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The Automation of Hacksaw Machine Design and Fabrication

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ABSTRACT

The goal of this project is to increase workpiece productivity by automating a standard power hacksaw using a Microcontroller. The user specifies both the total number of pieces and individual component lengths before starting the automated cutting process. To suffer a knife attack. A keypad and an LCD screen allow users to input data into the system. Check his claims using independent sources. The operator may simply feed the workpiece into the machine without worrying about its exact length. Whenever a new piece is cut, the previous cuts must be removed from the chuck. Once we have those two pieces of information, we may begin the user-specified amount of work. A chuck is used while chopping a part. The budget has been severely reduced. A conveyor brings the workpiece to the machine. An infrared (IR) sensor and a DC motor work together to halt feeding once the desired length has been attained. The workpiece is held in place by a cylindrical fixture during the cutting process. This method employs the usage of an AC motor. A reciprocating motion is needed to cut materials. The revolving mechanism has its own weight linked to it. By penetrating the workpiece with a hacksaw blade, we can generate the downward force required to cut it. When one piece of material has been sliced, the self-weight mechanism will activate an automatic limit switch. If a workpiece has not been cut yet, the microcontroller will resume the process.

AUTOMATION; POWER HACKSAW; MICROCONTROLLER; RELAY; and LCD

INTRODUCTION

Power hacksaws make quick work of sawing through metal and plastic tubes and shafts. Cutting a solid shaft or rod with a hacksaw that has a diameter of more than fifteen millimeters is challenging. In the 1920s, Americans devised power hacksaw machines to speed up this labor-intensive process. The machine in Figure 1 is an example of an automatic machine, which does not need any intervention from the operator. Cutting the workpiece requires a downward force and a reciprocating motion. Once an operator is present, the process of extending the workpiece is complete and no more action is required. The artwork has been disassembled.

Fig 1.Power Hacksaw Machine

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mating 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

Power hacksaw machines, like as the ones described above, have a disadvantage since they must be operated by people. The item must be taken out and put back in place several times. Manufacturing facilities that produce pumps utilize these machines for cutting raw materials. motors' shafts to the correct measurements. It will be difficult for the operator to cut such a vast area.Cutting a motor shaft requires him to keep track of how many spares he has on hand. We can't be compared to other animals since humans aren't as flexible as they are. Machines might make mistakes, it's true. It may also be found to be very big in comparison to the overall length of time it takes to cut a piece if there is a small gap between each session, which is why it is preferable to have as little time as possible between them. If the proposed machine had been available, it would have been put to good use.

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.

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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 = 2πNT/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

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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.

$$\text{Diameter of bore} = 0.05 \text{ m}$$

$$\text{Air Pressure supplied} = 3 \text{ bar} = 300000 \text{ N/m}^2$$

$$\text{Area of cylinder bore} = (\pi/4) \times d^2 = (\pi/4) \times (0.05)^2 = 0.0019625 \text{m}^2$$

Therefore, force obtained at the rod end

$= \text{Pressure} \times \text{Area}$

$= 300000 \times 0.0019625$

$= 588.75 \text{ N} = 60 \text{ kg}$

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.

Diamet
Air Pre

Area o:

Therefo

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.

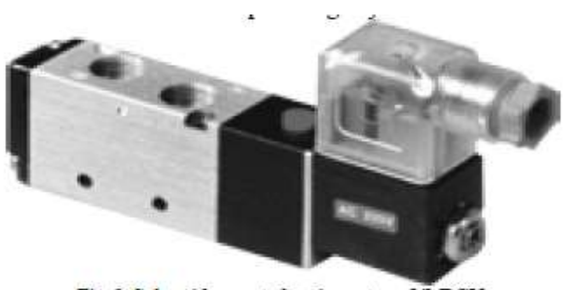

Fig 6. Solenoid operated spring return 5/2 DCV

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.

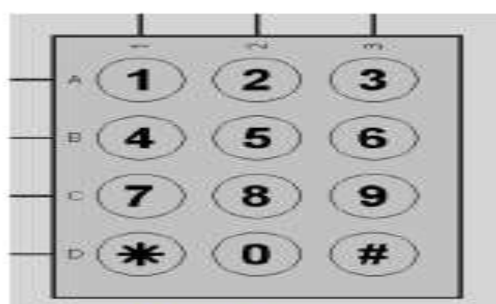

Fig. 9 Keypad

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-

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piec
e 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.

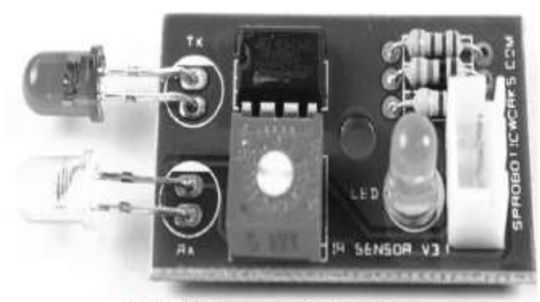

Fig10 IR Sensor and Toothed Disc

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.

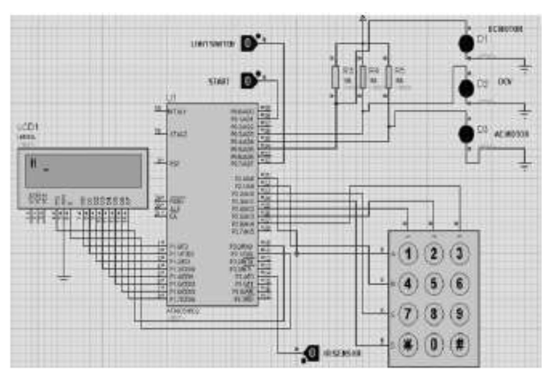

Fig 11Proteus simulation

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 instructs the Automated Hacksaw machine on how many pieces need to be cut and how long each one should be. The operator has the option of clearing the data before starting the machine. Inputting the necessary information and pressing the start button causes the conveyor to feed the workpiece into the chuck and start the operation. The program is terminated when the microcontroller exceeds a certain size limit. All conveyor motors will be turned off as planned. In order for the microcontroller to correctly measure the work-piece in terms of the user-defined length, it must first receive a sufficient number of IR sensor pulses. The moment the conveyor roller's teeth meet the spinning disc's teeth. The controller receives a signal from the infrared sensor. A linear shift has taken place when there is a one-centimeter shift in the disc between teeth.

This is because a solenoid DCV maintains the workpiece in place, allowing it to be machined. While doing so, the blade presses down on the workpiece, making it able to hold its own. The controller triggers the AC motor to begin cutting whenever it receives a command. When there is just one variable at play. A limit switch is activated when the self-weight is reduced, and the microprocessor is reset. To get the desired number of cuts, the process must be repeated until the operator is satisfied. All costs have been accounted for.

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

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NCLUSION AND FUTURE SCOPE

Power hacksaw machines may soon be replaced with a well-known automated alternative. Automated power hacksaw machines can produce more in less time than their manual counterparts. The primary benefit of this machine is that it requires a minimum of human input. The manufacturing of power hacksaws is a rapidly expanding sector of the economy that places a premium on human effort. Creating anything brand new. Machines with this level of automation could be the key to fixing the problem at hand. It's possible that the fabrication of pumps might benefit from using an automated hacksaw machine. Quite a few shafts are often required to be cut. Pieces of work that can be cut with a machine. The size of the saw blade of a power hacksaw may be changed. A blade 12 inches in length is being utilized for the time being. A blade replacement service is a potential extra feature of automated hacksaw machines. Create pieces of varying lengths with a single cut. The number of items you want to process must be entered. Required must be trimmed to the specified dimensions. An instrument will allow for this to happen. A microcontroller with more memory and a greater degree of complexity than the AT89C51.

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In his 2011 book, "Fluid Power with Applications," Anthony Esposito cites the sixth edition of his textbook, published by Pearson.

[2] The 8051 Micro Controller and Embedded Systems, 2nd Edition, Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, Pearson Education Inc., 2008.

From the Janatics ltd. product manual: [3] Pneumatic cylinder with solenoid DCV

You may get a list of common power hacksaw blade sizes at http://www.planomillers.com/. The 2nd of August, 2013 pageview

To see the pinout for the ULN2003 integrated circuit (used in the relay circuit), visit http://www.engineersgarage.com/.10 August 2013 - seen