Design and Fabrication of Automated Hacksaw Machine

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ABSTRACT
It is the goal of this project to automate a standard power hacksaw machine in order to increase the productivity of workpieces by utilising a Microcontroller. Two inputs are needed from the user to operate the automated cutting machine: the number of pieces to be cut and the length of each piece. To be slashed. Using a keypad and an LCD display, the user may enter the information they need. check the information he has provided. In order to cut the work-piece, the operator does not need to measure its length or to put it into the machine. unloading the chuck each time after cutting a new piece. As soon as we get the two inputs we need from them, we're ready work-length specified by the user is automatically fed into the machine. A chuck is used to hold the component in place as it is chopped. There have been a lot of cuts made. With the use of a conveyor, the machine feeds the work-piece. An IR sensor and a DC motor guarantee that the feeding stops when the appropriate length has been achieved. When cutting, a cylinder is utilised to keep the workpiece in place. It's done using an AC motor. Workpieces must be cut using a reciprocating action. The reciprocating mechanism has a self-weight linked to it. Hacksaw blade penetration mechanism to give the appropriate downward power needed for the workpiece. An automatic limit switch will be activated after one piece of material has been sliced, which is detected by the self-weight mechanism. The microcontroller will restart the cycle process if the required number of workpieces have not been cut.

AUTOMATION; POWER HACKSAW; MICROCONTROLLER; RELAY; and LCD

INTRODUCTION

Metal and plastic shafts and tubes can be cut using power hacksaws. With a hand-held hacksaw, cutting solid shafts or rods with diameters more than fifteen millimetres is very difficult. Consequently, a power hacksaw machine was designed in the United States in the 1920s to do the tough and time-consuming operation. Figure 1 shows a power hacksaw machine that is called an automated machine since the user does not have to manually operate it. The reciprocating motion and downward force on the workpiece must be provided by you in order to cut it. Once the operator is on the scene, however, the workpiece has been put into the machine to the desired length, and the machine is now running. The piece of art has been entirely dismantled.

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Fig 1.Power Hacksaw Machine

One of the reasons we decided to automate work-piece feeding was to eliminate the need for the operator to manually feed the piece into the vice to the desired length. In addition, the operator must unload the workpiece and advance the remainder of the workpiece to the desired length repeatedly until the end of the workpiece is reached after a shaft has been cut once. Despite this, the Power hacksaw machine is able to cut through the shaft or rod without a problem cutting does not need any human effort, but it does necessitate a human interaction to feed the workpiece several times.

Measurements are obtained prior to feeding each time. As a result, it became necessary to fully automate. And now we have a suggestion that would help remove the work of those who are involved in chopping it down.

A. Defining the Issue

There is a drawback to power hacksaw machines that are controlled by humans, like as the ones discussed above. Repeatedly removing and re-installing the workpiece These devices are used in pump-making factories to cut material. The shafts of the motors to the desired dimensions. Having to cut a large area will be challenging for the operator.Each time he has to cut a motor shaft, he has to count the number of shafts he has in stock. Because humans aren't as adaptable as other animals, we can't compare ourselves to them. There is a chance that machines might be inaccurate. In addition, if there is a short gap between each session, it will be much better may be discovered to be rather large in relation to the total amount of time it takes to cut a piece. If the suggested machine had been in place, it would have been employed appropriately.

B. The Methodology I'm Using

Automated feeding of the work-piece eliminates one of the disadvantages of a power hacksaw machine using a conveyor belt to guide the workpiece to the chuck's jaws When the conveyor motor has come to a complete halt, A microprocessor and an IR sensor feed the desired length into the chuck. This was followed by the use of pneumatics. When cutting, the cylinder is expanded to hold the work piece securely and prevent it from moving. This is just what I was looking for. Done by the use of a microcontroller and a solenoid-operated DCV. The blade's self-weight is then connected to it.Pneumatic cylinders will be used to lower the cylinder that was previously in a raised position.

Cutting will begin at the point where the hacksaw blade comes into contact with the work-piece. In order to do this, one must retreat. Solenoid DCV solenoid operates the weight-lifting cylinder. Following this, the cutting motor is activated such that the blade may be adjusted to reciprocate on the work-piece to cut using a microcontroller After cutting a piece, the cycle repeats itself takes place without any human interaction and continues until the desired number of pieces has been fed cut.

COMPONENTS USED AND CALCULATIONS

Following is a breakdown of the many parts that went into this undertaking.

A.Ignition Coil

A DC motor is used to drive the conveyor via a chain drive in this suggested equipment. AC motor that drives a simple crank mechanism to reciprocate a Hacksaw blade.

B. Direct Current Motor

Figure 2 shows a dc motor connected to a chain drive that drives the conveyor roller. It receives a signal from the microcontroller. The conveyor continues to feed the workpiece into the chuck until it reaches the desired length. An IR sensor and a toothed disc mounted to the conveyor shaft work together to accomplish this serve as an Encoder.

Fig 2 Conveyor motor

The B.1 Specifications

A step-down transformer and a bridge rectifier provide the electric power needed to drive the DC motor.

Table 1 Technical Specifications of DC motor

Voltage and Power	12 V DC, 50 Watts
Load Current	10 A
No load current	2 / 2.5 A
Speed	60 RPM
Torque	10 Nm

C. Alternating Current Motor

A simple crank mechanism drives an AC motor, which converts rotational motion into the reciprocating motion needed to cut metal with a hacksaw blade (see figure 3). An oscillating movement.

Fig. 3 AC motor used for cutting process

After the pneumatic chuck is securely in place, the AC motor is activated. Transmission of electricity to a pulley through a belt transmission increases the motor's torque.

C.1 arithmetic

The AC motor's torque must be raised in order to provide the cutting power required for workpieces. An AC motor's rotor is connected to a pulley through a belt drive. As a result, less will be wasted increasing the speed and torque of the spinning shaft. It is connected to the reciprocating mechanism via a pulley.

Motor Pulley diameter= 0.03 m

Driven Pulley diameter= 0.3 m

Therefore, Reduction Ratio= 10:1

Speed of motor, N (driving) = 1200 rpm

Driven speed N (driven) = 120 rpm

Power = 0.25 hp = 0.186 kW ;

Power = $2\pi NT/60$

Torque T (Driving) = 1.48 Nm = 0.15 kgm, Therefore, Torque T (Driven) = 14.8 Nm = 1.5 kgm

C.2 Specifications

The AC motor's torque, power, and speed are shown in Table 2, which is based on the torque at the rotor of the motor shaft.

Table 2 Technical Specifications of the AC Motor

Voltage and Power	230 V AC, 186 Watts
Maximum Load Current	10 A
HP	0.25
Speed	1200 RPM
Torque	0.15 kg-m / 1.48 Nm
Motor pulley diameter	30 mm

Pneumatic cylinders with double-acting mechanisms

In this machine, two pneumatic cylinders are used. During the cutting operation, one cylinder acts as a chuck to keep the workpiece in position, while the other is used to elevate and lower it. Reduce one's own body mass. Figure 4 shows a pneumatic cylinder being utilised as a chuck to perform the same purpose as a vice. A high-performance hacksaw. A solenoid triggered DCV controls it. Holding the workpiece, the cylinder expands. Microcontroller signals activates the DCV solenoid

Fig4. Chuck cylinder

Details of the D.1 specification

In an automated hacksaw machine, the chuck cylinder is one of the most critical components since it is responsible for holding the work-piece securely so that it does not move while cutting.

Table 3 Technical Specifications of the Chuck cylinder

Bore Diameter	50 mm
Stroke Length	100 mm
Action type	Double acting
Maximum air pressure	10 bar
Rod diameter	20 mm

Input and Output D.2

In order to retain the workpiece, the chuck cylinder has to generate the ideal pressure. If the force created at the rod end of the cylinder is less than the cutting force of the AC motor, the workpiece will be damaged.

Diameter of bore = 0.05 m

Air Pressure supplied = 3 bar = 300000 N/m^2

Area of cylinder bore $= (\pi/4) \times d^2$

$= (\pi/4) \times (0.05)^2$

$= 0.0019625 m^2$

Therefore, force obtained at the rod end

= Pressure x Area

= 300000 x 0.0019625

= 588.75 N = 60 kg

Lifting cylinder for heavy loads

Figure 5 shows a pneumatic cylinder that is used to elevate and lower one's own weight. It will be expanded at the start of the game. In order to allow for the cutting process, it retracts. Make a work-piece hacksaw blade rest on it. A solenoid actuated DCV is also used to regulate it. In order to put the cylinder down, it retracts. When a signal from the microcontroller activates the solenoid DCV, a blade is placed on the workpiece.

Fig 5. Weight-lifting cylinder

As stated in Section E.1:

An opposing force is continually exerted on the weight-lifting cylinder's rod end because of its self-weight and the blade arrangement. When the work-piece is to be fed into the chuck, the cylinder must be able to expand smoothly and quickly.

Table 4 Technical Specifications of the Weight-lifting cylinder

Bore Diameter	30 mm
Stroke Length	100 mm
Action type	Double acting
Maximum air pressure	10 bar
Rod diameter	15 mm

E.2 Calculations

It is essential that a pneumatic cylinder of a reasonable bore diameter is chosen for withstanding the weight even when the pneumatic pressure is less.

Diameter of bore = 0.03 m

Air Pressure supplied = 3 bar

$= 300000 \text{ N/m}^2$

Area of cylinder bore = $(\pi/4) \times d^2$

$= (\pi/4) \times (0.03)^2$

$= 0.0007065 \text{ m}^2$

Therefore, force obtained at the rod end

= Pressure x Area

$= 300000 \times 0.0007065$

$= 211.95 \text{ N} = 21.60 \text{ kg}$

Integers 5 and 2 DCV with spring-return actuation via solenoid

Using the DCV indicated in figure 6, the two pneumatic cylinders are controlled by the microcontroller signal. The DCV features a 12 volt solenoid for use with the device. This is what the DCV's regularly open port looks like: Attached to the weight-lifting cylinder of the extension port in order to maintain the elevated state of the own weight. The norm is Chuck cylinder's extension port is linked to the closed port of the DCV so that the solenoid may be triggered when the DCV is closed. The controller sends a command to stretch and secure the workpiece.

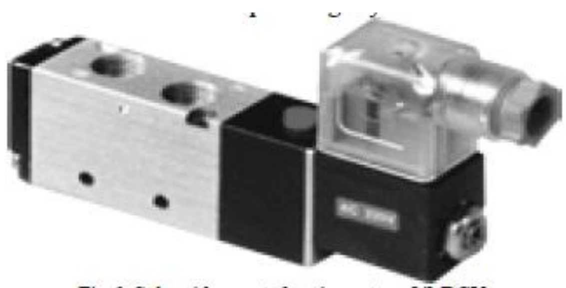

Fig 6. Solenoid operated spring return 5/2 DCV

G. AT89C51 Microcontroller with LCD Display.

Figure 7 depicts an AT89C51 microprocessor from Atmel's 8-bit microcontroller series. It is crucial for the programed motors and cylinders to be controlled by this device.Flawless syncing. The AT89C51 has a total of 32 input and output pins across its four input and output ports. Because they are simple to programme and powerful enough, these controllers are often employed in automated systems. All but a few of the smaller ones. Using the LCD display seen in figure 8, inputs such as the number of items to be processed may be viewed. It is possible to specify which pieces should be cut and how long each piece should be by using the keypad. The LCD asks the user to enter his password.

Fig. 7 Microcontroller AT89C51

Fig.8 LCD Display

As illustrated in figure 9, the operator uses a four-by-three keypad (H. Keypad) to input the number of pieces to be cut and the length of each piece. Receives the inputs, displays them on the LCD, and then utilises them to cut the material.Keyboard shortcuts for the Star and Enter keys have been included. The operator will be able to provide the customer with information. Each piece's length must be measured in centimetres, with no additional decimal points.

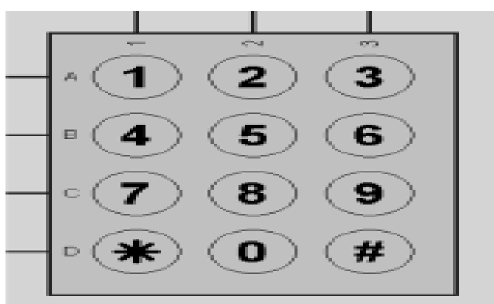

Fig. 9 Keypad

Infrared (IR) sensor and toothed disc I

The IR sensor illustrated in figure 10 mounted to the conveyor roller functions as an encoder. The IR sensor provides a positive signal to the microcontroller every time a tooth passes in front of it.Counter to keep track of the pulse count. The work-piece has been detected by the IR sensor when it receives two pulses.

Chuck has been pushed one centimetre inward. A major component in developing an automated hacksaw is the IR sensor. A machine that feeds the workpiece into the chuck at the desired length. There is a way to calibrate the IR sensor. The sensor's sensitivity may be adjusted through a knob on the module itself. Actually, the adjustment has been made. An operational amplifier or comparator IC may be used as a potentiometer.

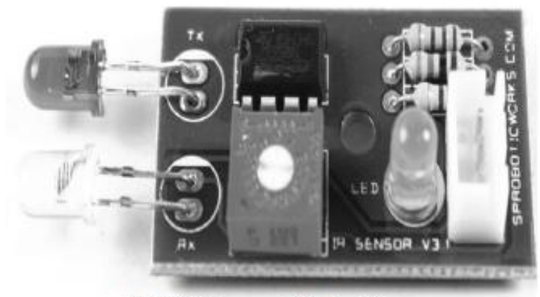

Fig10 IR Sensor and Toothed Disc

Assumptions in the first section

Each tooth that crosses in front of the IR sensor receives a pulse from the slotted disc through the sensor's interface. Two consecutive slots passing the IR sensor will be the result of the rotational motion. linear movement of one centimetre was achieved. In this case, the distance between two slots is one centimetre, and the thickness of each slot is one millimetre thick. One-hundredth of an inch. Consideration is given to both its thickness and circumference while designing the toothed disc.

As well as the tooth's slots To identify teeth, the IR sensor's detection range must be expanded. Calculating the radius of a revolving slotted disc is done as follows.

Circumferential Distance required between two successive teeth = 1 cm

Number of teeth = 12; Number of slots = 12

Considering the circumferential length of each slot as 0.5 cm, the circumference of the toothed disc must be [12 + (12x0.5)] = 18 cm

Required radius of the toothed disc = R

Since $2\pi R$ = Circumference of disc,

$2 \times \pi \times R = 18$ cm

Therefore, R= 2.86 cm, which means that a twelve toothed disc of radius 2.86 cm must be used.

DESCRIPTION OF THE HACKSAW MACHINE

Proteus Simulation

Using Proteus software, the circuit in the figure 11 was simulated. In order to communicate with the machine, a 4x3 matrix keyboard is employed. There are no RS or EN control pins attached to port three of the microcontroller, but there is a direct ground connection to port two for RW control. There must be an external factor.

Because port zero has no built-in pull-up resistors, connect a pull-up resistor in series with each of the pins. Because the microcontroller's output current is insufficient to drive the relay circuit, an IC is needed to power these relays. ULN2003 is linked to the microcontroller's output pins. In every case, there's a frequent issue that arises in the field relay circuits because an EMF is created in the opposite direction when current travels through a coil to that of the applied current and tends to run counter to it. As a result, the issue must be solved by presenting a solution. Diode that is biassed in the opposite direction as the current being applied. This causes the EMF generated to go to the positive terminal of the power supply. Relay instead of EMF opposing the provided current, which would be counterproductive. So, the relay circuit is made up of an IC that is termed a relay

At the terminals of each of the four relays, a reverse biassed connection between the ULN2003 and four diodes.

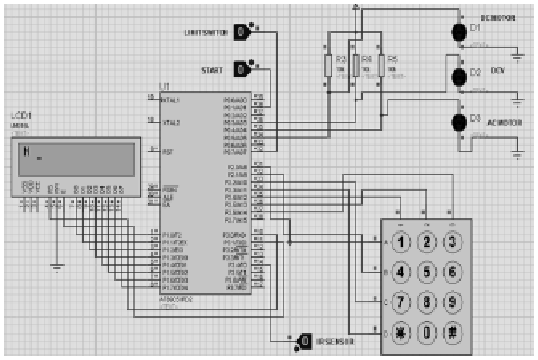

Fig 11Proteus simulation

B. A description of the Project's setup

The Automated Hacksaw machine consists of a conveyor belt, a base, and a self-weighted attachment. A hacksaw blade is used to cut The DC motor, IR sensor, and toothed disc are all positioned on the conveyor arrangement. linked to the microcontroller's The AC motor serves as the foundation for the rest of the arrangement, which contains of chuck that is pneumatically operated. There are two upwardly protruding structures on the AC motor's side: Pivoting the self-weight mechanism Stiffness may be achieved by adjusting the length of the hacksaw blade. At the free end of the mechanism, a threaded screw arrangement is used. Photographic Fig. 12 illustrates this mechanical arrangement as seen from above.

Fig.12 Photographic view of mechanical setup

A. Obtaining user information

The operator enters two pieces of information into the Automated Hacksaw machine: the number of pieces to be cut and the length of each piece. The data may be reset by the operator at any point before

Pressing the start button on the machine. The order in which the tasks are carried out the conveyor will feed the workpiece into the chuck when the right data has been entered and the start button has been pressed. The microcontroller halts the programme when it reaches the specified length. Conveyor motors will be halted as previously stated. In relation to the user defined length of the work-piece, the microcontroller when the IR sensor has given enough pulses to the microcontroller When the conveyor roller's teeth pass before the revolving disc's teeth. The controller receives a pulse from the IR sensor. The movement of the disc between teeth signifies that the linear movement is one centimetre in length.

As a result of this, the solenoid DCV will stretch and hold the workpiece in place, allowing it to be machined. At the same time, the blade presses on the workpiece, resting the self-weight on it. The controller then sends a signal to turn on the AC motor, which begins the cutting operation. In cases when there is just one component. Has been slashed, the self-weight activates a limit switch, causing the microprocessor to reset the whole system. Procedure again until the operator specifies the number of pieces to be cut to their satisfaction. The accounting for the overall cost.

Table 5 shows both the mechanical and electrical setups.

Table 5.Cost of fabrication

COMPONENTS	Quantity	COST (RS)
Conveyor	1	2,000
Base With Chuck	1	7,000
DC Motor	1	1,500
Pneumatic cylinder	2	2,500
Pneumatic DCV	1	800
Hacksaw Blade	1	250
Controller and Electronics	-	1,500
TOTAL COST		15,500

CONCLUSION AND FUTURE SCOPE

The standard power hacksaw machine may be replaced by an automated power hacksaw machine, which is well known.

In compared to traditional power hacksaw machines, automated power hacksaw machines are able to produce more in a shorter amount of time. The primary benefit of this machine is that the amount of human interaction is minimised to the utmost.

When it comes to power hacksaws, time and labour play a crucial part in this rapidly developing industrial sector.In the making of something. This problem can be solved by utilising automated machinery of this kind. There are several sectors, such as pump production, where an automated hacksaw machine may be put to use. Typically need to cut a large number of shafts. Work-piece sizes that can be cut using the machine. The blade size of an automated hacksaw machine may be changed. It currently employs a 12-inch blade for this purpose cutting. Another feature that may be added to automated hacksaw machines is the ability for the user to get a blade replacement service.

In one cycle, cut varied lengths of work-pieces. As a result, the number of items of work to be processed must be entered by the user. To be sliced into the various lengths that are given. An aid will make this feasible. A more sophisticated microcontroller than AT89C51 with a large configurable memory capacity.

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