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Design and Fabrication of AI Based Vehicle to Prevent Road Accident

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Abstract
This study aims to introduce the concept of artificial intelligence in the automotive industry. In recent years, artificial intelligence has grown significantly, and ever since, advancements have been made in every aspect of the contemporary world. This article discusses the necessity for a strong artificial intelligence in the automotive industry and the recent expansion that has occurred up to this point. With a user order, this vehicle may navigate automatically. A vehicle controller will be used to regulate the vehicle's mobility. This vehicle is made up of a mechanical module (base) that holds the power unit, microcontroller unit, wheels, sensors, and DC motors. The circuit is powered by the power unit. DC motors increase motion capability. For smoother and quicker navigation, the microcontroller unit receives input from ultrasonic sensors, interprets it, and uses a motor controller to regulate the movement of motors. With the use of this technology, autonomous vehicles also referred to as "smart cars" that can navigate and resolve on-road situations safely and intelligently can be researched and produced. In the near future, cars based on this idea will improve road safety, reduce minor accidents, makes life easier and more convenient. In order to redefine this technology and make it even more superior and inexpensive, more study and funding are needed in this area.
Keywords: *Artificial Intelligence; mechanical module; microcontroller unit; vehicle's mobility; quicker navigation;*

1. Introduction
An AI vehicle refers to a vehicle that is capable of navigating and operating without human input. These vehicles use artificial intelligence (AI) and various sensors and technologies to perceive their environment, make decisions, and navigate safely [1]. Key components of an AI vehicle include:
Sensors: These include cameras, radar, ultrasonic sensors, and other technologies that help the vehicle perceive its surroundings.
Processor and Control Systems: Powerful processors and control systems process data from sensors in real-time and make decisions about how the vehicle should navigate [2].
Mapping and Localization: Autonomous vehicles often use detailed maps and localization systems to understand their position and the environment around them.
Communication Systems: Vehicles may communicate with each other and with infrastructure through V2V (vehicle-to-vehicle) and V2I (vehicle-to-infrastructure) communication systems [3].
Machine Learning and AI Algorithms: AI algorithms enable the vehicle to learn from data and adapt to different driving scenarios. Machine learning is crucial for improving the vehicle's

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decision-making capabilities over time.

2. Literature

The term "strong AI," which referred to AI that could typically accomplish any intelligent work that a human could, became popular in the 1950s as modern AI absorbed it. A hominid could. Feeble AI, approaches to narrower challenges, is the ultimate result of the lack of progress in strong AI. These two instances accounted for the majority of AI research up to the 1980s. However, in the 1980s, mechanism learning emerged for research, with the goal of enabling computers to learn and create models so they could carry out tasks. From 2016 to 2018 [4], the European Commission funded development for connected and automated driving through Coordination Actions CARTRE and SCOUT programs [5]. In March 2021, Honda was the first manufacturer to sell a legally approved Level 3 car. Nuro began autonomous commercial delivery operations in California in 2021 [6]. Nuro was approved for Level 4 in Palo Alto in August, 2023. In December 2021, Mercedes-Benz received approval for a Level 3 car. In February 2022, Cruise became the second service provider to offer driverless taxi rides to the general public, in San Francisco [7]. In December 2022, several manufacturers had scaled back plans for self-driving technology, including Ford and Volkswagen [8,9].

3. Method

3.1 Components

Arduino Uno and L293D Driver Shield are the brain of this project.

3.1.1 Arduino Uno

Arduino Uno is an open-source microcontroller board based on the Microchip AT-mega328P microcontroller and developed by Arduino.cc. Figure 1 represents the Arduino Uno.

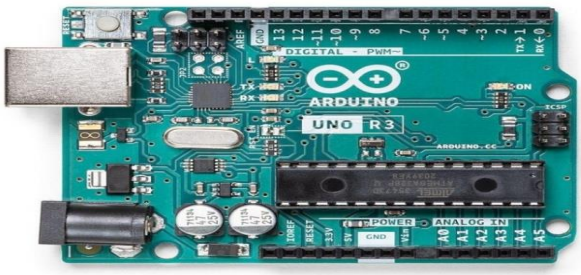

Figure 1 Arduino Uno

The board is equipped with sets of digital and analog I/O pins that may be interfaced to various expansion boards (shields) and other circuits. 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 USB B cable [11]. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

3.1.2 Ultrasonic Sensor

The HC-SR04 is a non-contact ultrasound sonar device that consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit for measuring distance to an object.

Figure 2 represents the Ultrasonic sensor, which senses the nearer obstacles.

Figure 2 Ultrasonic Sensor

3.1.3 DC Motor

A DC motor is a device that transforms any sort of energy into mechanical energy to make something move. DC motor is used to rotate the wheels of this vehicle. Figure 3 represents the DC motor. According to the motor capacity the vehicle moves.

Figure 3 Dc Motor

3.1.4 Wheel

In order to move the vehicle wheel is required. In this project 3 wheels are used. It is a necessary component of a vehicle. Figure 4 represents the wheel.

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Figure 4 Wheel

3.1.5 Servomotor

A servomotor will be turning actuators or direct actuators that ponder exact control of other straight positions, speed & speed increment. The servo motor will be a shut circle servo mechanism that uses positions to investigate for last positions development & controlled [12]. This obligation for the control will be a sign (direct & electronic) watching out for their positions prepared to the yield shaft. Figure 5 represents the servomotor.

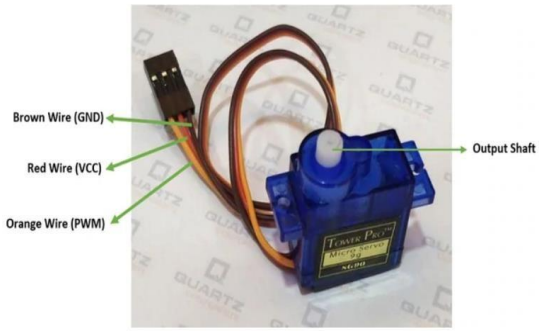

Figure 5 Servomotor

3.1.6 Battery

An 18650 is a lithium-ion rechargeable battery. Their proper name is"18650cell".The 18650 cell has voltage of 3.7v and has between1800mAh and 3500mAh (milli-amp-hours). 18650s may have a voltage range between 2.5 volts and 4.2 volts, or a charging voltage of 4.2 volts, but the nominal voltage of a standard 18650 is 3.7volts. There are two types: protected and unprotected. In this project we used protected type. 18650 protected batteries have an electronic circuit. The circuit is embedded in the cell packaging (battery casing) that protects the cell from over charge, heat, over discharge, over current and short circuit [10]. An18650 protected battery is safer than an 18650 unprotected battery (less likely to overheat, burst or start on fire). Figure 6 represents battery.

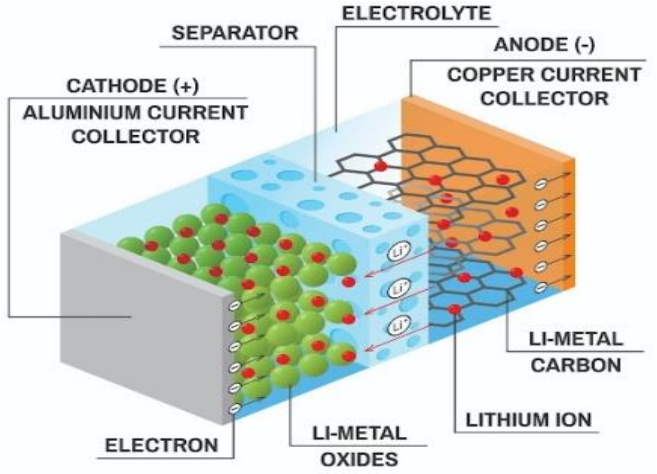

Figure 6 Battery

4. Experimental Set-Up

The schematic layout of this prototype represents in Figure 7.

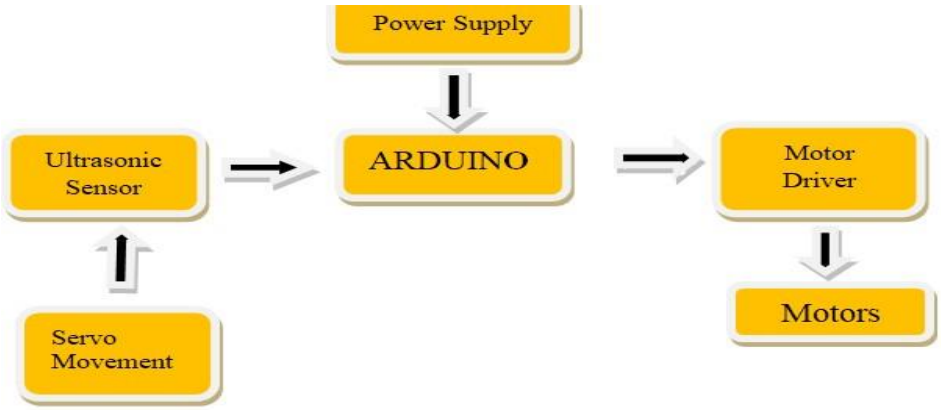

Figure 7 Schematic Layout of The Project

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The prototype of the experimental set-up is formed by assembled all the components together according to the above schematic layout in proper position. A mechanical base is used as a vehicle Platform to carry the loads on the vehicle. Sensors are connected for visual data and object direction. Ultrasonic sensors are used for proximity sensing. Global positioning systems are used for location tracking. For software algorithms Arduino Uno is connected. Figure 8 represents the experimental set-up of the AI prototype vehicle.

Figure 8 Experimental Set-Ups Ai Vehicle

5. Working Principle

The working principle of an AI-powered vehicle involves a complex interplay of various technologies and systems to enable the vehicle to perceive its environment, make decisions, and navigate autonomously. Initially video camera detects the obstacles. Sensors monitor the positions of nearby obstacles and send the signal to Arduino Uno. Two infrared sensors on both sides are used to detect orientation. The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in the Java programming language. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. The programs are installed as per our requirements in Arduino Uno. It commands the servomotor to change the directions. To have full control over the DC motor, we must control the DC motor speed and rotation direction. The speed of a DC motor can be controlled by varying its input voltage. This is how AI vehicle work to prevent from accident.

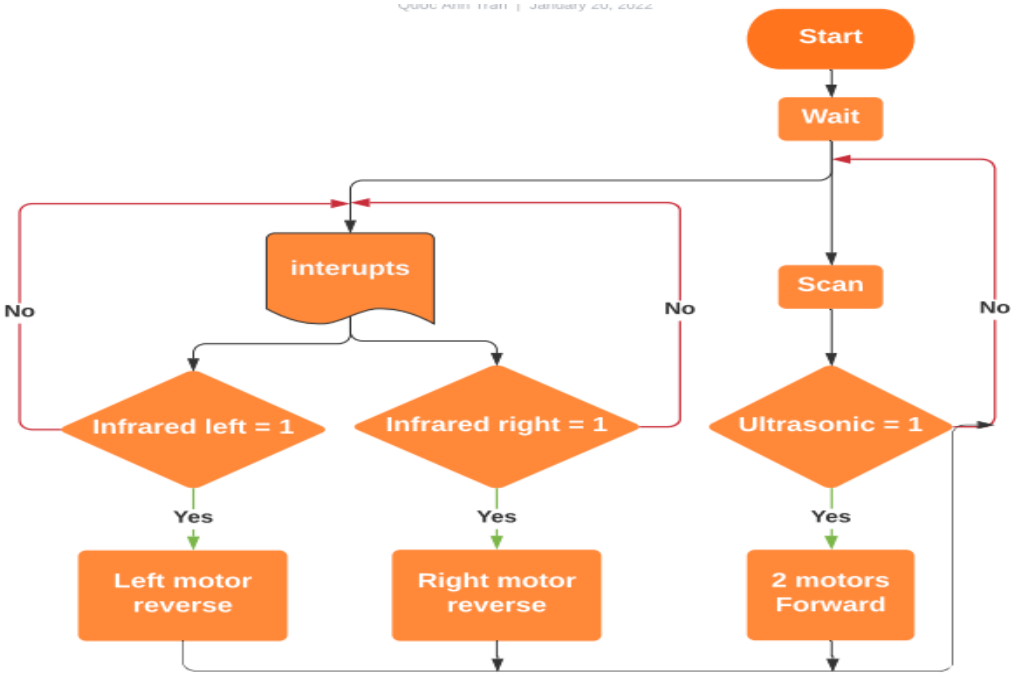

Figure 9 Flowchart

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The idea of this project was visualized as a flow chart in Figure 9. The robot waited for the trigger of any sensors. All of the sensors worked simultaneously, so robot did not have to wait for any latency delay. If ultrasonic distance sensor detected human in range between 10-50 centimeters, the robot would follow that human and go forward. Otherwise, it would stay at the same position. Meanwhile, both two sensors on the left or right perceived any movement from human on that side which led the robot to turn depend on that signal direction.

6. Result and Discussion

Several experiments were carried out, and the performance of the human following robot was evaluated. The ultrasonic and infrared sensors were tested. It was discovered that the sensor was accurate within a range of 4 meters. Then we ran the test to see if the robot kept a specific distance from the target object. The serial communication between Arduino, motor shield, and various motors was then tested. We made the necessary changes to the processing and control algorithm based on the results of these tests and experiments. Following the completion, we discovered that the results were very satisfying, with the robot perfectly following the person wherever it went. As a result, the goal of implementing a good Human-Robot interaction was met.

Artificial intelligence (AI) has revolutionized the automotive industry and has been integrated into vehicles in various ways, leading to advancements in safety, convenience, and efficiency [13]. Here are some applications of AI in vehicles:

1. **Autonomous Driving:** AI enables vehicles to perceive their environment, make decisions, and navigate without human intervention.
2. **Advance Driver Assistance Systems (ADAS):** ADAS utilizes AI to enhance vehicle safety by providing features like adaptive cruise control, lane-keeping assistance collision avoidance, and automated parking.
3. **Manufacturing Optimization:** From design to production and post production, leveraging AI in automotive manufacturing can mean significant cost and time savings.
4. **Traffic Management and Optimization:** AI-based systems can analyze traffic patterns, predict congestion, and optimize routes in real-time.
5. **Smart Parking Solutions:** AI-powered systems assist drivers in finding available parking spaces, reducing traffic congestion, and improving urban mobility.
6. **Emotion Recognition and Driver Monitoring:** AI-powered systems can monitor driver behavior, detecting signs of drowsiness, distraction, or erratic driving [14]. These systems can alert drivers or take corrective actions to prevent accidents.

Conclusion

The advent of AI in vehicles has brought about a revolutionary transformation in transportation and automotive technology. Here are some key conclusions regarding AI in vehicles:

1. Safety Advancements
2. Autonomous Driving
3. Improved Efficiency
4. Enhanced User Experience
5. Challenges and Ethical Considerations
6. Regulatory Frameworks

AI in vehicles holds immense potential to transform transportation by enhancing safety, efficiency, and user experience. However, addressing technical challenges, ethical considerations, regulatory frameworks, and ensuring public trust are crucial for the successful integration and widespread adoption of AI-powered vehicles in the future [15].

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