İZMİR KATİP ÇELEBİ UNIVERSITY

MECHATRONICS ENGINEERING DEPARTMENT

ENG401 INTERDISCIPLINARY ENGINEERING DESING PROJECT FINAL REPORT

Project Title: **CNC Router Integrated Electrospinning System**

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1. Abstract

Electrospinning stands out as a highly effective method for nanofiber production, widely used in biomedical applications such as tissue engineering and drug delivery. However, the efficiency, precision, and quality of nanofiber production are largely dependent on the design and functionality of the electrospinning system. This project introduces an innovative approach to enhancing the precision and flexibility of the electrospinning process through the integration of a CNC router system.

The CNC Router Integrated Electrospinning Collector System ensures precise linear motion along the X-axis, meeting the requirements for reliable and efficient operation. The system incorporates mechanical and electronic components, including a stepper motor for motion control, a coupling for torque transmission, and a ball screw mechanism for smooth and accurate motion. The control system, developed using Arduino-based programming, allows for precise operation, adaptability, and user-friendly control.

The mechanical design focuses on optimizing all components to achieve the desired quality standards in fiber production. A guide-based system has been implemented to linearize the motion of the rotating drum-shaped collector surface, ensuring accurate deposition of the polymer solution. This approach enhances the uniformity and consistency of nanofiber collection while minimizing material loss and stabilizing the production workflow.

Through the collaborative efforts of Mechatronics and Biomedical Engineering students, the project serves as a foundation for further advancements in automated biomedical systems. The interdisciplinary teamwork showcases practical innovation and engineering synergy, providing a valuable reference point for future developments in electrospinning technology.

2. Introduction

Biomedical engineering increasingly relies on precise mechanical and electronic control technologies to improve manufacturing processes. Among these, electrospinning has emerged as a crucial technique for producing nanofibers used in various biomedical applications. However, existing systems often lack the precision and efficiency needed to ensure consistent and reliable fiber production.

The CNC Router Integrated Electrospinning Collector System was designed to address these challenges by integrating a precise ball screw mechanism and an Arduino-controlled electronic system to facilitate smooth, accurate, and automated fiber deposition. The project focuses on optimizing the position of the rotating drum collector, ensuring improved deposition accuracy and production efficiency.

The project underscores the significance of interdisciplinary collaboration, combining mechanical engineering principles with electronic control systems. The outcome is a robust and cost-effective solution that prioritizes stability, durability, and ease of maintenance, making it suitable for laboratory environments and biomedical research applications.

3. Problem Definition

The current electrospinning systems lack precision and efficient control, resulting in inconsistent nanofiber deposition and limited reliability for biomedical applications. The challenge is to design a CNC Router Integrated Electrospinning Collector System that ensures precise linear motion, seamless integration of mechanical and electronic components, and user-friendly operation, while prioritizing stability, durability, and ease of maintenance.

Assumptions

1. The electrospinning process requires precise linear motion of the collector to ensure consistent fibre deposition.
2. The use of Arduino for control programming is sufficient for the required level of precision and adaptability.
3. The system will be used in a laboratory or controlled environment, minimizing exposure to external factors like extreme temperatures or vibrations.

4. The target users are trained professionals or researchers familiar with basic programming and operation of electrospinning equipment.

Constraints

1. **Mechanical Precision:** The system must maintain a high degree of precision in motion control, with minimal error in linear displacement along the X-axis.
2. **Durability and Stability:** The platform must be stable during operation, with minimal vibrations or structural deformation, and should withstand prolonged use without significant wear or breakdown.
3. **Budgetary Limits:** The design and development should remain cost-effective, using readily available components like stepper motors, ball screw mechanisms, and Arduino controllers.
4. **Ease of Maintenance:** The system should be designed for easy assembly, disassembly, and maintenance, allowing users to replace parts or troubleshoot issues without specialized tools.
5. **Integration Complexity:** The mechanical and electronic components must be integrated seamlessly, ensuring synchronized operation and minimizing control system errors.
6. **Safety:** The system must comply with safety standards for biomedical equipment, ensuring it does not pose risks to the operator or the materials being processed.

4. Methodology

These project steps are examined under subheadings as mechanical parts and electrical-electronics parts.

Mechanical Part

Conceptual Design

In our project, we planned to use a lead screw mechanism to precisely adjust the distance between the syringe and the rotating drum. Before starting the design process, we measured the dimensions of the collector to be placed on the mechanism using a caliper. Based on these measurements, we decided to create a design with a lead screw in the center and two support rods on each side. After completing the necessary calculations, we implemented the design. The lead screw, equipped with a gear mechanism, is driven by a motor. By moving the lead screw back and forth, the motor precisely controls the proximity of the drum to the syringe. This setup ensures accurate deposition of the polymer solution and proper fiber collection during the electrospinning process. The use of the lead screw mechanism allows for fine adjustments during electrospinning, significantly improving the system's precision and stability.

During the electrospinning process, preventing the metal components of the motor and controller from coming into contact with the polymer solution was of critical importance, as such contact could cause undesired deviations. To address this issue, we designed and produced custom protective parts using a 3D printer to safeguard the motor and control components. These protective parts not only ensured the smooth operation of the system but also provided mechanical protection for the project. Additionally, the 3D-printed structures enhanced the flexibility of the design, streamlining the production process and making it faster and more cost-effective. While constructing the system, we used wood as the primary material to reduce costs. With a larger budget, we could have used metal to develop a more robust and durable system.

To improve the overall stability of the system, a specially designed support piece was placed beneath all components. This support added weight to increase stability and minimized vibrations and instability during the electrospinning process. As a result, all components remained firmly in place, movements became more precise and controlled, and the electrospinning process became more efficient. In conclusion, this design successfully enhanced the safety, accuracy, and stability of the system, making the electrospinning process more efficient, reliable, and controlled.

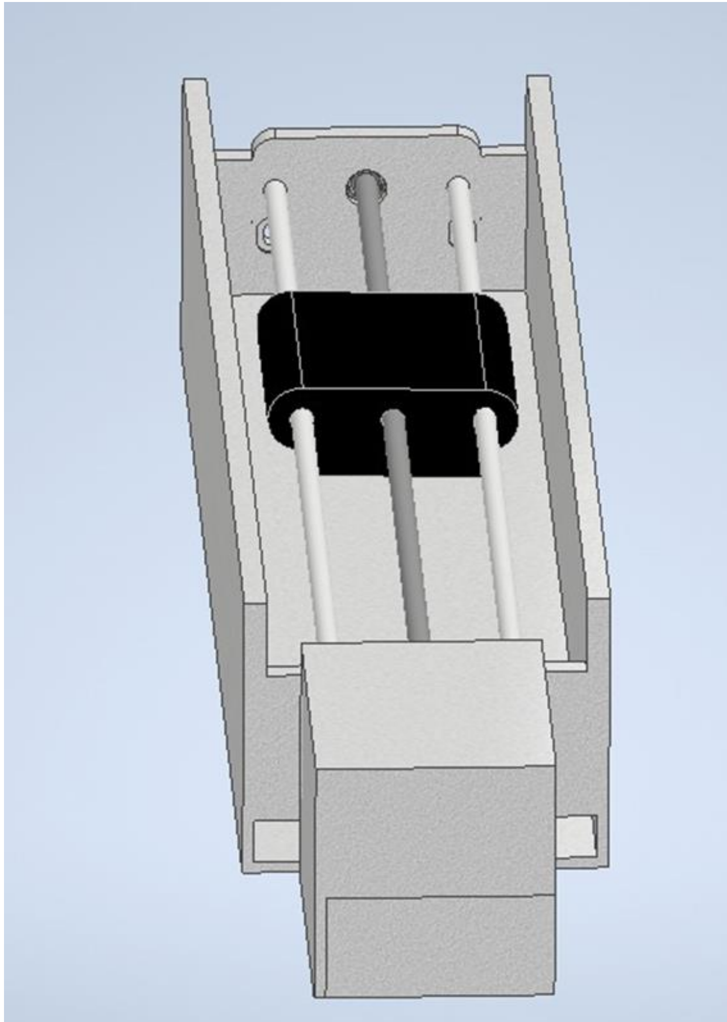


Figure 1.1

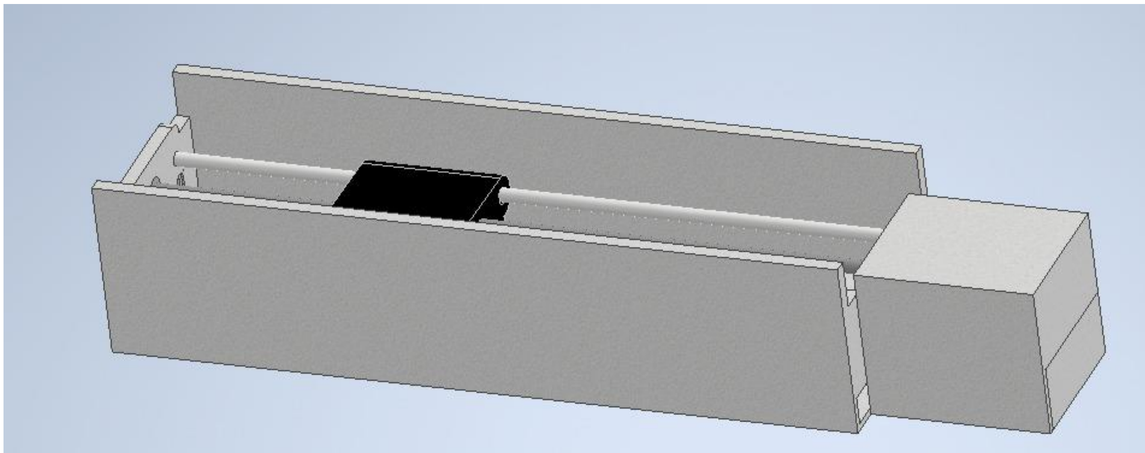


Figure 1.2

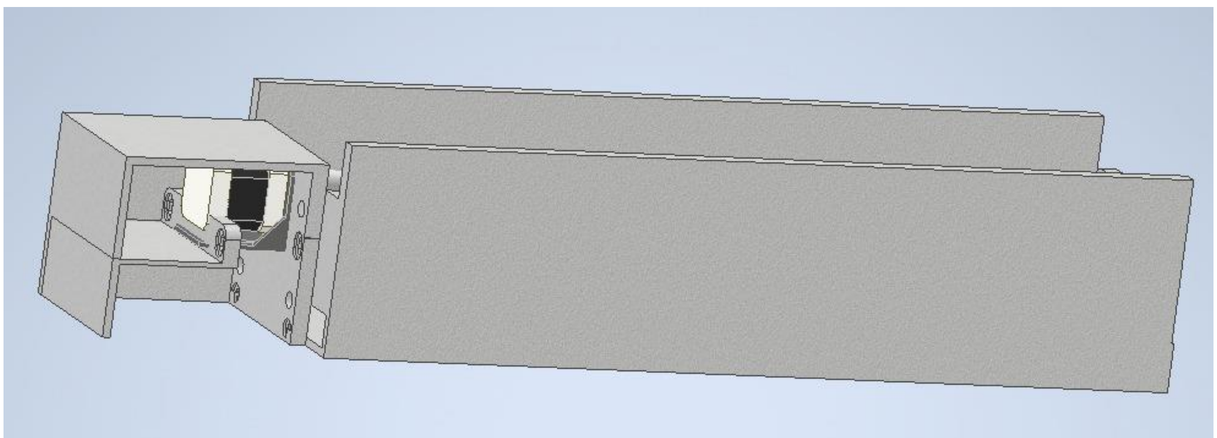


Figure 1.3

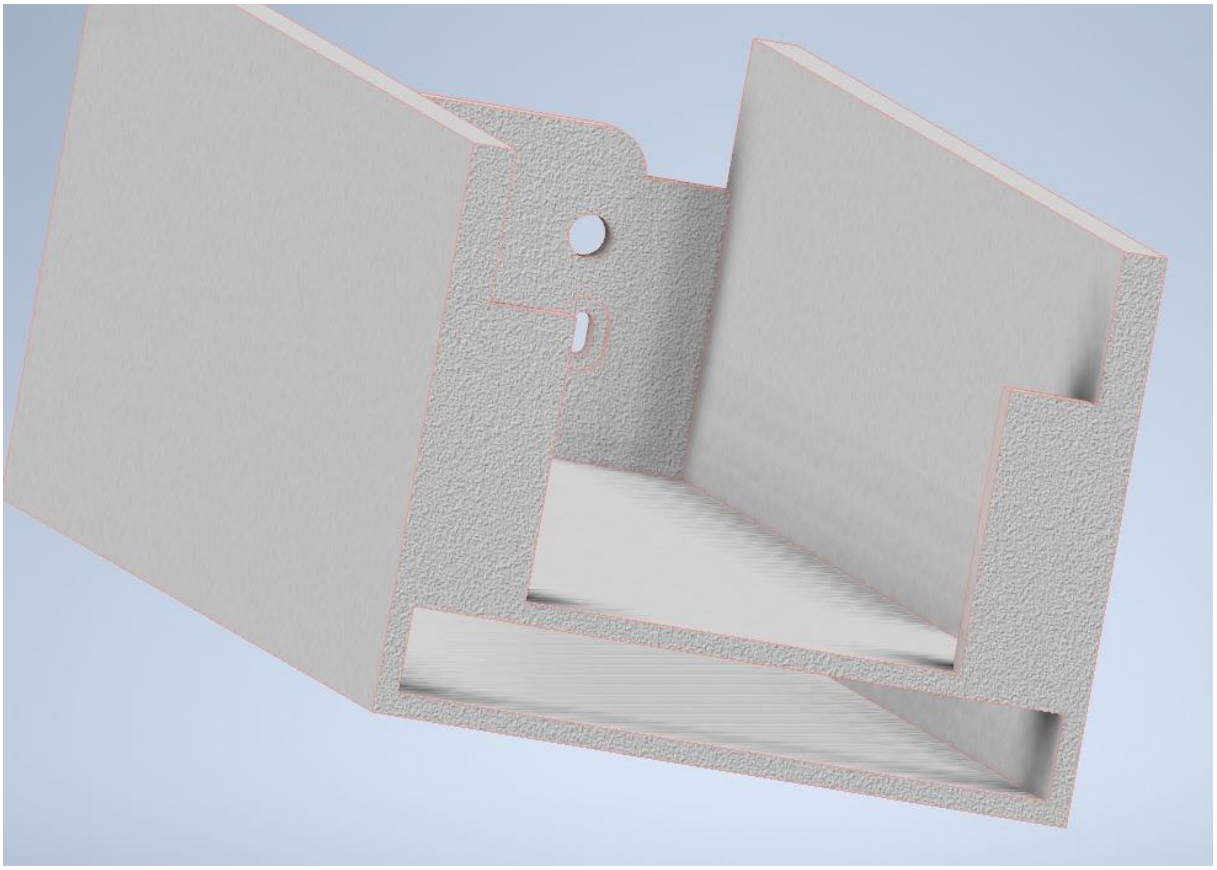


Figure 1.4

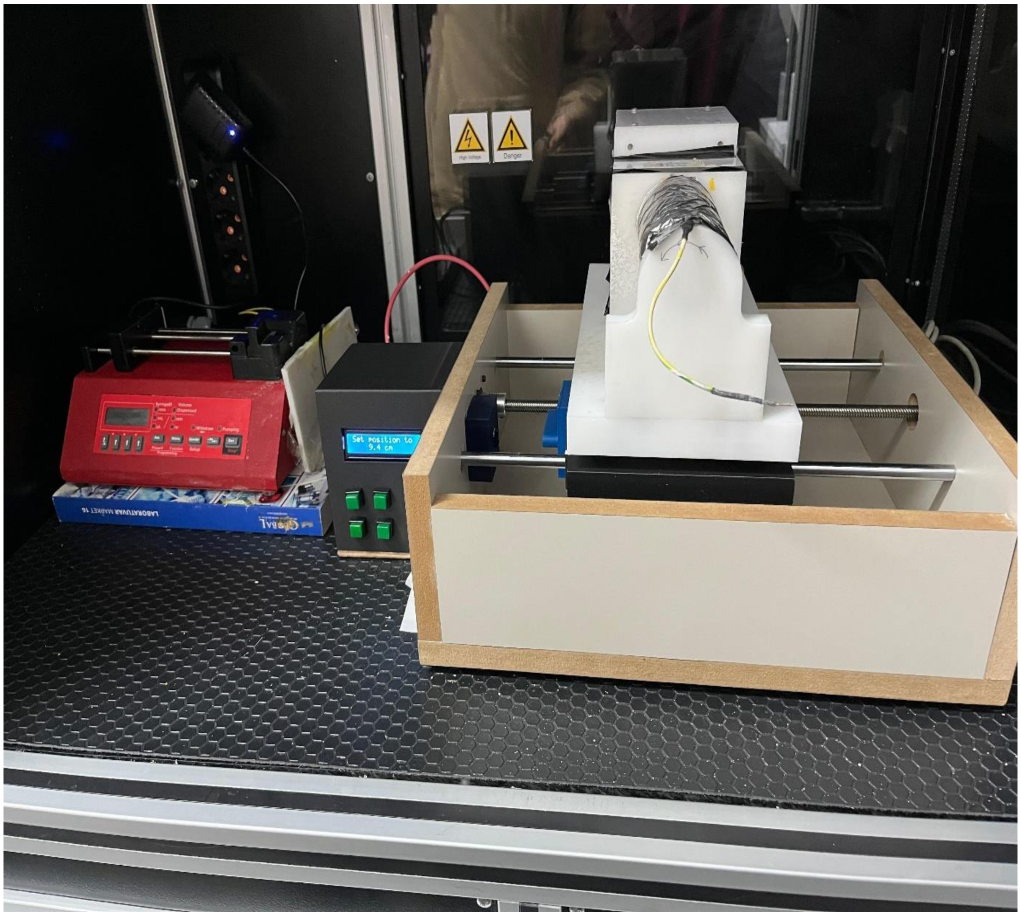


Figure 1.5 The image of the system we designed and produced with the drum collector on the electrospinning machine

Electrical-Electronics Part

Stepper motors were chosen for the project due to their unique advantages in precision and control, making them an excellent fit for applications requiring high accuracy, such as controlled fiber deposition. The NEMA 17 stepper motor, paired with the A4988 stepper motor driver, offers a reliable, cost-effective, and easy-to-use solution for controlling both drum rotation and X-axis movement. Here's why this combination was selected:

Advantages of NEMA 17 Stepper Motors

- Precision and Accuracy: Stepper motors provide precise angular movement, which is critical for ensuring consistent fiber deposition.

- High Torque at Low Speeds: NEMA 17 motors deliver sufficient torque for smooth operation even at low speeds, ensuring stability during fiber placement.
- Cost-Effectiveness: These motors are widely available and affordable, making them suitable for budget-conscious projects.
- Reliability: Their design eliminates the need for additional feedback sensors, simplifying the system while maintaining accuracy.

Features of the A4988 Stepper Motor Driver

- Microstepping Capability: The A4988 supports up to 1/16 microstepping, enabling finer resolution and smoother motion, critical for delicate applications like fiber deposition.
- Ease of Integration: This driver easily interfaces with microcontrollers such as Arduino, simplifying the control of speed, direction, and step modes.
- Compact and Durable Design: Its small form factor and robust construction make it easy to integrate into the system and handle troubleshooting efficiently.

The combination of NEMA 17 stepper motors and A4988 drivers ensures precise, consistent, and reliable operation, making them ideal for the specific requirements of this project.

Advantages of Using I2C LCD

The use of an I2C LCD offers several advantages:

- Compact Wiring: The I2C interface reduces the number of required microcontroller pins, enabling a cleaner and more efficient design.
- User-Friendly Display: The LCD presents clear and structured information, improving the usability of the CNC router.
- Enhanced Precision: Real-time updates allow users to monitor and adjust operations with precision, ensuring optimal results in machining tasks.

Motor Torque Calculation

When calculating the torque on the screw shaft, how the motor torque is transmitted to the screw shaft, the gear ratios in the system and the mechanical properties of the screw shaft are taken into consideration. The torque is calculated according to the load on the screw shaft, the screw pitch and the efficiency factor. The axial load acting on the screw shaft is calculated with the following formula;

$$T=\frac{F*p}{2\Pi*\eta}$$

T=Torque

F=Load on the screw shaft

p=The pitch of the screw shaft

η=Efficiency of the screw shaft

According to this formula, the outer diameter of the screw shaft we choose, the pitch of the screw shaft, the efficiency of the screw shaft and the axial load express the amount of torque required for the rotation of the screw shaft.

Step Resolution to Speed Dynamics: Precision Control in Stepper Motor Systems

The NEMA 17 stepper motor is a popular choice for applications requiring precision and repeatability due to its well-defined step resolution. These motors typically have 200 full steps per revolution, corresponding to a step angle of 1.8°. This inherent resolution eliminates the need for external feedback mechanisms, providing an open-loop control system with high reliability.

When combined with microstepping drivers such as the A4988, the step resolution can be further increased. For instance, using 1/16 microstepping, the motor achieves 3200 microsteps per revolution, with each microstep corresponding to an angular displacement of 0.1125°. This fine resolution allows for smooth and precise motion control, which is particularly advantageous in applications demanding high accuracy, such as controlled fiber deposition or other forms of automated material placement.

Moreover, the consistent step size and high torque at low speeds ensure excellent repeatability and stable operation. This makes the NEMA 17 stepper motor a cost-effective and robust solution for precision-driven applications in various fields, including automation, robotics, and additive manufacturing.

The step resolution of the NEMA 17 stepper motor, combined with the microstepping capability of the A4988 driver, provides a high degree of control over angular displacement. This precision directly influences the motor's operational dynamics, particularly its rotational speed and the resulting linear motion in the system.

The rotational speed of the stepper motor is determined by the step rate, which is the number of steps (or microsteps) executed per second. For a motor with 200 steps per revolution, the relationship between step rate and rotational speed is expressed as:

$$Rotational\ Speed(RPM = \frac{Step\ Rate(step\ per\ second)\ x\ 60}{Steps\ per\ Revolution}$$

When microstepping is applied, the effective step rate increases proportionally. For example, under 1/16 microstepping, the motor would require 3200 steps for a full revolution. This increases the potential for smoother motion at lower speeds and finer control at higher speeds.

In applications involving linear motion, such as in this project, the rotational speed translates to linear velocity through the mechanical conversion mechanism. The relationship depends on the system's gear ratio or pitch:

$$\text{Linear Velocity} = \text{Rotational Speed (RPM)} \times \text{Conversion Factor}$$

Thus, by controlling the step rate, both the motor's angular speed and the system's linear velocity can be precisely regulated, ensuring the desired speed and accuracy for critical tasks like fiber deposition.

User Interface in CNC router system: The Role of I2C LCD

In this project, an I2C LCD module was utilized to enhance the user experience by providing real-time feedback and intuitive control over the CNC router's linear motion along the lead screw. The integration of the I2C interface not only simplifies wiring but also allows for efficient communication between the microcontroller and the display, minimizing pin usage while delivering a clear and concise user interface.

- **Real-Time Position Display**
  The I2C LCD continuously updates the current position of the CNC router, calculated based on the lead screw's pitch and the step count from the stepper motor. By converting rotational steps into linear displacement, the system ensures precise feedback, which is critical for applications requiring accuracy and repeatability. Users can monitor the position in millimeters (or another desired unit) on the display, allowing them to track the machine's status at all times.

- **User Interaction and Target Position Control**
  Beyond displaying the current position, the LCD serves as an interface for user input. By entering a desired target position via a keypad or another input device, the user can instruct the CNC router to move to a specific location along the lead

screw. The system processes this input and calculates the necessary steps to reach the target position, ensuring smooth and accurate movement. The display then provides real-time feedback on the router's progress as it moves toward the set destination, enhancing control and reliability.

In summary, the integration of the I2C LCD not only provides essential feedback on the router's position but also empowers the user with precise control over the system, making it an indispensable component in this CNC router setup.

Connections of Motor, Motor Driver, LCD screen

Vdd and GND	Should be connected to the 5v and GND parts of the Arduino.
Vmot and GND	Should be connected to 12 volts and GND to provide the 12 volts needed by the stepper motor.
1A,1B,2A,2B	Pins to which the stepper motor is connected.
Dır	Controls the direction of the motor.
Step	Controls the steps.
MS1, MS2, MS3	Microstep Selection Pins
Sleep and Reset	When they are connected to each other, the controller becomes active.
En	When the Enable pin is active, the motor is grounded. We can limit the power usage by making this pin active and passive.

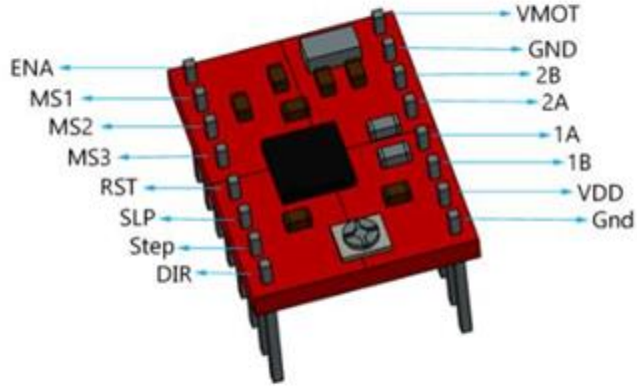


Figure 1- Pins of A4988 Stepper Motor Driver

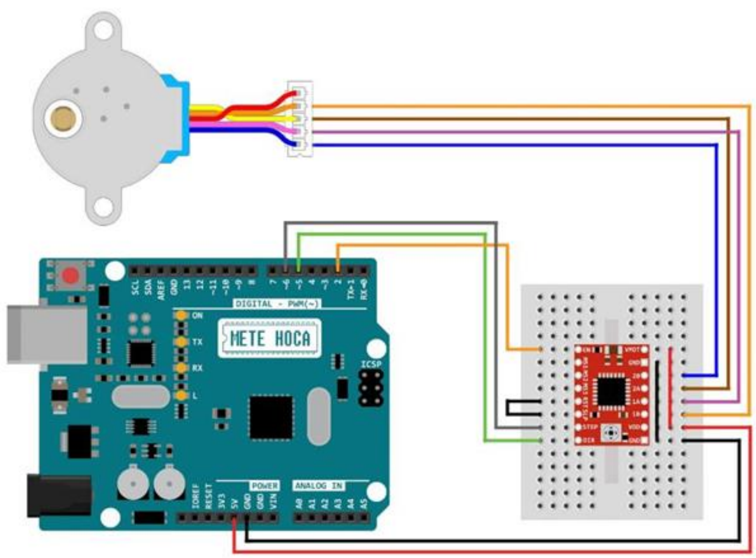


Figure 2- A4988 Stepper Motor Driver Connections with Arduino

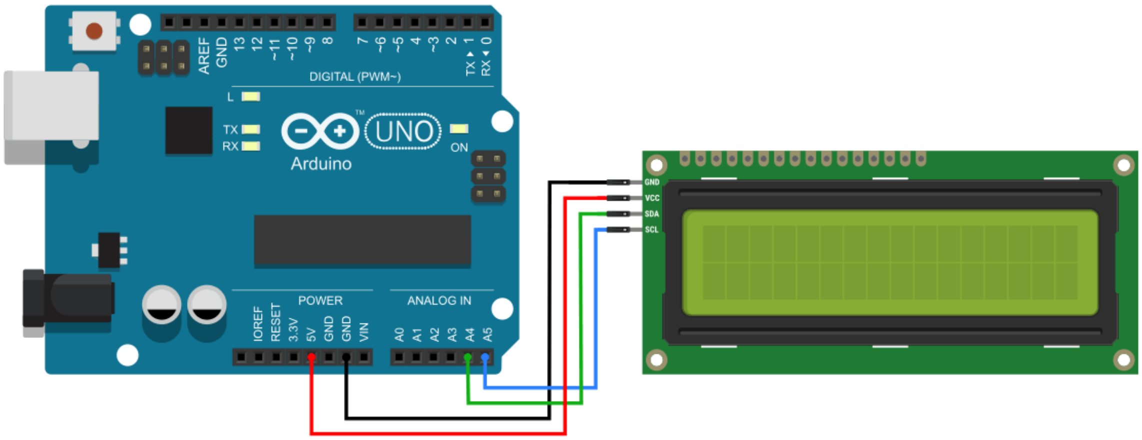
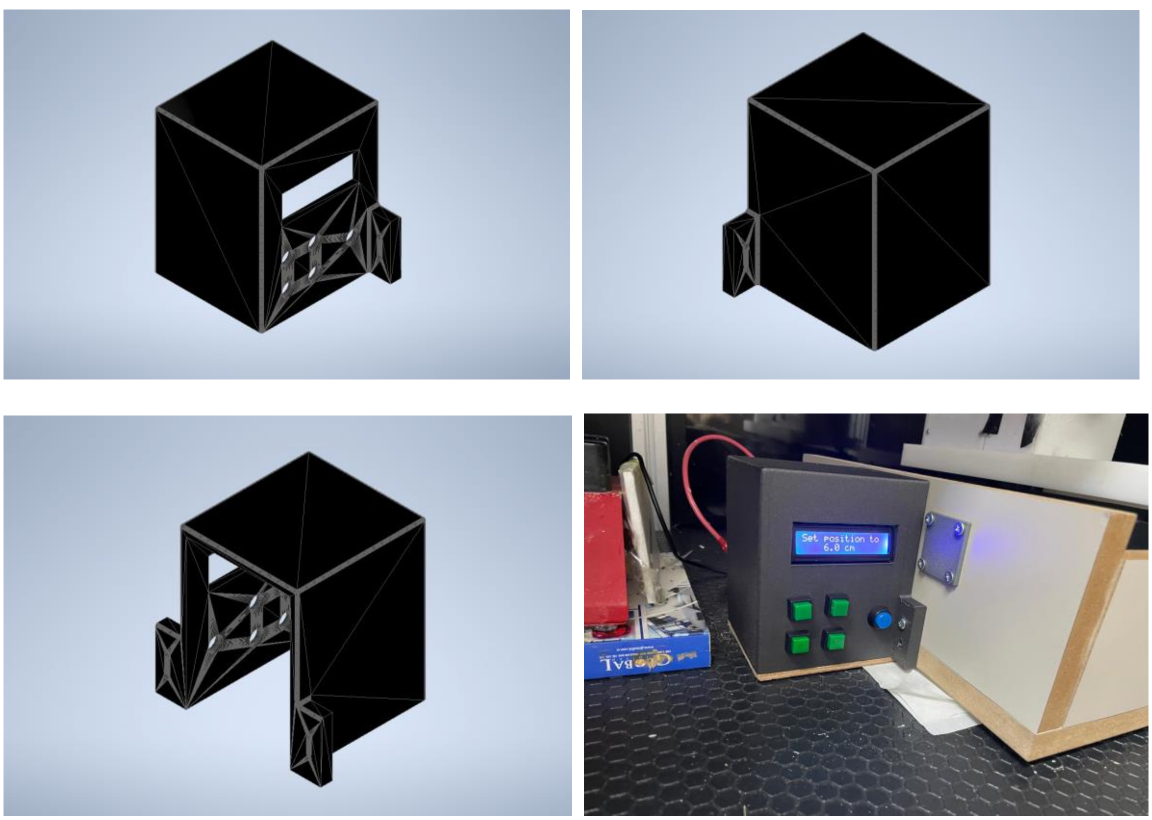


Figure 3- Pin connections I2C LCD and Arduino Uno

The Control Panel

This control panel is designed to manage the movement of the electrospinning system, providing an intuitive interface for users to adjust position settings and monitor system status via the buttons and LCD screen.



Technical Drawings and Real-Life Visuals of the Control Panel

System Features

Button Functions:
Top-left button (button1Pin - Pin 6): Increases the position by 1 cm.
Top-right button (button2Pin - Pin 7): Increases the position by 1 mm.
Bottom-left button (button3Pin - Pin 8): Decreases the position by 1 cm.
Bottom-right button (button4Pin - Pin 9): Decreases the position by 1 mm.
Blue button (button5Pin - Pin 10): Moves the motor to the set position.

LCD Screen Display:
Displays the current system status and the target position set by the user.
Initially shows a "Welcome!" message and moves the motor to the home position.
Displays "Set position to X.X cm" to indicate the user-defined target position.
During movement, it shows "Motor goes to X.X cm" to inform the user of the ongoing process.

LCD Code Explanation:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
```

- **Wire.h:**

This library is used for I2C communication. It facilitates data exchange between the microcontroller and I2C-compatible devices like the LCD. I2C is a two-wire protocol (SDA and SCL) that allows multiple devices to communicate using fewer pins.

- **LiquidCrystal_I2C.h:**

This library simplifies working with I2C LCD displays. It provides functions for writing text, clearing the screen, setting the cursor, and more. It eliminates the complexity of manually handling I2C communication.

```
LiquidCrystal_I2C lcd(0x27, 16, 2);
```

0x27: The I2C address of the LCD. This address allows the microcontroller to identify the specific device on the I2C bus. The address may vary depending on the hardware.

16: The number of columns on the LCD (16 characters per row).

- **The number of rows on the LCD (2 rows)**

The above command creates an LCD object named lcd, which is used for all LCD-related operations.

```
lcd.init();         // Initialize the LCD
lcd.backlight();    // Turn on the LCD backlight
```

lcd.init(): This initializes the LCD. Without this, the screen won’t function correctly.

lcd.backlight(): Turns on the LCD’s backlight for visibility.

- **Displaying Text with lcd.print()**

This function writes text or numbers to the LCD.

```
lcd.print("Welcome!");
```

This displays the text **"Welcome!"** on the current line and cursor position.

- **Setting Cursor Position with lcd.setCursor()**

This sets the position where text will appear on the LCD.

```
lcd.setCursor(4, 0); // Set cursor to column 4, row 0
lcd.print("Welcome!");
```

This example places **"Welcome!"** starting at the fifth character (column 4) of the first row (row 0).

- **Clearing the Screen with lcd.clear()**

This clears all text from the LCD.

```
lcd.clear();
```

- **Welcome Page**

```
void welcome_page() {
  lcd.setCursor(4, 0);
  lcd.print("Welcome!");
  delay(3000);
  lcd.clear();

  lcd.setCursor(1, 0);
  lcd.print("Motor goes to");
  lcd.setCursor(0, 1);
  lcd.print("initial point...");
}
```

This function is displayed when the system initializes.
First, it shows **"Welcome!"**, clears the screen, and then displays a message informing the user that the motor is moving to its initial position.

Homing (Initial Positioning)

Upon startup, the motor moves in the reverse direction until it reaches the limit switch. When the limit switch is triggered, the motor stops, and the system resets to the initial position.

- **Setting Position**

```
void set_position_to() { cm = (value / 10); // Calculate the cm part mm = (value % 10);
// Calculate the mm part lcd.setCursor(0, 0); lcd.print("Set position to");
lcd.setCursor(4, 1); lcd.print(cm); // Display cm part lcd.print('.'); lcd.print(mm); //
Display mm part lcd.print(" cm"); }
```

This function displays the user-defined target position in centimeters (e.g., 2.5 cm).
It calculates the integer (cm) and fractional (mm) parts of the value and formats the output accordingly.

Step Calculation:

The user-defined value is multiplied by the "hatve_orani" parameter (20.0) to calculate the total number of steps required.

The motor moves step-by-step to the designated position.

- **Displaying Target Movement**

```
void motor_goes_to() {
  lcd.clear();
  cm = (value / 10);
  mm = (value % 10);
  lcd.setCursor(0, 0);
  lcd.print("Motor goes to");
  lcd.setCursor(4, 1);
  lcd.print(cm);
  lcd.print('.');
  lcd.print(mm);
  lcd.print(" cm");
}
```

This function is called when the motor starts moving to the target position.

It clears the LCD and displays the target position in real-time.

Error Prevention Mechanism:

The user cannot set the position below 0 cm or above the maximum limit of 30 cm.
This control panel offers a user-friendly interface, allowing precise and repeatable control of the electrospinning process, ensuring improved accuracy and efficiency.

5. Results and Conclusion

Results

The CNC Router Integrated Electrospinning System project focused on designing and developing a precise and automated solution to enhance the electrospinning process. The project aimed to improve the precision, stability, and user-friendliness of the system through the integration of mechanical and electronic components.

In the mechanical aspect, the system was successfully constructed using a lead screw mechanism for accurate linear motion control, supported by guide rods to ensure stability and minimize deviations. Custom-designed protective enclosures were created using 3D printing technology to shield critical electronic components from potential exposure to the polymer solution, contributing to the system's longevity and operational reliability.

Cost-effective materials were selected for the framework to balance budget constraints with functional requirements.

In the electronic aspect, the implementation of NEMA 17 stepper motors controlled by A4988 drivers provided precise and repeatable motion control. The system's electronic control was developed using an Arduino-based platform, offering flexibility and ease of programming. An I2C LCD display was integrated to facilitate real-time monitoring and user interaction, enabling straightforward control of motion parameters.

While the construction phase of the project has been successfully completed, the testing phase is still ongoing. The system has been assembled and calibrated, and it is now ready for validation by biomedical engineering students. We are currently awaiting data collection from the biomedical team, who will conduct extensive testing to evaluate the system’s effectiveness in achieving consistent fiber deposition and its suitability for biomedical applications.

Conclusion

In conclusion, the CNC Router Integrated Electrospinning System has successfully reached the construction phase, demonstrating the feasibility of integrating mechanical and electronic subsystems to enhance precision and automation in electrospinning processes. The interdisciplinary collaboration between mechanical and electronic engineering students has resulted in a robust and adaptable system that holds promise for future biomedical applications.

Key achievements of the project include:

Precision and Control: The integration of the lead screw mechanism and stepper motors provides a high degree of motion accuracy, ensuring better control over the deposition process.

Structural Stability: The system design includes support elements to minimize vibrations and improve the uniformity of motion, which is crucial for maintaining fiber consistency.

Modular and Scalable Design: The use of readily available components and modular assembly techniques allows for easy upgrades and adaptations for future improvements.

User-Friendly Interface: The incorporation of an I2C LCD and simple user controls enhances the usability of the system, making it accessible to researchers and operators with minimal training.

Despite these accomplishments, further validation through systematic testing is required to confirm the system's performance under real-world conditions. The next steps involve collaborating with the biomedical engineering team, who will provide experimental data and feedback based on their specialized testing procedures. This data will be crucial in assessing fiber quality, process repeatability, and overall system efficiency. Based on their findings, potential refinements will be considered to optimize the design and operation of the system.

Ultimately, this project lays the groundwork for potential future advancements in electrospinning technology, offering a practical and cost-effective approach to automated fiber production with applications in biomedical engineering and related fields.

6. References

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7. Appendices

THE CODE

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

const int dirPin = 0; // Motor yön pini
const int stepPin = 1; // Motor adım pini
const int switchPin = 11; // Switch bağlı olduğu pin, 3 idi önceden 11'e          cektim
const float hatve_orani = 20.0; // Tam tur için adım oranı
const int button1Pin = 6; // İlk buton pini (1 cm artırır)
const int button2Pin = 7; // İkinci buton pini (1 mm artırır)
const int button3Pin = 8; // üçüncü buton pini (1 cm azaltır)
const int button4Pin = 9; // Dördüncü buton pini (1 mm azaltır)
const int button5Pin = 10; // Beşinci buton pini (hareket ettirir)


LiquidCrystal_I2C lcd(0x27, 16, 2); // set the LCD address to 0x27 for a 16 chars and 2
line display
int konum = 0; // Mevcut motor konumu (adım cinsinden)
int value = 0; // Kullanıcı tarafından ayarlanan değer
int tur_adimi = 0; // Hesaplanan toplam adım sayısı
bool homingCompleted = false; // Homing işlemi tamamlandı mı kontrolü
int cm = 0;
int mm = 0;
void setup()
{
  pinMode(stepPin, OUTPUT);
  pinMode(dirPin, OUTPUT);
  pinMode(switchPin, INPUT_PULLUP);
  pinMode(button1Pin, INPUT_PULLUP);
  pinMode(button2Pin, INPUT_PULLUP);
  pinMode(button3Pin, INPUT_PULLUP);
  pinMode(button4Pin, INPUT_PULLUP);
  pinMode(button5Pin, INPUT_PULLUP);
  lcd.init();       // initialize the lcd
```

```
  lcd.backlight();    // Turn on the LCD screen backlight
}

void loop()
{
  // Switch'e basılana kadar saat yönünün tersine dön
  if (!homingCompleted) {
    welcome_page(); // Showing welcome page to user.
    while (digitalRead(switchPin) == HIGH) {
      digitalWrite(dirPin, LOW);
      digitalWrite(stepPin, HIGH);
      delayMicroseconds(2000);
      digitalWrite(stepPin, LOW);
      delayMicroseconds(2000);
      }
    homingCompleted = true; // Switch basıldığında homing tamam
    lcd.clear();
  }

  set_position_to();
  // Button1'e basıldığında değeri 10 artır
  if (digitalRead(button1Pin) == LOW) {
    delay(200);
    value += 10;
    if (value >= 300) {
      value = 300;
    }
  }

  // Button2'ye basıldığında değeri 1 artır
  if (digitalRead(button2Pin) == LOW) {
    delay(200);
    value += 1;
    if (value >= 300) {
      value = 300;
    }
  }

  // Button3'e basıldığında değeri 10 azalt
  if (digitalRead(button3Pin) == LOW) {
    delay(200);
    value -= 10;
    if (value < 0) {
      value = 0;
    }
  }

  // Button4'e basıldığında değeri 1 azalt
  if (digitalRead(button4Pin) == LOW) {
    delay(200);
```

```
    value -= 1;
    if (value < 0) {
      value = 0;
    }
  }

  // Adım sayısını hesapla
  tur_adimi = static_cast<int>(value * hatve_orani);

  // Button5'e basıldığında hareket ettir
  if (digitalRead(button5Pin) == LOW) {
    motor_goes_to();
    tur_adimi -= konum;

    if (tur_adimi > 0) {
      delay(200);
      digitalWrite(dirPin, HIGH);

      for (int x = 0; x < tur_adimi; x++) {
        digitalWrite(stepPin, HIGH);
        delayMicroseconds(2000);
        digitalWrite(stepPin, LOW);
        delayMicroseconds(2000);
      }
    }
    else if (tur_adimi < 0) {
      delay(200);
      digitalWrite(dirPin, LOW);

      for (int x = 0; x < abs(tur_adimi); x++) {
        digitalWrite(stepPin, HIGH);
        delayMicroseconds(2000);
        digitalWrite(stepPin, LOW);
        delayMicroseconds(2000);
      }
    }

    delay(1000);
    konum += tur_adimi;
    lcd.clear();
  }
}




void welcome_page()
{
  lcd.setCursor(4, 0);
  lcd.print("Welcome!");
```

```
  delay(3000);
  lcd.clear();

  lcd.setCursor(1, 0);
  lcd.print("Motor goes to");
  lcd.setCursor(0, 1);
  lcd.print("initial point...");


}


void set_position_to()
{
  cm = (value/10);
  mm = (value%10);
  lcd.setCursor(0, 0);
  lcd.print("Set position to");
  lcd.setCursor(4, 1);
  lcd.print(cm);      // Print the cm part
  lcd.print('.');     // Print the decimal point
  lcd.print(mm);      // Print the mm part
  lcd.print(" cm");
 // lcd.clear();
}

void motor_goes_to()
{
  lcd.clear();
  cm = (value/10);
  mm = (value%10);
  lcd.setCursor(0, 0);
  lcd.print("Motor goes to");
  lcd.setCursor(4, 1);
  lcd.print(cm);      // Print the cm part
  lcd.print('.');     // Print the decimal point
  lcd.print(mm);      // Print the mm part
  lcd.print(" cm");

}
```