Automation in Paper Cutting Machine
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Abstract:
This project aims to eliminate major human errors in paper measurement processes. Currently the concept is focused on precise paper cutting; its horizon can be broadened over a wide range of products. Moreover, this automation assembly over any manual paper cutting machine thus is saving your capital of purchasing a whole new product. Unlike most automation processes, this won't replace any human from his job; rather make his life easier with speedy processes. All the operator needs to do is enter the desired length of paper, and the machine does its task of moving the sheet accurately under the blade. Here's a simple automated process applied on the cutting machine of most relevant product around us.

I. INTRODUCTION

Need for precision: Precision! Now that's been of utmost importance for any production process. Measurement of raw materials, components, constituents is inevitable since man settled for its Nomadic lifestyle. We started from 'cubit' measurements using body parts, then to blocks and scales, and today utilizing the modern-day laser, ultrasonic techniques providing microscopic accuracy. Artificial Intelligence is right around the corner to take over job. Yet, in many measuring & cutting processes, especially paper manual labour is used inducing human error. In small scale industries, the handheld measuring 'rules' efficiently for measuring paper sheets, but the worker might make a blunder when the job gets repeated. Human errors are commonly witnessed when the workman serves like a machine, perhaps expected to function like a machine. Furthermore, paper cutting being much underrated as a skilled job, automating this elementary process at every workplace never saw the light of day. Automation, as a concept, always hunts for processes to reduce errors and mitigate losses, and here we found one. A manual paper cutting machine in a printing press.

Instrumentation to the rescue: This is a microcontroller based project of automated paper cutting machine which is installed in a fully- functional printing press, currently employing manual labour. Our objective is to provide much accuracy to the measurement part and swiftness to the overall process as well. The major components used in the operation will be stepper motor, microcontroller, LCD display, 7-segment display, keypad. Certainly this is lower on budget hence could be installed at any established printing press.

Controlling the loop: Simplicity is the key as the user needs to just enter the required length of the paper need to be cut. This will be the input to the microcontroller which would generate the proportional pulses to rotate the stepper motor, calibrated with respect to cover the required length. The motor moves the back gauge back & forth and stationing it exactly below the cutting blade for the expected job. The firmware can be programmed for same lengths to be measured continuously, thus no need to re-enter the length as well. Length of the paper covered by back gauge is legibly displayed on the 7-segment display. This process would provide maximum accuracy, thus avoiding the mundane job of scaling each pile of paper manually.

All-inclusive concept: As this is an external assembly installed over an existing machine, the concept is not confined only upon this job. This also provides a future prospect which is not only limited to paper cutting but to any product demanding length precision. Precision! Now that's been of utmost importance for any production process.

II. MAJOR COMPONENTS:

A. STEPPER MOTOR

B. ARDUINO UNO
III. WORKING

The matrix keypad, LCD display, 7-segment display are mounted on an acrylic panel giving it a compact look. Input to the machine is given by operator through a 4x4 matrix keypad. LCD display shows the desired length of the paper to be cut. This input goes to the microcontroller. The 7-segment display facilitates a legible, real-time view of the current length.

Algorithm of the firmware is designed such as the Stepper motor rotates in proportion to the given length. The input pulse is formulated in the Arduino Uno microcontroller and the required degree of the rotation is obtained. As we know, the stepper motor gives us a minimum step angle of 1.8°, thus enabling us to input minute lengths of small units. The degree of rotation is the output pulse given to the stepper drive DM 542 which thereupon moves the shaft of the motor. The motor shaft is connected to the back gauge shaft using timing pulley & belt arrangement. The back gauge, now supported with the gear arrangement, can move back and forth. As per calculation, 1 rotation of stepper motor = 6mm movement of back gauge.

When the back gauge is moving, the 7-segment display gives a direct reading to the user about how long the gauge has moved. After the back gauge has reached the required length it is displayed on the control panel for confirmation. As a result, we obtain a precise movement of the back gauge which places the sheet of papers directly under the blade.

IV. FLOW SHEET DIAGRAM

![Flow Sheet Diagram](image-url)
The timing pulley and belt arrangement protects the stepper motor from wearing out during high loads. As the back gauge shaft is connected to the belt, if the load exceeds the motor limit, the belt would break thus avoid damaging the motor. The 7-Segment display provides a sharp and clear view to the operator about the real-time position of the back gauge. As the motor is not directly connected to the back gauge, the timing pulley saves a lot of torque for the motor.

VI. CONCLUSION

This shows that with basic components we can automate a machine thus bringing automation to the roots of industry processes. It proves that automation cannot be confined only up to large scale plants, but can be implemented at the small scale industries as well. It was observed that, if approached, industries even at the grassroots level are open to change. The fact is one has to bring it to the masses and explain about it's benefits. Unlike the usual talk that automation eliminates job, but this project proves that it doesn't eliminate any job or employee, but makes the job much easier. This is how we automated a manual paper cutting machine providing the most precisely measured paper sheets. This was achieved using limited components and finance thus expanding the spectrum for more such projects.

VII. REFERENCES


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