

# Automatic Insulation Paper Cutting Machine Using Arduino

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**Abstract:** Insulation Paper cutting machine is one of the simplest machine which cuts the paper in needed amount and in proper dimensions. The manually handed insulation paper cutting machine which causes improper cutting of the insulation paper. So we made the automatic machine which eliminates this drawback. The main peculiarity of machine is its automatic working, reduced man power, required less time. This machine can also be used in motor manufacturing company and also in transformer manufacturing machine but main aim of this project is this machine is mainly made for the motor manufacturing machine. By applying these modifications to the conventional machine reduces one worker, less time and accuracy. It is well suited for small scale industries.

**Keywords:** Insulation paper, Amount, Dimensions, Industries.

## 1. Introduction

Industries are one of the important places where the Motor are manufactured. This automatic insulation paper cutting machine plays a very important role, as they have a very great impact on the Motor manufacturing company. There are many reasons why a motor manufacturing company do not get Satisfied profit because of many reasons one of the reason is they required long time for cutting the insulation paper. To overcome this problem in industry we made this automatic insulation paper cutting machine.

The insulation paper is used at the middle of stator and the winding for insulation purpose this insulation paper is cutted by the manually operated machine. Due to this the time required to cut the insulation paper is too large and thus it requires one employee/worker to handle the machine till the insulation paper is fully cutted. Hence the production rate is slow. This Drawback can be overcome by the automatic insulation paper cutting machine which does not require employee or worker at the time of paper cutting. Once the paper is inserted in the machine and it start to cut the paper automatically and thus the production rate gets increases.

## 2. Literature review

There are many types of paper cutting machine some of them are manually or automatically. But the drawback of manually handed machine is the improper cutting as well as improper

dimension. Also the automatic machines are costly and not affordable to use for the industry. We decided to make automatic machine only but in different way by using arduino and the electronic circuit. As we done training in motor manufacturing industry for 45 days we decide to convert this manually handed machine to automatic machine. The electronic circuit components use the PCB, O-LED display, Stepper motor Drive-A4899, Arduino Mega Controller, Input and output pins, PCB terminals, Male and female Header and ON- OFF Buttons. (as shown in fig. 1).

As (shown in fig. 2) the Mechanical construction of our machine it consists of NEMA 17 Stepper motor along with coupled roller, one L- channel, Two C- Shape Channel, Stepper motor with pully along with the timing belt, wooden board, aluminium sheet and the sliding contact with the arrangement of the cutting blade (as shown in fig. 3).

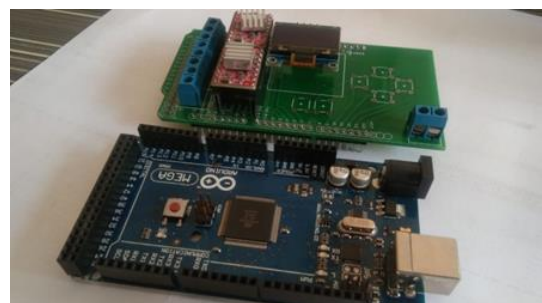


Fig.1. Electronic circuit components with Arduino mega

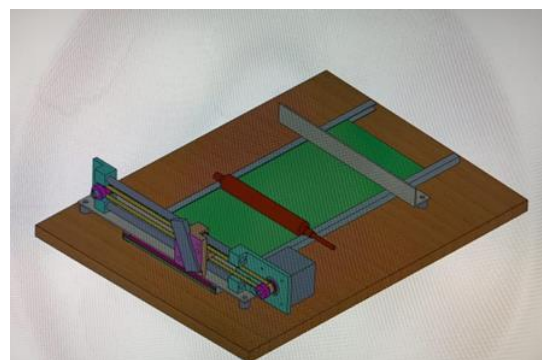


Fig. 2. Mechanical construction and arrangement or setup (3D view)

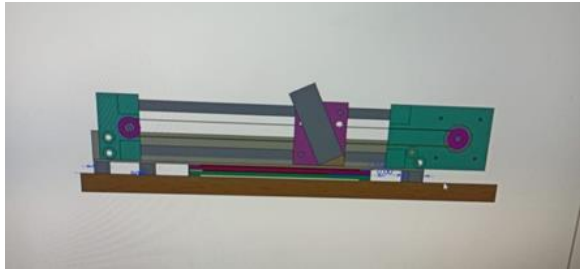
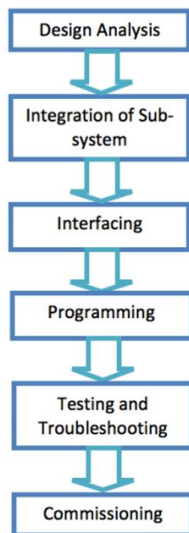


Fig. 3. Moving slider contact with arrangement of cutting blade (front view)

A. Proposed methodology and Operating principle

1) Flow of working

The designs generated for our project are then implemented in the prototyping phase of the project. The specific steps taken in this stage could be found in fig. as shown below. (Fig. 3) It consists of stepper motors and a slider module. The stepper motors are used to achieve very precise positioning and/or speed control of the synchronous belt that guides the slider in positioning. The research presents the development of a slider-cutting machine that can perform to cut or engrave most of the flat-sheet materials. It has only 2 axis direction, the X and Y axis that is operated by stepper motors and where the slider diode is placed and controlled. The Arduino software is used for programming.



The Arduino MEGA and the stepper drivers that serves as the brain of the machine. The Arduino MEGA that has been used is programmable controller. So the input designs and sketches will be from its compatible OLED display software and inputs will be downloaded to the Arduino and the microcontroller itself commands what the stepper motors with Motor Driver A4988 will do motor control operation.

2) Detailed Information of A4988

The main part of the electronic components is the A4988 stepper drive and the Arduino, which control the Stepper motors speed as well as the clockwise and anticlockwise motion.

As A4988 module has a built-in translator that means we only need to connect the Step and Direction pins to Arduino. Step pin is used for controlling the steps while the direction pin is used to control the direction. Stepper motor is powered using a 12V power source, and the A4988 module is powered via Arduino. Potentiometer is used to control the direction of the motor.

If you turn the potentiometer clockwise, then stepper will rotate clockwise, and if you turn potentiometer anticlockwise, then it will rotate anticlockwise. A 47  $\mu$ f capacitor is used to protect the board from voltage spikes. MS1, MS2, and MS3 pins left disconnected, that means the driver will operate in full-step mode. Stepper motors typically have a step size of 1.8° or 200 steps per revolution, this refers to full steps. A microstepping driver such as the A4988 allows higher resolutions by allowing intermediate step locations. This is achieved by energizing the coils with intermediate current levels. For instance, driving a motor in quarter-step mode will give the 200-step-per-revolution motor 800 microsteps per revolution by using four different current levels.

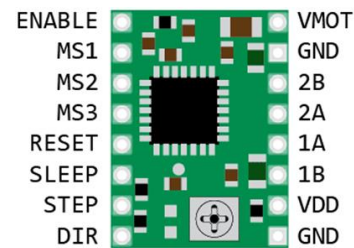


Fig. 4. (S4988 stepper driver)

The resolution (step size) selector pins (MS1, MS2, and MS3) allow you to select one of the five step resolutions according to the table. All three inputs have internal 100k $\Omega$  pull-down resistors, so leaving the three microstep selection pins disconnected results in full-step mode.

We often use a CNC-shield or expansion board in combination with these drivers. The expansion board has 3 dip switches to set MS1 – MS3 high or low and on the CNC-shield you can install jumpers. If you are using the driver with a breadboard, you can just use jumper wires to connect the selector pins to 5V.

3) Wiring- connecting A4988 to Arduino and stepper motor

The Wiring diagram shows you how to connect the A4988 driver to a stepper motor and the Arduino.

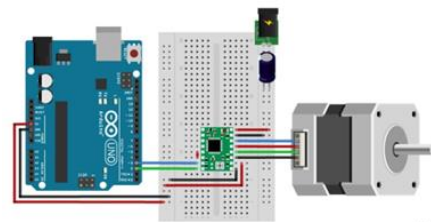


Fig. 5. Wiring diagram

Table 1

MS1	MS2	MS3	Microstep resolution
Low	Low	Low	Full step
High	Low	Low	1/2 step
Low	High	Low	1/4 step
High	High	Low	1/8 step
High	High	High	1/16 step

Table 2

A4988	Connections
VMOT	8-35V
GND	Motor Ground
SLP	RESET
RST	SLP
VDD	5V
GND	Logic ground
STP	Pin 3
DIR	Pin 2
A1, A2, B1, B2	Stepper Motor

*GND and VMOT (top right):*

- The two coils of a stepper motor are connected to A1, A2 and B1, B2 as above shown.
- The GND pin (lower right) is connected to the ground pin of the microcontroller and VDD is connected to 5V.
- The STP (step) and DIR (direction) pin are connected to digital pin 3 and 2 respectively. You can use choose different digital pins if you want, but these are the ones that we uses for the tutorial and the example code.
- The SLP pin is an active low input. Meaning, pulling this pin low puts the drive in sleep mode, minimizing the power consumptions. RST is also an active low input. When pulled low, all STEP inputs are ignored until you it high. If you are not using this pin the you can connect it to the adjacent SLP/SLEEP pin to bring it high and enable the driver.
- The EN (enable) pin can be left disconnected, it is pulled

low by default. When this pin is set high the driver is disabled.

In the reset of this tutorial we have left MS1, MS2 and MS3 disconnected, so the driver operates in full step mode. This makes explaining the code a bit easier. Normally we used 1/8 or 1/6 microstepping and connect the appropriate pins to 5V. The table shows the easy wiring connection of A4988 driver to a stepper motor and the Arduino.

*B. Working Principle*

The system works by pulling paper inserted into the machine body at intervals using a stepper motor. As the supply is ON the O-LED display shows the quantity and length of the insulation paper. After setting the length and quantity back stepper motor start to rotate which rotates the roller and thus the paper moves towards the cutting side. When the paper comes out in the given dimension the second stepper motor having the arrangement of sliding contact with the razor blade over the paper, cutting it in to perfect strips. An Arduino Mega controls the device, along with pair of stepper drivers via a custom designed PCB.

**3. Conclusion**

This automatic paper cutting machine eliminates wrong dimensions and inaccurate number of papers, reduce the overall time taken for cutting insulation paper and also it reduces man power. The developed automatic insulation paper cutting machine is used for 1 Hp, 2 Hp and 3 Hp motor and also it can be used for all type of motors as per the size of insulation paper.

**References**

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