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Review Article about Design Smart Medication Transport Cart

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Abstract:

The smart medical cart represents a paradigm shift in healthcare logistics, leveraging cutting-edge technology to enhance the distribution of medical supplies. The integration of an Arduino Uno microcontroller and AI-enhanced camera system not only automates the tracking and delivery process but also introduces a level of precision and reliability previously unattainable with manual methods.

This autonomous vehicle is designed with a dual focus on functionality and user interaction. The AI algorithm is trained to recognize and follow healthcare personnel, ensuring that the cart remains unobtrusive yet responsive to the dynamic environment of a medical facility. The inclusion of an auditory alert system serves as a proactive measure to maintain adherence to transport schedules, which is crucial for time sensitive medications.

The smart cart's design is a testament to the interdisciplinary nature of modern medical technology,

where engineering and healthcare converge to create solutions that are both innovative and practical. Its development underscores the importance of continuous improvement in healthcare operations, aiming to deliver care that effective.

1. Introduction

1.1. Introduction

The purpose of this project is to design and develop an autonomous medical cart that follows humans, with the aim of facilitating the transportation of medications and other medical materials in hospitals, clinics, and other medical facilities By avoiding traditional methods of transporting medicines, it works on:Reducing the effort and time required for medication transportation: As the cart is autonomous, it will independently handle the transportation process, saving effort and time for medical professionals. Increasing the accuracy and safety of medication transportation: Equipped with advanced control and safety systems, the cart will help ensure the safety of medications during transportation Improving work efficienc in hospitals and clinics: By taking over some tasks performed by medical professionals, the cart will help improve work efficiency and increase productivity

1.2. Problem Statement

1.2.1. Human Error and Delays:

Human error can lead to incorrect deliveries, missed doses, or delays. Nurses may be busy attending to other This delay can impact patient well-being, especially for time-sensitive medications.

1.2.2. Inefficiency:

Manual transport can be inefficient, especially in large healthcare facilities. Nurses spend valuable time walking between medication storage areas and patient rooms.

1.2. 3.Risk of Contamination:

Traditional medicine transport involves physically handling medication containers.

1.2.4. Temperature Sensitivity:

Some medications are temperature-sensitive. Traditional transport may not adequately maintain the required temperature conditions.

1.3. The Project Aims

1. Effort and time of medication transportation
2. Safety of medication transportation
3. Work efficiency in hospitals and clinic

2. Literature Review

I. PAPER1: November 2015

Design and Construction of An Arduino based Wireless Remote Controlled Video Capturing Vehicle [1]

The objective of the research work

was to develop a mobile remote-controlled monitoring system called the Video Capturing Vehicle (VCV). The VCV is a wireless remote-controlled device designed for capturing video footage in areas that are inaccessible to humans or in biologically hazardous environments. It aims to aid scientific research, data gathering, and control in such areas.

Components:

mechanical mobility system, an Arduino Uno R3 microcontroller, a Bluetooth slave for wireless

control signal reception, a distance sensor for obstacle avoidance, an L298N motor shield for controlling the movement of wheels, motor drivers, and wheels for actual movement, and an IP camera for video surveillance.

- The remote control is operated via a smartphone, which acts as an interface to the control application. The smartphone communicates wirelessly with the VCV through the Bluetooth module and sends control signals to control its movement. VCV is designed to provide mobile flexibility and greater freedom, allowing it to access any geographical location and deliver video feeds to remote operators.
- Overview of the VCV system, including its components and functionality.

Additionally, the design and implementation process are discussed, and a block diagram illustrating the interconnection modules of the VCV system is presented: video acquisition vehicle, camera display system, and remote control system.

Challenges

- The VCV structure has some imbalance in the Centre of gravityand was not strong enough to carry
- The Bluetooth serial communication always interfered with the distance sensor communication. Hence the VCV movement will achieve about 90% of its intended movement.
- Powering the Arduino Uno through batteries was problematic.

II. PAPER 2: February 2016

Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor,

Android And Bluetooth For Obstacle Detection[2]

The objective of the research work design and development of an obstacle avoidance robotic vehicle. The goal of the project is to create an autonomous robot capable of detecting obstacles and avoiding collisions

- The robot is controlled using an Arduino board, and communication with the robot is established through an Android application running on a smartphone or tablet. The Android application connects to a Bluetooth module, which enables the transmission of commands to the robot. The authors mention that although there are similar apps available, they have specifically programmed this project to be used with an Android app.
- his paper includes a literature review section where the authors discuss previous research on robot navigation and obstacle avoidance. obstacle avoidance potential field methods.

The article concludes with a section on the Android application, mentioning its role in wirelessly controlling the robot using Bluetooth technology.

III. PAPER 3: April 2020

ANDROID CONTROLLED SURVEILLANCE ROBOT WITH OBSTACLE DETECTION USING ARDUINO [3]

The objective of the research work develop a surveillance robot vehicle that can be controlled and monitored using Android smartphones. The robot is equipped with an Arduino UNO microcontroller and an inbuilt camera for capturing real time video. It utilizes wireless Bluetooth connectivity to establish communication between the robot and the smartphone..

The surveillance robot is designed to detect obstacles in its path using an ultrasonic sensor, thereby avoiding collisions. The captured video from the robot can be used for recording and taking pictures. The authors emphasize the need for lightweight and cost-efficient robotic technologies to replace bulky and expensive surveillance systems currently availableIntroduction of Arduino Uno

R3 as an open-source electronic circuit board with various features. Description of HC-SR04 ultrasonic sensor as a distance measuring device using ultrasonic waves Introduction of L298N motor driver as an IC type H-bridge for controlling inductive loads, including motors.

The article provides an overview of the project, including the use of an Android application called "Arduino Bluetooth Controller" for controlling the robot. The user interface of the application includes arrow buttons, a terminal, an accelerometer, buttons and slider, metric and voice control options. The accelerometer allows the user to control the robot's movements by tilting the smartphone in different directions.

Furthermore, the article discusses the implementation of object detection to ensure the safety of the robot. When an obstacle is detected in front of the robot, it prevents forward movement even if the user commands it to move forward. The obstacle detection system relies on a sensor placed in front of the robot.

IV. PART4: January 2021

Ultrasonic Signal Implementation in Arduino-Based Obstacle Robot Control System [4]

The objective of the research work an overview of the research conducted. The study focuses on developing an obstacle robot that utilizes ultrasonic signals to detect and avoid unknown obstacles. The robot consists of three main components: Arduino Uno as the controller, L298N driver for motor/wheel control, and HC-SR04 ultrasonic sensor for sending and receiving ultrasonic signals. The ultrasonic sensor is positioned at the front of the robot to detect obstacles in its path. The research aims to determine the accuracy of obstacle distance detection and enable the robot to stop when obstacles are detected

Research Objectives

Authors aim to develop an obstacle robot controlled by an Arduino Uno, L298N driver, and HC-SR04 ultrasonic sensor .Ultrasonic sensor's role in distance measurement and obstacle avoidance highlighted. Emphasis on accurate distance detection for effective obstacle avoidance.

V. PART5: June 2022

Obstacle Detection in Self-Controlled Cars [5]

The objective of the research work the creation of an obstacle detection and collision avoidance system for autonomous cars. It employs sensors, cameras, and radars to perceive the car's surroundings and navigate safely. The focus is on detecting both existing and sudden obstacles. The authors suggest using an ultrasonic sensor (HCSR04) on the car's front, mounted on a servo motor, for obstacle detection and distance measurement. The system includes a motor driver module and four DC wheel motors for vehicle movement. The Arduino Uno microcontroller is used for control and obstacle avoidance.The introduction highlights the growing demand for autonomous projects and the role of sensors in enabling environmental interaction. It aims to build an obstacle avoidance vehicle using ultrasonic sensors.

System Design:

The system design section details the project's components, including the Arduino Uno microcontroller, TT gear motors, wheels, and a servo motor. The Arduino Uno serves as the control unit, TT gear motors provide motion, and the servo motor rotates the ultrasonic sensor for obstacle detection

Design and Methodology.

In This Section, We Will Explain About Components Used In This Project And Design of System

3.1 Components:

The main components used in this project are presented as follows**:**

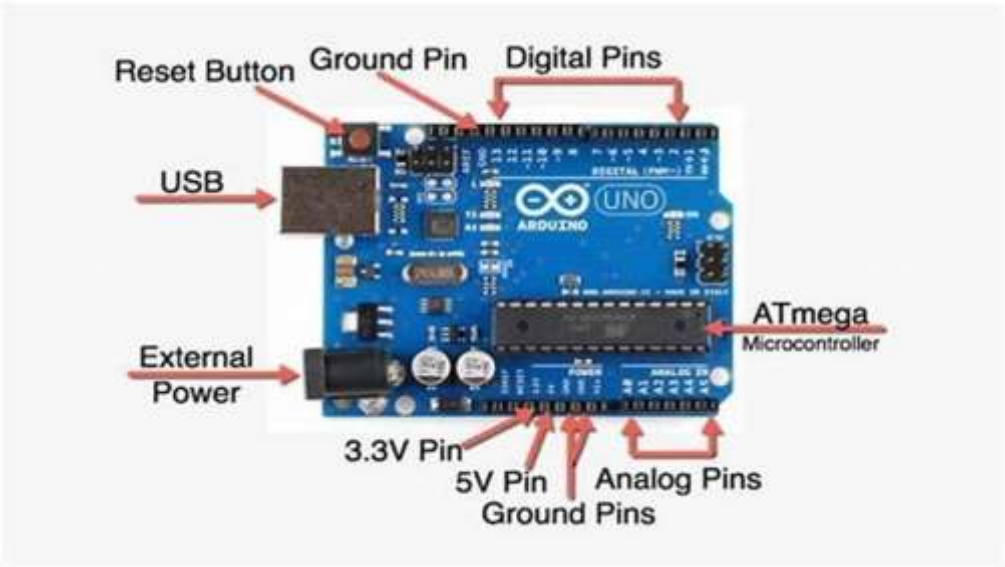
3.1.1 Arduino Uno R3

Arduino Uno R3 is an open source electronic circuit board in which there is an

Atmel microcontroller chip output. Arduino Uno R3 is a board based on the ATmega328.

Arduino Uno R3 has 14 digital input / output pins (6 of which can be used as

PWM outputs), 6 analoginput pins using a 16 MHz crystal, including pins A0 to A5, USB (Universal Serial Bus) connection, power jack, ICSP header and reset button. The analog pin on the Arduino Uno R3 has an analog reference voltage (Aref) of 5 volts. The shape of the Arduino Uno R3 board seen in figure (3-2)



Features:

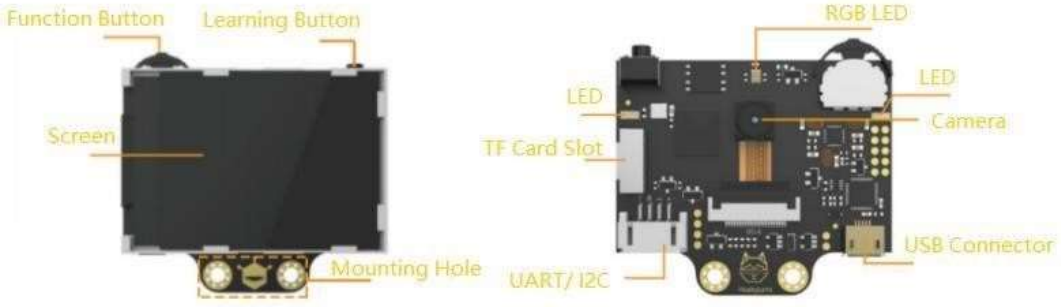
- ✓ Microcontroller: ATmega328
- ✓ Operating Voltage: 5V
- ✓ Input Voltage (recommended): 7-12V
- ✓ Input Voltage (limits): 6-20V
- ✓ Digital I/O Pins: 14 (of which 6 provide PWM output)

- ✓ Analog Input Pins: 6
- ✓ DC Current per I/O Pin: 40 mA
- ✓ DC Current for 3.3V Pin: 50 mA
- ✓ Flash Memory: 32 KB of which 0.5 KB used by bootloader
- ✓ SRAM: 2 KB (ATmega328)
- ✓ EEPROM: 1 KB (ATmega328)
- ✓ Clock Speed: 16 MHz

3.1.2 Huskylens:

HuskyLens is an intelligent machine vision sensor that can track objects using built-in artificial intelligence algorithms. Some of the features of using it for a robot that follows humans .

- ➢ HuskyLens can recognize faces, objects, colors, tags, and lines, andclassify them.
- ➢ HuskyLens connects to Arduino or Micro: bit via UART or I2C port and sends them data about the location, size, and type of the target.
- ➢ HuskyLens contains a learning button that allows the robot to store and retrieve learned models.-HuskyLens can recognize faces, objects, colors, tags, and lines, and classify them.
- ➢ HuskyLens enables the robot to determine the direction, speed, and distance of the target and move towards or away from it.
- ➢ HuskyLens contains a learning button that allows the robot to store and retrieve learned models.



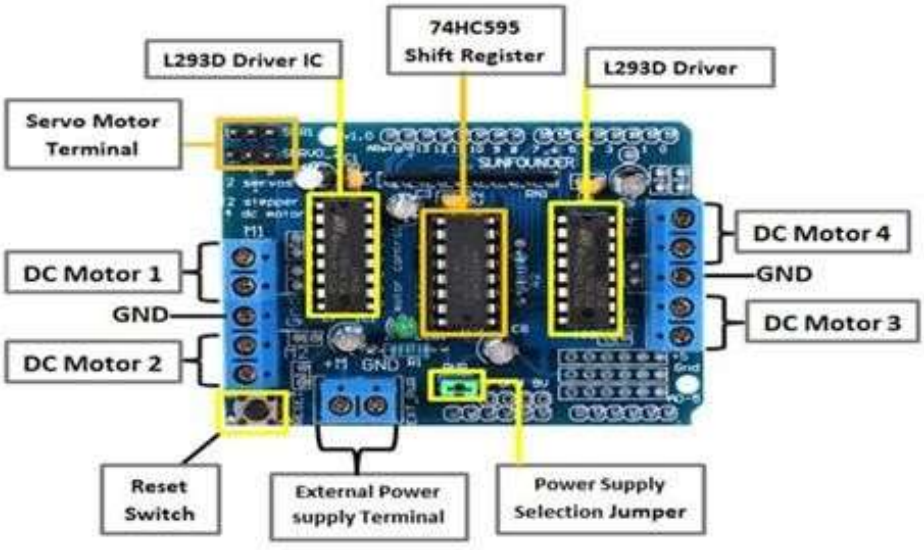
Features:

- ✓ Processor: Kendryte K210
- ✓ Image Sensor: OV2640 (2.0Megapixel Camera)

- ✓ Supply Voltage: 3.3~5.0V
- ✓ Current Consumption(TYP): 320mA @ 3.3V, 230mA @ 5.0V (face recognition mode; 80% backlight brightness; fill light off)
- ✓ Interr: UART; I2C
- ✓ Display: 2.0-inch IPS screen with 320*240 resolution
- ✓ Built-in Algorithms: Face Recognition, Object Tracking, Object Recognition, Line Tracking, Color Recognition, Tag Recognition, Object Classification
- ✓ Dimension: 52mm x 44.5mm (2.05*1.75 inch）

3.1.3 L293D Motor Driver Shield:

The L293D Motor Driver Shield is a versatile electronic module designed to control and drive DC motors and stepper motors conveniently. L293D use 16 pin DIP package, its internal integration is a bipolar H - bridge circuit. This kind of bipolar pulse width method has many advantages, such as the current continuous, or micro current vibration when the motor stops, which is a lubrication effect. It can eliminate the dead zone of static friction when positive and negative.



L293D IC is known as a motor driver. It is a low voltage operating device like other ICs. L293D provides a 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 that can operate two DC motors or a single stepper motor. So as the motor driver

shield consists of two L293D ICs hence 4 DC motors or 2 stepper motors can easily be controlled by this driver.

The 74HC595 is a serial-in and parallel-out shift register IC. We can use shift registers such as 74HC595 to save microcontrollers pins. The shift register controls several outputs simultaneously. Using serial in parallel out protocol, it obtains data serially from the Arduino board and transmits it through the parallel pins.

- While using this shield 6 analog Pins (which can be used as digital pins too), pin 2 and pin 13 of Arduino are free.In the case of using Servo motor, pins 9, 10, 2 are in use. In the case of using DC motor, pin11 for #1, pin3 for #2, pin5 for #3, pin6 for #4 and pins 4, 7, 8 and 12 for all of them are in use.
- We can use free pins by wired connections.

Features:

Height: 3 cm

EAN: 0695626478670

Item Weight: 60.0 gm

Length: 4 cm

Width: 2 cm

3.1.4. Gear Motor:

- DC motor converts electrical energy in the form of Direct Current into mechanical energy in the form of rotational motion of the motor shaft.
- The DC motor speed can be controlled by applying varying DC voltage; whereas the direction of rotation of the motor can be changed by reversing the direction of current through it.
- For applying varying voltage, we can make use of the PWM technique.
- For reversing the current, we can make use of an H-Bridge circuit or motor driver ICs that employ the H-Bridge technique.

3.1.5. Wheels:

- A tire or wheel is a ring-shaped component that surrounds a wheel's rim to transfer a vehicle's load from the axle through the wheel to the ground and to provide traction on the surface over which the wheel travels.
- When it comes to safety, tires are one of the most important components of the trolley. The brakes stop the wheels, not the trolley!
- It's the tires that stop it. Tyres provide the contact between the trolley and the road. They have to transmit drive forces, braking forces, and lateral forces.

3.2. Design of System:

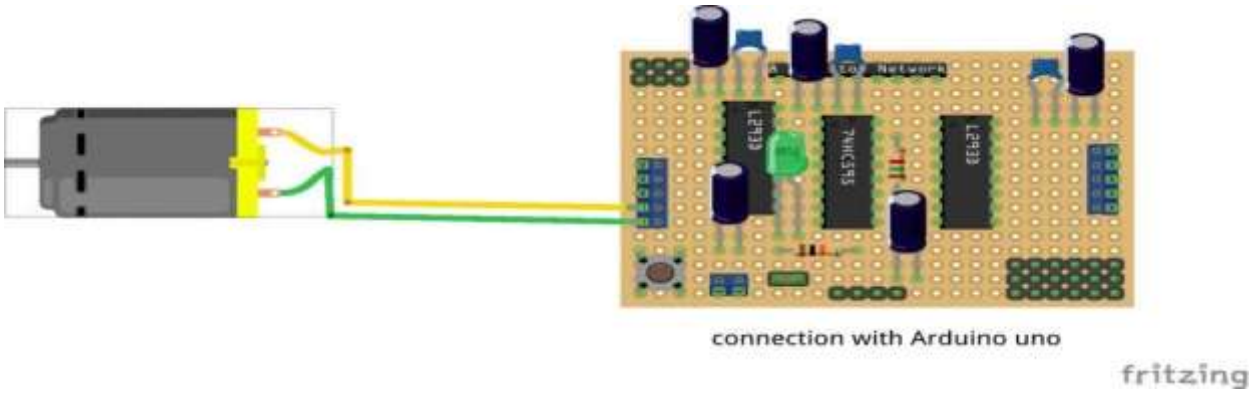
In this section, it explained:

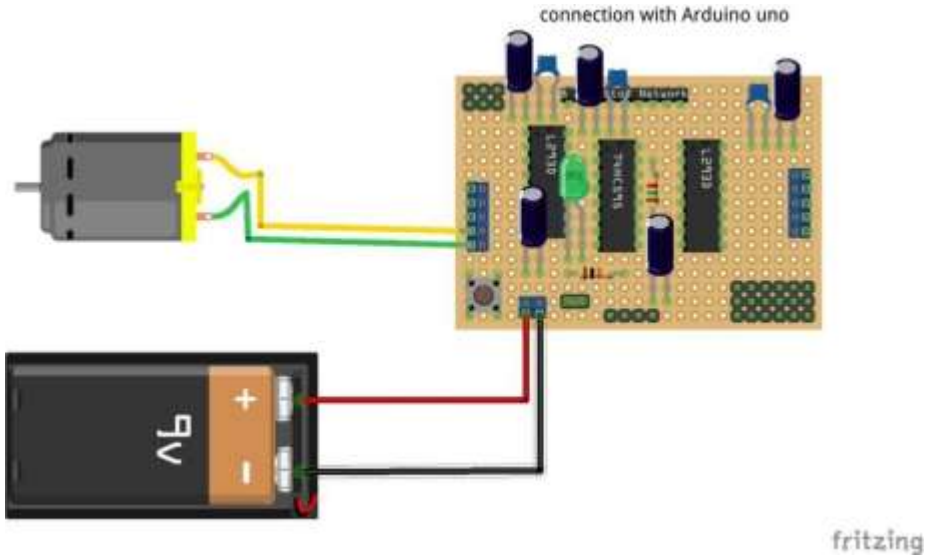
1) Design of L293D with Arduino Uno and DC motor 2) Design of L293D with Arduino Uno and huskylens

3) Design of the whole system.

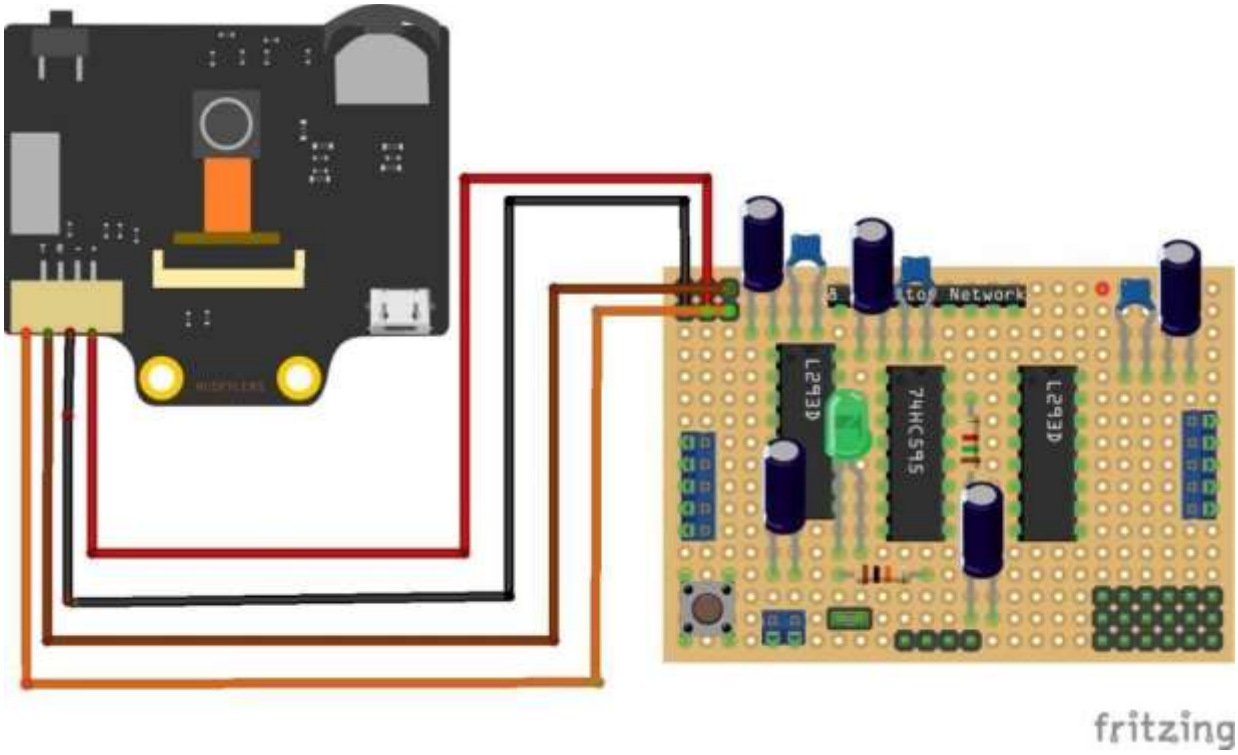
Note To facilitate the programming of all components, a personal computer was utilized, employing an Integrated Development Environment (IDE) suitable for coding in the Arduino language.

3.2.1 Design of L293D with Arduino Uno and DC motor:

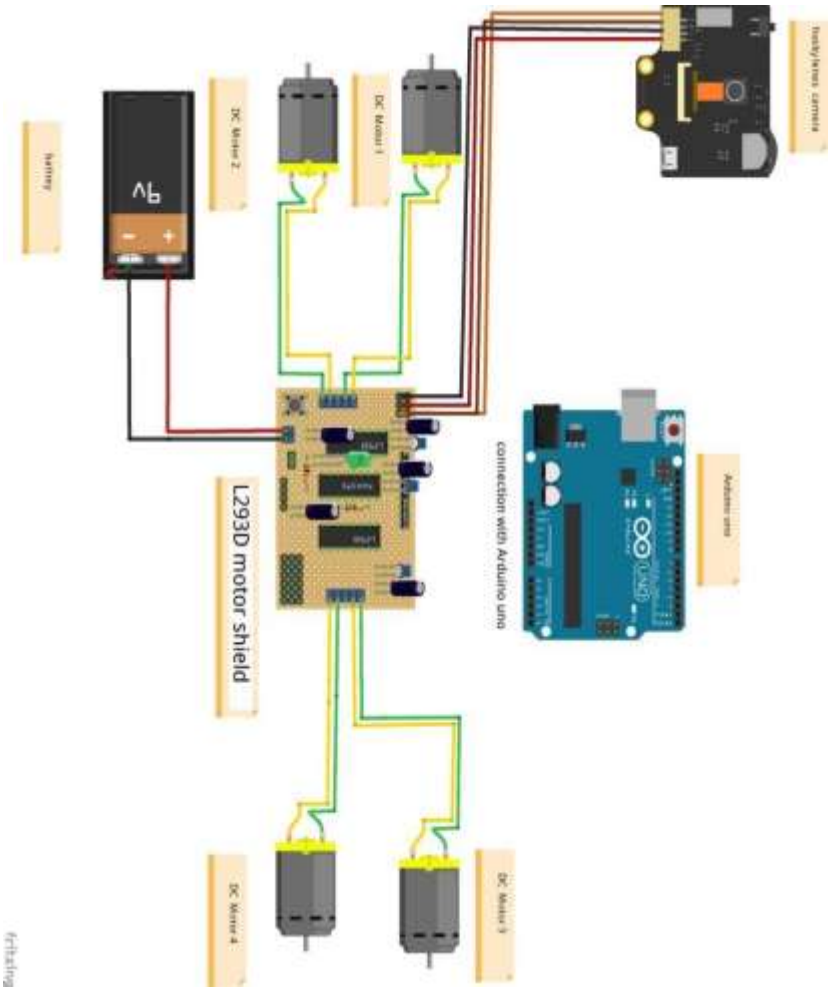




3.2.2 Design of L293D with Arduino Uno and DC motor:



3.2.2. All system Design



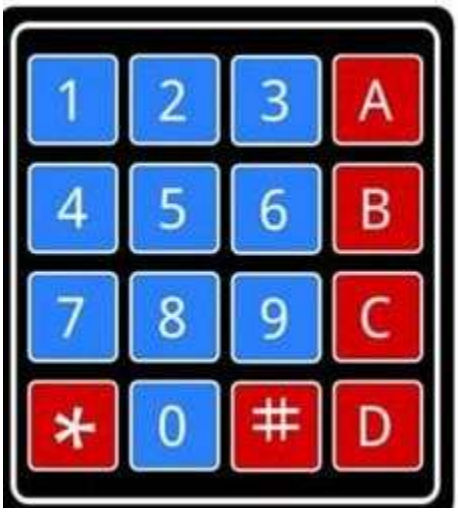
3.3 Design Medical Reminder for project:

In This Section, We Will Explain About Components Used In this medical reminder And Design of System

3.3.1 Components:

We will use Keypad with Arduino connection with Liquid Crystal Displays (LCD)and buzzle.

- **Keypad:**



The keypad is a set of buttons arranged in rows and columns (called matrix). Each button is called key.

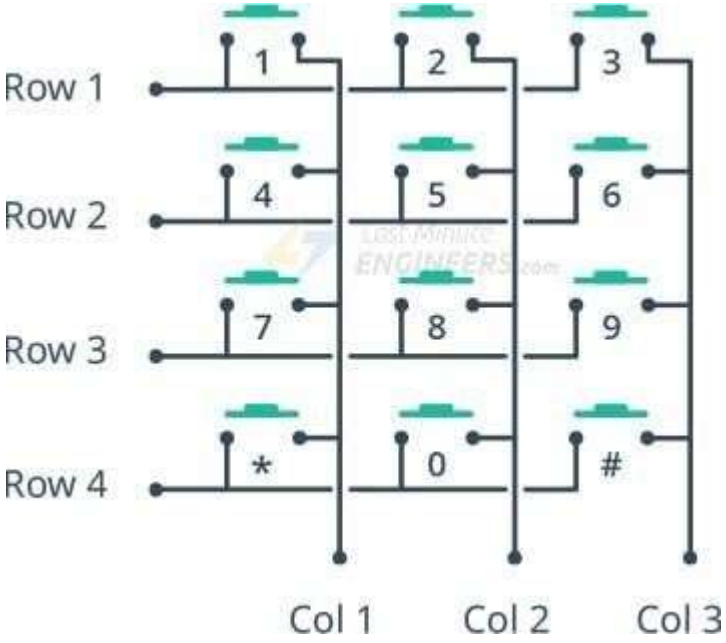
Keypad has various types. Two popular types we will use keypad 4x4 (16 keys).

Keypad will transfer the data entries from the user to the processor for the purpose of executing them

WORKING PRINCIPLE

1. First, when no buttons are pressed, all of the column pins are held HIGH, and all of the row pins are held LOW:
2. When a button is pressed, the column pin is pulled LOW since the current from the HIGH column flows to the LOW row pin:
3. The Arduino now knows which column the button is in, so now it just needs to find the row the button is in. It does this by switching each one of the row pins HIGH, and at the same time reading all of the column pins to detect which column pin returns to HIGH:
4. When the column pin goes HIGH again, the Arduino has found the row pin that is connected to the button:

Show the next figure



- **Liquid Crystal Displays (LCD):**

A LCD display 16*2 is actually a basic and simple to use LCD module. It includes LCD glass, COB (Chip on PCB Board) LCD control board, backlight, zebra to connect LCD glass and control board and a bezel to hold everything together. 16×2 LCD display can display 16 characters per line and there are two lines. Each character has 5×7 dot matrix pixels and the cursor underneath**.**

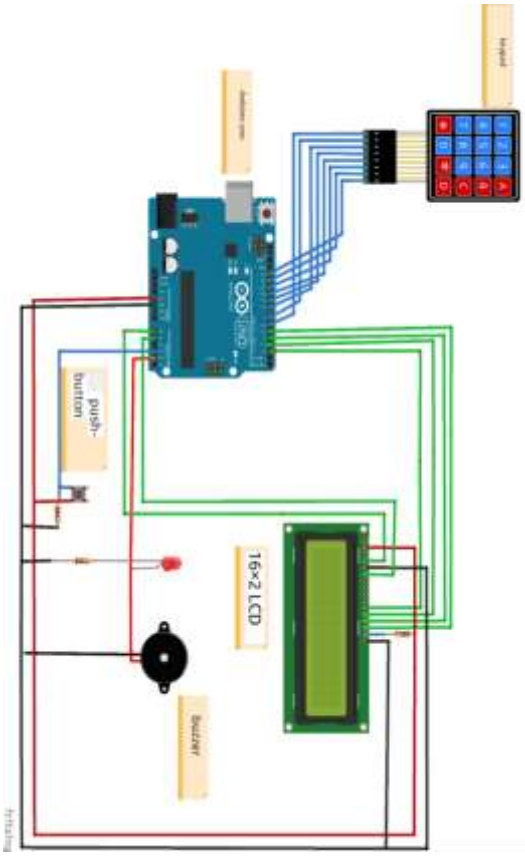
- **Arduino buzzer:**

The Arduino buzzer is a device that produces sound when an electric current is passed through it. The buzzer Arduino can be directly connected to the Arduino and produce different tones by giving different frequency electric pulses to the buzzer**.**

How does the Arduino Buzzer work?

The Positive pin (+ve) of the Arduino buzzer has to be connected to the VCC of Arduino and the Negative pin (-ve) has to be connected to the GND pin of the Arduino.When the Positive pin is connected to the 5 Volts pin of the Arduino directly, the buzzer produces a sound of constant frequency.

3.3.2. Design of Medical Reminder:



4. Conclusions:

the development of the smart medical cart epitomizes a transformative advancement in healthcare logistics. By harnessing the prowess of an Arduino Uno microcontroller and an AI-powered camera system, the cart transcends traditional manual delivery methods, offering an unprecedented degree of accuracy and dependability in the tracking and transportation of medical supplies.

The cart's autonomous nature, underscored by its dual emphasis on operational efficacy and user-centric design, allows for seamless integration into the healthcare milieu. The AI algorithm's capacity to identify and shadow medical staff ensures that the cart is discreet yet adaptive to the fluctuating conditions within medical establishments. The incorporation of an auditory alert mechanism acts as a sentinel, safeguarding the punctuality of medicine transfers, which is vital for the administration of time-sensitive treatments.

This confluence of engineering acumen and healthcare insight yields a solution that is not only innovative but also pragmatically viable. The smart cart's inception is a testament to the interdisciplinary collaboration that is quintessential in the evolution of medical technologies. It underscores the imperative for ongoing enhancements in healthcare logistics, with the ultimate objective of delivering efficacious, efficient, and error-minimized care.

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