Wireless 360° Rotating Vehicle

Mr. Mohd Firasath Ali[1], M.A. Raoof Rasheed, Md. Fazal, Mohd Abdul Razzak, Mohd Anas Mohiuddin[2]

[1]Assistant Professor, [2] UG students, Mechanical Engineering Department, Nawab Shah Alam Khan College of Engineering and Technology, Hyderabad. 5000024.

Abstract: This paper presents the design and implementation of a 360-degree wireless rotating car using Arduino Uno, Bluetooth module, servo motor, and L293D motor driver navigating seamlessly through a smartphone application. Arduino Uno is the central microcontroller, processing commands received from the Bluetooth module. The L293D motor driver is utilized to control the DC motors, enabling the car to move forward, backward, and rotate in place. An integrated servo motor provides precise control over the steering mechanism, facilitating the car's ability to perform 360-degree rotations. This project demonstrates the integration of simple electronics and programming to create an efficient, remotely controlled vehicle with versatile movement capabilities. The implementation showcases potential applications in robotics and remote-controlled systems, highlighting the versatility and effectiveness of Arduino-based projects in modern technological solutions. It have various perspectives like to transport things, overwhelming bags and furthermore in vehicles, which will help in decreasing rush hour gridlock and spare time. The aim of research is to foster a zero turning vehicle.

Key Words: Arduino, control, robotics, 360degree

I. INTRODUCTION

Several models proposed for the 360-degree rotating vehicle, like a lifting plate placed at the bottom center of the vehicle, to lift up the vehicle and then rotate which is quite inappropriate and unrealistic [1]. Some operated by chain sprocket, chain or belt drive along with DC motors, quite complex in design, construction & not suitable for the real-life application. Quadra-steering mechanism of three several phases were Introduced to reduce the turning radius of the vehicle, providing complicacy in the design. In contrast, this work provides better comfort compare to normal wheel problems like parking, U-turn [2,3]. All Four wheels equipped with battery operated motor-drivers controlled by an RF remote minimizing the fuel expenses [4].

1.1. OBJECTIVES

1. To design and implement a 360-degree rotating car controlled wirelessly via a Bluetooth connection.
2. By Using an Arduino Uno as the central microcontroller, integrate with other components.
3. To use battery for saving the environment by reducing the harmful gasses of fuel.
4. To demonstrate the practical applications of Arduino-based systems in creating efficient, remotely controlled vehicles with versatile movement capabilities, showcasing their potential in robotics and remote-control technologies.
5. To demonstrate practical application of a zero turning vehicle in real life.

II. LITERATURE SURVEY

2.1. Design and Development of AKEA: A 360-degree rotating vehicle: A design of a 360-degree rotating vehicle called AKEA, eliminates problems of parking and U-turn, without moving the vehicle, with no extra space. It includes lifting plates, chain sprockets, chain or belt drives, and quad-steering mechanisms while several shortcomings, including complexity in design, unrealistic features and increased turning radius. It incorporates sustainable and recycled materials. These features include side-ways movement, 360-degree rotation, and mobile phone operation via Bluetooth, with a range of 100 meters. However, sensors for self-driving and Wi Fi for broader connectivity may improve the design [5].

2.2. Design and Fabrication Of "360 Degree Car Parking": Car parking is a major problem faced in most parts of the country due to space constraints. The present study aims to develop a system to reduce the turning radius of a car. It has Ackerman steering and chain drive mechanism with the arrangement of the various kinematics links. First vehicle is stopped and the wheels are then turned in the required direction with the help of the steering system. It has a turning radius nearly equal to negligible of the length of car itself [6].

2.3. LITERATURE REVIEW: Several models were proposed earlier some of them include Quad-steering mechanism of three several phases was introduced to

reduce the turning radius of the vehicle, but increases complexity in the design. Hydraulic hoses, connecting rods and toggle discs were proposed earlier to be introduced to make a connection between the front and rear wheel steering rack to implement a centrally and radially adjustable zero-turning 4-wheel steering system [7-9].

Previously, Honda had four-wheel steering as an option in their 1987-2000 Prelude and Honda Ascot Innova models (1992-1996). Mazda also offered four-wheel steering on the 626 and MX6 in 1988. General Motors offered Delphi's Quadra steer in their consumer Silverado/Sierra and Suburban/Yukon. Since introduce in 2002, only 16,500 vehicles were sold with this system. GM discontinued the technology at the end of the 2005 model year. Nissan/Infiniti offer several versions of their HICAS system as standard or as an option in much of their line-up. A new "Active Drive" system is introduced on the 2008 version of the Renault Laguna line. It was designed as one of several measures to increase security and stability. It lowers the effects of understeer and decreases the chances of spinning by diverting part of the G-forces generated in a turn from the front to the rear tyres. At low speeds, the turning circle can be tightened so parking and manoeuvring are easier [10-13].

2.4. CAD model:

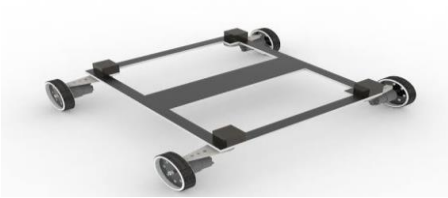


Fig 1: CAD model of the chassis

Proposed system has the benefits of:

1.Enables forward, backward, and 360-degree rotational movements, enhancing navigation capabilities in various environments.

2. Bluetooth connectivity make remote operation via a smartphone, offering user-friendly control.

3. Integrates a servo motor for precise steering, ensuring accurate, smooth directional changes.

4. Demonstrates a scalable and modular system, allowing for easy upgrades and integration.

5. A 360-degree rotating car beat parking zone by ease of parking in no space to turn the vehicle. People who are new to driving to make easier U-turns.

7. To use in industries to transfer materials and goods at less time where there are tight spaces.

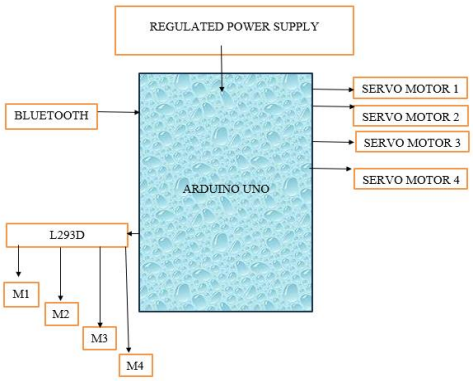


Fig 2: Block Diagram of System components

III. METHODOLOGY

The control system consist of Arduino connected to the Bluetooth module for wireless control and motor driver using a rechargeable battery.

2.5. Description Of components: All digital circuits require regulated power supply.

ARDUINO UNO: It is the most common version of Arduino, a microcontroller board based on the ATmega328 having 14 digital input/output pins, 6 PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. By connecting to a computer with a USB cable or power with an AC-to-DC adapter or battery it gets started.

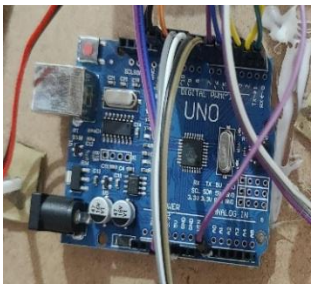


Fig 3: Arduino UnoR3 board with all the connections

USB Plug & External Power Supply Plug It is terminated in a barrel jack and use for loading code onto Arduino board. If more than 12V, the regulator may overheat and damage the board.

Voltage Regulator: controls the amount of voltage that is let into the Arduino board.

Power Pins: Voltage In Pin – inpu to Arduino board.
5V Pin – gives regulated output 5V

Ground Pins: It is negative terminal.

IOREF Pin: Gives voltage reference to operate microcontroller by enabling outputs 5V or 3.3V.

Input and Output Pins: 14 digital pins used as digital input or output with 40 mA & 20-5k Ohms.

Serial Out (TX) & Serial In (RX): It receives (RX) and transmits (TX) TTL serial data. External Interrupts: Pins 2 and 3 configured to trigger an interrupt on low, rising or falling edge, or a change.
PWM – the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11) are Pulse-Width Modulation (PWM) simulates analog output (fading an LED).
SPI – Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK) supports SPI communication with SPI library.
API – From A0 to A5, provide 10 bits of resolution converting from analog to digital. It has 5 volts, upper end range may be changed by AREF Pin.
TWI – Pins A4 (SDA) and A5 (SCL) support TWI communication using the Wire library.
Reset Pin reset the microcontroller.
LED: light up when Arduino plugs to power source.
On-Board LED –A built-in LED connected to pin 13. If LED is ON; Pin is HIGH, else LOW.
TX, RX LEDs -show receiving or transmitting data.
Reset Button: It connects the reset pin to ground and restart code. It is useful to test code multiple times.
L293D MOTOR Driver: It works on the concept of H-bridge, a circuit allowing the voltage to be flown in either direction.

Fig 4: l293D with Dc motor

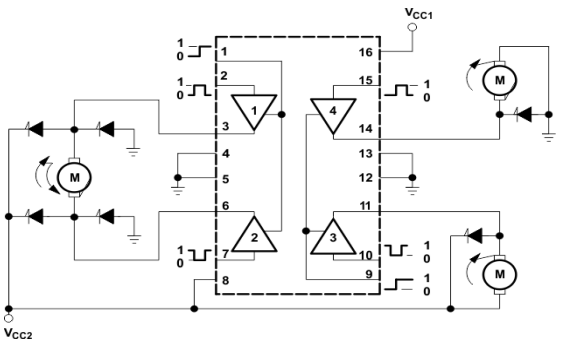


Fig 5: H-Bridge interface with L293D

Two H-Bridge circuit in IC rotates two DC motor independently. L293D has two pins 1, 9 drives the motor. For driving the motor with left H-bridge enable pin 1 to high and with right H-Bridge enable pin 9 to high. If one of pin1 or pin9 goes low the motor in the corresponding section stops. It is suitable for use in switching applications at frequencies up to 5 kHz.
Working of L293D: There are 4 input pins, pin 2,7 on the left and pin 15 ,10 on the right. With Logic 0 or 1 across the input pins, rotates the motor.
L293D Logic: consider Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.
•Pin2=Logic1, Pin7 = Logic 0 | Clockwise Direction
•Pin2=Logic0, Pin7 = Logic 1 | Anticlockwise Direction
•Pin2=Logic0, Pin7=Logic 0 | Idle [No rotation]
•Pin2=Logic 1, Pin7 = Logic 1 | Idle [No rotation]

SERVO MOTOR

Fig 6: Servo Motors

It controls angular or linear position, velocity, and acceleration, operating in a closed-loop system. A potentiometer or an encoder, monitors the motor's position with high precision and reliability. It consist of a DC motor, a gear reduction unit, a control circuit, and a position sensor [14]. It sends a control signal that specifies the desired position by comparing it from position sensor. Errors are adjusted its position to match with control signal.

Transformer: Primary & Secondary, windings linked together through CORE, an inductively coupled electrical conductor. Current change in primary causes a change in Magnetic Field & induce alternating voltage in secondary coil.

Rectifier: It converts an AC signal into DC signal with the help of diode, which allows current to pass only in forward bias i.e. when the anode of the diode is positive with respect to the cathode & blocks in the reversed biased condition. Varying ouput received.

Filter Capacitor: To smoothen the waveform, a Filter capacitor used. It depends on the current consumed by the circuit, the frequency of the waveform & the accepted ripple.

$$C = \frac{V_r F}{I}$$

Where,
Vr= accepted ripple voltage. (less than 10% V)
I= current consumed by the circuit in Amperes.
F= frequency of the waveform.
Voltage Regulator: varying input voltage converted into a constant regulated output voltage.

1. Linear Voltage Regulator: they dissipate the excessive voltage resistively as heat.
2. Switching Regulators: Regulate the output voltage rapidly, since their output is either ON or OFF it dissipates very low power, achieving higher efficiency as compared to linear voltage regulators.

Table 1: Specifications of IC7805:

SPECIFICATIONS	IC 7805
V_{out}	5V
V_{ein} - V_{out} Difference	5V - 20V
Operation Ambient Temp	0 - 125°C
Output I_{max}	1A

IC 7805: 7805 is an integrated 3-terminal positive fixed linear voltage regulator, supporting input voltage of 10 volts to 35 volts and output voltage of 5 volts, current rating of 1 amp. It has a built-in current limiter to reduce output current if it gets too hot. It is manufactured by companies like National Semiconductors and Fairchild Semiconductors. The last two digits represent the voltage; for instance, the 7812 is a 12-volt regulator (see Table 1).

Bluetooth module: It is used in wireless network transmission. Generally, it is divided into the following types: data transmission module, remote control module, etc.

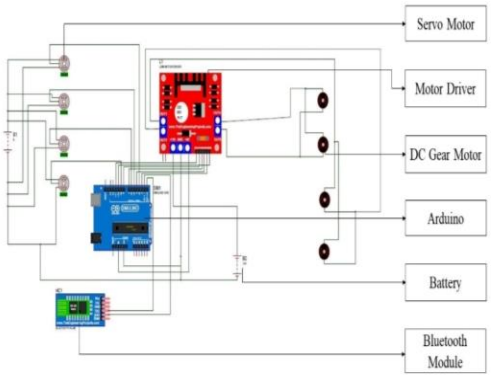


Fig 7: Control circuit diagram

Arduino uno R3 board acts as the main control unit of the circuit. Bluetooth module, Motor drivers and the servo motor are connected to the Arduino using connecting wires.

Work Flow
1. Designing chassis as per the CAD model Fig 1.
2. Hardware components DC & Servo motors selected as per requirements such as RPM & Torque.
3. Battery is selected as per the power consumption
4. Assemble the components as in Fig 2 and 8.

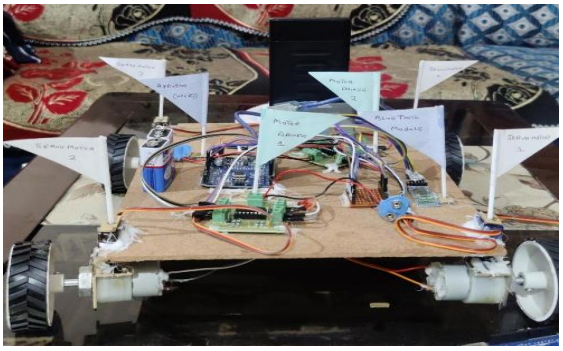


Fig 8: Resulted 360° vehicle with all connections.

360-degree rotation working:
https://photos.app.goo.gl/L9k2i5ft58jN7PpA8

3.6. SOFTWARE Description and Working:
Arduino IDE: Download any version of Arduino IDE from Arduino Official website, which is compatible with Windows, IOS, or Linux OS. Launch Arduino and unzip the folder. There is application icon with an infinity label (application.exe), click the icon to start the IDE

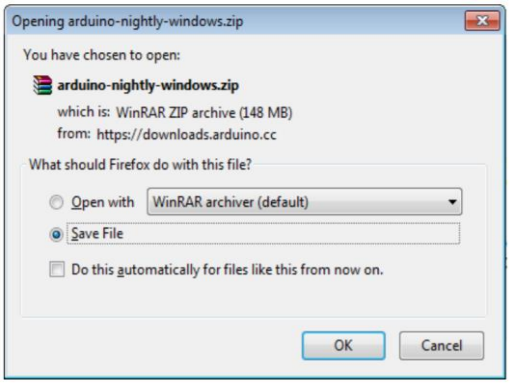
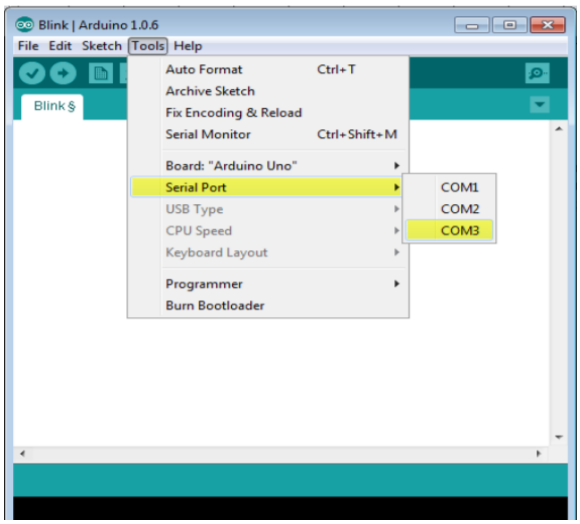


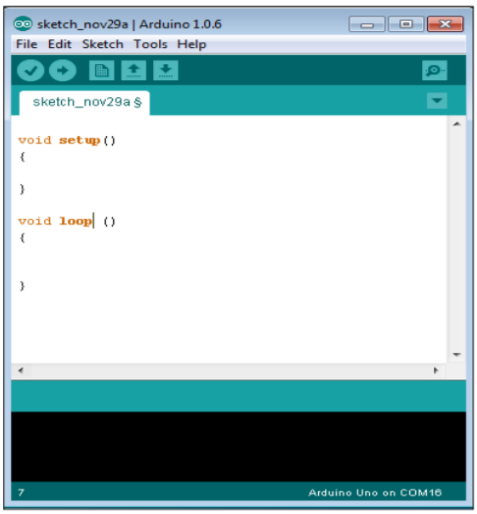
Fig 9: Arduino installation.

Once the software starts, there are two options:
• Create a new project. • Open an existing project.
To create a new project, select File --> New
Here, the name Blink selected. It turns the LED on and off with some time delay. Select the serial port, the serial device of Arduino board. Go to Tools -> Serial Port menu. COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, disconnect Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.



Arduino programs can be divided in three main parts: Structure, Values (variables and constants), and Functions. Software structure consist of two main functions:•Setup( ) function

•Loop( ) function.



Data types in C: It is an extensive system for declaring variables or functions of different types determining how much space it occupies in the storage and how the bit pattern stored is interpreted.

Working of the model:

1. Bluetooth module connects the Arduino and device to control vehicle or commands.
2. Arduino sends signal to servo motors driver.
3. Motor drivers transmits signal to the four DC motors for moving of the vehicle.
4. DC motors controls horns attached to it via Arduino, enabling specific angular(30º,60º,90º) turns.
5. It then lock the wheels and dc motor at the commanded angles.

The three different positions of the vehicle for movements are explained below:

The first is the normal position for the movement of vehicle forward, backward, right or left. Here the wheels are positioned at 90degree angle as in fig 10.

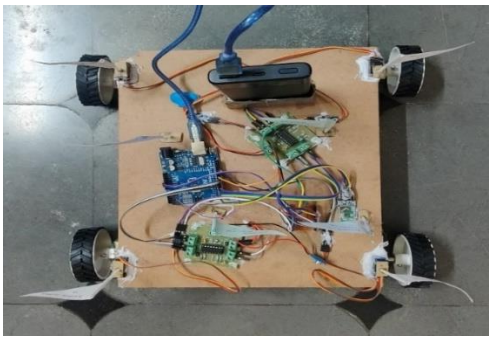


Fig 10 (a): Straight position of vehicle

The second position is for the sideways movement. Here the wheels are positioned at 30 degree angle as shown in the picture

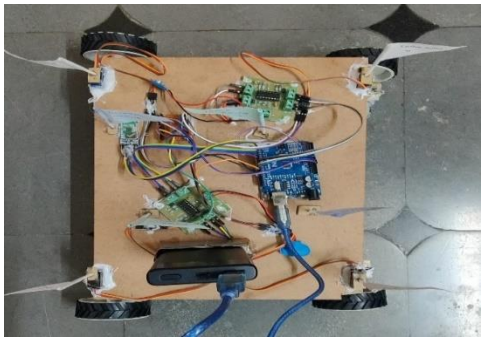


Fig 10 (b): sideways position of vehicle

The third position is for the 360 degree rotation. Where the vehicle makes rotation while standing at the same position.

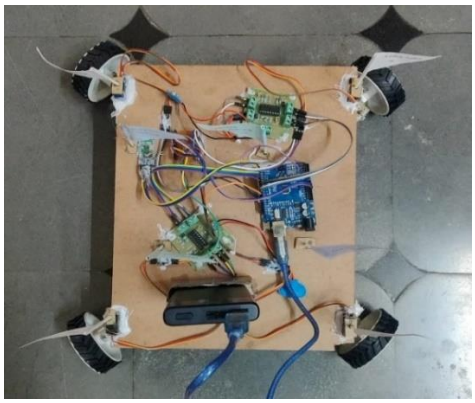


Fig 10 (c): 360 degree rotation position of vehicle

IV RESULTS AND CONCLUSION

Result: The above vehicle was constructed after considering all the observation. Nevertheless, creating a real-life model of 360°rotation might be difficult. The safety concerns of such a vehicle would also be

needed to carefully considered. The idea of a vehicle that rotates 360 degrees has the ability to completely alter how we perceive mobility and transportation. Drivers of such a vehicle might be able to move in any direction, making it simpler to maneuver in confined places and congested streets. This could be especially helpful in cities where transportation congestion is a big issue.

Conclusion: This research opens up a variety of fascinating options for mobility and transportation. Vehicles might negotiate confined spaces and congested metropolitan areas more effectively if they could rotate in any direction. Parallel parking mode and 360-degree turning mode can only be achieved when the vehicle is in stationary mode. Four-wheel steering mode can be achieved during low-speed condition. Different steering mechanism beneficial in lightweight passenger cars also employed in automated guided vehicles for industrial purpose.

FUTURE SCOPE

It can be used for transportation of goods in factories and hubs as there are tight spaces in between the work areas. In automobile industry, as new drives get difficulty in taking Uturns and parking. In 2023 Hyundai automobile company launched a car similar to 360 degree rotating vehicle.

REFERENCES

[1] Yogendra al, 2022 300-DEGREE ROTATING WHEEL VEHICLE USING A LIFTING PLATE International Research Journal of Engineering and Technolgy,

[2] p.1Hat, KB, Gupta, P. Pawar, A. & Javed M. 2017. Development of 360-degree Rotating Vehicle, InternationalJournal Jer Intovutive Research in Science & Technology

[3] Arunkumar, S. M, Chandan, K. S. Yuhan, G. M. & Jabangerr, A. B. 2017. 360 Degree Wheel Rotation Vehicle. International Journal of Latest Engineering Research and Applications, 2(517)

[4] Sudip, K., 2016. DESIGN OF 360-DEGREE ROTATING CAR. IJARIIE, 2(5), p. 5.

[5] Adedeji. A. Kasali, Yussuoff A. Abiodun, Emola. W. Shola, Olajide. S. Anthony “Design and Development of AKEA: A 360-degree rotating vehicle” in journal August 2023Global Journal of Engineering and Technology Advances, DOI:10.30574/gjeta.2023.16.2.0142

[6] Arun, S., Abhishek, K. & Rajiv, C., 2014. Study of 4-Wheel Steering Systems to Reduce Turning Radius and Increase Stability. International Conference of Advance Research Innovation, p. 7.

[7] Bobade, S. et al., 2017. Design & Fabrication of Mechanised Car with the Hel of Internal Gear to Obtain Zero Degree Rotation and Straight-Line Stability. S.l GRD Journals-Global Research and Development Journal for Engineering.

[8] P Suresh, K., Swapnil, J. & N Prasanthi, K., 2019. Design and Fabrication of Four-Wheel Steering. International Journal of Innovative Technology and Exploring Engineering, 8(10), p. 7

[9] Sathish Kumar, Mohammed Shabirullah “DESIGN AND FABRICATION OF “360 DEGREE CAR PARKING” in journal Published 2017

[10] Bobade, 2017. Design & Fabrication of Mechanised Car with the Hel of Internal Gear to Obtain ären Lingree Rotation and Straight Line Stability SJ GRD Journals-Global Research and Development Journal for Engineering.

[11] De EMA.A5.5.5.K. &PY.2019. Design and Fabrication of 360 Degree Rotating Vehicle International Journal for Research in Applied Science & Engineering Technology, 7(2), p.5.

[12] Khan, N. M. & Vatsal, S. 2010. Design, Analysis and Fabrication of an Effective steering system International Journal for Research in Applied Science & Engineering Techanlogy, 6(5), p. 14.

[13] P Suresh, N Prasanthi, K. 2019. Design and Fabrication of Four-Wheel Steering, International of renovative Technogym and Exploring Engineering, 8[10],7

[14] Shirsath, S. et al., 2016 ZERO TURN VEHICLE International Research Journal of Engineering and Technology,