

# AUTOMATIC PAPER VENDING MACHINE

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**Abstract**—The usage of paper is inevitable and its demand is increasing steadily particularly in the places such as educational institutions, government offices, etc. At the same time, time is a precious thing that one does not want to waste in any way. In stationary shops it is quite difficult to buy papers during rush time period and the counting of the paper depending on the requirement would cause further time delay and there is a chance for the error in the manual counting of paper. To avoid these problems, this project titled “Automatic Paper Vending Machine” is proposed to deliver the paper to the public by using the sensors and microcontrollers based on the Mechatronics principles. It will be more cheap and economic for the bulk production and it will be very useful for the college and school students. Here it is designed to deliver sheets by inputting the respective coin in the system. It will help us to save more time and manual work will be nullified.

**Index Terms**—Automation, vending, paper

## I. INTRODUCTION

When the world is running hastily with advancement, time is the undisputedly the most valuable resource of all. It becomes inevitable to save the time by all possible means. In places such as shopping malls, wholesale and retail outlets, automation is incorporated for the automatic delivery of the products to the customers. A vending machine is a machine that dispenses items such as snacks, beverages, alcohol, cigarettes, lottery tickets, cologne, consumer products, and even gold and gems to customers automatically, after the customer inserts currency or credit into the machine. For instance, the automatic cold drink vending machine, ice-cream vending machine, chocolate vending machine, water/tea/coffee vending machines, etc. can be increasingly found to encroach the shops nowadays, which reduces the time and also reduce the human effort required to recognize, search, count and deliver the product

along with the cash handling. The Automatic Teller Machine (ATM) is the best example of all, for the application of engineering principles to reduce time and human effort.

These kinds of vending machines operate based on the application of electronics engineering, mechanical engineering and electrical engineering, which are collectively termed as the Mechatronics. Thus, it is proposed in this project to design and fabricate an automatic paper vending machine, with the application of mechatronics principles, so as to reduce the time taken and the human effort taken to deliver the paper to the customer in required quantity and size, and also meet the higher demand for paper at the peak time, such as examination seasons near educational institutions and almost everlasting demand near the government offices.

## II. OBJECTIVES

The main objectives of this project are as follows:

1. To use the mechatronics principle and provide solution for the faster delivery of paper with coin based dispatch.
2. To reduce the wastage of time and the unnecessary crowding in the stationery shops especially during exam times.
3. To improve the accuracy of the counting of the paper, to exactly meet the number of papers demanded by the customer.

## III. METHODOLOGY

The Automatic Paper Vending Machine works under the methodology of the mechatronics system with the objective to provide automation. Generally the automation deals with the elimination of manual work using electronic processing of mechanical work control mechanism.

It consists of three main units which include:

- A. Input unit
- B. Processing unit
- C. Output unit

*Input Unit:*

The input unit of the automatic paper vending machine comprises of the components required to receive the coin from the customer and sensing the genuineness of the coin.

*Processing unit:*

The processing unit comprises of the components required to ensure the reception of the genuine coin. It further, signals the output unit to deliver the number of paper to the customer, on insertion of a genuine coin inside the automatic paper vending machine.

*Output unit:*

The output unit comprises of the components required to deliver the paper to the customer. It works on the instruction from the processing unit.



Fig. 1 A simple representation of the Automatic Paper Vending Machine

The entire system works based on the application of electronic, mechanical and electrical system.

a. Electronic system:

The electronic part of the system includes the microcontroller with the integrated chips so as to perform the processing of the system. The microcontroller is used for the entire processing and is coded using the software “embedded C” program. Each and every part of the entire system has been controlled by the microcontroller. This include the sensing of the reception of the genuine currency coin through the coin inlet, deciding the number of paper to be delivered, instructing the electrical motor to deliver exactly the number of paper, to be delivered.

b. Mechanical system:

The mechanical part of the system includes the working mechanism. The mechanical components include the rollers, shaft, bearings, gears, etc. This includes the power transmission from the motor to the delivery of the paper out of the automatic paper vending machine. The fabrication of the base and structure of the entire machine has also comes under the mechanical work.

The fabrication of the steel casing is done by using welding and riveting process, as required.

c. Electrical system:

The electrical system in the automatic paper vending machine includes the motors, power supply unit with the transformer. The input power supply is to be stepped down to provide the power to the microcontroller system in required voltage. The power supply to the electrical motor is also to be taken care of. The required type of electrical motor so as to deliver the paper out of the vending machine is to be chosen.

IV. DESIGN OF AUTOMATIC PAPER VENDING MACHINE

The automatic paper vending machine proposed in this paper, is made by the following list of components:

- A. Microcontroller
- B. Transformer
- C. DC Motor
- D. Roller
- E. Transmission drives
- F. Power supply board
- G. LCD
- H. Coin sensor
- I. Casing

*Microcontroller:*

A microcontroller (sometimes abbreviated  $\mu C$ ,  $uC$  or  $MCU$ ) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

The microcontroller used in this machine is the PIC16F877A Microcontroller.



Fig. 2 PIC16F877A Microcontroller

*Transformer:*

A transformer is an electrical device that transfers energy between two or more circuits through electromagnetic induction. A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the secondary winding. This varying magnetic field at the secondary induces a varying electromotive force (EMF) or voltage in the secondary winding. Making use of Faraday's Law in

conjunction with high magnetic permeability core properties, transformers can thus be designed to efficiently change AC voltages from one voltage level to another within power networks.

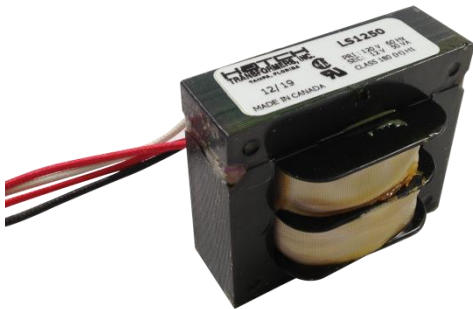


Fig. 3 Step down transformer

In this system, two step down transformers are used (one for the DC motor and another for the microcontroller) to step down the power from 230V to 12V power supply.

*DC Motor:*

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

In this system, the DC Motor of 12V, 5A is used.



Fig. 4 DC Motor

*Roller:*

Roller plays a vital role in the delivery of the paper. Here we use the laser printer rollers because it does the same operation in that. The photoreceptor is pressed or rolled over paper, transferring the image. Higher-end machines use a positively charged transfer roller on the back side of the paper to pull the toner from the photoreceptor to the paper.



Fig. 5 Feed roller

*Transmission drives:*

In the automatic paper vending machine, the power is to be transmitted from the motor to deliver the paper through shafts and rollers. Here, belt drive and gears are incorporated for this purpose.



Fig. 6 Belt drive

The belts are used to transmit power from one shaft to another by means of pulleys which rotate at the same speed or at different speeds. Gears are toothed members which transmit power / motion between two shafts by meshing without any slip. Hence, gear drives are also called positive drives. In any pair of gears, the smaller one is called pinion and the larger one is called gear immaterial of which is driving the other.

*Power supply board:*

A power supply board (PSB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PSBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer. Conductors on different layers are connected with plated-through holes called vias. Advanced PSBs may contain components - capacitors, resistors or active devices - embedded in the substrate.



Fig. 7 Power supply board

*LCD:*

A liquid-crystal display (LCD) is a flat panel display,

electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. The LCD displays information about the coin availability, insertion of the coin, etc.



Fig. 8 LCD

*Coin sensor:*

A currency detector or currency validate is a device that determines whether bills or coins are genuine or counterfeit. These devices are used in many automated machines found in retail kiosks, self-checkout machines, gaming machines, transportation parking machines, automatic fare collection machines, and vending machines.

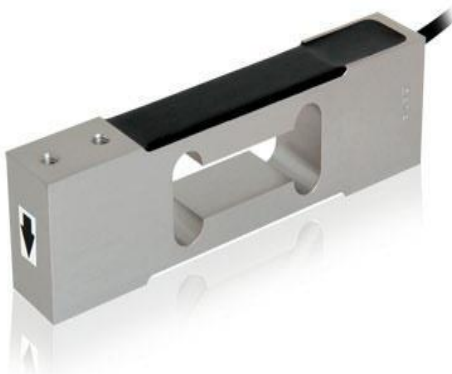


Fig. 9 Coin sensor

The process involves examining the currency that has been inserted, and by using various tests, determining if the currency is counterfeit. Since the parameters are different for each coin or bill, these detectors must be programmed for each item that they are to accept.

*Casing:*

The sheet metal plays a vital role in the automatic paper

vending machine, by making the casing of the system to enclose the entire system. Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are constructed with sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. The casing protects the entire system from outside.

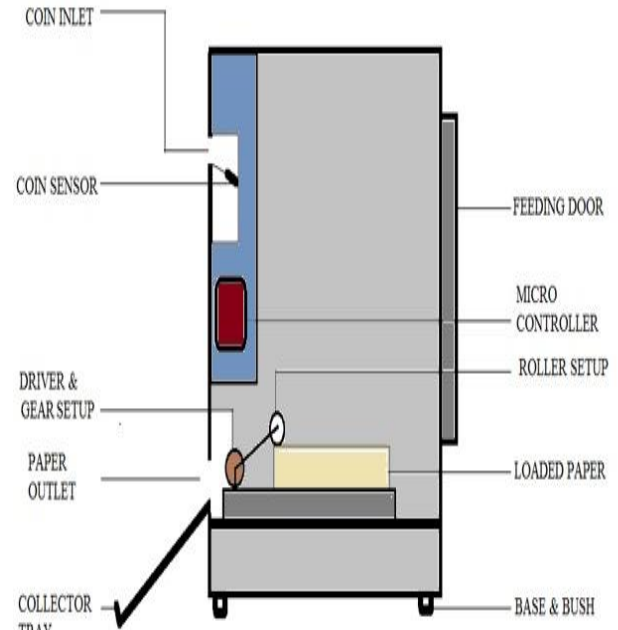


Fig. 10 Layout of the Automatic Paper Vending Machine

V. WORKPLAN

The working of the automatic paper vending machine can be clearly explained in three stages:

Stage 1:

Here the papers are fed into their location such that the rollers are connected to make contact with the first paper at the top of the bundle, such that the paper would be delivered out by the roller when the electrical impulse is given in the form of microcontroller instruction

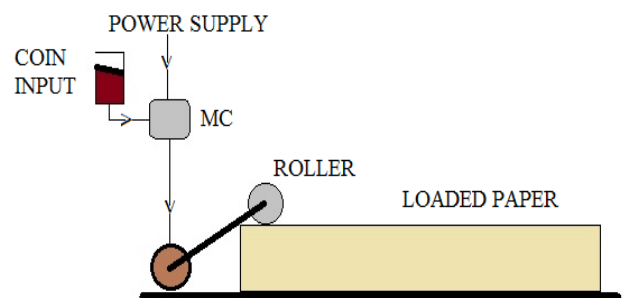


Fig. 11 working stage 1

Stage 2:

When the coin is inserted into the coin input, it passes

through the coin sensor and the coin is checked for its genuineness by the coin sensor. After ensuring the arrival of a genuine coin, the microcontroller sends the electrical impulse to the DC Motor such that the motor drives the roller through gear and belt drives.

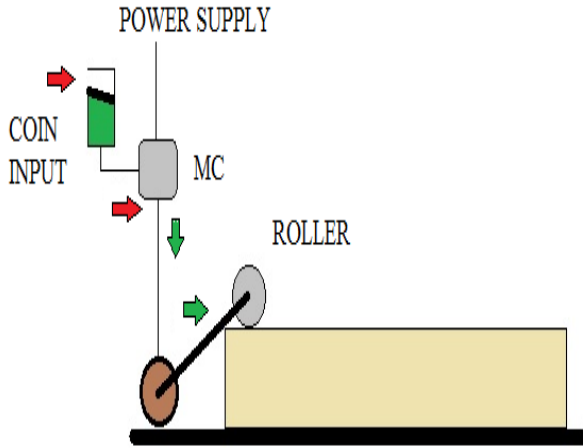


Fig. 12 working stage 2

Stage 3:

The roller drives out the paper at the top of the bundle such that the first paper would be delivered out.

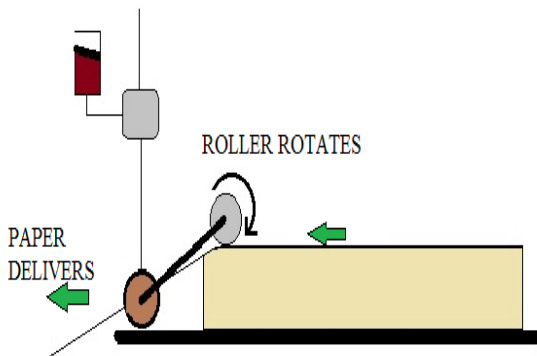


Fig. 13 working stage 3

Note: The setup is arranged in such a way that one sheet of paper would be delivered when a 1Rupee (Indian Rupees – INR) is inserted. And two sheets of paper would be delivered when a 2 Rupee (INR) coin is inserted. The sensing of the coin and the respective impulse would be given by the coin sensor.

### VI. ADVANTAGES

The main advantages of this automatic paper vending

machine include:

1. It reduces the time taken to deliver the paper when a customer asks for the number of papers.
2. The counting of the required number of papers to be delivered would be accurate.
3. Faster delivery of papers to the customers would be possible during peak time and the unnecessary crowd near the stationery shops near the educational institutions, during examination season would be avoided.
4. Reduces human effort.

### VII. DISADVANTAGES

The disadvantages of this automatic paper vending machine include:

1. The insertion of fake currency coins inside the currency collector could not be prevented, though papers would not be delivered for them.
2. The coin sensor senses the density and size of the material of the coin. It is possible to access the papers by inserting fake coins with the material of same density and size.

### VIII. KIT IMAGE



Fig. 14 Interior of the automatic paper vending machine back side



Fig. 15 Paper feed mechanism

### IX. APPLICATIONS

This type of automatic paper vending machines applications in places such as

- outlets,
- Educational institutions,
- Government offices such as District Collector office, Tahsildar office, employment exchanges, etc.
- Courts, etc.

### X. CONCLUSION





Though, automatic vending machines are available to deliver various commodities, the vending machine to deliver raw sheets of paper do not exist, which is a much needed one. Paper finds applications almost everywhere and this type of automatic paper vending machines could be used to reduce time and human effort with improved accuracy.

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