Automated Hacksaw Machine Design and Construction

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ABSTRACT

This project's purpose is to use a Microcontroller to automate a typical power hacksaw machine in order to boost workpiece productivity. To run the automated cutting machine, the user must enter the desired number of pieces to be cut, as well as the desired length for each piece. To be hacked with a knife. Information may be entered into the system through a keypad and LCD display. verify the facts he has given you. The operator does not need to measure the length of the work-piece or insert it into the machine in order to cut it. removing the cuttings from the chuck each time a fresh piece is cut. Upon receipt of the two inputs required, we're ready to proceed with the work-length indicated by the user. Chopping a component requires the use of a chuck. A lot of money has been slashed. The workpiece is fed into the machine through a conveyor. Feeding stops when the correct length has been reached thanks to an IR sensor and a DC motor. A cylinder holds the workpiece in position while it is being cut. An AC motor is used in this process. To cut workpieces, a reciprocating movement is required. A self-weight is attached to the reciprocating mechanism. Using a hacksaw blade penetration mechanism to provide the necessary downward force for the workpiece. The self-weight mechanism will engage an automated limit switch when one piece of material has been cut. Workpieces that have not been cut will be restarted by the microcontroller.

AUTOMATION; POWER HACKSAW; MICROCONTROLLER; RELAY; and LCD

INTRODUCTION

Cutting shafts and tubes out of metal and plastic is easy using power hacksaws. Solid shafts or rods with diameters of more than fifteen millimetre are difficult to cut using a hacksaw. Power hacksaw machines were invented in America in the 1920s to do this difficult and time-consuming task. Automatic machines, such as the one shown in Figure 1, are those that do not need the operator to do any manual labour. In order to cut the workpiece, you must give the reciprocating motion and the downward force. Workpiece lengthening has already been completed once an operator is on site, thus there is no need for further action. The artwork has been taken apart piece by piece.

Fig 1.Power Hacksaw Machine

Automating work-piece feeding allowed us to do away with the necessity for an operator to manually feed the piece into the vice until it reached the correct length for the application. After cutting one shaft, the operator must also unload the workpiece and advance it to the required length a number of times until it reaches its final destination. Power hacksaw machine is capable of cutting through the shaft or rod without difficulty, but it does demand a person to feed the workpiece several times. Prior to each meal, measurements are taken. As a consequence, complete automation was required. A new idea has emerged that might ease the burden on those responsible for cutting 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

Conveyor belt-driven power hacksaw machines have one major disadvantage: the workpiece must be fed manually into the machine's chucks. Automated feeding avoids this drawback. A full stop to the conveyor motor is the last step. Chip and an IR sensor are used to determine how long to cut. After this, pneumatics were used. During cutting, the cylinder expands to keep the work piece in place and prevent it from shifting. This is just what I needed. A microcontroller and a DCV powered by a solenoid are used to do this. The self-weight of the blade is then attached to it. In order to lower the prior elevated cylinder, pneumatic actuators will be required.

Cutting begins when the hacksaw blade touches the workpiece for the first time. Retreating is the only way to do this The weight-lifting cylinder is controlled by a solenoid DCV solenoid. Once the cutting motor is enabled, a microcontroller is used to drive a reciprocating blade on the workpiece to cut. Without any human intervention, the cycle repeats itself until all of the appropriate parts have been fed into and 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 N/m^2

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

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

$= 0.0007065 \ m^2$

Therefore, force obtained at the rod end

= Pressure x Area

= 300000 x 0.0007065

= 211.95 N = 21.60 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.

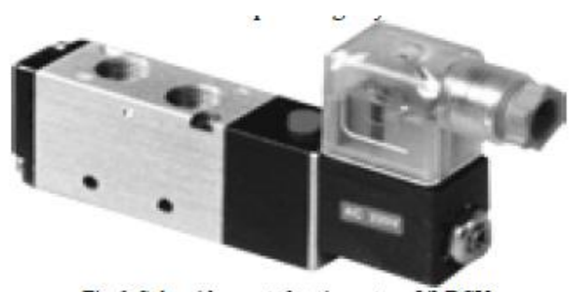

Fig 6. Solenoid operated spring return 5/2 DCV

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.

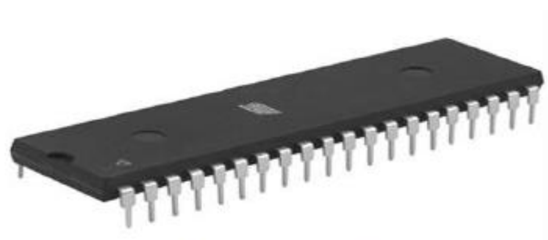

Fig. 7 Microcontroller AT89C51

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.

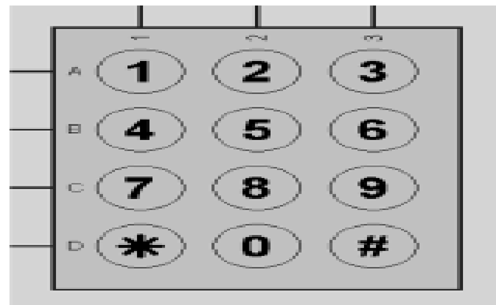

Fig. 9 Keypad

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.

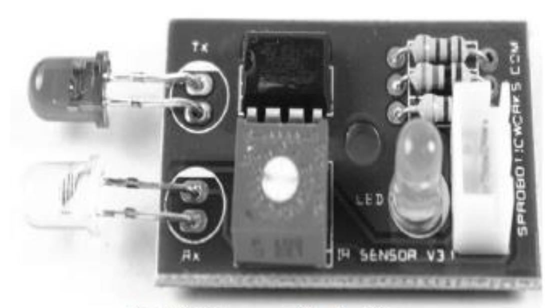

Fig10 IR Sensor and Toothed Disc

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.

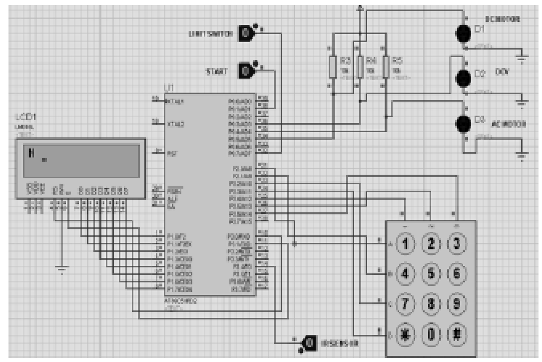

Fig 11Proteus simulation

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 number of pieces to be cut and the length of each piece are entered into the Automated Hacksaw machine by the operator. Before pressing the machine's start button, the operator has the option of resetting the data. When the correct data is input and the start button is pushed, the conveyor will feed the workpiece into the chuck and begin the process. Whenever the microcontroller reaches a certain length, the programme is stopped. As previously announced, all conveyor motors will be shut off. It is only after the microcontroller has received sufficient IR sensor pulses that the work-piece may be accurately measured in terms of its user-defined length. When the teeth of the conveyor roller come into contact with the teeth of the spinning disc. The IR sensor sends a pulse to the controller. When the disc between teeth moves one centimetre, the linear movement has occurred.

It is because of this that the workpiece is held in position by a solenoid DCV, enabling it to be machined in the process. Meanwhile, the blade applies pressure to the workpiece, allowing the workpiece to support its own weight. Cutting commences when the controller gives a command to the AC motor. In circumstances when just one component is involved. Because of the self-weight being cut, a limit switch is triggered, and the microprocessor is forced to start again. Repeat the procedure until the operator selects the quantity of pieces to be cut to their satisfaction.. Accounting for all of the expenses.

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

A well-known automated power hacksaw machine may take the place of the regular power hacksaw machine.

Power hacksaw machines that use automated systems are able to generate more in less time than those that use conventional systems. The fundamental advantage of this machine is that human involvement is minimised to the maximum.

Power hacksaws are a fast-growing industrial industry that relies heavily on time and labour.

Making something from the ground up. Automated equipment of this kind may provide a solution to this issue. An automated hacksaw machine may be useful in a variety of industries, including pump manufacturing. Typically, a considerable number of shafts have to be cut. Machine-cuttable workpiece dimensions. An automated hacksaw machine's blade size may be adjusted. For the time being, a 12-inch blade is being used. Automated hacksaw machines may also have the option of a blade replacement service for the user.

Cut a variety of different lengths of work-pieces in a single operation. It's necessary that you input how many things you want to process. To be cut into different lengths according to the instructions. This will be possible thanks to a tool. A microcontroller with a higher level of sophistication than the AT89C51 and a larger amount of programmable memory.

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