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# Wireless Controlled Hexa Wheel Robot based on HC-05 Technology

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***ABSTRACT: Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing.***

***In this digital age, Robotics represents a transformative shift. As you are all aware, Robotics is utilized extensively in the manufacturing, research laboratories, traffic management, search initiatives, and defence activities. These have streamlined human employees' tasks which was previously performed by humans. Now a days smart phones or android is an open-source operating system which means that any manufacturer on use it in their phones free of charge. More properties make the Android system very applicable for university use: Android uses the Java programming language, which our students are familiar with. Getting started with the Android API is easy; the API is open, i.e. developers can access almost every low-level function and are not sandboxed. In addition, the Android API allows easy access to the hardware components. In the working principle of Robot is based on RF (Radio Frequency) emitted by Bluetooth can be regarded as the control which deals with the use of radio signal to remotely control any device or Robot. Based on all these information we have design and developed a Six Wheel Robotics Module using HC-05 Technology.***

***Keywords:- Robot, HC-05, Arduino uno, Driver, Ultrasonic.***

## I. INTRODUCTION:

Nowadays we can see that things which were previously controlled manually are automated using machines and electronic remote controls. The main objective of this paper is to create an Android application which can be used to control the robot using wireless technology. Nowadays android is the most popular operating system used for smart devices. Smart devices which are using the Android platform are also becoming more popular these days because of its smart and easy to use touch interface. Also hardware technology utilized in smart phones is improving significantly day by day. Hence, we can say that using such a powerful and generalized platform of the Android smart phones to control the robotic or any other system will be the great advantage for industrial and other general purpose use. The wheeled robot is used in this paper will be able to connect with an Android smart phones using HC05 Bluetooth module. The system is implemented in the robot using Arduino controller will provide us the constant feedback of the current status of performance of the robot. By using that feedback from the system errors in the system will be reduced and consistency of the performance of the system will be maintained.

## II. LITERATURE REVIEW:

Demonstrates mobile application utilizing Bluetooth technology to control a mobile robot using manual control was designed and realized for Android operating systems. An Arduino-controlled rotary ultrasonic
obstacle-avoidance system with HC-05 control is presented in this paper. Here I presented and described an in-house differential drive robot controlled by a bluetooth based control mechanism. An interface program can be used to control this robotic system or a microcontroller driven module can operate independently.
Variety of research has already been done in the last few years. We have surveyed the most famous research carried out in the last five decades for almost every area of issues related to mobile robots, according to the IEEE database.

### 2.1. From 1970 to 1979

In a research paper, Kirk et al. (1970) proposed a dual-mode algorithm to send an intelligent mobile rover to other planets to explore uncertain terrain. Gaussian functions for probability density were used to find the optimal path for the rover in uncertain terrain. Cahn et al. (1975) developed an algorithm to solve problems in robot navigation and the avoidance of obstacles with the help of information of the range defined in the environment. This algorithm system requires a very small amount of memory from minicomputers. McGhee et al. (1979) presented an extension of limb coordination for mobile robots in the case of terrain that constitutes regions not fit for weight-bearing.

### 2.2. From 1981 to 1984

Blidberg (1981) studied the effect of the microprocessor type on the intelligent mobile robot and reviewed the increasing memory size and distributed processing and the consequent effect on communication, mission capabilities, navigation, and control. Thorpe (1983) presented a study on the CMU rover which was developed in the Robotics Institute of Carnegie-

Mellon University at that time. This article explained the FIDO Vision and navigation system of the CMU rover, as well as the working principle of the rover. Harmon (1984) provided a one-person perspective on the problem of planning the route in unknown natural terrains for the operation of autonomous mobile robots.

**2.3. From 1991 to 1994**

Shiller et al. (1991) presented a method for the motion planning of autonomous robots moving on regular terrain. The proposed methodology obtained the mobile robot's speeds and the geometric path that minimize the time of motion considering terrain topography, surface mobility, obstacles, and vehicle dynamics. The avoidance of dynamic obstacles by the intelligent mobile robot was carried out by the hidden Markov model, which was proposed by Zhu (1991). The hidden Markov model-based algorithm for stochastic motion control was developed. Additionally, the characteristics that differentiated the motion control and the visual computation requirements were discussed in dynamic domains from those in static domains. Manigel et al. (1992) proposed a method for controlling a mobile robot by computer vision. The method provided proper guidance for mobile robots along roadways depending on given visual signals. The algorithms were developed to utilize a Kalman filter and geometric coordinate transformation to locate the relative position of the mobile robot on the road and identify the curvature of the road ahead. Yuh et al. (1993) presented a neural network-based controller for remotely operated vehicles. Three learning algorithms of a neural network controller for online implementation were described with an equation of criticism. The performance of the learning algorithms was compared and analyzed with computer simulation. Gruver et al. (1994) provided a comprehensive study of recent developments of autonomous robotics in the manufacturing systems, services, and aids of robotics for disabled human beings. The references highlighted the advances in robot control, sensor integration, walking machines, mechanical hands, powered prostheses, and manufacturing automation. Guldner et al.

**2.4. From 2001 to 2004**

Martinez et al. (2001) drew a comparison between principal components analysis (PCA) and linear discriminant analysis (LDA). As far as previous research showed, object recognition by LDA-based algorithms was superior to PCA-based algorithms. However, this research explained that this case is not always true. In the case of a small training data set, PCA is superior to LDA. DeSouza et al. (2002) studied the developments in the domain of vision for navigation of mobile robots in the last 20 years. The survey included both outdoor and indoor navigation. The cases of navigation using object recognition, optical flows, and techniques of paradigm appearance based on environments were discussed in this article. Lee et al. (2003) proposed a novel approach to locate the position of an autonomous robot with the help of a moving object image. This approach integrated data from the observed location with the help of the estimated position and the dead reckoning sensors, using captured moving objects images by a stationary camera to locate the position of a mobile robot. This approach was applied to a moving object on the wall to describe the reduction of uncertainty while locating the location of a mobile robot. The human-robot interaction in the field of rescue robotics was discussed in Murphy (2004).

**2.5. From 2011 to 2021**

Song et al. (2011) presented a methodology for the invention and characterization of a robot for home security surveillance with automatic recharging and docking capabilities. The presented system had a docking station and a surveillance robot. The size of the surveillance robot was palm-sized, and it had three wheels with a triangular shape. The success rate of this robot was 90% after 60 different docking attempts. Stephan et al. (2012) presented a review report on the social implications of technology (SSIT) society contributions in this world since the IEEE society's founding in 1982. In addition to surveys, they studied the main important key technologies which have significant future social impacts. Security and military technologies were studied significantly in this survey. Broggi et al. (2013) presented future automated vehicles which have the vision of the Intelligent Systems Laboratory (VisLab) and artificial vision, ranging from the selection of sensors up to their exclusive testing. The options of VisLab's design were discussed with the help of the BRAiVE intelligent mobile robot as an example of a prototype. This methodology also presented final remarks on the perspective of VisLabs on future vehicles. Endres et al. (2014) proposed a new mapping system that created a 3D map of higher accuracy with the help of an RGB-D camera. Sensors and odometry were not required in this approach. The impact of various parameters was discussed and analyzed, such as various visual features, the feature selection of the descriptor, and methods of validation. Dong et al. (2015) investigated design problems and formation control analysis for UAV swarm systems (unmanned aerial vehicles) to obtain time-dependent formations. First, the formation protocols were given for UAV swarm systems to get predefined time-dependent formations. The theoretical results obtained in this approach were verified on the platform of quadrotor formation. Zeng et al. (2016) considered a new technique of autonomous relaying, where the relay nodes were mounted on UAVs (unmanned aerial vehicles), and therefore, the UAVs could move at a very high speed. In this approach, the authors studied the problem of maximization in systems of mobile relaying by the transmit power of source/relay optimization across the trajectory of the relay, subject to the mobility constraints in practical terms, as well as the constraint of information-causality at the relay. An iterative algorithm was proposed for relay trajectory and power allocations optimization, alternately. Rasekhipour et al. (2017) presented a path planning controller for model prediction. The dynamics of the vehicle and the potential function were parts of the objective function. Therefore, during optimal path planning using vehicle dynamics, the path planning system could handle

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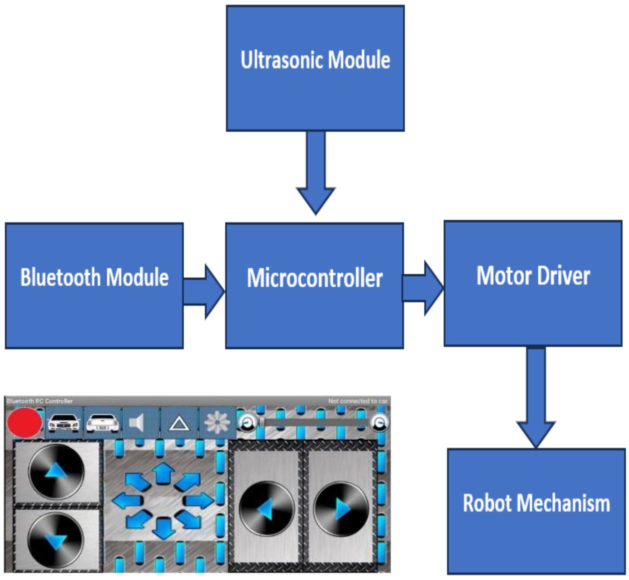
different obstacles and road structures distinctly. The controller of path planning was simulated and modeled on a vehicle model of CarSim for some complicated scenarios of the test. The outcome of this approach showed that, with the help of this path planning controller, the autonomous vehicle could avoid obstacles and observe road regulations with an accurate vehicle dynamic. Quin et al. (2018) proposed a versatile and robust estimator of monocular visual-inertial state (VINS-Mono). This approach began with a robust process for the initialization of the estimator. A nonlinear method with an optimization process was applied to obtain visual-inertial odometry of higher accuracy by fusing measurements of the pre-integrated inertial measurement unit and observations of the feature. A module of loop detection in combination with coupled formulation allowed for minimum computation of re-localization. The presented work was a complete, reliable, and versatile system that was applicable for many applications which require localization with higher accuracy. Nicholson et al. (2019) presented a technique for 2D (two-dimensional) object detections with various views to simultaneously evaluate a quadric 3D (three-dimensional) surface for every object and position of camera localization. This paper also included development of a model of the sensor for the detection of objects that addressed the problem of partly visible objects and illustrated how to mutually evaluate the pose of the camera and dual constrained quadric parameters in the graph of factor-based SLAM having a general camera perspective.

Yurtsever et al. (2020) discussed the emerging technologies and common practices in autonomous driving. This study also described issues with automated driving, such as unsolved problems and technical aspects. The study included emerging methodologies, present challenges, system architectures of a high level, and core functions having mapping, planning, perception, human-machine interfaces, and localization, which were reviewed thoroughly. Zhu et al. (2021) reviewed deep reinforcement learning (DRL) methods and a DRL-based navigation framework. Then, it made a systematical comparison and analysis of the differences and relationships between four major application scenarios: indoor navigation, social navigation, and local obstacle avoidance. Lastly, the development of DRL-based navigation was described.

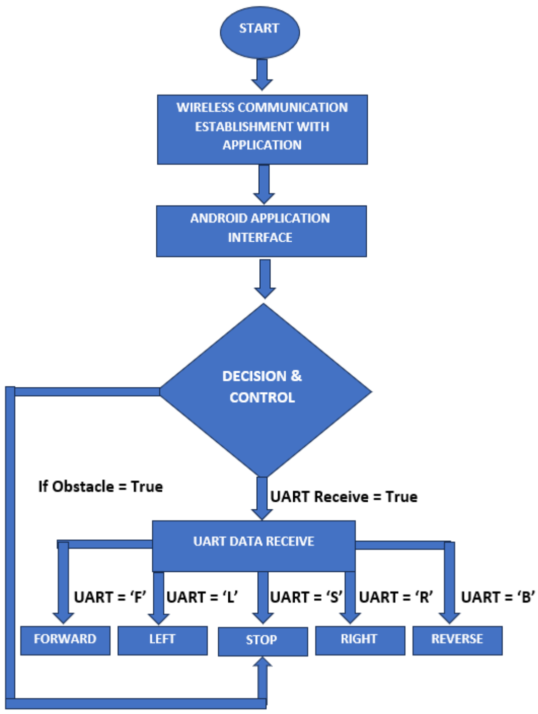
## III. BLOCK DIAGRAM




Android Application

Fig: 1 Block Diagram of the System

## IV. FLOW CHART



## V. WORKING

It is clear from the block diagram, that the Bluetooth is connected with microcontroller via Serial Communication whereas Ultrasonic module is digitally connected to MC. After processing the wireless signal from the Bluetooth to the microcontroller, it will send a digital command to operate the motor, but the amount of current required to drive the motor is high, hence motor driver will amplify the current to operate the motor.

If UART Receive is equal to 'F' then Robot will drive in Forward direction, whereas if receive signal is 'L' it will Left Turn, if Receive is 'R' it will Right Turn, if Receive is 'B' it will move backward and if Receive Signal is 'S' then Robot will Stop.

## VI. CIRCUIT DIAGRAM

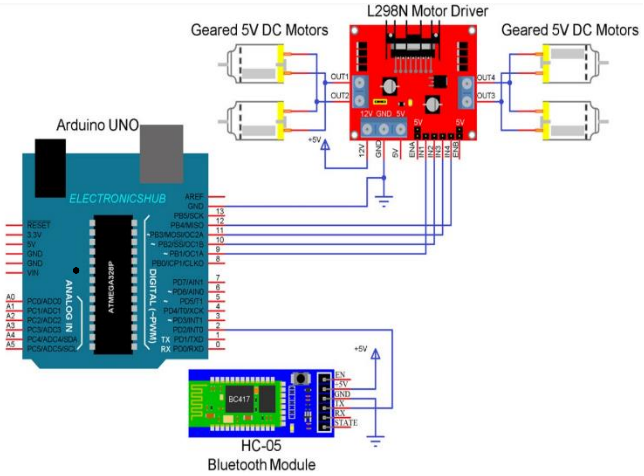



Fig:2 Circuit Diagram

## VII. COMPONENTS DESCRIPTION

1. **ARDUINO UNO.**

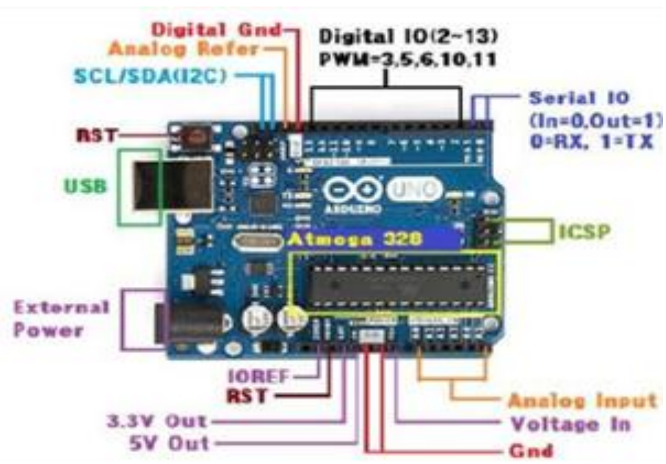



Fig:3 Arduino Uno

This is the brain of robot loaded by a program written in embedded c language to do the required functioning and is interfaced with Bluetooth module. The motor driver are used to make the system work as required.

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010.[2][3] The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "uno" means "one" in Italian and was chosen to mark the initial release of Arduino Software. The Uno board is the first in a series of USB-based Arduino boards; it and version 1.0 of the Arduino IDE were the reference versions of Arduino, which have now evolved to newer releases. The ATmega328 on the board comes pre programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as USB to Serial Converter.

**2. HC-05 Bluetooth Module**

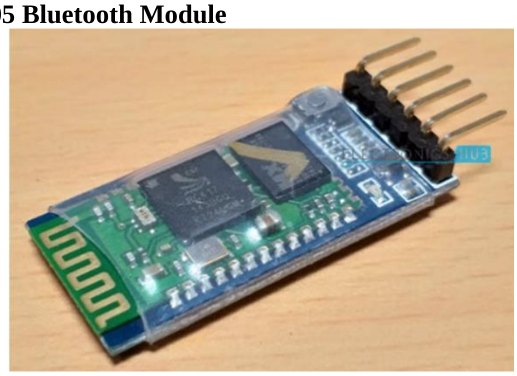


Fig:4 HC-05 Bluetooth Module

The HC-05 Bluetooth Module is responsible for enabling Bluetooth Communication between Arduino and Android Phone.

The HC-05 Bluetooth Module has 6 pins – Vcc,GND,TX,RX,Key,and LED.It comes pre-programmed as a slave,so there is no need to connect the key pin,unless you need it change it to master mode the major difference betwween master and slave modes is that,slave mode the Bluetooth module cannot initiate a connection,it can however accept incoming connections.After the connection is established the Bluetooth module can transmit and receive data regardless of the mode it is running in.If you are using upon to connect to the Bluetooth module, you can simply use it in the slave mode.The defau;lt data transmission rate is 9600kbps. The range for Bluetooth communication is usually 30m or less.The module has a factory set pinoff "1234"which is used while pairing the module to a phone. Frequency:2.4GHz ISM band,Power supply:+3.3VDC 50mA,Working temperature:-20 `+75 Centigrade

**3. L2938N Motor Driver**

The L298N Motor Driver module consists of an L298 Motor Driver IC, 78M05 Voltage Regulator, resistors, capacitor, Power LED, 5V jumper in an integrated circuit.

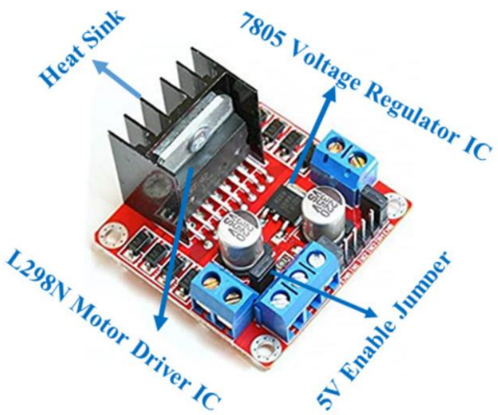



Fig:5 L298N Motor Driver

**4. ULTRASONIC MODULE**


Fig:6 Ultrasonic Module

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).
In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be:

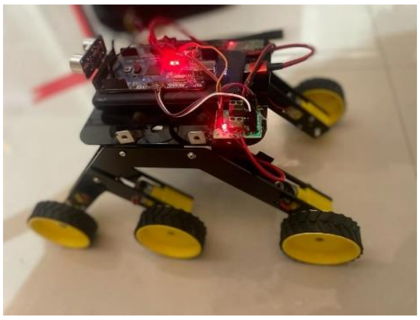
D = 0.5 x 0.025 x 343
or about 4.2875 meters.

**5. BO MOTOR**

Fig:7 BO Motor

Bo motor (Battery Operated) lightweight DC geared motor which gives good torque and rpm at lower voltages. Here you can get a BO motor with varying rated speeds. This motor can run at approximately 200 rpm when driven by a single Li-Ion cell.

## VIII. ROBOT IMAGE



## IX. APPLICATIONS

**1) In Domestic Use:** This project can be used at homes for many purposes like picking up and placing some objectsfrom one to other.

**2) In Spying** Operations: This robot can help in spying operations. The object recognition and android control makes it Hi-Fi.

**3) For Handicapped People:** This project can help the handicapped people especially those who had lost their feet unfortunately.

**4) Robo Races:** The tilt control of robots can be used in robo races which will be revolutionary.

**5) Miltary Application and Hostage Rescue.**

## X. CONCLUSIONS

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 make 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.

## XI. FUTURE SCOPE

A wireless camera is mounted on the robot vehicle for spying and surveillance purpose even in night time by using infrared lighting. Future modifications can be made to perform different tasks with precise control such as: 1) A Robot Mounted with camera 2) A headset, with a full-color display 3) A mission control centre.

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