rapid hazard avoidance maneuver when operation of the vehicle is in the rough changing terrain to alter the speed in various situations, optical dynamic detection method for detecting the buried bomb materials around the vehicle environment and to mount a robotized arm on the vehicle to lift the suspicious object, thereby scanning it using portable x-ray device. The additional features to be incorporated with the present construction of the vehicle are highly promising.

IX. CONCLUSION

In this paper, the design and implementation of unmanned robotic ground vehicle has been depicted in detail and a minimum realization able to realistically demonstrate capability potential with the given mission is represented. The paper delivers an entirely novel technique for nullifying the terror activities inside the buildings. Furthermore, the proposed system has the capability of revolutionizing design of next generation defence weapon system. The test tasks were very much pertained to surveillance and tactical reconnaissance was satisfactory. The salient part of the whole

system includes system integration and information flow between the control room and the robotic vehicle. The system level enables the task oriented operations that combines the autonomous motion of the robotic vehicle and task execution capabilities. The designed vehicle has the potentialities to uproot terrorism instead of facing it and it is dedicated to save brave hearts to the nation.

REFERENCES

- [1] Jones K, "Special Weapons Observation Remote recon Direct Action System (SWORDS)", In proceedings of AVT-SCI Joint Symposium, Neuilly-sur-Seine, France, pp 36-1 – 36-8, Nov 2007.
- [2] Abhinav Kumar Singh, Nilaya Mitash Shanker and Anand Prakash Yadav, "RF Controlled Terrorist fighting robot" International Journal of Computer Science & Communication Vol. 1, No. 1, January-June 2010, pp. 109-112.
- [3] T.Iwamoto, H.Yamamoto, "Mechanical Design of Variable Configuration Tracked Vehicle," J. of Mechanical Design, 112, 289-294, 1990.
- [4] Amalia F. Foka and Panos E. Trahanias, "Predictive Autonomous Robot Navigation", Proceedings of 2002 IEEE/RSJ International conference on intelligent robots and systems EPFL, Laussane, Switzerland, October 2002.
- [5] Coombs, D., et al., 2000: Driving autonomously off-road up to 35 km/h. Proc. of the IEEE Intelligent Vehicle Symposium, 186-191