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Electric Press Machine by Using Stepper Motor

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Abstract: ***In ancient times material was shaped manually using hand hammers. Later on, big hammers were used to press large quantities of material at a time or to press a thick metal workpiece. Then after steam power and windmills were utilized to operate the large steam hammers. Prior to the invention of the machine press, workers were required to manually hammer metal by hand to change the shape of materials. After that, it cannot able used to change the shape of large or big size material, and itit'shysically ineffective. The steam hammer was developed around the mid – the 1800s and is also known as a drop hammer, the steam hammer or drop hammer was essentially an early version of the modern-day machine press. The only difference is that the steam hammer was powered by steam, whereas most modern-day machine presses are powered by hydraulics and electricity. Now day world, we are normally using a mechanical press machine and hydraulic press machine. In this paper, we are explaining about electric press machine by using stepper motor.***

Keywords: Arduino UNO R3, TB6600 4A Stepper Motor Driver, Permanent magnet Stepper Motor, SMPS (switched-mode power supply)

I. INTRODUCTION

In this paper, we are explaining electric press machines by using a stepper motor. [1] In ancient times, the material was shaped manually using hand hammers. Later on big hammers were used to press large quantities of material at a time, or to press a thick metal workpiece. Then after steam power and wind mills were utilized to operate the large steam hammers. [1,2] Before the invention of the machine press, workers were required to manually hammer metal by hand to change its shape of materials. After that, it cannot able used to change the shape of large or big size material and it's physically ineffective. The steam hammer was developed around the mid –1800s ait is also known as a drop hammer, the steam hammer or drop hammer was essentially an early version of the modern-day machine press. The only difference is that the steam hammer was powered by steam, whereas most modern-day machine presses are powered by hydraulics and electricity. Then steam power and windmills were utilized to operate the large steam hammers. Later on due to electrification, most of the power presses now use electrical power or hydraulic power to obtain the required pressure. Today the power presses are category based on the mechanisms either mechanical press or hydraulic press or electrical press.[3] In this device, a direct 220volt supply is given to SMPS (switched-mode power supply) and in the ba, CK we get 24volt output. In order components which work only under 24volt supply. [10,14] This 24volt supply is given to the driver from SMPS and the driver generates signals according to our coding which we want and these signals from TB6600 driver moves to Arduino Uno which is connected with the driver and Arduino intimates the direction and angle which has to be driven by motor and again the by the help of driver the motor runs. Now day world, we are normally using mechanical press machines and hydraulic press machines. In this paper, we are explaining about electric press machine by using stepper motor.

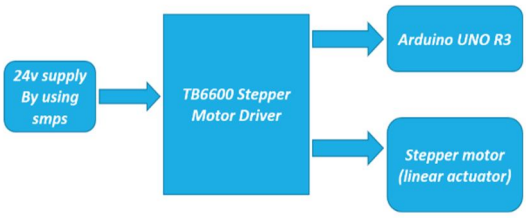
Table1: Used Material

Material name	Used material
Permanent magnet Stepper Motor	1 Stepper motor
TB6600 4A Stepper Motor Driver	1 Stepper motor driver
Arduino UNO R3	1 Controller
Arduino IDE	Software
Metal rod, wood	Tool
SMPS (switched-mode power supply)	Power supply

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II. PROPOSED WORK



In this proposed work direct 220volt supply is given to SMPS (switched-mode power supply) and in the back, we get 24volt output. In order components which work only under 24volt supply. This 24volt supply is given to the driver from SMPS and the driver generates signals according to our coding which we want and these signals from the TB6600 driver moves to Arduino Uno which is connected with the driver and Arduino intimates the direction and angle which has to be driven by motor and again the by the help of driver the motor runs.

III. COMPONENT EXPLANATION

A. Permanent Magnet Stepper Motor



Figure 1: stepper motor

The permanent magnet stepper motor has a stator construction is similar to the single stack variable reluctance motor. this type of stepper motor rotor part consists of a permanent magnet. Concentrating windings on diametrically opposite poles are connected in series to the two phase winding on the stator. A stepper motor is a brushless DC motor whose rotor rotates through a fixed angular step in response to each input current pulse received by its controller. Rotation occurs because of magnetic interaction between rotor poles and poles of the sequentially energized stator windings. A stepper motor is a digital actuator whose input is in the form of programed energization of the stator windings and whose output in the form of discrete angular rotation. The stepper motor is ideally suited for an actuator in computer control systems, digital control systems The main feature of a stepper motor is that the rotor rotates in discrete angular intervals or steps, one step being taken each time a command pulse is received. When the definite number of the pulse is applied to the motor, the rotor rotates through a definite known angle. Due to this, the stepper motor is mainly used for open loop position control because no feedback signal from the motor shaft is needed. Stepper motor develops torque ranging from 1 micro-newton to 40 newton-meter. The output power ranges from 1 w to a maximum of 2500 w. In this device, the permanent magnet stepper motor is used in a linear actuator.

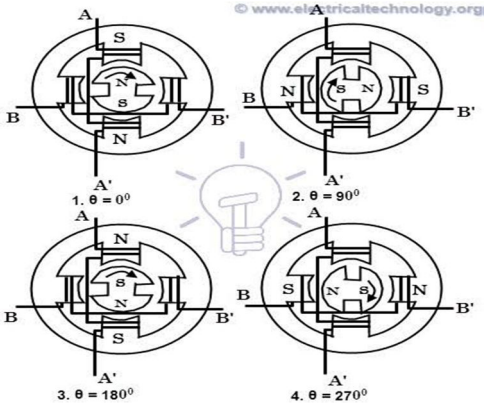


Figure 2: angle diagram for stepper motor

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B. Arduino UNO R3

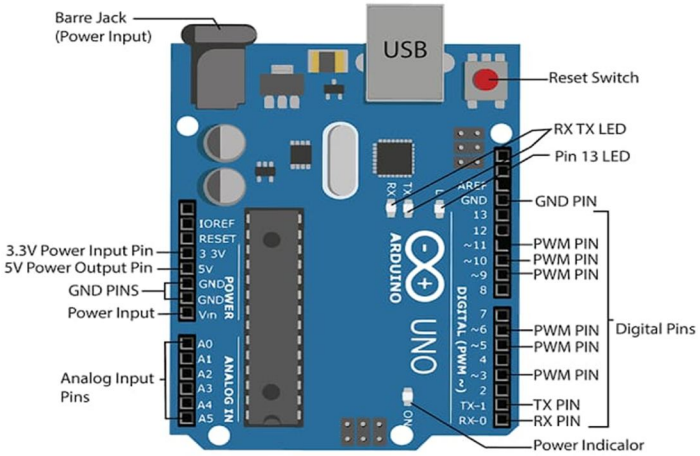


Figure 3: ARDUINO UNO R3

The Arduino Uno r3 is a microcontroller board based on the device. The Arduino Uno r3 is an open-source microcontroller board on the ATMEGA328 chip. This board has 20 digital input/output pins, an onboard 16 MHz ceramic resonator, a port for USB connection, an onboard DC power jack, an ICSP header, and a microcontroller reset button. It contains everything needed to support the microcontroller. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with a DC adapter or battery to get started. The main advantage of using this board is, if we make any mistakes in the future we can able change those mistakes. By using the codes, we can able to give commands to the Arduino Uno r3 board. In this its acts as a controller.

C. Stepper Motor Driver

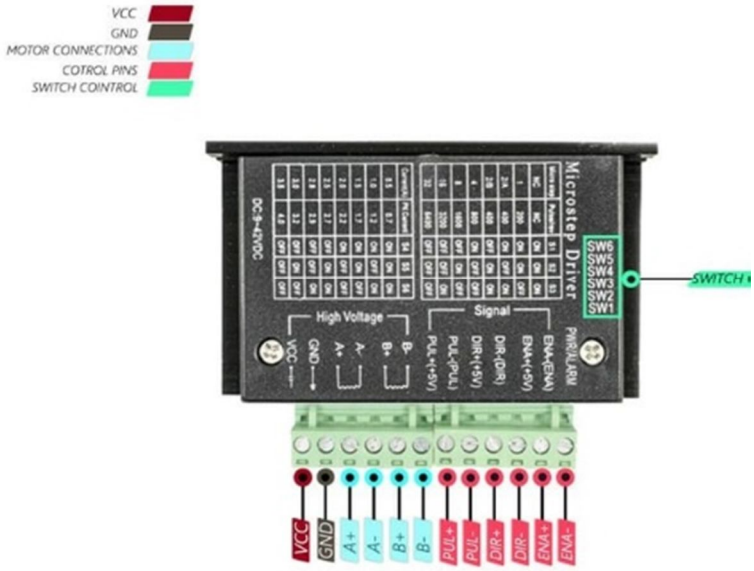


Figure 4: TB6600 Stepper motor driver

The TB6600 is an easy-to-use professional stepper motor driver that you can adjust its micro-steps. This module could control a two-phase stepping motor. A key feature of this module is that you can change the micro-step settings by the built-in switches on the driver. The stepper motor driver is the driver circuit that's enabled to function the way it does. In this device, we are using a TB6600 stepper motor driver. In this driver, by using switches we are easily able to give rotational angles and current.

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Table 2: Micro-Steps for Stepper Motor Driver

S1	S2	S3	Microstep resolution
ON	ON	ON	NC
ON	ON	OFF	Full step
ON	OFF	ON	1/2 step
OFF	ON	ON	1/2 step
ON	OFF	OFF	1/4 step
OFF	ON	OFF	1/8 step
OFF	OFF	ON	1/16 step
OFF	OFF	OFF	1/32 step

Table 3: Current

Current (A)	Peak current	S4	S5	S6
0.5	0.7	ON	ON	ON
1.0	1.2	ON	OFF	ON
1.5	1.7	ON	ON	OFF
2.0	2.2	ON	OFF	OFF
2.5	2.7	OFF	ON	ON
2.8	2.9	OFF	OFF	ON
3.0	3.2	OFF	ON	OFF
3.5	4.0	OFF	OFF	OFF

D. SMPS (switched-mode power supply)



Figure 5: SMPS (switched-mode power supply)

SMPS full form switched-mode power supply. SMPS is an electric power supply that incorporates a switching regulator to convert electrical power efficiently. SMPS is used to transfer the power form like DC or AC to AC or DC loads. In this device, SMPS is used to convert AC to DC load (220v supply to 24v supply).

E. Plywood

After completion of the circuit connection, all those things are attached to wood. Here we are using plywood. Wood dimension,
S1, S2= (17”) (1.2”) (2.2”)
T1, B1= (7”) (1.2”) (2.2”)
M1= (5”) (1.2”) (2.2”)
Base= (7”) (6”) (0.75”)
*Make a 20mm hole in M1 and a 20mm half hole in T1.

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F. Arduino IDE Software

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board.it runs on Windows, Mac OS X, and Linux. The environment is written in C, C++, Java, and based on processing and other open-source software. This software can be used with any Arduino web editor, start coding online with the Arduino web editor, save your sketches in the cloud, and always have the most up-to-date version of the IDE, including all the contributed libraries and support for new Arduino boards.

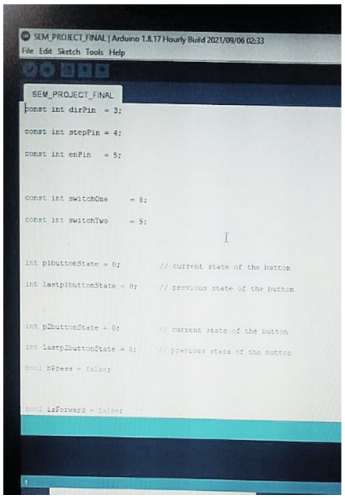


Figure 5: ARDUINO IDE SOFTWARE

IV. CIRCUIT DIAGRAM AND WORKING EXPLANATION

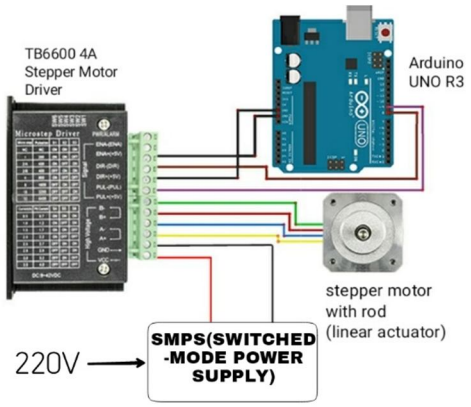


Figure 6: circuit diagram

The 24volt input is given to the system. The wires of the stepper motor are separated as pairs of coil A & coil B and connected to the driver. Since to make the circuit simple all the negative signals are connected in series and one output is taken out. The other wires are taken from ENA (+), DIR (+), PUL (+). From here the negative signal is given to the Arduino ground and the other positive wires line PUL (+) is given to (digital PWM) pulse width modulation 12. DIR (+) is connected with PWM pin 11 and ENA (+) with PWM pin 10. Here the Arduino PWM helps in the way of adjusting and generating different average dc voltages and the motor runs accordingly with coding. In this device, a direct 220volt supply is given to SMPS (switched-mode power supply) and in the back, we get 24volt output. In order components which work only under 24volt supply. This 24volt supply is given to the driver from SMPS and the driver generates signals according to our coding which we want and these signals from the TB6600 driver moves to Arduino Uno which is connected with the driver and Arduino intimates the direction and angle which has to be driven by motor and again the by the help of driver the motor runs.

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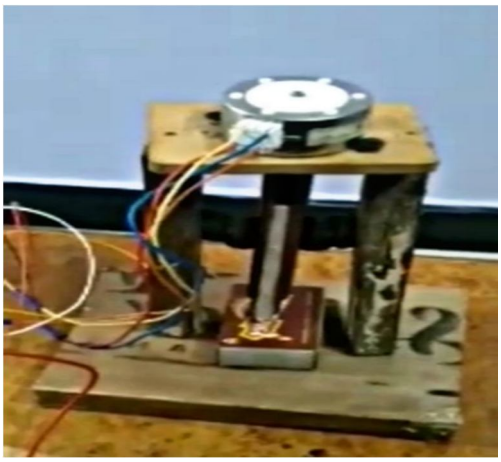


Figure 7: hardware of press machine

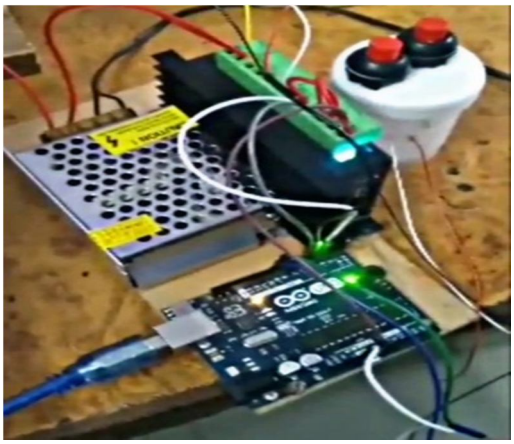


Figure 8: Hardware of circuit connection

V. MOTOR ROTATION OUTPUT

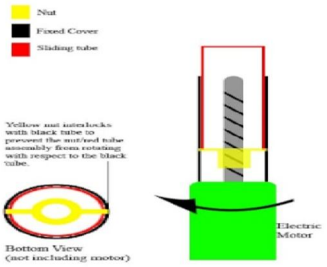


Figure 9: Forward rotation diagram

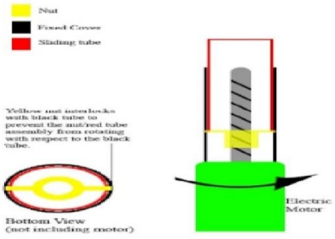


Figure 10: Reverse Rotation diagram

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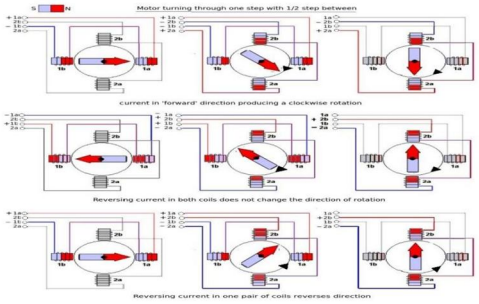


Figure 11: Rotation view

VI. CODING FOR ARDUINO

```
#define STEPPIN 12
#define DIRPIN 11
#define ENAPIN 10
const int STEPTIME = 5;
void setup()
 {
// put your setup code here, to run once:
 pinMode(STEPPIN,OUTPUT);
 pinMode(DIRPIN,OUTPUT);
 pinMode(ENAPIN,OUTPUT);
}
void loop()
 {
// put your main code here, to run repeatedly:
 forward(400);
}
void forward(int steps)
{
 int i;
digitalWrite(ENAPIN,LOW);//ENABLE IS ACTIVE LOW
digitalWrite(DIRPIN,HIGH);//SET DIRECTION
for(i=0;i<steps;i++)
{
```

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```
digitalWrite(STEPPIN,HIGH);
delay(STEPTIME);
digitalWrite(STEPPIN,LOW);
delay(STEPTIME);
}
digitalWrite(ENAPIN,HIGH);//DISABLE STEPPER
}
void reverse(int steps)
{
int i;
 digitalWrite(ENAPIN,LOW);//ENABLE IS ACTIVE LOW
digitalWrite(DIRPIN,LOW);//SET DIRECTION
 for(i=0;i<steps;i++)
{
 digitalWrite(STEPPIN,HIGH);
  delay(STEPTIME);
  digitalWrite(STEPPIN,LOW);
 delay(STEPTIME);
 }
 digitalWrite(ENAPIN,HIGH);//DISABLE STEPPER
}
```

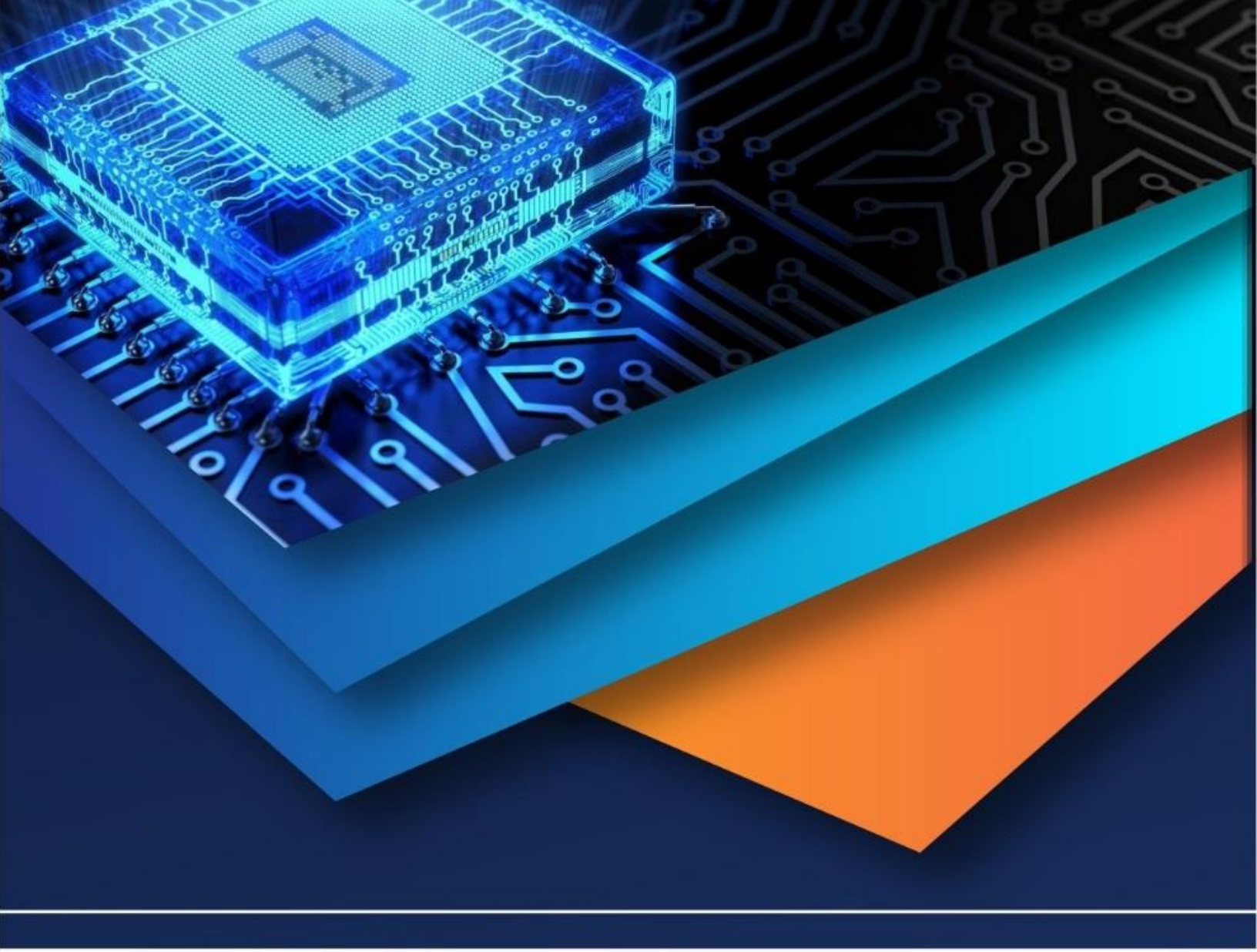
VII. CONCLUSION

This paper presents about the electric press machine using stepper motor which is most void used, this project performs the function under - stepper motor, TB6600 driver, Arduino Uno and SMPS (switched-mode power supply), the specification of our project is, This would use to cut, bend or form any shape in the material as per our wish. The codes which we used here mainly help in changing the angles which we require, Ex. 10degree, 30degree, 90degree, 180degree and 360degree etc. Under these angle bases, the output will be formed with the help of other components this will be a compact one that is easy to handle, and all the mechanical and electrical parts are kept separately to study easily and also would help in detecting the errors. The existing press machines in markets have only the feature to long press the material and doesn't have any cutting option or forming option. Our project helps in having all these features in one machine that can be used for cutting, forming, and pressing, all these processes are only possible because of the stepper motor this helps in step turn rotation since the angle rotation exists and all these processes are possible to make.

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