Self Driving AI Robot Car Using Arduino Uno

Article *in* Journal of Systems Engineering and Electronics · July 2024

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ABSTRACT

This project describes a small car made with an Arduino Uno R3, L293N motor driver, Bluetooth module, and ultrasonic sensor. The car can do two things: avoid obstacles on its own and be controlled by a phone app. In obstacle avoidance mode, the car uses the ultrasonic sensor to see and move around objects by itself. In manual control mode, you can drive the car using a Bluetooth app on your phone. This project shows how to mix automatic systems..

I. INTRODUCTION

The concept of a self-driving Arduino car involves merging the realms of robotics and embedded systems to create an autonomous vehicle capable of navigating its environment without human intervention. In this project, we harness the capabilities of the Arduino Uno , integrating sensors, actuators, and wireless communication to enable a small-scale, self- driving car.

Creating a self-driving car using Arduino involves a fascinating intersection of technology and innovation. This ambitious project leverages various components and systems to achieve autonomous navigation. At its core, an Arduino microcontroller serves as the brain, orchestrating the car's functions.

Sensor arrays, such as ultrasonic, infrared, or LIDAR sensors, provide crucial data about the car's surroundings, enabling it to perceive obstacles, detect lanes, and make decisions in real time. Motor controllers interpret the commands from the Arduino, regulating the vehicle's movement based on sensor inputs. Machine learning algorithms might also play a role, aiding in decision-making processes by analyzing sensor data and optimizing driving behavior

Assembling these elements demands meticulous hardware assembly, software programming, and testing phases to ensure safety and efficiency. Moreover, this project not only explores the technical aspects of robotics and autonomous systems but also delves into crucial considerations of safety protocols, regulatory compliance, and ethical implications surrounding self-driving vehicles. Overall, building a self-driving car with Arduino is a challenging yet rewarding endeavor that encapsulates the essence of cutting-edge technology and engineering prowess

An obstacle avoidance-based project domain revolves around developing systems that enable machines or robots to navigate environments while identifying and circumventing obstacles in their path

II. LITERATURE SURVEY

Fundamental Concept

Creating a self-driving AI robot car using an Arduino requires a foundational understanding of key concepts in robotics, artificial intelligence (AI), and embedded systems. At its core, this project involves mastering the principles of robotics, including kinematics, dynamics, and the interaction between sensors and actuators. Integrating sensors such as ultrasonic and infrared, the robot must interpret its environment and respond accordingly. In the realm of AI, decision-making algorithms play a pivotal role, guiding the robot's actions based on sensor inputs.

Fundamental concepts like finite state machines and potentially machine learning algorithms are employed to make informed decisions. Control systems, particularly PID controllers, are crucial for precise motor control, ensuring the robot navigates smoothly. A grasp of real-time systems is necessary, as the robot's responsiveness hinges on timely processing of sensor data. Mechanical concepts come into play during chassis design, motor mechanics, and overall hardware assembly .

Additionally, a keen understanding of programming, specifically Arduino programming in the C++ language, is essential for implementing algorithms and orchestrating the robot's autonomous behavior. Lastly, safety measures, real-time testing, and community engagement contribute to a comprehensive approach in realizing a functional self-driving AI robot car. This multidisciplinary endeavor not only enables the creation of an autonomous system but also fosters a deeper understanding of robotics and AI principles.

III. METHODOLOGY

III.1 Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection,a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started[10].

You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again [11].

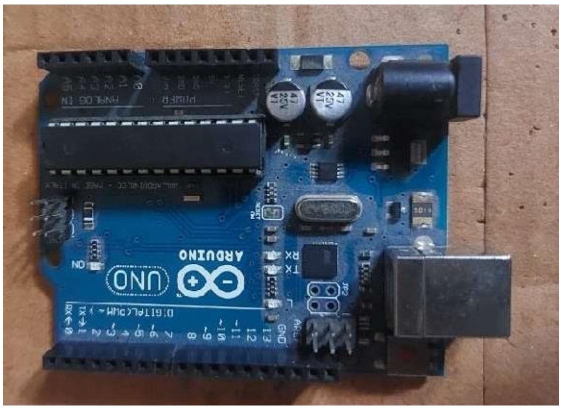

Figure 1. Arduino Uno R3

III.2 SERVO MOTOR

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate withgreat precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor.

It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply, then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor.

III.3 MOTOR DRIVER

This **L298N Motor Driver Module** is a high-power mot or driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. **L298N Module** can control up to 4 DC motors, or 2 DC motors with directional and speed control.

78M05 Voltage regulator will be enabled only when the jumper is placed. When the power supply is less than or equal to 12V, then the internal circuitry will be powered by the voltage regulator and the 5V pin can be used as an output pin to power the microcontroller. The jumper should not be placed when the power supply is greater than 12V and separate 5V should be

given through 5V terminal to power the internal circuitry.

ENA & ENB pins are speed control pins for Motor A and MotorB while IN1& IN2 and IN3 & IN4 are direction control pins for Motor A and Motor B.

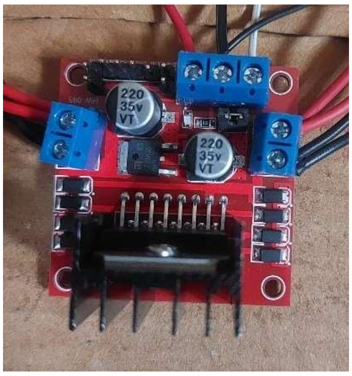

Figure 2. Motor Driver

4.4 ULTRASONIC SENSOR

The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It's ideal for any robotics projects you have which require you to avoid objects, by detecting how close they are you can steer away from them! The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high frequency ultrasonic sound, which bounce off any nearby solid objects, and the receiver listens for any return echo. That echo is then processed by the control circuit to calculate the time difference between the signal being transmitted and received. This time can subsequently be used, along with some clever math, to calculate the distance between the sensor and the reflecting object!

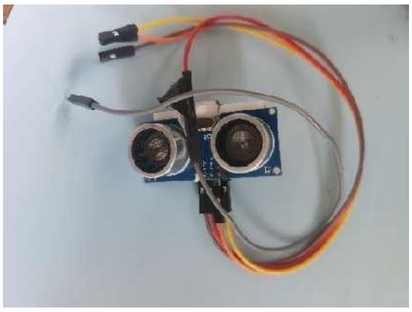

Figure 3. Ultrasonic Sensor

3.5 HC-05 BLUETOOTH

The HC-05 is a class 2 Bluetooth module designed for transparent wireless serial communication. It is pre-configured as a slave Bluetooth device. Once it is paired to a master Bluetooth device such as PC, smart phones and tablet, its operation becomes transparent to the user [2]. All data received through the serial input is immediately transmitted over the air. When the module receives wireless data, it is sent out through the serial interface exactly at it is received. No user code specific to the Bluetooth module is needed at all in the user microcontroller program.

Figure 4. HC-05 Bluetooth

3.6 Application Control

Android is an open-source mobile application development platform. These Application is build using android application RC controller using popular language java and cotlin .[5,8]

we have collected all the components required to make our project. Then we cut MDF paper in to the car like shape. then connected wire to 4 gear motor and connected it to a chassis of vehicle and then we also connected motor driver circuit, Arduino uno, 12 v battery, Bluetooth-HC-05, switch to on-off car. Then from RC controller android app we connected toBluetooth. By this way we have made our whole Bluetooth control car model [2,5].

IV. CONCLUSION

In conclusion, this car project using Arduino Uno R3, L293N motor driver, Bluetooth module, and ultrasonic sensor shows a good mix of hardware and software to do two things: avoid obstacles and be controlled by an app.

This project shows how useful Arduino and thesecomponents can be, and how they can be used to make a car that reacts and interacts well.

In obstacle avoidance mode, the car uses the ultrasonic sensor to see and move around obstacles by itself, showingit can work alone in different places. In manual control mode, the car can be controlled directly by a user through a Bluetooth app, making it easy to drive and steer. These two modes show how we can mix automatic systems with user control, which could lead to more advanced projects in robots and remote-controlled devices.

Overall, this project is a good example of how simple microcontrollers and sensors can be used to make complex, useful devices, giving a basic understanding that can be built on for more advanced projects in robotics and automation.

RESULT

First time I designed this model is different-different types of struggles in this paper. I kept the connections to the designed model according to the instructions which is given by me successfully [19]. Finally, this designed model can move the several directions and also it can move the robot car from one place to another place. I have tested this designed model many times and many places it performing tasks according to our requirements without any problems. I have designed this model to control user in long distances with the help of Bluetooth Module [19].

Figure 5. Result

REFERENCES

[1] Mayur Bhangale, Gaurav Dhabade, Akshay Khairnar, Mamta Bhagat "Self Driving car to demonstrate real time obstacles and object detection" International Research Journal of Engineering and Technology Volume 03 Issue: 11 Nov-2016.

[2] Design of a Bluetooth Enabled Android Application for a Microcontroller Driven Robot By Vito M. Guardi,(May 2014).

[3] Ajahar Ismailkha Pathan, Amit Sinhal, "Encode Decode Linux based Partitions to Hide and Explore File System", International Journal of Computer Applications (IJCA), Vol. 75(12), pp. 40-45, Aug 2013.

[4] Robot Control Design Based On Smartphone by Xiao Lu, Wenjun Liu, Haixia Wang, Qia Sun, IEEE, 978-1-4673-1382, pp-2820- 2823, Jun 2013.

[5] Awab Fakih, Jovita Serrao, "Cell Phone Operated Robotic Car" International Journal of Scientific and Engineering Research, ISSN2229-551.

[6] International Federation of Robotics (IFR). World robotics market 2006.
[7] Android phone controlled robot using Bluetooth by Arpit Sharma, Reetesh Verma, Saurabh Gupta, Sukhdeep kaur bhatia, IJEEE, Vol.7,pp-443-448, Nov- 2014

[8] Mohsin Raza "Autonomous Vehicles: Levels, Technologies, Impacts and Concerns" International Journal of Applied Engineering Research Volume 13, Number 16 (2018).
[9] Ajahar Ismailkha Pathan, Shezad Habeeb Shaikh, "A Survey on ETS Using Android Phone", International Journal Of Innovative Research In Technology (IJIRT), Volume 5 Issue 3 | ISSN: 2349- 6002, Page-99-104, August 2018
[10] Shubh Srivastava, Rajanish Singh "Voice Controlled Robot Car Using Arduino" International Research Journal of Engineering andTechnology Volume: 07 Issue: 05 May 2020.
[11] Conejero, J.A., Jord, N.C. and Sanabria-Codesal, E. (2016), "*An algorithm for self-organization of driverless vehicles of a car-rental service*", Nonlinear Dynamics, Vol. 84 No. 1, pp. 107-114.
[12] Android phone controlled robot using Bluetooth by Arpit Sharma, Ritesh Verma, Saurabh Gupta, Sukhdeep kaur Bhatia, IJEEE, Vol.7 pp-443-448, Nov- 2014
[13] Prof. Swati Khawate, Komal Prajapati, Yash Anand, & Kakshil Chandodwala. (2022). Voice Controlled Robotic Car using Arduino. International Journal of Scientific Research in Science, Engineering and Technology, 119–129.
[14] Shahzeb Ali, Azam Rafique "Self-Driving and Driver Relaxing Vehicle" ICRAI November-2016.
[15] Smart phone based robotic control for surveillance applications By M. Selvam, (IJRET 2014)
[16] Jangid sheetal Kailash, Vaishnika Balmukund Patil, Neha Vinay Patil, Ajahar Ismailkha Pathan," Behavioural, Emotional State Based Music Selection & Playlist Generating Player", International Journal Of Current Engineering And Scientific Research (IJCESR), Vol-4(12), pp. 39-43, Dec 2017.
[17] Range-based navigation system for a mobile Robot-Neil MacMillan, River Allen, Dimitri Marinakis, Sue Whitesides, IEEE 2010.
[18] H. Durani, M. Sheth, M.Vaghasia, and S.Kotech, "Smart Automated Home Application (Pramanik et al., 2016) using IoT with Blynk App," Proc. Int. Conf. Inven. Commun. Comput. Technol. ICICCT 2018, no. Icicct, pp. 393–397, 2018, doi: 10.1109/ICICCT.2018.8473224.