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ANDROID CONTROLLED SURVEILLANCE ROBOT WITH OBSTACLE DETECTION USING ARDUINO

Rahul Dogra[1], Navneet Chaurasiya[2], Saurabh Dokhale[3], Nikhil Raje[4]

[123]*Student, Computer Engineering, Pillai Hoc College of Engineering and Technology, Rasayani, Maharashtra*
[4]*Professor, Computer Engineering, Pillai Hoc College of Engineering and Technology, Rasayani, Maharashtra*

Abstract- *We propose a surveillance robot vehicle that uses the Arduino UNO microcontroller which is controlled using Android smartphones. Surveillance robots generally consist of a video camera and wireless radios which are nowadays available in all smartphones that fulfill all required specifications above. Which can be of the asset using APIs (Application Programming Interfaces) I.e provided for the Android operating system. The robot vehicle perhaps is remotely controlled by a smartphone using Bluetooth connectivity. To capture video from the robot vehicle in real-time, where the camera is inbuilt on the robot and Android Smartphones are utilized for inputs for movements of four motors that can accomplish a zero turning radius. The camera is attached to the robot vehicle itself this makes it easier to taking video of the scene or object of interest. The surveillance robot uses an ultrasonic sensor to detect any obstacle in front of the vehicle to avoid a collision. The video capturing from the robotic vehicle can be used for recordings and taking pictures.*

Key Words: **Android controlled, driver motors, ultrasonic sensor, API, real-time video**

1.INTRODUCTION

Observation of behavior, activities, or information for influencing, managing or directing purposes is called surveillance. This includes monitoring from a far distance by using closed-circuit television (CCTV) which can also be done by a robot. Video surveillance is used for the monitoring of some situations, any area or any person of interest. Such scenarios often occur in a military case where surveillance of borders and enemy territory is of the essence to the national security and gathering important intelligence. Human surveillance is appointing a military soldier near sensitive areas like enemy territories to get intelligence on constant changes. However, human beings have physical limitations and stationing in unattainable places is impossible in some cases. Even there are additional risks of a military soldier being lost in the incident of being spotted and captured by the enemy. Currently, available technology enables the possibility of remotely monitoring areas of interest by the usage of robots instead of a human being. Hence, We developed a robot is capable of real-time video surveillance that can be controlled by a user through a GUI interface from a safe distance. The robot has an inbuilt camera that will record the scenes in front of it and transmit the real-time video to the user where he will be safely watching and controlling the robot.

1.1 OBJECTIVE

The currently accessible robotic technologies like locomotive robots and self-guided vehicles like patrol robots, pathfinder robots, industrial carrying robots, etc., make human life comfortable for which they were developed. But the current analytical robots that are available have bulky hardware and controllers mounted onto them, which makes them expensive and hectic to troubleshoot. Hence, to relieve humans from such burden new methods has to be devised and better progression by making the robot lightweight.

This project deals with making a robot with a wireless mode of control and monitoring of individuals or areas with manual control techniques and building it in an optimal method that is cost-efficient and user friendly.

1.2 OVERVIEW

You can see video and take pictures from currently available surveillance and other home automated devices. But, You can also use this technology to monitor from a remote place and also control the surveillance device from your Android Smartphones. You can do this by attaching the surveillance camera on a movable robotic vehicle that is controlled from your Android Smartphone. You are still able to take pictures and watch video feeds and also record them.

2. DESIGN AND METHODOLOGY

The robotic vehicle is made using Arduino UNO, camera, Wireless Bluetooth module, DC motor, Arduino Motor Shield, HC-SR04 Ultrasonic sensor and is battery powered.

Firstly the user must install the android application "Arduino Bluetooth Controller" available on Google Play Store. After you have installed the application, make certain that Bluetooth connection is turned on the device to connect to the Wireless Bluetooth module of the robot. After connection is established from the application, the user can now select the mode of operation of the robotic vehicle. During any assignments the robots can send video to the user.

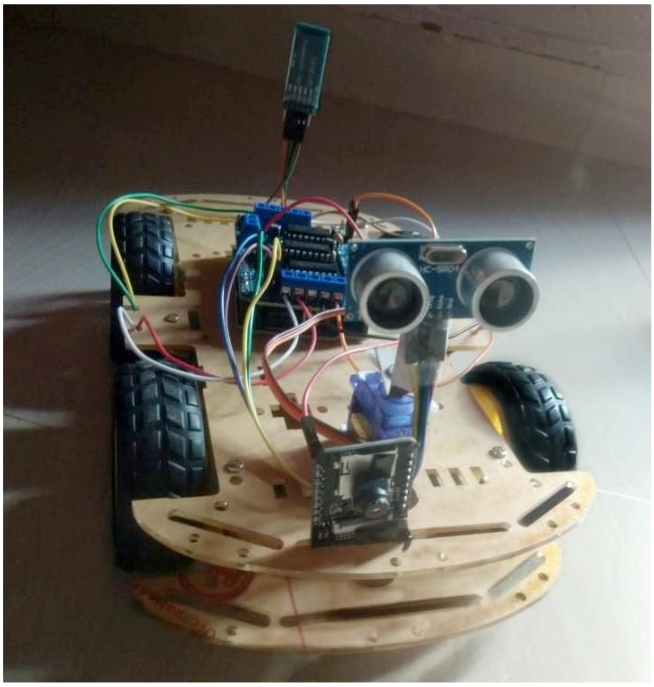
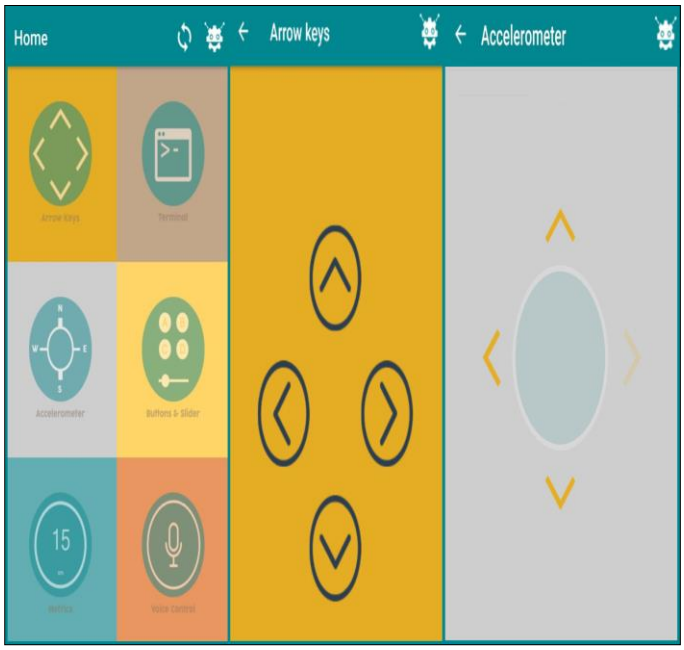


Fig -1: Robot Vehicle

The Android application transfers the input data signal's to the Arduino UNO via Bluetooth on the user's smartphone. Arduino UNO recognizes all input signals coming from the connected device which are further sent to the Arduino motor shield which sends signals that should be addressed to the drive motor. Thus, the robot vehicle moves in certain directions to the corresponding input signals received. The user is able to command the movements of the robotic vehicle such as forward and backward movement and clockwise and anti-clockwise rotations, the robot from the user's Android smartphone. The robot vehicle can detect any obstacles in front of the vehicle. If the Robot Vehicle detects that it's facing an inanimate obstacle in front then stops itself. The user all this time can see them through a surveillance camera on the robot vehicle.

3. USER INTERFACE

The user must install the Arduino Bluetooth Control App from the Google Play Store on Android device.



Bluetooth must be turned on the device to connect to the robot. After installing the application, the user must then connect to the Wireless Bluetooth Module of the robotic vehicle. User Interface of application consists of arrow buttons, terminal, accelerometer, Buttons and slider, metric and voice control.

Fig -2: Home User Interface

Figure2 shows the home screen which consists on various option to control the robotic vehicle such as the arrow keys, terminal, accelerometer, button & slider. Arrow keys bring up the arrow keys interface. Terminal brings up the terminal screen that shows all the movement of the robotic vehicle. Accelerometer is selected for the gyroscope sensor controls which is available in all current devices.

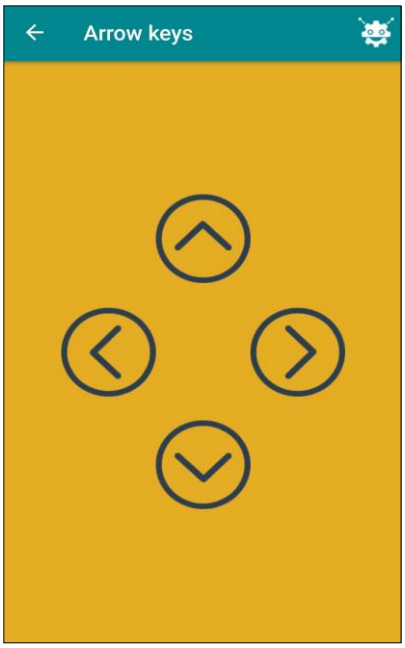


Fig -3: Arrow Keys

Figure3 shows the arrow keys interface of the android application. The Arrow button interface is for controlled movement of the surveillance robotic vehicle arrow buttons provided like forward and backward arrow buttons, anticlockwise button, and clockwise arrow buttons.

Whenever a button is clicked on the Android smartphone the input is sent via Bluetooth to the robotic vehicle then the robot moves accordingly. Forward button and backward arrow buttons are for the robot movement towards forward and backward direction respectively whereas the anti-clockwise button, and clockwise arrow buttons are for robot anti-clockwise and clockwise rotation by the user.

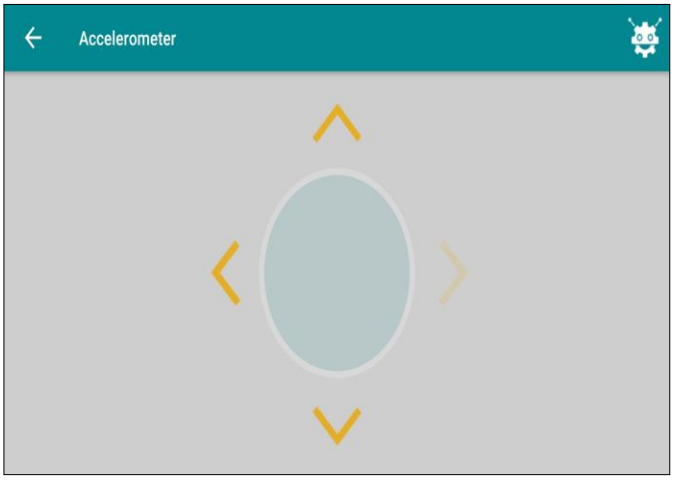


Fig -4: Accelerometer Interface

When Accelerometer is selected the user can control the robot using the gyroscope in their smartphone. When the user tilts the smartphone in front, back, left and right the robot will be moved accordingly this done using a gyroscope sensor that is available on all devices nowadays.

Table -1: Shows Robot Movement (Gyroscope)

Robot Movements Using Gyroscope	
Front Tilt : Forward	Robot moves forward
Back Tilt : Backward	Robot moves backward
Left Tilt : Left	Robot rotate anti-clockwise
Right Tilt : Right	Robot rotate clockwise

4. OBJECT DETECTION

When considering the scenarios where the robotic vehicle may collide with any obstacle which comes in front of the vehicle while moving with the accelerometer. Therefore, for the safety measures for the vehicle, we prepared a system that can detect any obstacle and prevent the vehicle from colliding with it with the help of a sensor placed in front of the vehicle. When any obstacle is detected in front by the robot, it will not move in a forward direction even if the user tilts the smartphone to the front direction because Arduino realizes that forward direction command cannot be executed since the sensor detects an obstacle in front of the robotic vehicle. Similarly, the vehicle is not able to move forward even though the user presses the up arrow button in arrow keys in the android mobile application because the sensor detects an obstacle in front of the vehicle, so the vehicle will not move until the obstacle is removed from the path.

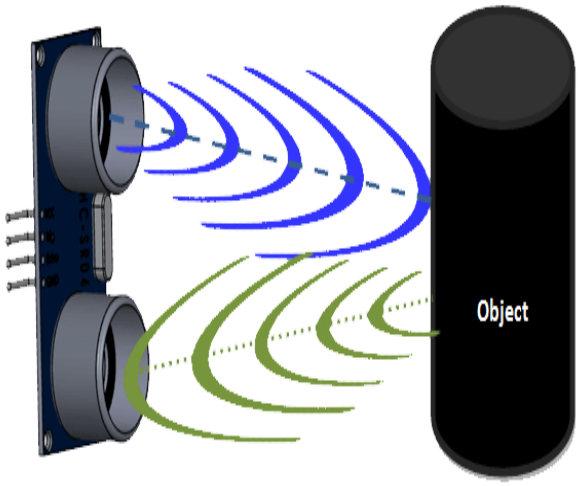


Fig -5: Ultrasonic Sensor Working

Figure5 shows the working of the HC-SR04 Ultrasonic sensor using which the Robot can automatically detect the obstacle in front of it is detected and distance between both entities. It is done by noting the time taken by ultrasonic waves transmitted from the ultrasonic sensor and receiving the echo waves after hitting any obstacle surface. Hence, the distance between an object and the robotic vehicle will be calculated using the formula.

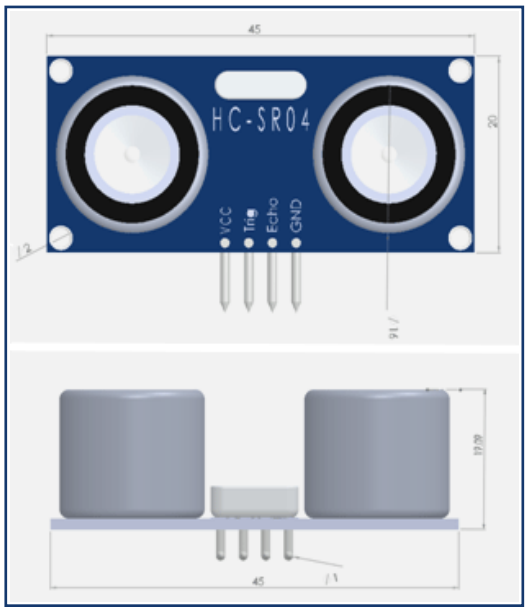


Fig -6: HC-SR04 Ultrasonic sensor

Figure6 shows the ultrasonic sensor we are using in the robotic vehicle for obstacle detection. HC-SR04 Ultrasonic sensor consists of 4 pins, with pin named Vcc, Trigger, Echo, and Ground. It consists of transmitter used for transmitting ultrasonic waves and receiver which is used for receiving the echoing ultrasonic waves.

5. HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements:
Arduino UNO, Motor Driver Shield L293D, Gear Motor TT Motor, HC-05 Wireless Bluetooth module, HC-SR04 Ultrasonic sensor, Memory Card, Camera module, Android Smartphone.
Software Requirements:
Operating System: Windows, Android Platform Arduino IDE: It is Abbreviation for Arduino integrated development environment is a software development platform which allow us to perform operation using the Arduino kits, write code, compile code and which can be loaded directly onto the Arduino UNO linked into the computer via USB port.

6. CONCLUSIONS

From the research, it can be concluded that an android smartphone can be used to perform the task of controlling the movement of the robots from one position to another position. The robot is set to be a cost-efficient alternative to many surveillance applications since it is based on android. The mobile robotic vehicle will accomplish missions such as navigating the hazardous environments safely for surveillance purposes of areas of special interest to humans which are strenuous for a human being in some special scenario.

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