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Automatic Speed Regulation of Vehicles based on speed zones using RFID

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Abstract

Maintaining appropriate vehicle speeds in different zones is crucial for road safety and traffic management. This project proposes an automatic speed regulation system for vehicles based on speed zones using RF technology. By integrating an RFID reader and cards, motor driver, DC motor, Arduino, and LCD display, this system automatically adjusts the vehicle's speed when it enters designated speed zones. The RFID reader detects the speed zone from RFID tags placed along the road. The Arduino processes this data and controls the motor driver to adjust the speed of the DC motor accordingly. The LCD displays the current speed and zone information. This innovative system enhances road safety and ensures compliance with speed regulations.

I. Introduction

In the present day scenario, traffic-related problems are becoming more serious day by day. As the population continuously increases, so does the number of vehicles on the road. Underdeveloped infrastructure and inadequate distribution of development are inflicting various problems, contributing to the traffic woes. Road accidents are largely attributed to rash driving and speeding. Many drivers fail to recognize the value of human lives, and the rate of accidents is escalating rapidly each year as the number of vehicles increases. Governments have implemented various measures to curb these accidents, but many of these initiatives have fallen short of addressing the root causes effectively. Several manufacturers have developed laser-based control systems to manage vehicle speed, but the high cost of these systems makes them inaccessible to many. Furthermore, these systems often struggle to detect pedestrians accurately, especially in scenarios where someone crosses the road unexpectedly. This limitation has prompted the need for a more efficient and cost-effective solution. Initially, we considered using laser diodes for our system, but the high cost led us to explore alternative technologies. The next option was the Infrared (IR) module. However, the IR module has a significant drawback: it requires a direct line of sight to function effectively, making it unreliable in many practical situations. Ultimately, we decided to utilize Radio Frequency (RF) technology for automatic speed regulation

Literature Review:

Nowadays people are driving very fast; accidents are occurring frequently, we lost our valuable life by making small mistake while driving (school zone, hills area, and highways). So in order to avoid such kind of accidents and to alert the drivers and to control their vehicle speed in such kind of places the highway department have placed the signboards. But sometimes it may to possible to view that kind of signboards and there is a chance for accident. So to intimate the driver about the zones and the speed limit automatically, is done by means of using RF technology. The main objective is to

design a Smart Display controller meant for vehicle's speed control and monitors the zones, which can runon an embedded system. Smart Display & Control (SDC) can be custom designed to fit into a vehicle's dashboard, and displays information on the vehicle. The project is composed of two separate units: zone status transmitter unit and receiver (speed display and control) unit. Once the information is received from the zones, the vehicle's embedded unit automatically alerts the driver, to reduce the speed according to the zone, it waits for few seconds, and otherwise vehicle's SDC unit automatically reduces the speed. **"Smart Zone Based Vehicle Speed Control Using RF and Obstacle Detection and Accident Prevention," Vinod Rao, Saketh Kuma, 2014.**

II. Proposed System:

Our proposed system aims to enhance road safety and streamline traffic management through automatic speed regulation using RF technology. The system operates by utilizing RFID tags, RFID readers, an Arduino microcontroller, a motor driver, a DC motor, and an LCD display to ensure that vehicles comply with designated speed limits in various zones.

The operation begins with the strategic placement of RFID tags in different speed zones along the roadway. Each RFID tag is pre-programmed with the specific speed limit for its respective zone. As a vehicle equipped with an RFID reader enters a speed zone, the reader detects the RFID tag and captures the speed zone data. This data is then transmitted to the Arduino microcontroller within the vehicle.

Upon receiving the data, the Arduino processes the information to determine the necessary speed adjustment required for the vehicle to comply with the designated speed limit of the zone. The Arduino communicates with a motor driver to control the speed of the DC motor that regulates the vehicle's speed. The motor driver adjusts the motor's speed accordingly, ensuring that the vehicle adheres to the speed limit specified by the RFID tag.

To provide real-time feedback to the driver, an LCD display is integrated into the system. This display shows the current speed of the vehicle as well as the speed limit of the zone they are in, allowing drivers to remain informed and compliant.

III. Block diagram:

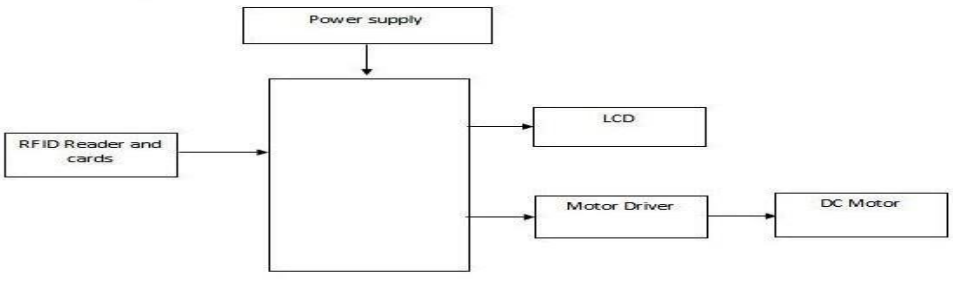


Fig: block diagram of proposed system

Schematic diagram:

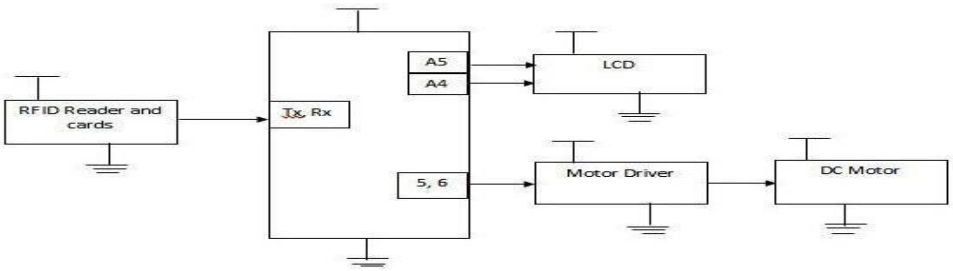


Fig: Schematic diagram of proposed system

IV. Hardware Requirements;

Arduino

The Arduino is one of the most popular and widely used Arduino boards. It's based on the ATmega328P microcontroller and offers a good balance of features, performance, and affordability, making it suitable for a wide range of projects, from simple to moderately complex.

Most electronic devices involve circuit-making using hardware components. The purpose of introducing Arduino was to make an easy-to-use device that can offer the feature of programming along with circuit making.

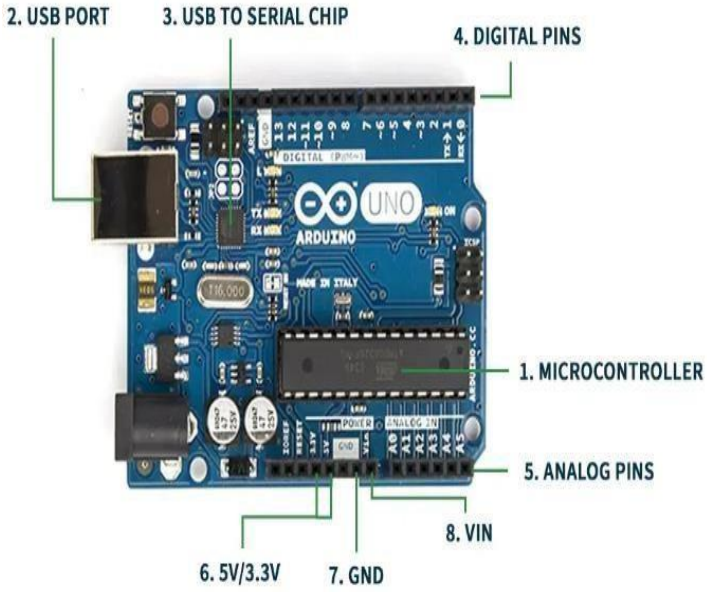
Therefore, Arduino is a programmable device that is used mostly by artists, designers, engineers, hobbyists, and anyone who wants to explore programming in electronics.

The Arduino uses its components to gather information from the surroundings and generate a precise output accordingly. The information is gathered using some components like sensors, and input pins, and an output is generated depending on the programming done. This output can range from illuminating an LED to turning the motors on.

Arduino are great devices that can be used for creating interactive projects. They can either be used alone to create basic projects or they can be integrated with Arduino, Raspberry Pi Pico , Node MCU, or nearly anything else using some programming in their software to create some advanced level of projects. It is good to know the specifications of different Arduino so that you can select the right Arduino for your project.

Arduino Hardware

Let us look at the hardware components of Arduino:

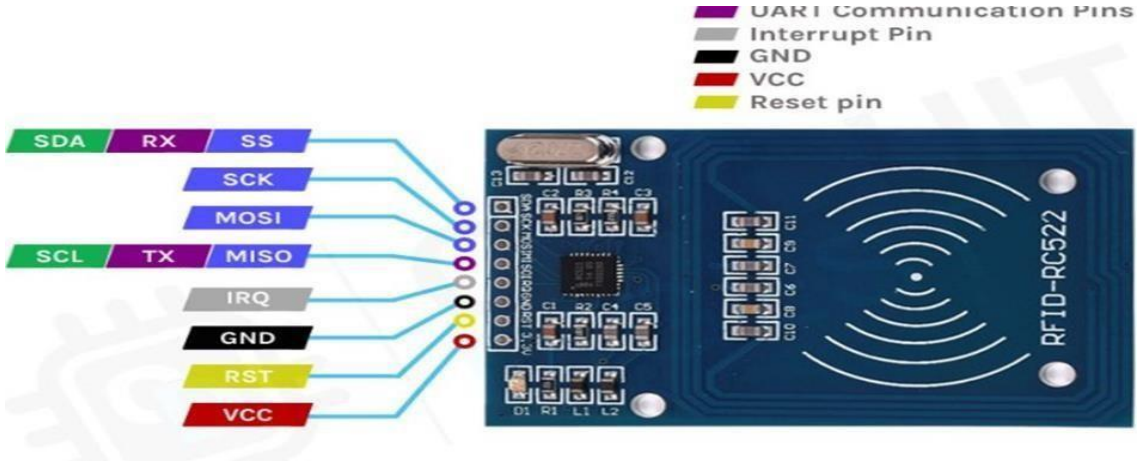


RC522 RFID Reader Module

RC522 is a Multi-communication RFID Module for Arduino and Microcontrollers. The RC522 is known as MFRC-522 due to its NFX semiconductor microcontroller. The module allows the developers to interface it with any other can act as a reader and write for UID/RFID cards. The RFID cards communicate with the module at a short distance with radio frequency due to the mutual induction technique. In most of the security and commercial products, the module is effective because the errors and issues with RFID Tags are detectable by it.

RC522 Pin Configuration Details

In this module, there are only two kinds of pins. So, the first one is power and the second one is the communication pins. Therefore, the device may have its microcontroller chip on itself but it only makes it to works as an RFID. The on-board microcontroller won't make the module a stand-alone device.



The core function of an RFID card is to automatically identify objects and transmit data in a contactless manner.

Fig: RIFD cards

LCD

LCD is a flat display technology, stands for "Liquid Crystal Display," which is generally used in computer monitors, instrument panels, cell phones, digital cameras, TVs, laptops, tablets, and calculators. It is a thin display device that offers

support for large resolutions and better picture quality. The older CRT display technology has replaced by LCDs, and new display technologies like OLEDs have started to replace LCDs. An LCD display is most commonly found with Dell laptop computers and is available as an active-matrix, passive-matrix, or dual- scan display. The picture is an example of an LCD computer monitor.

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

DC Motor

DC Motor is an electrical machine which, when provided with direct current electrical energy, converts it into mechanical energy. It is based on electromagnetic induction, where a conductor carrying current (normally a coil of wire) placed in a magnetic field experiences force to rotate. This rotation is used to perform mechanical work. There are many applications for DC motors, they can be used in robotics; electric vehicles, and some industrial machinery as well as household devices. DC motor can be used at such places where speed control is required.

That is why DC motors are often used in trolleys, electric train production systems, elevators, etc.

L293D Motor Driver IC

There are multiple kinds of motion we face in our daily life some are linear some are rotatory motion. Both motions have their importance in machines and our life. In the 19th century, the scientist started discovering/inventing some ways of producing current and motions when British physicist John Ambrose Fleming invented the right-hand rule.

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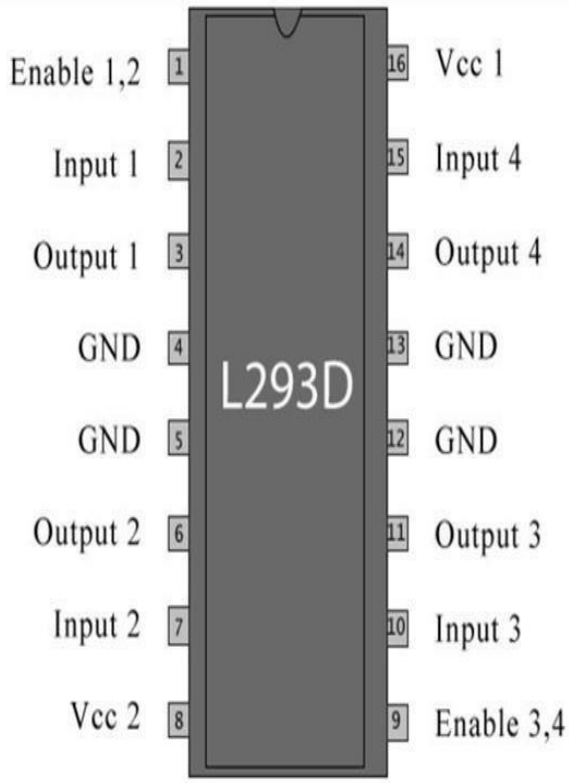
L293D IC is known as a motor driver. It is a low voltage operating device like other ICs. The other ICs could have the same functions like L293d but they cannot provide the high voltage to the motor. L293d provides the continuous bidirectional Direct Current to the Motor. The Polarity of current can change at any time without affecting the whole IC or any other device in the circuit. L293D has an internal H-bridge installed for two motors. H-Bridge is an electrical circuit that enables the load in a bidirectional way. L293D Bridge is controlled by external low voltage signals. It may be small in size, but its power output capacity is higher than our expectation. It could control any DC motor speed and direction with a voltage range of 4.5 – 36 Volts. Its diodes also save the controlling device and IC from back EMF. To control the max 600mA amount of current an internal "Darlington transistor sink" installed in it, which could be used to control a large amount of current by providing a small amount of current. It has also internal "pseudo-Darlington source" which amplifies the input signal to control the high voltage DC motor without any interception.

L293D pin out



POWER SUPPLY:

REGULATED POWER SUPPLY

Virtually every component of an electronic system converts DC electricity. Therefore, the DC power source will be necessary for each of these stages. A battery can power any system that uses little electricity. However, batteries may not be the most straightforward or affordable option for gadgets that need constant power. An unregulated power supply, which includes a filter, rectifier, and transformer, is the most effective option. Down below, you can see the diagram.

The electrical circuits inside any given device must be capable of supplying a consistent DC voltage within the device's specified power supply limit. Both the voltage and the current may only go as high as this DC supply allows. The problem is that the electrical devices are vulnerable to breakdowns caused by fluctuations in the mains supply.

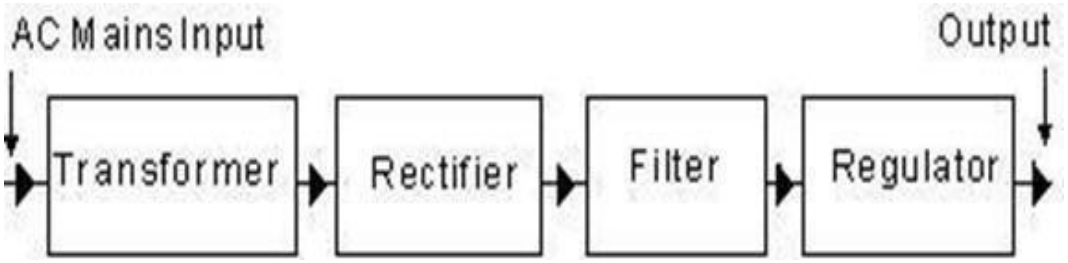


Fig 3.5 Block diagram of Regulated power supply

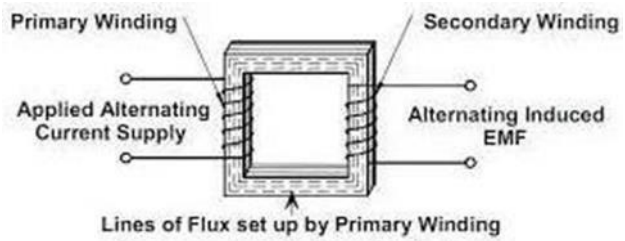
TRANSFORMER

Simply said, a transformer is a static device that aids in the conversion of electrical power from one circuit to another, while maintaining the same frequency. In a circuit, changing the voltage requires changing the current ratings in a direct proportional fashion.

TRANSFORMER WORKING PRINCIPLE

A transformer operates on the principle of mutual inductance, which occurs when two circuits linked by a common magnetic flux experience a change in current. Two electrically separate coils that are inductively linked are magnetically coupled via a reluctance channel to make a basic transformer. To better grasp the operation of the transformer, refer to the diagram provided below.

Below, you can see the primary and secondary windings of a power transformer. In the core's cross-section, you can make see the little spaces that exist between the lamination strips. Imbricated is the word that best defines these staggered joints. The two coils have a rather large mutual inductance. A mutual electromotive force is induced in the transformer by the coil, which is connected to an alternating voltage source, via the alternating flux that builds up in the laminated core.



VOLTAGE REGULATOR

A voltage regulator is a kind of electrical regulator that is specifically designed to automatically keep the voltage level constant. A combination of active and passive electrical components, as well as an electromechanical mechanism, might be used. A number of AC or DC voltages may be controlled by it, depending on its architecture.

The purpose of a voltage regulator is to "regulate" the voltage level automatically. It takes the input voltage and reduces it to the required level, then maintains that level throughout the supply. As a result, the voltage remains constant regardless of the supplied load.

All three of these pins are regulators.

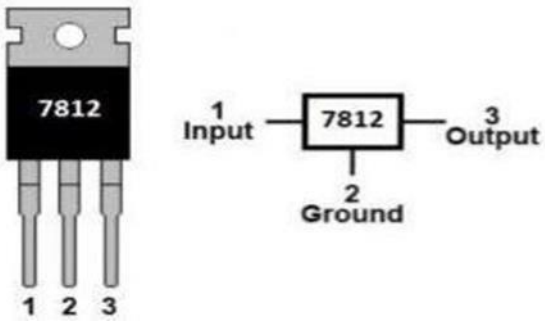


Fig 3.15 12

V Voltage Regulator There are two types of regulator are they.

- Positive Voltage Series (78xx) and
- Negative Voltage Series (79xx)

V. Schematic Daigram:

Schematic diagram:

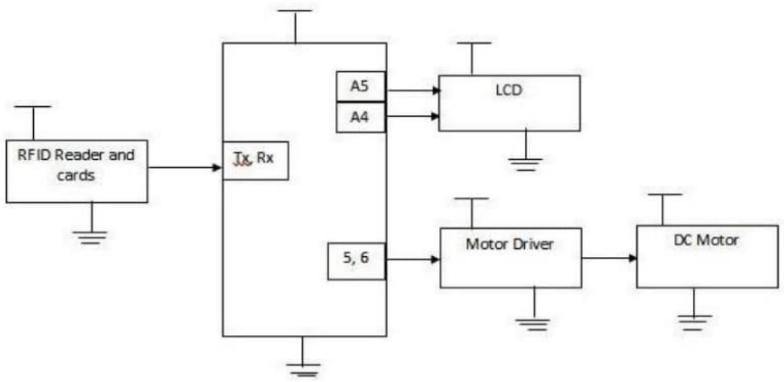
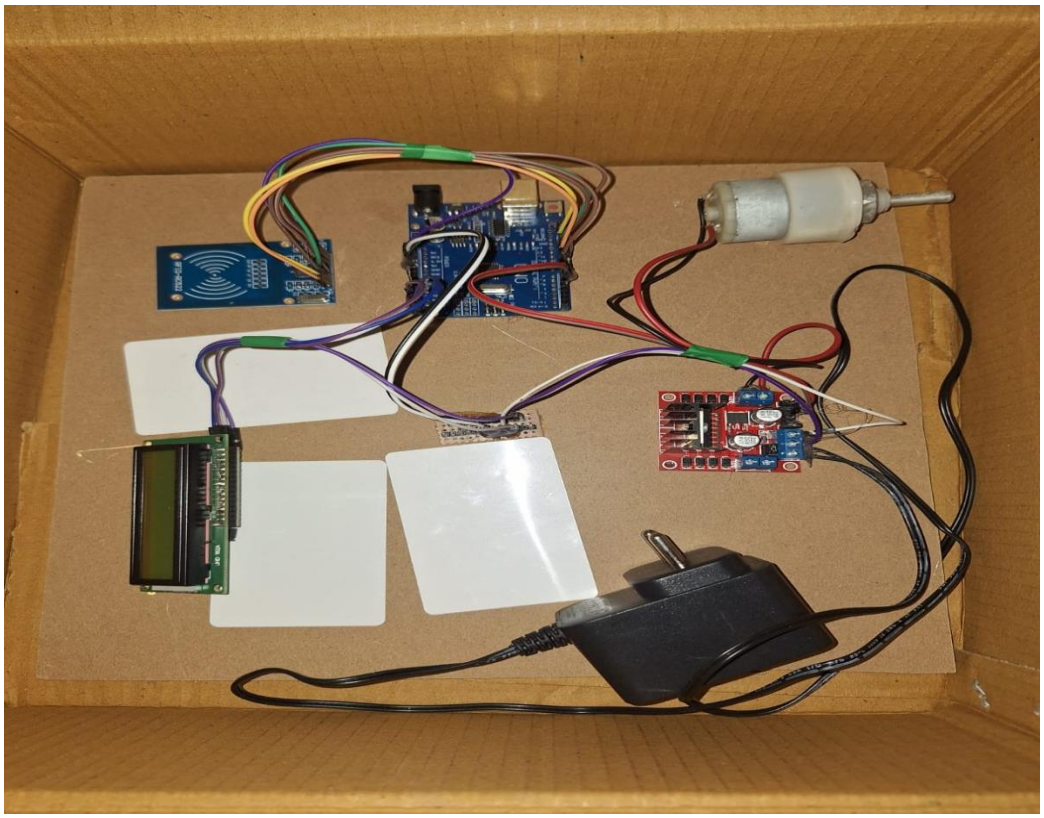
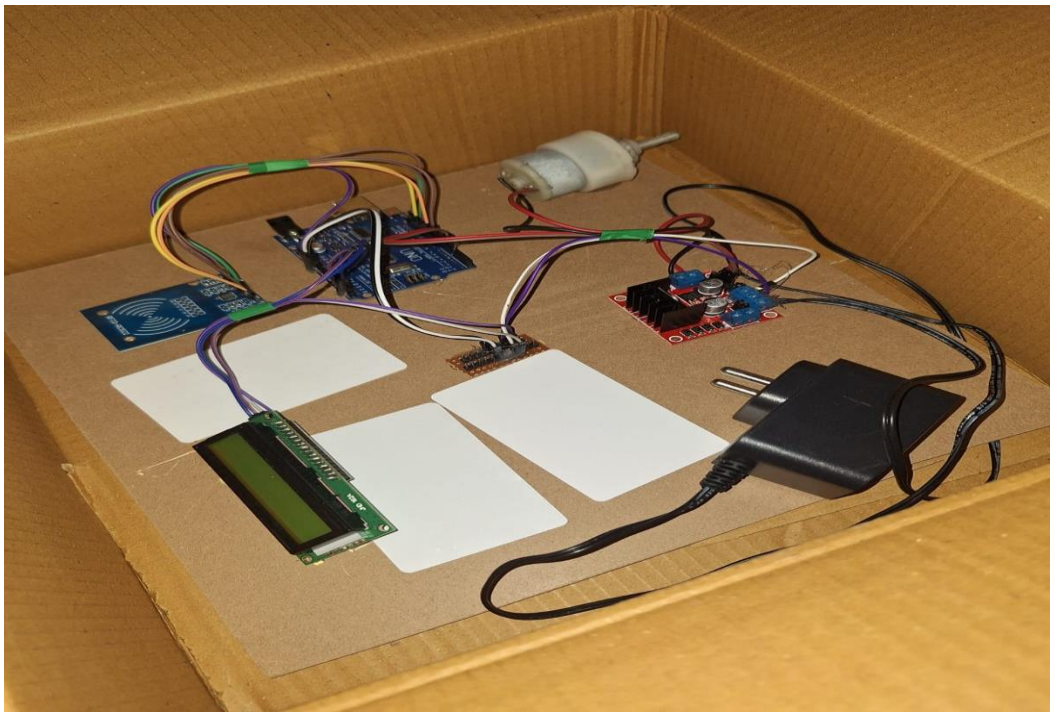


Fig: Schematic diagram of proposed system

VI. Result:





RESULT AND CONCLUSION:

The automatic speed regulation system using RF technology offers a practical solution for enhancing road safety and managing traffic effectively. By placing RFID tags in various speed zones and equipping vehicles with RFID readers, this system ensures vehicles automatically adjust their speed to comply with designated speed limits.

The integration of an Arduino microcontroller, motor driver, DC motor, and LCD display provides a cohesive approach to speed regulation and real-time feedback.

This system reduces human error, enhances road safety, and minimizes the need for manual enforcement. Its cost-effectiveness and ease of implementation make it a feasible option for widespread adoption. Overall, this project demonstrates the potential of RF technology to create safer and more efficient roads, benefiting drivers, passengers, and pedestrians alike.

VII. FUTURE SCOPE:

The mini-project "Automatic Regulation of Vehicles using RFID" has a scope focused on utilizing RFID technology to manage and control vehicle speed, access, and potentially other aspects of vehicle operation within specific zones. This can involve automatically adjusting speed limits, controlling access to restricted areas, or even preventing theft. The project leverages the ability of RFID to identify and track vehicles equipped with tags, enabling automated responses based on predefined rules and location

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