Smartphone Android operated Robot using Arduino

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***Abstract*— In current era, smart phone has become the most essential thing in our daily life. This research paper describes, Android operating system based robot platform and smart phone operated control and monitoring system are introduced. Many robots have been built for manufacturing purpose and can be found in factories around the world. The design of the robot is such that it is controlled by a mobile app. This project describes how to control a robot using mobile through Bluetooth communication, some features about Bluetooth technology, components of the mobile and robot. We present a review of robots controlled by mobile phone via moving the robot upward, backward, left and right side by the android application such as Arduino, Bluetooth. Here we are using Bluetooth communication, interface microcontroller and android application. We are using Arduino software to interface the Bluetooth module with microcontroller. According to commands received from android the robot motion can be controlled another thing is used in the project, that is spy camera. This robot is capable of spying using a wireless camera. This robot can be reprogrammable and can be interchanged to provide multiple applications.**

Keywords*— *Wireless, Android, Bluetooth, Arduino, Robotic Car, spy camera

Introduction

The project aims in designing a Robot that can be operated using Android mobile phone. This paper represents android application based Bluetooth controlled robotic car[1]. The controlling of the Robot is done wirelessly through Android smart phone using the Bluetooth feature present in it. Here in the project the Android smart phone is used as a remote control for operating the Robot. Here we use Bluetooth communication to interface Arduino UNO and android. Arduino can be interfaced to the Bluetooth module though UART protocol. Bluetooth is an open standard specification for a radio frequency (RF)-based, short-range connectivity technology that promises to change the face of computing and wireless communication. It is designed to be an inexpensive, wireless networking system for all classes of portable devices, such as laptops, PDAs and mobile phones. It also will enable wireless connections for desktop computers, making connections between monitors, printers, keyboards, and the CPU cable-free. The controlling device of the whole system is a Microcontroller. Bluetooth module, DC motors are interfaced to the Microcontroller. The data received by the Bluetooth module from Android smart phone is fed as input to the controller. The controller acts accordingly on the DC motors of the Robot. The robot in the project can be made to move in all the four directions using the Android phone. The direction of the robot is indicated using LED indicators of the Robot system. According to commands received from android the robot motion can be controlled [2] This project is more necessary to the modern society in context of spying and surveillance. The controlling of the Robot is done wirelessly through Android smart phone using the Bluetooth feature present in it. Here in the project the Android smart phone is used as a remote control for operating the Robot. In smartphone an Android app is used to send data to the microcontroller that works as given instructions burned to it. Remote controlled spy robots are also available that use RF signal and works properly. In this system a camera is also used. Researchers have developed many robots in this arena of robotics Spy robots[3]. The computing power, sensing capabilities and intuitive programming interfaces of modern smartphones afford an inexpensive yet highly capable robotic platform. Smartphone based robots are becoming increasingly popular, with many exciting applications emerging in both academia and industry [4]. In achieving the task the controller is loaded with a program written using Embedded ‘C’ language. Still there exists a requirement of a cost-effective automation system, which will be easy to implement. An example of such a cost-effective project has been proposed.

I. Related Works

In this project, we will show how to implement a Bluetooth Controlled Servo Motor using Arduino. Using this project, we can control a servo motor like TowerPro SG90 or MG90S with the help of an App in an Android Smartphone over Bluetooth connection. Servo Motors are basically DC Motors with additional circuitry that aid in achieving accurate positioning of the servo motor. In order to control the rotation of the servo motor's shaft, you need a special signal called Pulse Width Modulation or PWM signal[5] .In this project, we will learn about HC-05 Bluetooth Module, how to interface this Bluetooth Module with Arduino and how the HC-05 Bluetooth Module can be used for controlling the Arduino Board over Wireless Communication[5].Bluetooth Communication is a 2.4GHz frequency based RF Communication with a range of approximately 10 meters. It is one of the most popular and most frequently used low range communications for data transfer, audio systems, hands free, computer peripherals etc. Coming to usage of Bluetooth Communication in DIY projects, HC-05 Bluetooth Module is the go to device. I have implemented several projects using HC-05 Bluetooth Module like Robotic Arm, Home Automation, LED Matrix etc[6].In this project, I'll show you how to build an Arduino & Bluetooth Controlled Robotic Arm using Android Phone. This Robotic Arm can be operated in either manual mode or can be programmable to be operated in Fully Automatic Mode. This Robotic Arm can be controlled using any Android based Smart Phone with Bluetooth. There is two modes of operation: Manual Mode and Automatic Mode. For regular or manual operation, you can control the Robotic Arm by manipulating the values of individual servo motors of the Robotic Arm.When Programming Mode is enabled, you can program your Robotic Arm for fully automatic operation. The Robotic Arm contains four Metal Gear Servos and 3D Printed Parts for the structure. In this project, we will show you how to build and develop a WiFi Controlled Robot using ESP8266 and Arduino. When I say WiFi Controlled Robot, I mean a robotic car that is controlled over a WiFi Network. This WiFi Controlled Robot is controlled with the help of an HTML Web Paged[7] .

II. PROPOSED ALGORITHM

Apart from Arduino, which is the main controlling module of the project, there are two other important modules that you have to be familiar with in order to implement the Bluetooth Controlled Robot project.

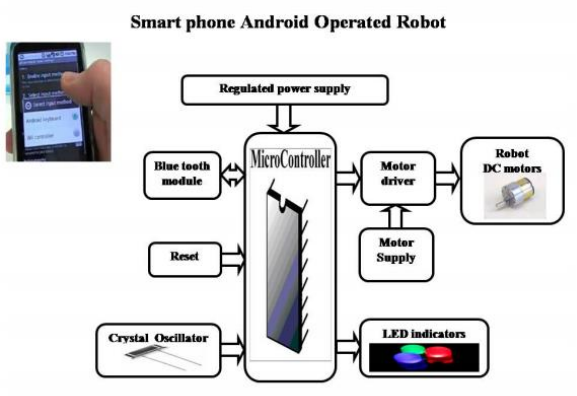

Fig.1. Block Diagram of smart phone Android Operated Robot

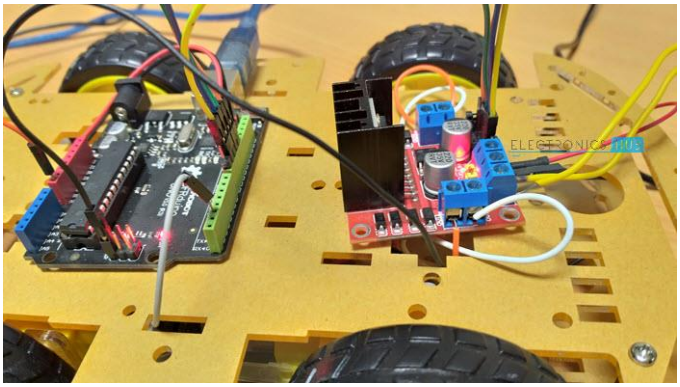

Fig.2. Circuit Diagram of smart phone Android Operated Robot

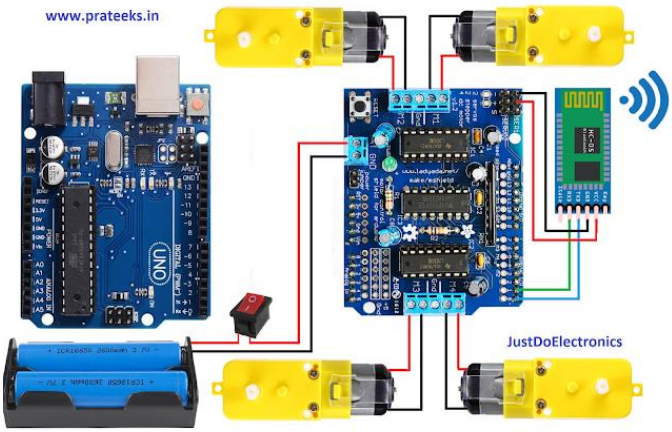

Fig.3. Circuit Diagram of Bluetooth Controlled Robot
Circuit Diagram of smart phone Android Operated Robot

Fig.4. HC-05 Bluetooth Module and the L298N Motor Driver Module of smart phone Android Operated Robot

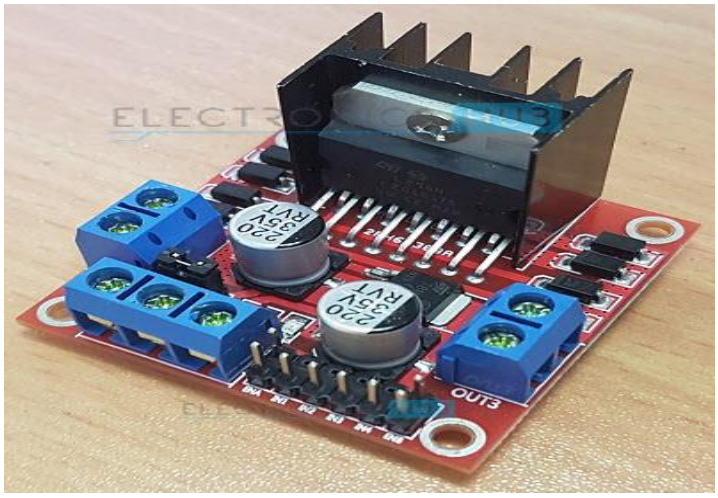

Fig.5. L298N Motor Driver Module of smart phone Android Operated Robot

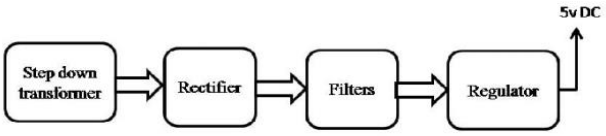

Fig.6. Regulated Power Supply of smart phone Android Operated Robot

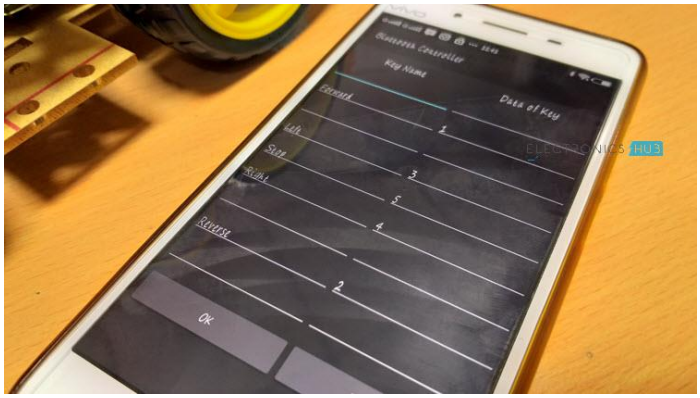

Fig.6.Android App of smart phone Android Operated

III. MY WORK

The project aims in designing a Robot that can be operated using Android mobile phone. The controlling of the Robot is done wirelessly through Android smart phone using the Bluetooth feature present in it. Here in the project the Android smart phone is used as a remote control for operating the Robot. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android boasts a healthy array of connectivity options, including Wi-Fi, Bluetooth, and wireless data over a cellular connection (for example, GPRS, EDGE (Enhanced Data rates for GSM Evolution), and 3G). Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. In addition, Android includes a full set of tools that have been built from the ground up alongside the platform providing developers with high productivity and deep insight into their applications. Bluetooth is an open standard specification for a radio frequency (RF)-based, short-range connectivity technology that promises to change the face of computing and wireless communication. It is designed to be an inexpensive, wireless networking system for all classes of portable devices, such as laptops, PDAs and mobile phones. It also will enable wireless connections for desktop computers, making connections between monitors, printers, keyboards, and the CPU cable-free. The controlling device of the whole system is a Microcontroller. Bluetooth module, DC motors are interfaced to the Microcontroller. The data received by the Bluetooth module from Android smart phone is fed as input to the controller. The controller acts accordingly on the DC motors of the Robot. The robot in the project can be made to move in all the four directions using the Android phone. The direction of the robot is indicated using LED indicators of the Robot system.

The main objectives of the project are:
1. Operating the Robot wirelessly through mobile phone.
2. Usage of Android touchscreen smart phone in performing the task.
3. Bluetooth wireless transmission.
4. Indicating Robot directions using LED indicators.
5. Using Camera see the overview

The project provides exposure to following technologies:
1. Google's Android open source technology.
2. Bluetooth wireless technology.
3. Interfacing Bluetooth module to Microcontroller.
4. DC motor working and need for a Motor driver.
5. Interfacing of Robot DC motors to

Microcontroller:
6. Embedded C programming.
7. PCB designing.
8. Camera.

IV. EXPERIMENT

The proposed smart phone controlled robot system is implemented in real mode. The controlling device of the whole system is a Microcontroller. Bluetooth module, DC motors are interfaced to the

Microcontroller. The data received by the Bluetooth module from Android smart phone is fed as input to the controller. The controller acts accordingly on the DC motors of the Robot. The robot in the project can be made to move in all the four directions using the Android phone. The direction of the robot is indicated using LED indicators of the Robot system. In achieving the task the controller is loaded with a program written using Embedded 'C' language. Assemble the robot, make the necessary connections and upload the code to Arduino. First, in the Android App, we have used 5 keys as Forward, Reverse, Left, Right and Stop. The corresponding data associated with each key is as follows:

Forward – 1
Reverse – 2
Left – 3
Right – 4
Stop – 5

When a key is pressed, the corresponding data is transmitted to the Bluetooth Module from the Phone over Bluetooth Communication.

Furthermore if distance between the robot and obstacle is less than 8 cm, the robot stops its movement. The proposed module of Smartphone controlled robot is shown below.

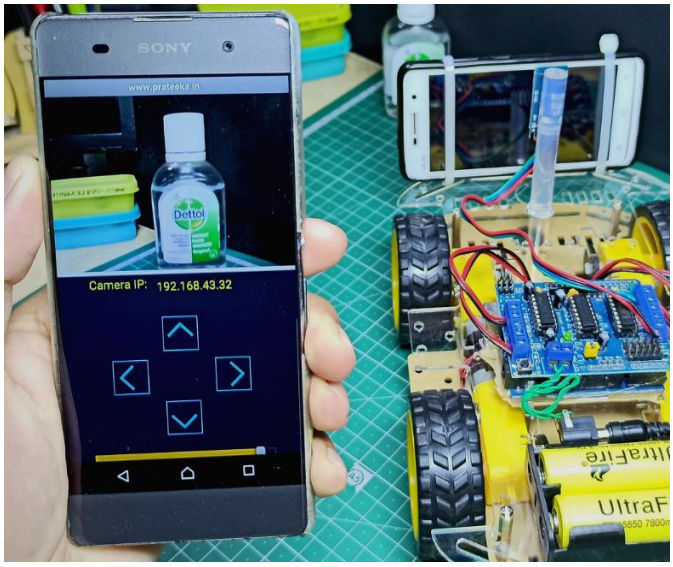

Fig.3- Smart phone Android Operated Robot

It is proved that the image taken from the robot and the control commands from the buttons on the phone are transferred to the robot, moving or stopping the robot without any technical difficulties. There was only 0.2 second time delay between the camera and phone in image delivery. This amount of time delay is almost negligible to human eyes. The other commands for robot movement were successfully implemented.

Important Source Code:

```
#include "AFMotor.h"

const int MOTOR_1 = 1;
const int MOTOR_2 = 2;
const int MOTOR_3 = 3;
const int MOTOR_4 = 4;

AF_DCMotor motor1(MOTOR_1, MOTOR12_64KHZ); // create motor object, 64KHz pwm
AF_DCMotor motor2(MOTOR_2, MOTOR12_64KHZ); // create motor object, 64KHz pwm
AF_DCMotor motor3(MOTOR_3, MOTOR12_64KHZ); // create motor object, 64KHz pwm
AF_DCMotor motor4(MOTOR_4, MOTOR12_64KHZ); // create motor object, 64KHz pwm

int state;
int Speed = 130;

void setup() {
motor1.setSpeed(Speed);    // set the motor speed to 0-255
motor2.setSpeed(Speed);
motor3.setSpeed(Speed);
motor4.setSpeed(Speed);
Serial.begin(9600);
delay(500);
}

void loop(){
if(Serial.available() > 0){   //if some date is sent, reads it and saves in state
state = Serial.read();
if(state > 10){Speed = state;}
}

motor1.setSpeed(Speed);         // set the motor speed to 0-255
motor2.setSpeed(Speed);
motor3.setSpeed(Speed);
motor4.setSpeed(Speed);
                Key Control Comman
    if(state == 1){forword(); }  // if the state is '1' the DC motor will go forward
else if(state == 2){backword();}  // if the state is '2' the motor will Reverse
else if(state == 3){turnLeft();}  // if the state is '3' the motor will turn left
else if(state == 4){turnRight();} // if the state is '4' the motor will turn right
else if(state == 5){Stop(); }      // if the state is '5' the motor will Stop
delay(80);
}

void forword(){
motor1.run(FORWARD); // turn it on going forward
motor2.run(FORWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
}
```

```
void backword(){
motor1.run(BACKWARD); // the other way
motor2.run(BACKWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
}

void turnRight(){
motor1.run(FORWARD); // the other right
motor2.run(FORWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
}

void turnLeft(){
motor1.run(BACKWARD); // turn it on going left
motor2.run(BACKWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
}

void Stop(){
 motor1.run(RELEASE); // stopped
 motor2.run(RELEASE);
 motor3.run(RELEASE);
 motor4.run(RELEASE);
}
```

Proposed Work

The authors propose to study the following major characteristics tied to the usability of an accelerometer equipped smart phone as a controller for a teleported vehicle. 1. Compare the efficiency and user feedback of the standard RC controller while viewing video feedback on the iPhone. 2. Conduct trials using the iPhone as both video screen and controller with a simple push button interface to control the robot. 3. Assess efficiency and user feedback when video is viewed on the iPhone and the robot is controlled via accelerometer input. A dead man switch will activate accelerometers, and operators will tilt forward, backward, and side to side to control the four-wheeled vehicle. A possible variation on this could test other methods for steering control rotation vs. tilt. 4. Compare/contrast the controller described in item 3 with two different "leveling" points. In one, the zero point1 would be a defined point in space i.e. user must hold device at a 45 degree angle to activate the dead man switch and therefore the accelerometers; alternatively, the device could self-level meaning the zero point is wherever the user activates the dead man switch. The results of this comparison have important usability implications, especially for users that require a more heads up controller environment. It will also help inform the researchers as to how users' mental models are built and how they perceive the controller should function and react. Ideally, the results of these tests will help answer a number of questions. Aside from learning more about how users expect a controller to act, data collected will also measure general suitability (efficiency, precision of operation) of accelerometers in tele-operation. Do users prefer a tilt interface over other conventional interfaces, and if so how is accelerometer control best implemented? We hope to identify appropriate settings regarding the zero point, accelerometer sensitivity, and video display size/resolution.

V. CONCLUSION

Food The operating system of smart phone is android which can develop effective remote control program. At the same time, this program uses blue-tooth connection to communicate with robot. It has proven to allow for meaningful two-way communication between the Android phone and the robot which would allow a non-expert to interact with and adjust the functionality of a system. The developed smart phone operating robot system was successfully executed with the help of correlating Android OS and embedded computer. Operation commands were well delivered and received without severe time delay. All operations were verified enough to be commercially employed. With this success, any kind of Android OS based robot control and monitoring in real time can be implemented and various applications will be extended in the short run. Although this research is still in an early stage of development, it has already proven to succeed in several of its goals. The operating system of smart phone is android which can develop effective remote control program. At the same time, this program uses blue-tooth connection to communicate with robot. It has proven to allow for meaningful two-way communication between the Android phone and the robot. The surveillance is always has been a quite sensitive task. And it includes so many risks. So it's better to use robot for this job instead of people. And if you are able to control the robots with efficiency and accuracy then you can guarantee yourself with good results and success. This system is a good step for secure surveillance using robots. Wireless control is one of the most important basic needs for all the people all over the world. But unfortunately the technology is not fully utilized due to a huge amount of data and communication overheads. Generally many of the wireless-controlled robots use RF modules. But our project for robotic control makes use of Android mobile phone which is very cheap and easily available. The available control commands are more than RF modules. For this

purpose the android mobile user has to install a designed application on her/his mobile.

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