SIMPLE DESIGN AND CONTROL OF UNMANNED GROUND VEHICLE VIA ARDUINO AND ANDROID APPLICATION

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Abstract

This paper presents the design and implementation of unmanned ground vehicle (UGV) using a simple approach. An unmanned ground vehicle is an automobile without any onboard human presence. It is remotely controlled by an operator. It can be used in scenarios where the presence of human operator is inconvenient and dangerous. It is an Arduino and Android application based controlled vehicle. Bluetooth module (HC-06) provides the communication between the vehicle components and Android application. The motion of the vehicle is based on two DC gear motors that are connected to the rear wheels of the vehicle. The vehicle is equipped with the video camera (V380S) and a gun to provide live video stream to the operator and to fire in lethal situations respectively. The developed vehicle shows the possible usage of such prototype in security and military applications.

Keywords: *Arduino; Bluetooth Module (HC-06); Camera (V380S); Unmanned Ground Vehicle; Design and Control*

Research Highlights

- Presents the design and implementation of unmanned ground vehicle (UGV)
- UGV can be used in scenarios where the presence of human operator is inconvenient and dangerous
- Developed vehicle shows the possible usage of such prototype in security and military applications

Graphical Abstract

Research Objectives

An Unmanned Ground Vehicle (UGV) is an automobile without any onboard human presence (1). The main objective of this work is to develop a vehicle using simple approach for security applications where on board human presence may be inconvenient and unreliable. Android applications are very simple and popular for controlling robots (2) (3). This vehicle could be controlled via gadgets used in daily life e.g Android smart phones. The previous work on UGVs shows a complex architecture and communication system that is difficult to control (4) (5). Since the UGV is an automobile without any onboard human presence, this research presents a teleoperated vehicle that can be used to facilitate the humans in dangerous and inconvenient situations.

Methodology

It is an Arduino based electro-mechanical vehicle which is controlled and guided by an android smart phone using the Bluetooth feature. There are two major control requirements of the vehicle, first is control of the driving system and second is control of the shooting system. Both the controls are accomplished by Android application. Android application is connected to Arduino via Bluetooth module HC-06. HC-06 receives command from Android application and sends it to Arduino. There is a slider on the application to control the movement of camera and gun. The movement of camera and gun is synchronized with each other. Both of them receive same command from Arduino. A layout of Android application is shown in Figure 1.

Figure 1: Application Preview

There is separate application to view live situation that camera is capturing. Camera has its own Wi-Fi system that can only be used by its application. Through this Wi-Fi system, user can view the live stream of the situation. The circuit implementation is shown in Figure 2.

Figure 2: Circuit diagram of overall control system

Results

An unmanned ground vehicle has been manufactured with a simple but powerful design approach. The control of the vehicle is efficient and fast. Android application is the main gateway for controlling the working of the vehicle. Bluetooth module and Arduino are used to execute the commands from Android application. Wi-Fi communication is used to view the live situation from camera. Each component of the vehicle is tested separately. Camera, communication modules, driving of the vehicle is tested. The vehicle is fully functional and all components are working properly.

- The range of communication is around 10 meters. The reliability of communication in 10 meter distance is acceptable and reliable. The response time is found to be around 1 second that is quite good.
- The quality of the video from the camera is quite acceptable. Servo motors are found to provide proper rotation to camera and gun according to the slider command.
- The operation of DC gear motors is found to be reliable. No vibrations and jerks are observed during the operation of the vehicle.

Findings

Functional tests were carried out and the main finding was the range of operation of the vehicle. Both Bluetooth module and camera can operate upto a range of 10m which needs to be enhanced. The main purpose of this research is to realize the importance of smart living. Smart phones have become an important part of life. They can be easily integrated with security purposed vehicles. This project is an excellent demonstration for design and manufacturing of more sophisticated UGVs for different applications in the future.

Acknowledgement

The authors are thankful to the Department of Electrical Engineering, Government College University Faisalabad for providing state-of-the-art laboratories to carry out the proposed work.

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