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“DIGITAL CONTROLLED RATIO CONCRETE MIXER MACHINE FOR CONSTRUCTION
SITES”

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ABSTRACT

Concrete mixing at construction sites is traditionally performed manually, which often leads to inaccurate material proportions, inconsistent concrete quality, and increased labor requirements. This paper presents the design and development of a Digital Controlled Ratio Concrete Mixer Machine that automates the proportioning and mixing process using electronic control systems. The system utilizes sensors, a microcontroller, and a digital interface to accurately measure and dispense cement, sand, aggregate, and water according to predefined mix ratios. The proposed machine minimizes human error, reduces material wastage, improves mixing consistency, and enhances productivity at construction sites.

Keywords: *Concrete Mixer, Digital Control, Automation, Construction Site, Microcontroller, Material Ratio Control.*

I. INTRODUCTION

Concrete mixing is the process of combining cement, sand, aggregates, and water in the correct proportions to produce a homogeneous mixture suitable for construction purposes. Concrete is one of the most important building materials used in the construction of buildings, roads, bridges, dams, and other infrastructure projects due to its strength, durability, and versatility.

The quality and performance of concrete depend largely on the accuracy of the mixing process. Proper mixing ensures uniform distribution of all ingredients, resulting in consistent strength and durability. In traditional construction practices, concrete is often mixed manually or using conventional mixers where material proportions are measured by workers. Such methods may lead to errors in material ratios, causing variations in concrete quality and increased material wastage.

With the advancement of technology, automated concrete mixing systems have been developed to improve accuracy and efficiency. These systems use sensors and digital control units to measure and dispense materials according to predefined mix ratios. Automated mixing reduces human intervention, minimizes errors, and ensures uniform concrete quality. The Digital Controlled Ratio Concrete Mixer Machine is an innovative solution that automates the concrete mixing process by accurately controlling the quantity of cement, sand, aggregate, and water. This helps achieve consistent concrete quality, reduces labor effort, saves time, and improves productivity at construction sites.

Concrete is one of the most widely used construction materials worldwide. The quality and strength of concrete primarily depend on maintaining accurate proportions of cement, sand, aggregates, and water. The Digital Controlled Ratio Concrete Mixer Machine automates the material feeding process by digitally controlling the proportion of each ingredient, ensuring consistent concrete quality and reducing human effort.

II. LITERATURE REVIEW

Previous studies on automated batching systems, sensor-based measurement, and microcontroller-controlled mixers have shown significant improvements in concrete quality, reduced material wastage, and increased productivity in construction applications.

Shklyan, Regina et al. Highway concrete median barriers are critical in preventing highway collisions, especially in work zones. Their function can be improved by increasing their reflectivity. Unfortunately their reflectivity is diminished during nighttime and wet weather conditions.

Dr. Iraj H.P. Mamaghani et al. The technology transfer workshops were intended to stimulate interest in concrete technology using SCC techniques. Attendees were expected to have a greater understanding of the potentials for solving problems where non-segregating mixes can be placed without vibration.

Xinhui LIU et al. We provide an up-to-date reference for the design of the gap connection of the conical logarithmic spiral blade. We solve the previous connection problem of spiral blade perfectly. And the MFG ameliorates the performance of the mixing and discharging and enhances the service life of the blade.

P. D. Kumbhar et al. Most of the existing mix design methods of HPC are not applicable for tropical climatic conditions due to wide variations in relative humidity and temperatures prevailing in different regions of tropical countries. Various parameters or variables involved in the mix design process have not been quantified in the existing methods and are usually left to the judgment of designer.

Behzad Nema toll ahia, et al. The 3D concrete printing (3DCP) techniques, namely extrusion-based and powder-based techniques, and the currently available 3DCP technologies are reviewed in this paper. The similarities and differences and the pros and cons of different 3DCP technologies are highlighted.

Previous studies on automated batching systems, sensor-based measurement, and microcontroller-controlled mixers have shown significant improvements in concrete quality, reduced material wastage, and increased productivity in construction applications.

III. MATERIALS AND METHODOLOGY

3.1 Materials specification and Part Details

3.1.1 MS Square channel



Fig.1. Square Channel

Table 1. specification of an MS (Mild Steel) square pipe / tube

Thickness	1.5 mm
Material	MS
Surface Treatment	Galvanized
Shape	Rectangle
Size	20 mm
Pipe Section	Square

Rectangular Hollow Section (RHS) Mild Steel Pipe



Fig.2. Rectangular Hollow Section (RHS) Mild Steel Pipe

MS square channels, also known as mild steel channels, are right-angled steel structures used in construction and other engineering applications. They are commonly used to carry horizontal gravitational forces.

Here are some specifications for MS square pipes:

- Shape: Square
- Surface treatment: Galvanized
- Material: MS
- Unit pipe length: 6 meters
- Pipe thickness: 3 mm
- Tensile strength: 500 MPa
- Thickness: 5-20 mm
- Tolerance: 0.1-3 mm

3.1.2 Hopper

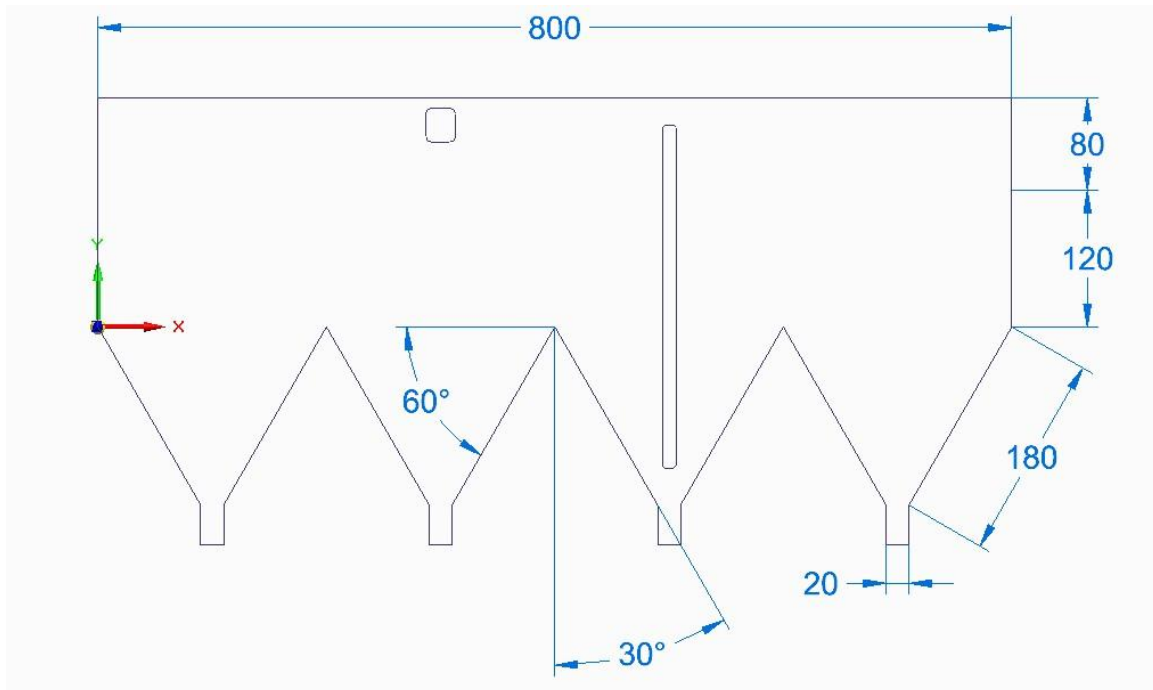


Fig. 3. CAD Design of Hopper Geometry with Dimensions

- Separate hoppers are provided for storing cement, sand, and aggregates.
- They supply materials to the mixing drum in controlled quantities.

3.1.3 DC Motor

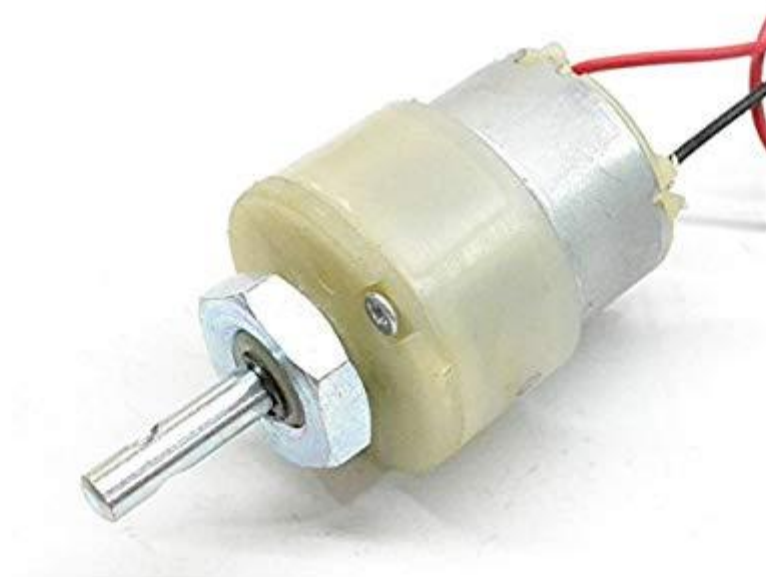


Fig. 4. Direct Current (DC) Motor 12V DC Motor

3.1.3.1 Features

12V – 10 RPM –

3.6KG•CM torque DC gear head motor

30:1 Gear Ratio

2mm rear encoder shaft

Good compromise between speed and torque for small robotic designs.

3.1.3.2 Description

Motor is a 12V DC geared motor with a .25” motor output shaft and a 2mm rear encoder shaft. The 2mm shaft works with our ENC300 quadrature encoder to allow the motor to be used in position control applications. Motor controllers that are rated for 12V@2A are ideal for controlling this motor. However, motor controllers with lower current ratings can also be used if they have over-current and overtemperature protection.

3.1.3.3 Specifications

- Operating voltage 4.5-18 V
- Startup torque (kilogram-force centimeter) 3.6 KG•CM
- Startup torque (inch-pound) 3.1 Inch•lbf
- Gear ratio 30:1
- No-Load Current (12V) 0.053 A
- Stall Current 1.5 A
- No-Load Speed (12V) 500 RPM

3.1.4 DC Solenoid Valve



Fig. 5. 24 Volt Normally Closed DC solenoid Valve for Water

This is a 24 volts normally closed DC solenoid valve for water control. This solenoid valves are normally used in water purifiers, Aqua guards and RO purifiers. Nowadays these valves are also used in making Automatic Hand Sanitizer.

This 24 volt DC solenoid has one inlet and one outlet for water flow. This valve is Normally closed type so when 24 volts DC supply is applied the valve turns on the water can flow through it.

The Solenoid has push fit connectors on each side. So, this connector will allow us to directly push the pipe or nozzle

into the solenoid without worrying of leaking.

3.1.4.1 Specifications of DC Solenoid Valve:-

- Solenoid valve for water purifier with 1/4" Size
- Orifice: 2.5mm.
- Fluid media:water
- Operation pressure: 0~8bar.
- CV value: 0.21.
- Power consumption:AC6.8VA(Holding)
- Seal material: EPDM, valve body material:PP.

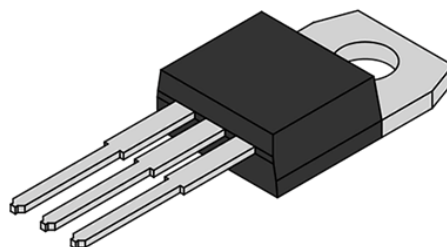
3.1.4.2 Features of DC Solenoid Valve:-

- Operating voltage: 24 volts
- Current Required: 400 ma.
- Type: Normally Closed.
- Nozzle Diameter: 6.3mm.

3.1.4.3 Application for DC Solenoid Valve:-

- RO Purifiers.
- Water Purifiers, Aqua guard.
- Automatic Hand Sanitizer.
- Soap water Dispenser,
- Water flow control.

3.1.5 Voltage Regulators



**7805 - 5V
VOLTAGE REGULATOR**

Fig. 6. 812 Voltage regulator

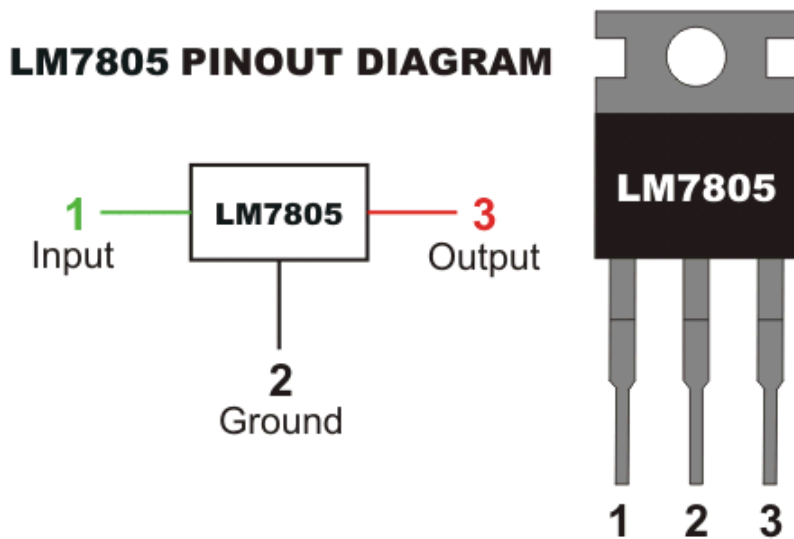


Fig. 7. 7805 pinout

3.1.5.1 Specifications

Table 2. Specification and Range

Sr.No	Specification	Range
1	DC output voltage	5V DC
2	DC input voltage	Upto 35V DC
3	Output current capacity	1.5 Amp
4	Operating junction temperatur	-55 to 150 celcius
5	Storage temprature	-65 to 160 celcius
6	Package used in our project	TO-220A Package(through hole package)
7	Short circuit current	2.5 amp for 1 milli seconds

3.1.5.2 Special features of 7812 voltage regulators

THERMAL OVERLOAD PROTECTION

SHORT CIRCUIT PROTECTION

PACKAGES AVAILABLE – TO220AB (Through hole package) , surface mount packages are also available.

3.1.5.2 General Information and purpose of use

In our project we have used 7812 voltage regulator for the voltage regulation purpose for controller. The L7800 series of three-terminal positive regulators is available in TO-220 ISOWATT220 TO-3 and D2PAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

3.1.5.3 Applications

- Power supplies.
- Voltage regulation.
- Battery chargers.

3.1.6 Motor Driver

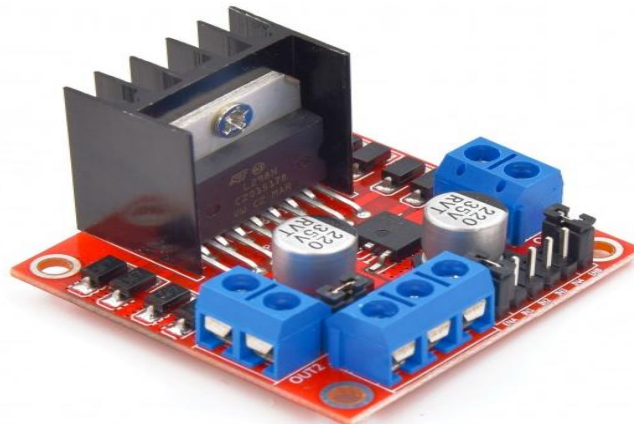


Fig. 8. Motor Driver

3.1.6.1 Data

- Input Voltage: 3.2V~40Vdc.
- Driver: L298N Dual H Bridge DC Motor Driver.
- Power Supply: DC 5 V - 35 V.
- Peak current: 2 Amp .
- Operating current range: 0 ~ 36mA.
- Control signal input voltage range .
- Low: $-0.3V \leq V_{in} \leq 1.5V$.
- High: $2.3V \leq V_{in} \leq V_{ss}$.
- Enable signal input voltage range :
 - o Low: $-0.3 \leq V_{in} \leq 1.5V$ (control signal is invalid).
 - o High: $2.3V \leq V_{in} \leq V_{ss}$ (control signal active).
- Maximum power consumption: 20W (when the temperature $T = 75^\circ C$).
- Storage temperature: $-25^\circ C \sim +130^\circ C$.
- On-board +5V regulated Output supply (supply to controller board i.e. Arduino).
- Size: 3.4cm x 4.3cm x 2.7cm.

3.1.6.2 Specification:

- Double H-bridge drive
- Chip: L298N (ST NEW)
- Logic voltage: 5V
- Drive voltage: 5V-35V
- Logic current: 0mA-36mA
- Drive current: 2A(MAX single bridge)

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- Storage temperature: -20 to +135
- Max power: 25W
- Weight: 30g
- Size: 43*43*27mm (approx 1.75" x 1.75" x 1")
- Compatible with L297/L298 driver

3.1.7 Arduino Nano Datasheet

Arduino Nano Pin

Table 2. Arduino Nano Pin Configuration

Pin No.	Name	Type	Description
1-2, 5-16	D0-D13	I/O	Digital input/output port 0 to 13
3, 28	RESET	Input	Reset (active low)
4, 29	GND	PWR	Supply ground
17	3V3	Output	+3.3V output (from FTDI)
18	AREF	Input	ADC reference
19-26	A7-A0	Input	Analog input channel 0 to 7
27	+5V	Output or Input	+5V output (from on-board regulator) or +5V (input from external power supply)
30	VIN	PWR	Supply voltage

Table 3. Technical Specification

Microcontroller	ATmega 32
Architecture	AVR
Operating Voltage	5v
Flash Memory	32 kb of switch2kb used by bootloader
SRAM	2kb
Clock Speed	16mhz
Analog I/O pins	8
EEPROM	1kb
DC Current per I/O pins	40mA I/O pins
Input Voltage	7-12v
Digital I/O pins	22
PWM Output	6
Power Consumption	19mA
PCB size	18*45mm
Weight	7g
Prouct Code	A000005

3.1.7.1 Power

The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

3.1.7.2 Memory

The ATmega328 has 32 KB, (also with 2 KB used for the bootloader. The ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

3.1.7.3 Input Output

Each of the 14 digital pins on the Nano can be used as an input or output, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions: Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attachInterrupt()` function for details. PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the `analogWrite()` function. SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language. LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though it is possible to change the upper end of their range using the `analogReference()` function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality: I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the `Wire` library (documentation on the Wiring website). There are a couple of other pins on the board: AREF. Reference voltage for the analog inputs. Used with `analogReference`. Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.1.7.4 Programming

The Arduino Nano can be programmed with the Arduino software (download). Select "Arduino Duemilanove or Nano w/ ATmega328" from the Tools > Board menu (according to the microcontroller on your board). The ATmega328 on the Arduino Nano comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.

3.1.8 LCD Display



Fig. 9. LCD Display

Compatible with Arduino/Genuino [UNO](#), [Leonardo](#), [Mega](#), 101 (Intel Curie), Micro, [Nano](#), Mini

I2C Address:0x20-0x27(0x20 default)

Back lit (Blue with white char color)

2. 3D View Of the PCB Board

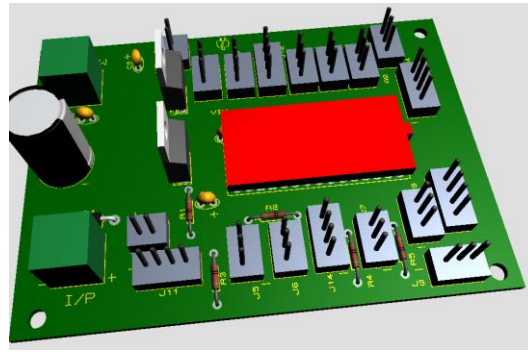


Fig.11. PCB 3D View With Components

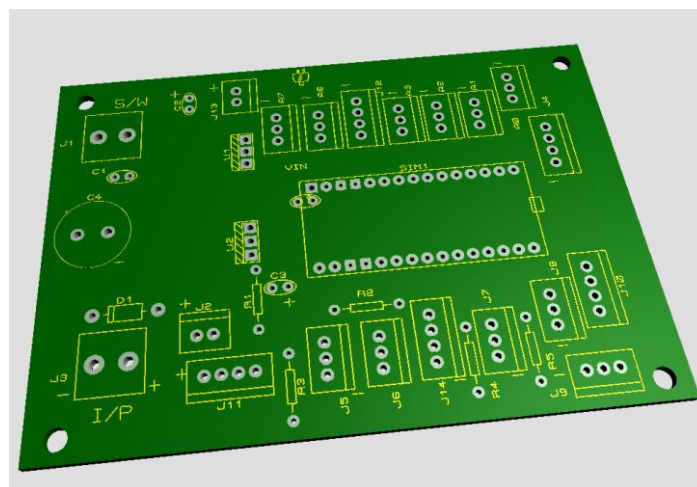


Fig.12. PCB 3D View With out Componen

1. PCB Track Layout

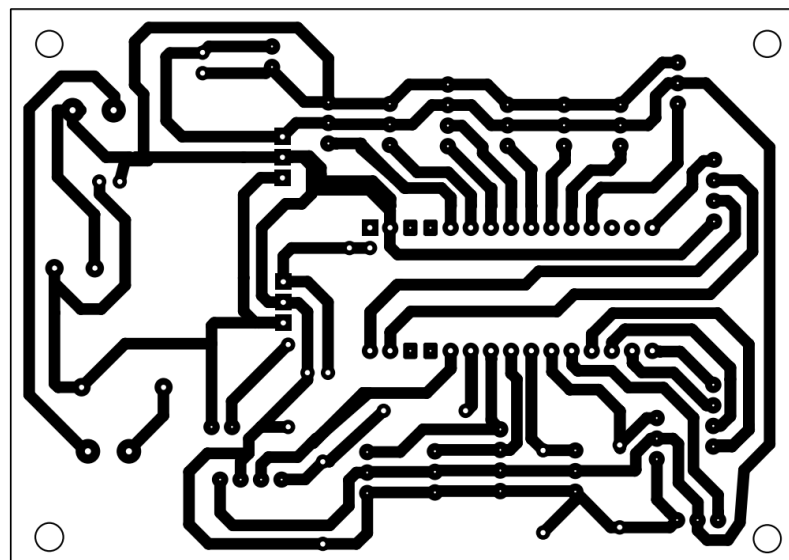
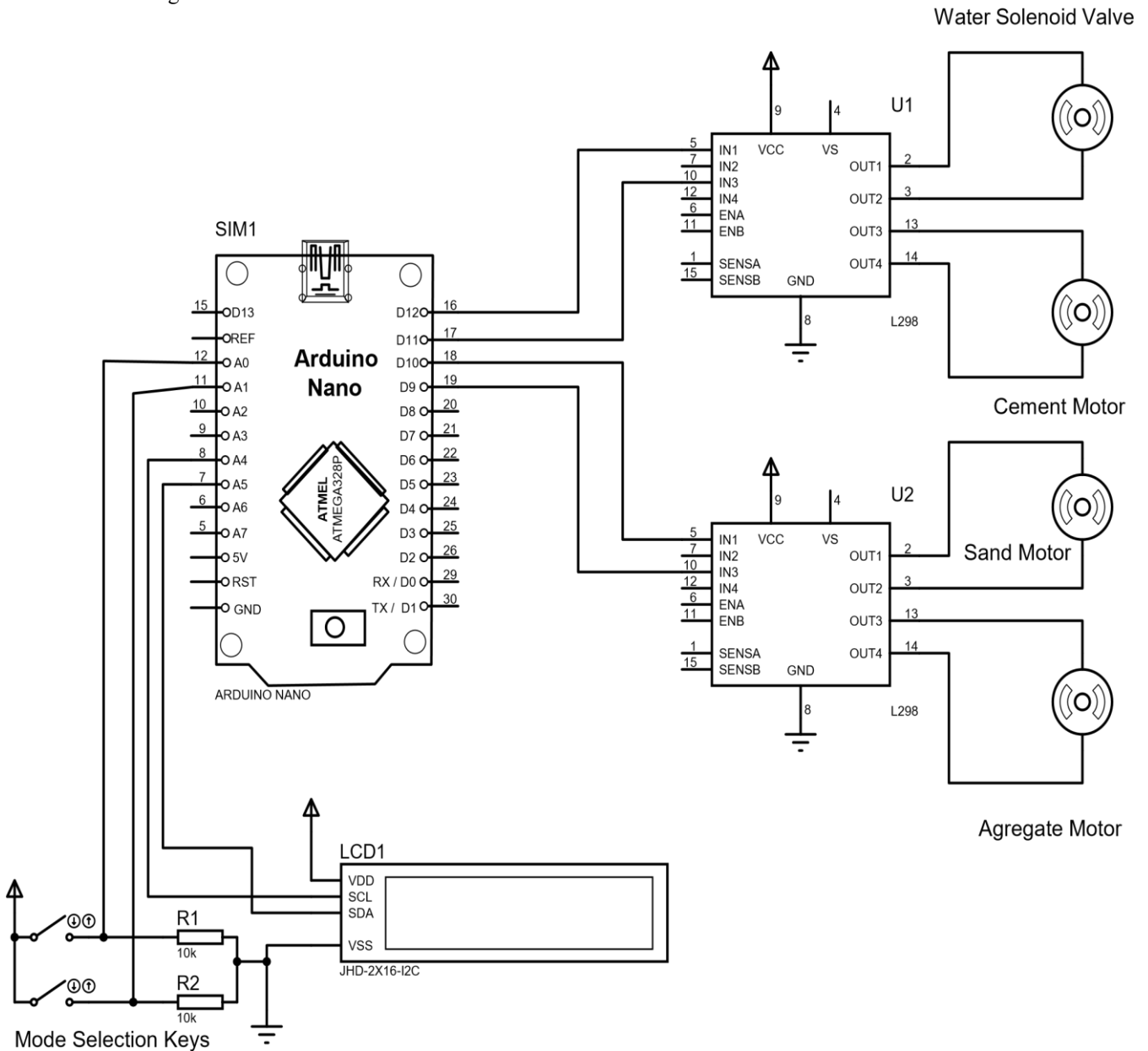


Fig.13. PCB Track Layout

3.1.10 Circuit Diagram



3. Program code for ratio selection

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,20,4);
int count = 0;

// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  pinMode(12,OUTPUT);
  pinMode(11,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(9,OUTPUT);
  digitalWrite(12,LOW); //Sand
  digitalWrite(11,LOW); //Cement
  digitalWrite(10,LOW); //Stone
  digitalWrite(9,LOW); //Water
  Serial.begin(9600);
  lcd.init();
  lcd.clear();
  lcd.backlight();
  lcd.setCursor(0,0);
  lcd.print("Controlled Ratio");
  lcd.setCursor(0,1);
  lcd.print("Concrete Mixer");
  delay(2000);
  lcd.clear();
}

void loop() {
  float avg = 0;
  for (int i = 0; i < 25; i++) {
    avg += analogRead(A0);
    delay(3);
  }
  avg /= 25.0;
```

```
if(avg > 500)
{
    count = count + 1;
    delay(200);
}
if(count > 6)
{
    count = 1;
}
lcd.setCursor(0,0);
lcd.print("Selected Ratio=");
if(count == 1)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M5 , 1:5:10 ");
}
if(count == 2)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M10 , 1:3:6 ");
}
if(count == 3)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M15 , 1:2:4 ");
}
if(count == 4)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M20 , 1:1.5:3 ");
}
}
```

```
if(count == 5)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M25 , 1:1:2  ");
}
if(count == 6)
{
    delay(10);
    lcd.setCursor(0,1);
    lcd.print("M30 , 1:0.75:1.5  ");
}

float avg2 = 0;
for (int i = 0; i < 25; i++) {
    avg2 += analogRead(A1);
    delay(3);
}
avg2 /= 25.0;

if(avg2 > 500)
{
    lcd.setCursor(0,0);
    lcd.print("Dispenser ON  ");
    if(count == 1)
    {
        digitalWrite(9,HIGH); //Water
        delay(3000);
        delay(3000);
        delay(3000);
        delay(1000);
        digitalWrite(9,LOW);
        delay(500);
        digitalWrite(10,HIGH);
        delay(3000);
```

```
delay(3000);
delay(3000);
delay(1000);
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(3000);
delay(3000);
delay(2000);
digitalWrite(12,LOW);
delay(500);
digitalWrite(11,HIGH);
delay(4000);
delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
if(count == 2)
{
digitalWrite(9,HIGH); //Water
delay(3000);
delay(3000);
delay(1000);
digitalWrite(9,LOW);
delay(500);
digitalWrite(10,HIGH);
delay(3000);
delay(3000);
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(3000);
delay(3000);
digitalWrite(12,LOW);
```

```
delay(500);
digitalWrite(11,HIGH);
delay(2000);
delay(2000);
delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
if(count == 3)
{
digitalWrite(9,HIGH); //Water
delay(3000);
delay(3000);
delay(1000);
digitalWrite(9,LOW);
delay(500);
digitalWrite(10,HIGH);
delay(3000);
delay(1000);
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(2000);
delay(3000);
digitalWrite(12,LOW);
delay(500);
digitalWrite(11,HIGH);
delay(2000);
delay(2000);
delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
```

```
if(count == 4)
{
digitalWrite(9,HIGH); //Water
delay(3000);
delay(3000);
delay(1000);
digitalWrite(9,LOW);
delay(500);
digitalWrite(10,HIGH);
delay(3000);
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(1500);
delay(3000);
digitalWrite(12,LOW);
delay(500);
digitalWrite(11,HIGH);
delay(2000);
delay(2000);
delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
if(count == 5)
{
digitalWrite(9,HIGH); //Water
delay(3000);
delay(3000);
delay(1000);
digitalWrite(9,LOW);
delay(500);
digitalWrite(10,HIGH);
delay(2000);
```

```
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(1000);
delay(3000);
digitalWrite(12,LOW);
delay(500);
digitalWrite(11,HIGH);
delay(2000);
delay(2000);
delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
if(count == 6)
{
digitalWrite(9,HIGH); //Water
delay(3000);
delay(3000);
delay(1000);
digitalWrite(9,LOW);
delay(500);
digitalWrite(10,HIGH);
delay(1500);
digitalWrite(10,LOW);
delay(500);
digitalWrite(12,HIGH);
delay(750);
delay(3000);
digitalWrite(12,LOW);
delay(500);
digitalWrite(11,HIGH);
delay(2000);
delay(2000);
```

```

delay(2000);
delay(2000);
digitalWrite(11,LOW);
delay(500);
}
delay(200);
lcd.clear();
}
}

```

V. CONCLUSIONS

The Digital Controlled Ratio Concrete Mixer Machine successfully automates the concrete mixing process for construction sites. The system reduces human error, minimizes material wastage, and improves productivity and concrete quality.

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