Ahsanullah University of Science & Technology
Department of Computer Science & Engineering

CSE 3216

Microcontroller Based System Design Lab

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Project Name: **CNC Machine**

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Introduction:

This proposal outlines the planned construction of a Computer Numeric Control (CNC) type machine. The purpose of the project is to construct a functional CNC type machine capable of writing sentences in English on a two-dimensional object such as paper. The machine will be able to move on three axes and will be able to write with pen. The device would be capable of functioning independent of computer for both writing and determining writing paths. The goal is to keep balance between high precision and speed for functioning the device.

Equipment:

- **Stepper motor:**

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. With a computer controlled stepping we can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor of choice for many precision motion control applications.

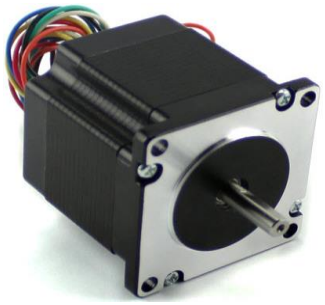


Fig: Stepper Motor

- **Servo motor:**

Servo motor a self contained electrical device, that rotate parts of a machine with high efficiency and great precision. The output shaft of this motor can be moved to a particular angle. Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement.

Fig: Servo Motor

- **L298 DC Motor Driver:**

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

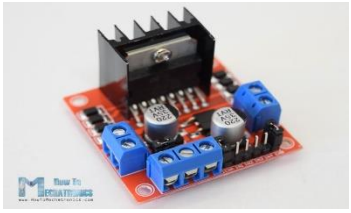


Fig : L298 Motor Driver

- **Arduino Mega 2560:**

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig : Arduino Mega 2560

- **HC-05 Bluetooth Module:**

HC-05 Bluetooth Moduleis an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.Itscommunicationis via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave modewhich means it able to use neither receiving nor transmitting data.

Fig: HC-05 Bluetooth Module

- **LCD:**

The Liquid Crystal Library allows to control LCD displays that are compatible with the Hitachi HD44780 driver.

Fig : LCD

- **Battery:**

A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte.

Fig : Lipo Battery

- **Wires:**

  Generally wires are used to connect the components with each other according to planned circuit.

- **Pen & Paper:**

  Pen is used to write the text which gives as input on the surface of a paper , which is mainly output.

Software:

- **Arduino IDE :**

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.This environment supports both C and C++ languages.

Features:

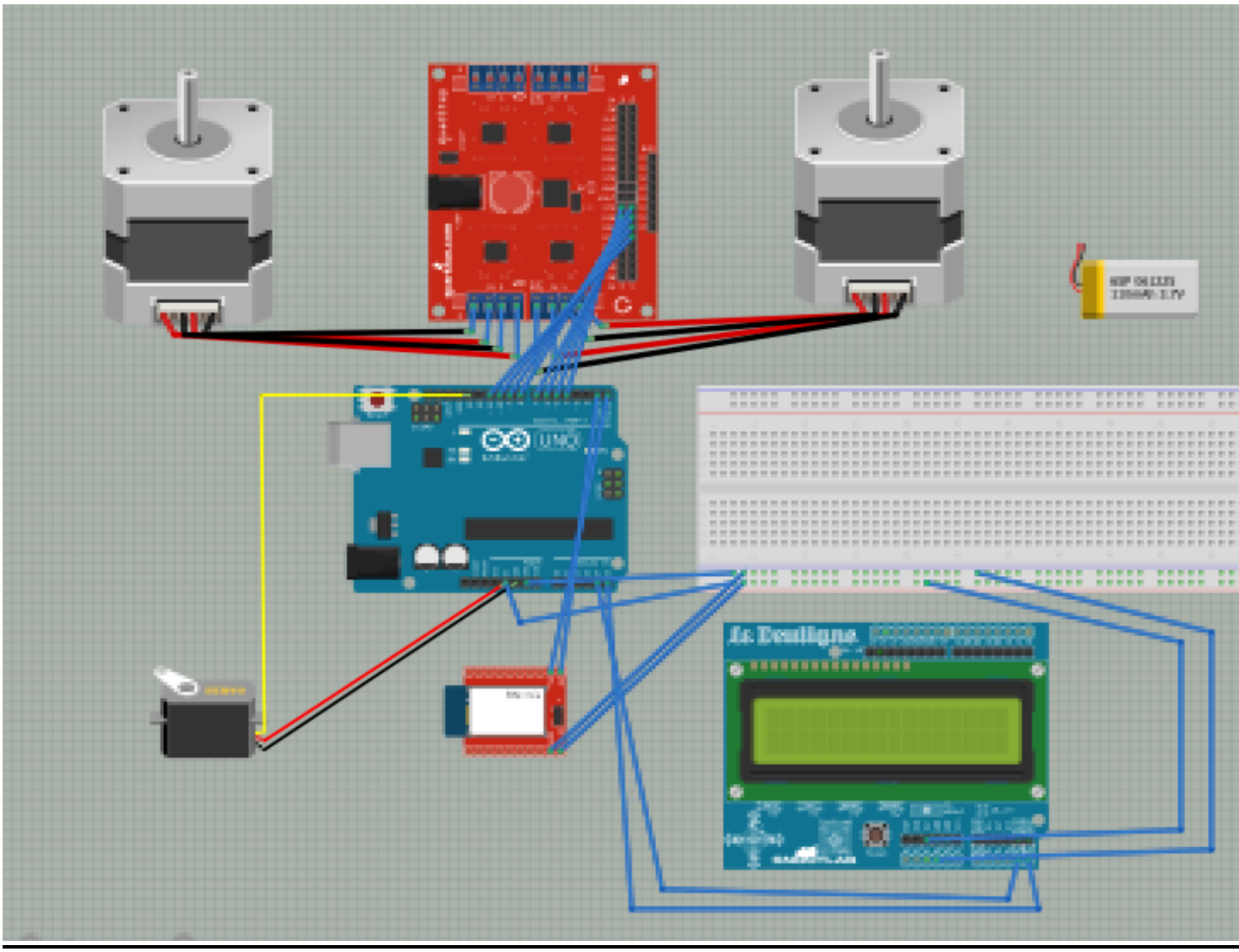
- Device would be able to write anything in English.
- Device will operate with high precision.
- Device would be independent of computer for functioning.
- Device would be dependent on computer for loading program into its microcontroller.
- Device will be operated by a DC power source.

Working Principle:

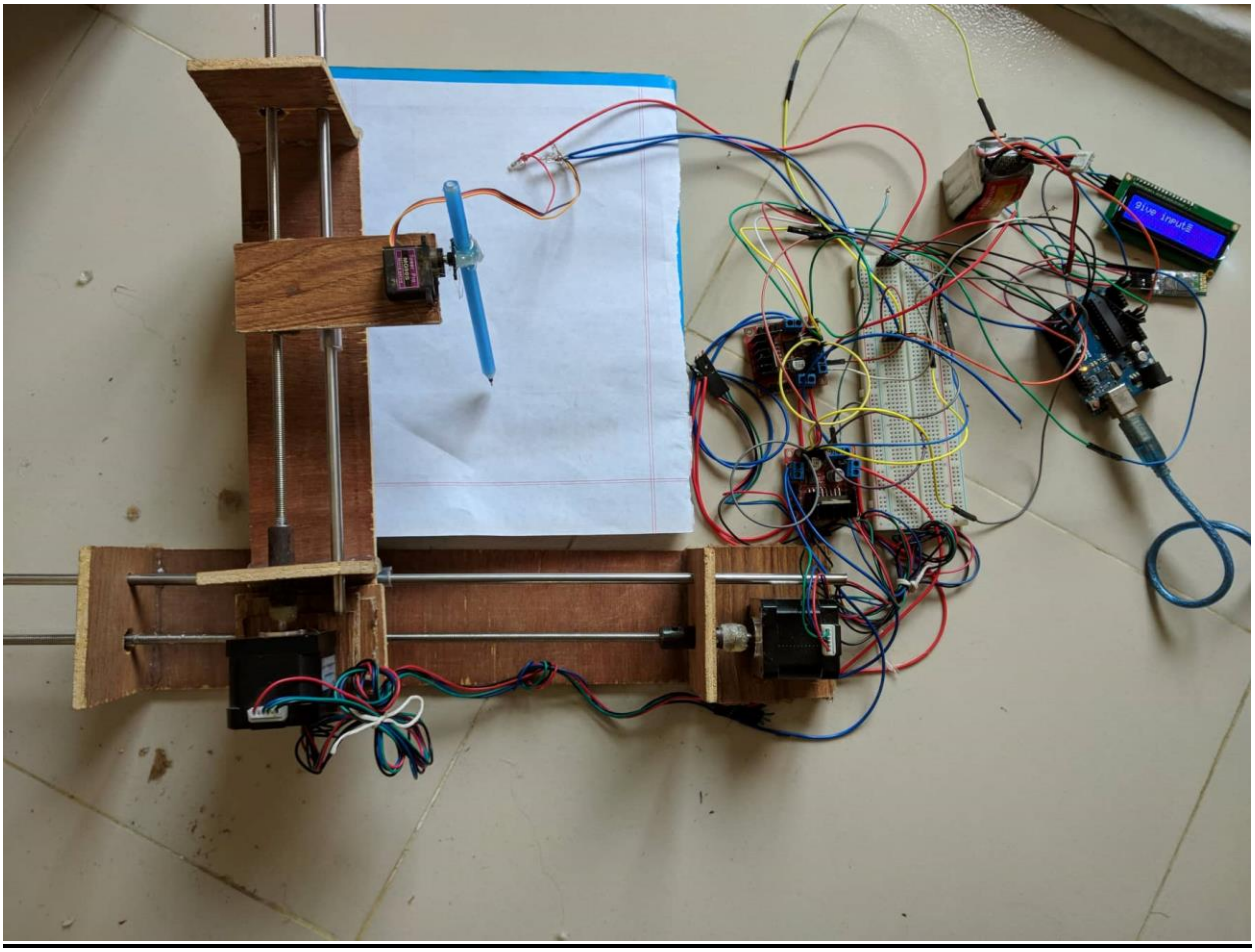
Two stepper motors which are controlled by two drivers (L298) rotate clock wise and anti-clockwise. A servo motor is stuck with a pen which rotates to Z- axis , this moves the pen up-down. Stepper motors move the pen through x and y axes. A Lipo battery supplies all the power to control the motors . All the components are stuck with an arduino board directly or indirectly . To make a CNC using arduino , we have written a code in Arduino IDE using the library function of the components which are controlled by

arduino board . We have used LCD to show the input which user takes. We have also used Bluetooth module to take input from other devices . After completing all the steps , we have given text as input , the pen has been written it in a white paper and this is the desired output.

Circuit Diagram:



Figures of Project :



Constrains:

- Sometimes motor drivers do not work properly as instructions.
- Sometimes motors do not move properly for having inadequate voltage.
- Some structural constrains, as a result , the pen can not move smoothly on the surface of paper.
- Over heating , as a result , wires get burnt.

Do and Don’ts:

Dos	Don’ts
Get input text from mobile wirelessly	
Print the text on the paper using pen	

Conclusion:

Our goal is to construct a writing machine which will operate with good accuracy and we will try to make it faster as much we can. Making a CNC machine of this type is not an easy task in the given time period. We will try our level best to achieve our goal in this project.

Appendix:

```
// Include the Arduino Stepper
Library
#include <Stepper.h>
#include <Servo.h>
#include<Wire.h>
#include<LiquidCrystal_I2C.h>


LiquidCrystal_I2C lcd
(0x27,2,1,0,4,5,6,7,3, POSITIVE);
// Create a servo object
Servo Servo1;
// Number of steps per output
rotation
const int stepsPerRevolution =
1000;

// Create Instance of Stepper
library
Stepper
myStepper(stepsPerRevolution,
8,9,10, 11);
Stepper my(stepsPerRevolution,
4,5,6,7);
    lcd.write("give input");
        char s = Serial.read();
        lcd.write(s);
        Serial.println(s);
        if(isAlpha(s))
        {
         lcd.clear();
        lcd.write("Got ");
        lcd.write(s);
        delay(3000);
            if(s == 'a')
        {
          lcd.clear();
          lcd.write("Printing A");
```

```
void setup() {
  // put your setup code here, to
run once:
  Servo1.attach(3);
  myStepper.setSpeed(40);
  my.setSpeed(40);

  //initiate lcd
  lcd.begin(16,2);
  // initialize the serial port:
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run
repeatedly:

      if(Serial.available())
  {
     delay(100);

     while(Serial.available())
     {
      lcd.clear();
          printA();
          lcd.clear();
        lcd.write("Printing Done");
        delay(3000);
        }
        else
        {
          lcd.clear();
          lcd.write("Sorry");
        delay(3000);
          } }} }}

void printA()
{
```

```
  Serial.println("Staring from
servo");
      Servo1.write(40);
      delay(500);
      Servo1.write(52);
      delay(500);
      Serial.println(" A er Vertical
Line ");

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);
      delay(500);
      Serial.println("A er horizontal
Line");
      my.step(stepsPerRevolution);
      my.step(stepsPerRevolution);
      my.step(stepsPerRevolution);
      delay(500);
        Serial.println("Reverse
Vertical Line ");
        myStepper.step(-
stepsPerRevolution);
        myStepper.step(-
stepsPerRevolution);
        myStepper.step(-
stepsPerRevolution);
        myStepper.step(-
stepsPerRevolution);
        myStepper.step(-
stepsPerRevolution);
        myStepper.step(-
stepsPerRevolution);
        Serial.println("Servo Up");
        Servo1.write(40);
        delay(500);
        Serial.println("Then going
back for mid Line ");

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);

myStepper.step(stepsPerRevoluti
on);
        Serial.println("Pen Down for
mid Line");
        Servo1.write(52);
        delay(500);
        Serial.println("Starting the
Mid Line");
        my.step(-
stepsPerRevolution);
        my.step(-
stepsPerRevolution);
        my.step(-
stepsPerRevolution);
        Serial.println("Finished the
Mid Line");
        Servo1.write(40);
        Serial.println("Job Done");
        delay(500);
        }
```