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Mechatronics Lab (IPPC-313)

Project Report : CNC Laser glowing

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CNC laser Glowing

Components:

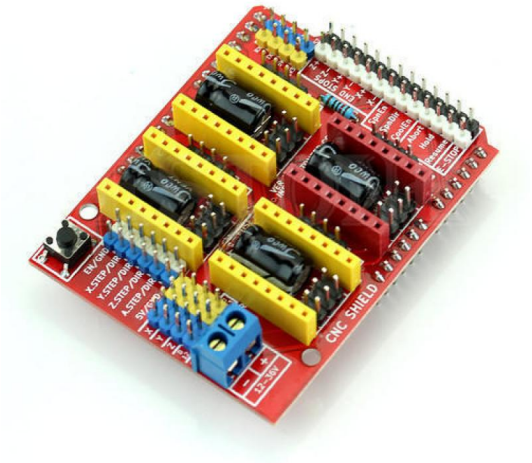
5 MW Laser:

- **Power Output:** 5 milliwatts
- **Application:** Laser glowing.
- **Safety:** Handle with care to avoid eye exposure. Consider using safety glasses.

Arduino UNO:

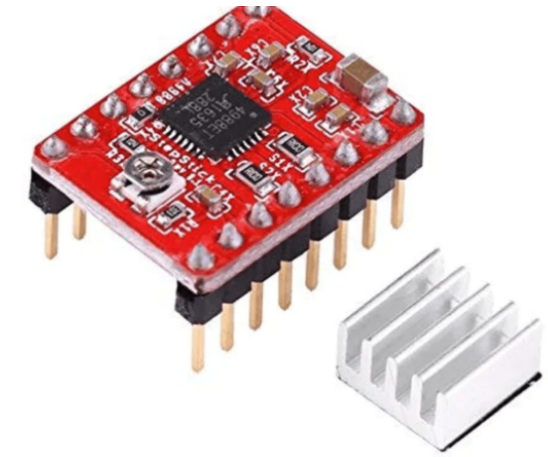
- **Microcontroller:** ATmega328P
- **Operating Voltage**: 5V Digital I/O Pins: 14 (of which 6 provide PWM output)
- **Analog Input Pins:** 6
- **Flash Memory:** 32 KB (0.5 KB used by bootloader)
- **SRAM:** 2 KB
- **EEPROM:** 1 KB
- **Clock Speed:** 16 MHz

CNC Shield:



- **Compatibility:** Arduino UNO
- **Stepper Motor Drivers:** Typically supports A4988 or DRV8825 drivers
- **Expansion:** Provides a platform for connecting stepper motors and other peripherals for CNC applications.

A4988 Driver X2:



Type: Stepper Motor Driver Features: Microstepping, adjustable current limiting, over-temperature shutdown

Quantity: Two drivers for controlling two stepper motors independently.

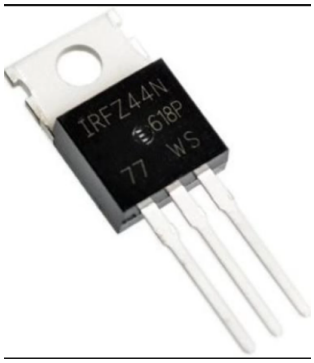
12 Volt SMPS:

- Output Voltage: 12V
- Application: Power supply for various electronic components in the CNC system.

10K 47E Resistance:

- **10K Resistor:** 10,000 ohms
- **47E Resistor:** 47 ohms
- **Usage:** Typically used for voltage dividers, current limiting, or other circuit-specific purposes.

IRFZ44N Mosfet:



- **Type:** N-channel MOSFET
- **Features**: Low on-state resistance, fast switching, high current capability Usage: Can be used as a switch or amplifier in electronic circuits.

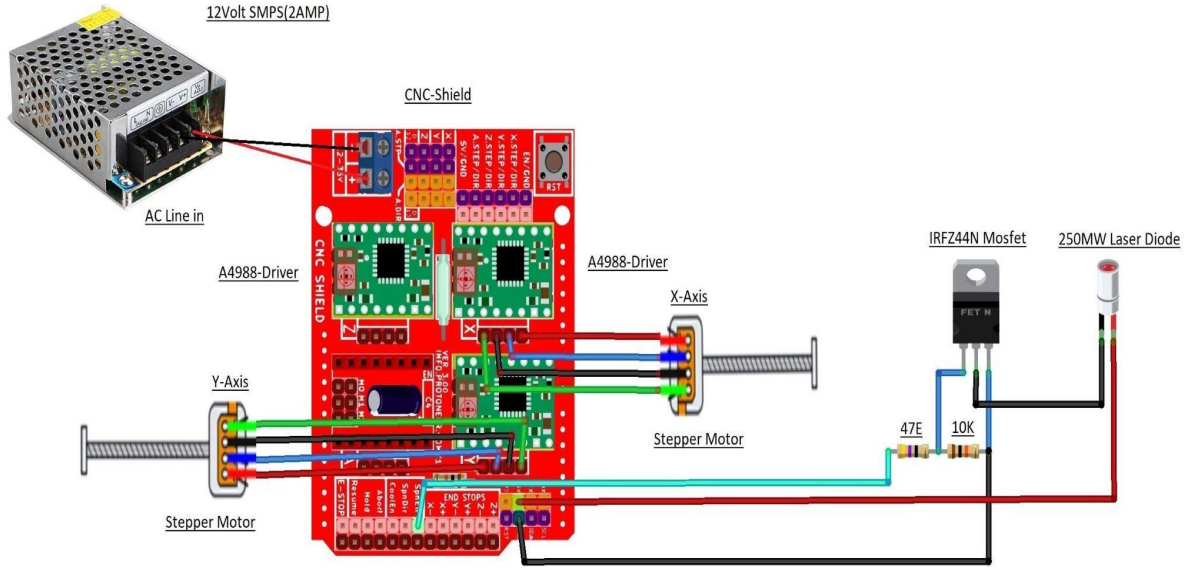
Old DVD Writer:

- **Components:** Stepper motors, gears, optical sensors.
- **Potential Usage**: Repurposed for motion control, sensors, or other mechanical components in your project.

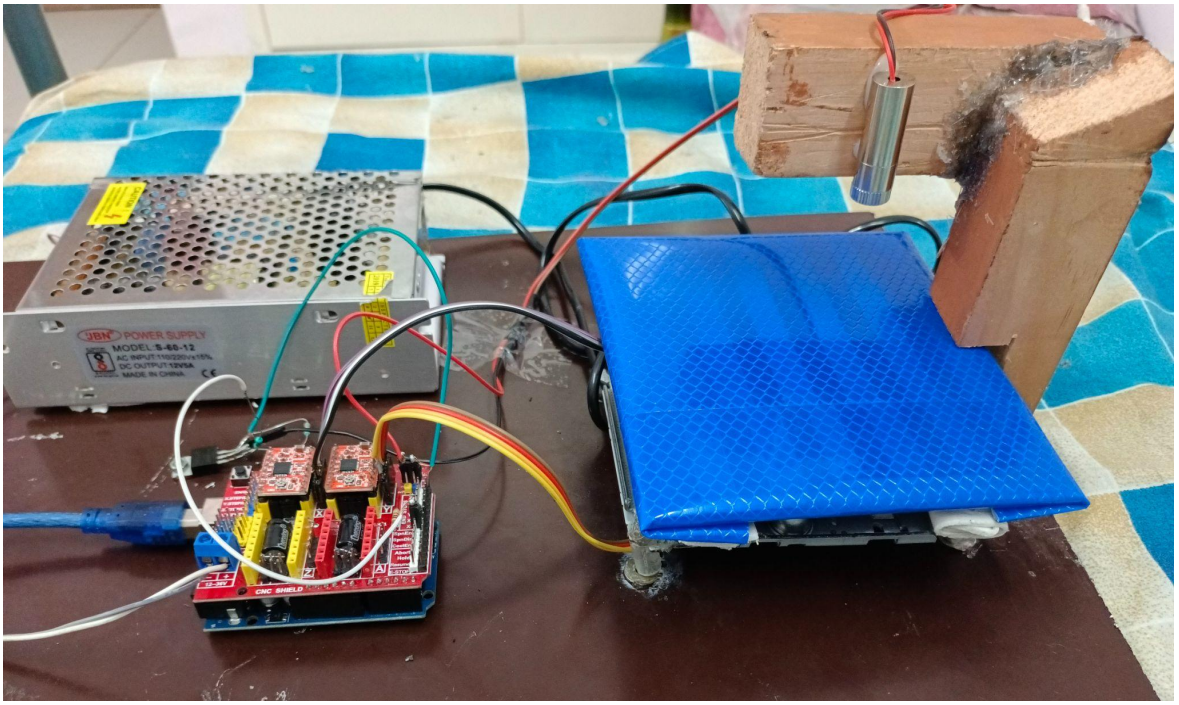
ACP Sheet:

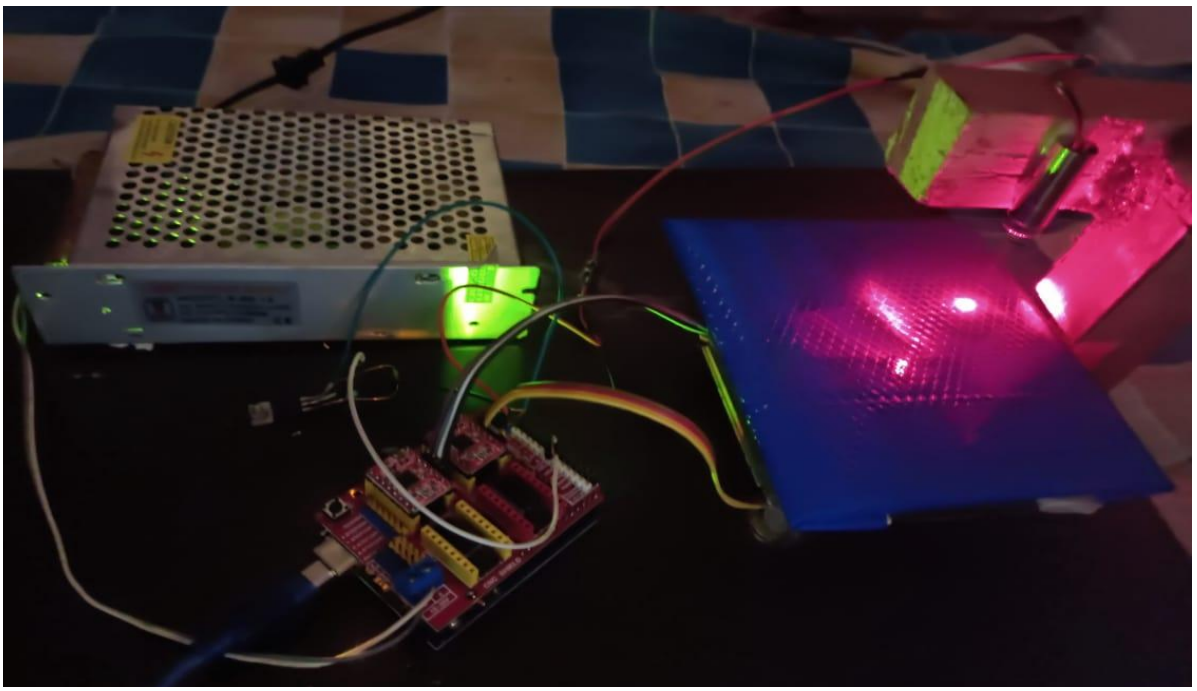
- **Material:** Aluminum Composite Panel Properties: Lightweight, durable, versatile
- **Usage:** Construction of the frame or enclosure for the CNC project.

CIRCUIT DIAGRAM:-



PHOTOS OF PROJECT:-





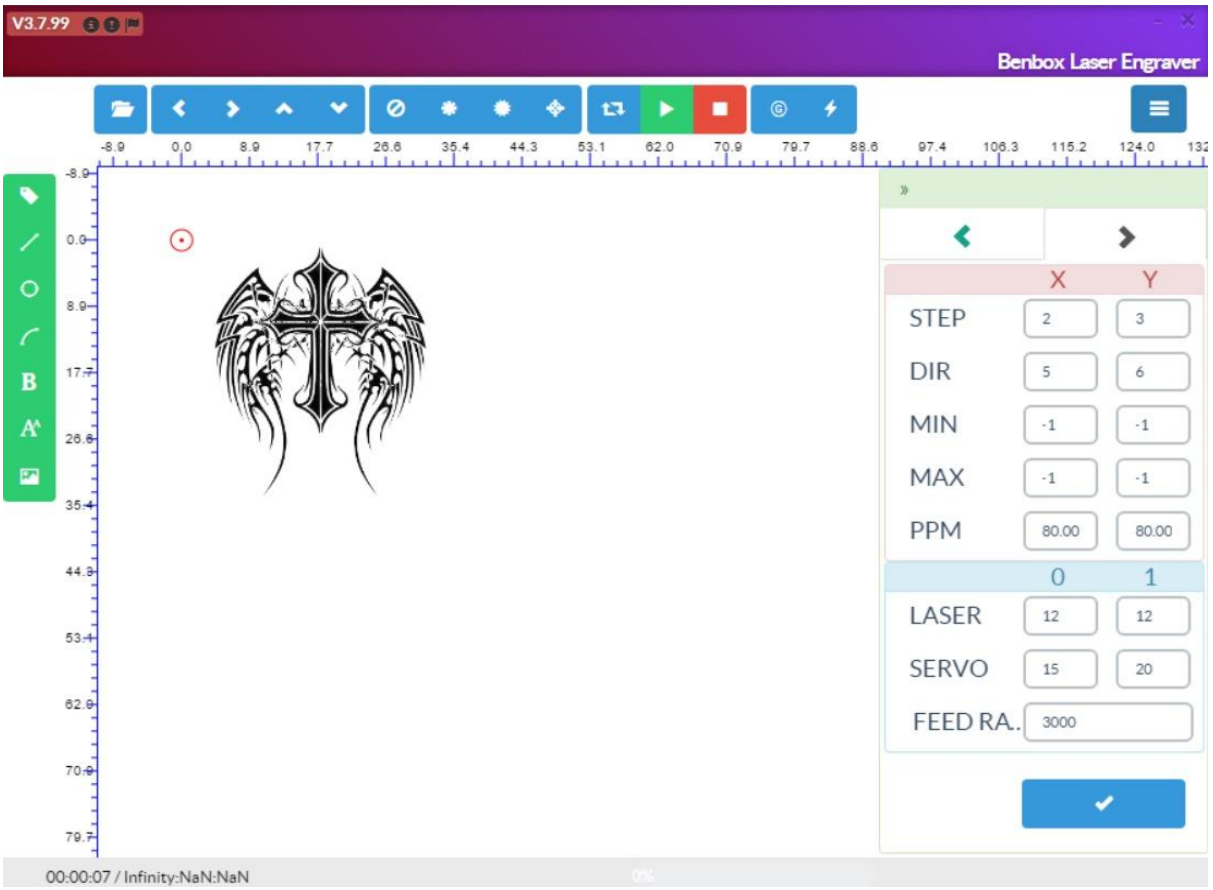
CODE:

```
#include <AccelStepper.h>

 // Define motor connections

#define X_STEP_PIN 2

#define X_DIR_PIN 5

#define Y_STEP_PIN 3

#define Y_DIR_PIN 6


// Define laser control pin

#define LASER_PIN 12


// Create stepper motor objects

AccelStepper stepperX(AccelStepper::DRIVER, X_STEP_PIN, X_DIR_PIN);

AccelStepper stepperY(AccelStepper::DRIVER, Y_STEP_PIN, Y_DIR_PIN);
```

```
void setup() {
  // Set up motor parameters
  stepperX.setMaxSpeed(1000.0);
  stepperX.setAcceleration(500.0);

  stepperY.setMaxSpeed(1000.0);
  stepperY.setAcceleration(500.0);

  // Set up laser pin
  pinMode(LASER_PIN, OUTPUT);
}

void loop() {
  // Move the motors to a specific position
  moveMotorToPosition(&stepperX, 1000); // Move to X position 1000
  moveMotorToPosition(&stepperY, 500);  // Move to Y position 500

  // Turn on the laser for a short duration
  digitalWrite(LASER_PIN, HIGH);
  delay(1000); // Laser on for 1 second

  // Turn off the laser
  digitalWrite(LASER_PIN, LOW);

  // Move back to the home position
  moveMotorToPosition(&stepperX, 0);
```

```
  moveMotorToPosition(&stepperY, 0);

  // Repeat the process for engraving more patterns
}

void moveMotorToPosition(AccelStepper *stepper, long targetPosition) {
  stepper->moveTo(targetPosition);
  while (stepper->distanceToGo() != 0) {
          stepper->run();
  }
}
```

SOFTWARE USED: BENBOX LASER ENGRAVING SOFTWARE:



CONSTRUCTION:-

To construct a CNC laser engraver from the specified components, begin by building a sturdy frame/base with ACP sheet, ensuring space for mounting the Arduino UNO and CNC Shield. Attach the A4988 drivers to the CNC Shield and position the 250 MW Laser to allow free movement along the X and Y axes. Connect the stepper motors from the old DVD writer to the A4988 drivers, ensuring correct wiring for stepper motor phases. Wire the CNC Shield to the Arduino UNO and connect the 12 Volt SMPS to power the stepper motors. For laser control, connect the 250 MW Laser to an IRFZ44N MOSFET, ensuring proper power and ground connections. Program the Arduino UNO with CNC control software, capable of interpreting G-code to control both stepper motors and the laser. Test the system by jogging the stepper motors and ensuring the laser turns on and off as intended. Calibrate the CNC machine for accurate movement along the X and Y axes, adjusting settings in the control program as necessary. Implement safety features in the program to ensure secure laser operation and always wear safety glasses when the laser is operational. Secure all connections, double-check wiring, and make any necessary adjustments for the finalization of the CNC laser engraver.

WORKING:-

The Laser Engraver/Glower is a mechatronics project designed to utilize laser technology for precise engraving or glowing on various materials. This project integrates mechanical, electrical, and software components to achieve controlled and accurate laser-based operations.

- **Mechanical Setup:**

X and Y planes implemented using a DVD writer mechanism for extended motion.

DVD writer serves as the motion system for precise control over the laser head's positioning.

- **Laser Module and Substrate:**

Laser module employed for creating desired patterns on fluorescent or UV paper.

Chosen substrate designed to glow in the dark when exposed to the laser.

- **Control Electronics:**

Arduino board used as the central control unit.

Programmable Logic Controllers (PLCs) and drivers connected to Arduino to manage the motion system.

- **Power Control:**

MOSFET integrated into the system for power control.

Resistors connected to the MOSFET to regulate power supplied to Arduino.

- **Laser Power Control:**

Laser connected to Arduino via two wires and resistors.

Power supplied to the laser is controlled through Arduino for desired engraving depth.

- **Software Integration:**

Benbox software used for system control.

User inputs commands and selects desired images in Benbox, which translates them into instructions for Arduino.

Sequence of Operation:

User selects the desired image in Benbox software.

Commands sent to Arduino, which interprets and processes them.

- **Motion Control:**

Arduino activates a motion control system, guiding DVD writers to move in X and Y planes based on selected image.

- **Laser Operation:**

Simultaneously, Arduino controls the laser module, adjusting power and position to trace selected patterns on fluorescent or UV paper.

- **Glowing Image Creation**:

Laser interacts with fluorescent or UV paper, causing it to glow in the dark and creating the desired pattern.

- **Real-time Monitoring:**

System may include sensors for real-time monitoring of temperature, ensuring safe laser operation.

SCOPE OF FUTURE IMPROVEMENT:-

Wireless Connectivity: Implement wireless connectivity options for easier file transfer and control. This could include Wi-Fi or Bluetooth capabilities.

Laser Power Upgrade: Consider upgrading to a more powerful laser module for increased cutting and engraving capabilities. This may involve adjusting the power supply and ensuring safety measures are in place.

Advanced Control Software: Explore more sophisticated CNC control software such as GRBL or other open-source alternatives. These platforms often offer advanced features and compatibility with a broader range of CNC operations.

Motor Upgrade: Upgrade the stepper motors for smoother and more precise movements. Higher torque motors may allow for increased accuracy in intricate designs.