"Mechanically Operated Mask Vending Machine"

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Abstract

Face-Mask has become the most essential product incurrent COVID-19 pandemic situation. The stress on the multiplemask resources is caused due to many factors. The speedily risingCOVID-19 situation on one hand and the changing lifestyles of people on the other hand have increased the need for masks. In remote areas, even today, the availability of masks is very less. Also, if amount of money paid are taken into account, it is clear that in most rural areas, families are paying more amount of money for a mask as compared to the normal rates that are charged in urban areas. To get rid of these problems, this project titled "Mask Vending Machine" is designed to dispatch mask to the public. Working of this machine is based on the Mechatronicsprinciples by using sensors and microcontrollers. Now-a-days, vending machines are to be had and operated on most effective one coin however our purpose is to make a mask vending system that is operated on unique coins.

Keywords : *Coin Acceptor, Coin Operated Vending Machine, Portable Vending Machine, Vending Machine*.

I. INTRODUCTION

Vending machine is an automatic machine that gives objects consisting of snacks, beverages, cigarettes and lotterytickets to clients after cash, a credit score card, or a particularly designed card is inserted into the machine. The first cutting-edge vending machines had been advanced in England with inside the early Eighteen Eighties and distributed postcards. Vending machines exist in many nations and, in extra current times, specialized vending machines that offer fewer not unusual merchandise in comparison to standard vending machine objects were created. Mask has become the most commercial products of the century. The pressure at the couple of Mask assets is an end result of a number of factors. On the only hand, the swiftly growing populace and converting existence have multiplied the want for fresh Mask. With the development with inside the generation there are numerous superior gadgets and machines which might be beneficial to the mankind. One of them is coin operated telephone. As we recognize the characteristic of it and the way it works. Coin Operated Mask Dispensing Machine, because the call indicates, is primarily based totally on Coin operation. It has been particularly designed to be used on Railway station, Bus deposes, public locations etc. This machine is primarily based totally on microcontroller. The inputs to the microcontroller are coin and output with inside the shape of Mask. Looking on the specs required for Mask Dispensing Machine and for simplicity of our application, microcontroller became determined to be first-rate suited. Now-a-days, automatic vending machines are maximum in use as they make numerous activities easier as well as more efficient. The machine has numerous input and outputs to provide service to the customer. This machine is much similar any vending machine. It is coin operated. It accepts money only in the form of coins and delivers Face Mask. Weknow that the available Mask resources have initiated towardthe end. This hassle is quietly associated with poor Mask allocation, inefficient use, and shortage of adequate and incorporated Mask management. Since last few decades, several monitoring systems integrated

with Mask level detection have been accepted; therefore, Mask controlling system implementations have potential significance in the society. Vending machine is going to be advanced in such a manner that Mask will get served to the customers. As it is a coin operated machine, the required quantity of Mask and respective amount of money is decided that are affordable for common people.

II. LITERATURE REVIEW

Vennan Sibanda, Lorraine Munetsi, Khumbulani Mpofu, Eriyeti Murena & John Trimble [1] in this paper the "design emphasis was focused on the product retrieval system for this, various concepts were idealized like Spiral Conveyor System, Chute System, Robotic Arm, Rotating Shaft System & Belt System but the chute type driven by rack and pinion gear system was the choice made. Material for the machine was selected based on environmental impact and non-contamination of food items under varying operating conditions. The control system though not discussed in this paper, was developed to offer a friendly customer service platform. Safety and security of the machine is based on fingerprint sensing and alarm system. Purchasing is possiblethought three options, use of a credit card, mobile phone and cash.

Eriyeti Murena, Vennan Sibanda, Solomon Sibanda &Khumbulani Mpofu [2] the design presented in this paper canhandle vending processes automatically with use of gatewaydevice.The objectives were met which offers the systemability to offer flexible payment methods, mobile and cardswiping thus making it a multipayment system device with a high degree of compatibility with all mobile phone types. Built on the IoTgateway device, the control system has ability to incorporateforeseeable future technological changes. Vending machines strategically located in various centers for competitive advantages can be linked through wide area networks (WAN) and local area networks (LAN) technologies. Use ofcellphone applications can be used to control and regulate themachines and get the necessary information as and when needed. It offers quite a reliable system with fast response.

Kanagasabapathi V., Naveenraj K., Neelavarnan V. &Naveen raj S [3] in this paper the primary point of the thought is to dispatch new innovation application in the public eye. Here Radio Frequency Identification (RFID) along with Arduino is used, to overcome the coin based vending machine which does not returned the balance amount if no change available. The customer can select the product before the RFID is read, after card is scanned the product can be collected at the chocolate collector. There are three units present in the machine, the cashless payment provided by theRFID in the first unit. In second unit, Arduino UNO executesthe programming section and finally, the machine delivers the product and displays the information on the display. The RFID scans the tag and the scanned signal is fed to Arduino. Then the motor driver circuit receives the power supply fromthe Arduino, motor starts to rotate the connected spiral ring inanticlockwise direction. Finally, chocolate is delivered to the customer.

M Irmansyah & E Madona [4] the aim of this research is toapplied microcontroller to control newspaper vending machine, Programmable Logic Device (PLD) to count coins,light sensor to detect the coin, sensor TCS3200 is used to detect color of money, dc motor to eject newspaper from vending machine and LCD to show instruction to purchase the newspaper. The type of microcontroller in this vending machine is ARDUINO ATMEGA328, PLD IC is GAL 22V10. Photodiode and infrared sensors can be used to detectcoin. While photodiode receives light from infrared, output voltage of photodiode is 3 volt and 0 volt when the light is closed by the coin. Technology Programmable Logic Device(PLD) can apply as decoder binary to decimal with seven segment displays to count coins. The value of RGB formoney is different for each & is read from 4 sides. DC motorto push will active if RGB value of money entered is detectedand suitable with RGB designed.

Rosa Cardaci, Sandra Burgassi, Davide Golinelli, Nicola Nante, Mario A. Battaglia, Daiana Bezini & Gabriele Messina [5] this pilot study demonstrates that the safety of vending machines is not absolute. VMs may, in fact, represent a potential threat to human health. For these reasons, VMs maintenance procedures and their cleaning andsanitization plans (application of appropriate cleaning procedures to be carried out by trained and sensitized personnel) play a fundamental role and need to be carried out properly. It is recommended that manufacturers and operators who deal with the maintenance of the VMs are aware of the risks; moreover, the producers should entrust to more modern cleaning and engineering/hardware technologies in the manufacture of the VMs, in order to avoidas much as possible, the direct contact between the components of the machine, the final product and the consumers' hands.

A. Solano, N. Duro, R. Dormido & P. González [6] this paper presents a real deployment of an IoT system for vending machines to enable mobile micropayments with an open and universal solution, independent from hardware manufacturers, financial institutions or telco operators. Dealing with micropayments is a challenging long tail problem. To solve it, this paper's solution uses new paradigms like cloud computing, IoT and web technologies. The paper covers all the phases needed to fully integrate the vending machines in the IoT in a scalable manner, leveragingcloud and open-source technologies and targeting the lowestcost-of-ownership for vending companies.

Razali Tomari, Aeslina Abdul Kadir, Wan Nurshazwani Wan Zakaria, Mohd. Hairol Jabbar, Mohd Helmy Abd Wahab &Mohd Fauzi Zakaria [7] to overcome various problems faced by people in waste disposal & recycling, in this project an automated recycle bin with a reward feature isproposed that derived from a reverse vending machine (RVM) concept. Basically, the system is implemented in a standard recycle bin provided by local municipal that equipped with microcontroller and collection of sensors. Thedeveloped BPU system consists of mechanical part and an electronic part. Throughout the process, the sensors responsible to identifying user information, weight the scale and eventually convert the weight to the corresponding pointsautomatically. Once the process completed, the user canclaim their points by using RFID point card.

III. COMPONENTS

The various components of mask vending machine are as follows:

A. Base Frame:

Frame is the main outer body or enclosure of the machine.It has 2-3 open holes on the front side or the door panel. One-hole acts as the window to collect the mask. Other holesare used to see the inner compartment of the machine from which available quantity of masks is visible. The material used for making frame is CRCA (Cold Rolled Close Anneal)

B. Coil Spring

Two coil springs were used for product retrieval. Coil spring is one of the types of spring of specific pitch & length.Since coil spring has coils which serves as a pocket for the mask (or any product), hence we used coil springs for dispensing the product (i.e., mask).

Fig. 1.**Coil Spring.**

Table- I: Specifications of coil spring

Parameters	Values/Range
Material	Stainless Steel (SS)
Wire diameter	2-5 mm
Load type	Torsion
Pitch	20-85 mm
Length	445 mm

C. Servo Motor:

A servomotor is a closed-loop servomechanism that usesposition feedback to govern its motion and positions. Theinput for controlling the servomotor is a signal (analogue or digital) defining the position directed for the output shaft The motor is paired with some kind of position encoder to provide speed and position feedback. In the easiest case, onlythe position is measured. Then the measured position ofthe output and the command positions are compared, wherethe command position is the external input to the controller. Ifthe output position is different from that required position, anerror signal is created and then the motor starts to rotate ineither direction, as required to bring the output shaft to theappropriate position . As the desired position is attained,the error signal decreases to zero and hence, the motor stops.

Fig. 2.**Servo Motor.**

Table- II: Specifications of servo motor

Parameters	Values/Range
Speed	20-32 RPM
Operating Voltage	12 V DC
Maximum torque	17.05 kg-cm
Weight	135 gm
No-load current	0.22 Amp
No-load output speed	23.5 RPM
Maximum power	3.80 W

D. Coin Acceptor:

A currency detector or coin acceptor or currency validatoris a device that determines whether coins are genuine or counterfeit The system entails analyzing the coins whichhave been inserted into the machine, and conducts numerousassessments to decide if they are counterfeit. Because the parameters are distinct for every coin, those coin acceptors need to be suitably and correctly programmed for every cointo be accepted.The simple and basic principle for coin detection is to check its physical properties against known characteristics of standard and acceptable coins. The coin acceptor identifies the coin in relation to its mass, diameter, size, thickness, metallic composition and/or magnetism, afterwhich it sends an electrical signal through its output connection. Today, electronic coin acceptors are being used in few locations that, further to analyzing the mass, weight and size, additionally scan the inserted coin with the use of optical laser beams and then compares the image to a pre-defined image list, or examine the coin's "metallic signature" on the basis of its metallic composition. In this project,DG60F series of coin acceptor has been used. It is an Electronic

coin acceptor with high reliability which is mostly used in vending machines, amusement facilities, and so on.

Fig. 3.**Coin Acceptor.**

Table- III: Specifications of coin acceptor

Parameters	Values/Range
Accuracy Rate	95 %
Coin diameter	15-29 mm
Coin thickness	1.8-3 mm
Operating voltage	12 V DC
Working current	50 mA
Recognition speed	≤ 0.6 s
Back shell material	PC plastic

E. Microcontroller:

The microcontroller used is Atmega 328. The Atmel 8bit AVR RISC-based microcontroller combines: 32 kB ISP flashmemory with read-while-write capabilities 1 kB EEPROM, 2kB SRAM,23 general purpose I/O lines, 32 general purpose working registers, 3 flexible, timer/counter with compare modes, internal and external interrupts, Serial programmable USART, A byte-oriented 2-wire serial interface , SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, Five software selectable power saving modes, operating frequency of 20MHz. The device operates from 1.8 to 5.5 volts. The device achievesthroughput approaching 1 MIPS per MHz.

Fig. 4.**Microcontroller**

F. Through Beam IR Module:

Two sensor modules used basically determine the time required for the Rs.10 coin to pass between a fixed distance which is considered as the standard for checking the authenticity of thecoin. The specifications for the same are as follows:

- Dimensions: 32mm (length) × 11mm (height) × 20mm (width).
- Main Chip: LM393, infrared on radio head.
- Working Voltage: DC 5V (having a signal outputinstruction).
- Single-channel Signal Output.
- Output valid signal is less & sensitivity is adjustable.

Fig. 5.**IR Sensor Module**

G. LCD Display:

The term LCD stands for liquid crystal display. It is a kindof electronic display module used in a wide range of applications such as various different circuits & devices like mobile phones, computers, calculators, TV sets, etc. These displays are especially preferred for multi-phase light-emitting diodes and seven segments. In a 16×2 LCD, 16×2 means that it can display 16 characters on each line andthere are total two lines. In this LCD each character is displayed in 5×7 pixel matrix. The 16×2 alphanumeric dot matrix display can display 224 different symbols and characters.

Fig. 6.**LCD Display.**

IV. DESIGN CALCULATIONS

- Thickness of Sheet = 1mm
- Density of Sheet = 7.86 kg/m^3
- Mass = m
- Volume = v
- Length of Sheet (l) = 725mm
- Width of Sheet (b) = 250mm
- Height of Sheet (h) = 500mm
- Length of Door Panel (L) = 675mm
- Height of Door Panel (H) = 440mm

A. Mass of Door Panel (m_1)

$\because$ Density = Mass/Volume
$\therefore$ Mass = Density × Volume
$\therefore m_1 = \rho \times v$
But, $v = L \times H \times t / 10^6$
$\therefore m_1 = 7.860 \times 675 \times 440 \times 1/10^6$
$\therefore m_1 = 2.12$ kg

B. Mass of Rear Panel (m_2)

$m_2 = \rho \times v$
But, $v = l \times h \times t / 10^6$
$\therefore m_2 = 7.860 \times 725 \times 500 \times 1 / 10^6$
$\therefore m_2 = 2.84$ kg

C. Mass of Slide Cover (m_3)

$m_3 = \rho \times v$
But, $v = b \times h \times t / 10^6$
$\therefore m_3 = 7.86 \times 250 \times 500 \times 1 / 10^6$
$\therefore m_3 = 0.98$ kg

D. Mass of Upper & Lower Member of Body (m_4)

$m_4 = \rho \times v$
But, $v = l \times b \times t / 10^6$
$\therefore m_4 = 7.86 \times 725 \times 250 \times 1 / 10^6$
$\therefore m_4 = 1.42$ kg

E. Total Mass of Body (m)

$m = m_1 + m_2 + (2 \times m_3) + (2 \times m_4)$
$= 2.12 + 2.84 + (2 \times 0.98) + (2 \times 1.42)$
$m = 9.76$ kg

F. Mass of Spring Supporting Member (m_5)

$m_5 = \rho \times v$
$= 7.86 \times 550 \times 175 \times 1 / 10^6$
$m_5 = 0.75$ kg

G. Mass of Motor Holding Bracket (m_6)

$m_6 = \rho \times v$
$= 7.86 \times 100 \times 100 \times 1 / 10^6 m_6 = 0.078$ kg

H. Mass of Electrical Components & Spring (m_7)

$m_7 = 2$ kg

I. Total Mass of Model (M)

$M = m + (2 \times m_5) + (2 \times m_6) + m_7$

$= 9.76 + (2 \times 0.75) + (2 \times 0.078) + 2$

$M = 13.4$ kg

J. Cutting Force Calculation for Door Panel

Cutting force = Perimeter × Shear strength × Thickness Cutting force = (Total slot cutting parameter length) × 280×1

$= 1336 \times 280 \times 1$

$= 374.08 \times 10^3$ N

Cutting force = 374.08 KN

K. Press Tonnage Capacity

Press tonnage capacity = Cutting force / 9.86

= 374.08 / 9.86

Press tonnage capacity = 37.93 Tons

V. DRAWING AND DRAFTING OF MODEL

After a design has been selected, the next step in is to make3D drawing of model. The design is firstly separated into number of parts and then each part is sketched manually on a paper with appropriate dimensions. The dimensioning is based on the reference of available vending machines. After dimensioning, each part drawing is created on computerusing Unigraphics software. After all partdrawings are completed, the parts areassembled to make the complete 3D model design.

A. Three-Dimensional (3D) Modelling of Parts

The spring holder is used to hold the coil springs. The collecting tray is used to collect the mask.

Fig. 7.**Spring Holders and Collecting Trays.**

Door Panel forms the front covering of the machine. It consists of hollow openings for collecting window, LED screen and Coin acceptor.

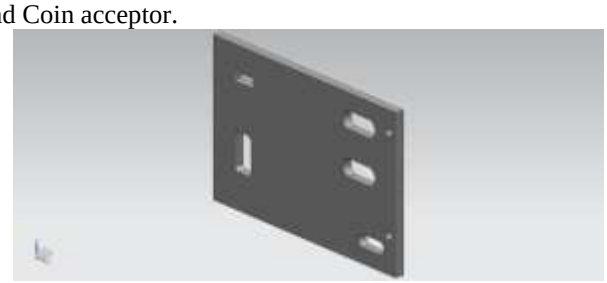

Fig. 8.**Door Panel.**

Internal assembly of the spring holder and collecting tray.

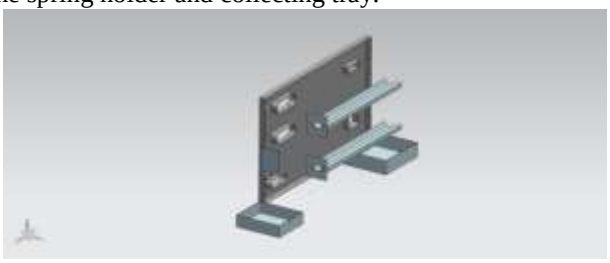

Fig. 9.**Internal Assembly.**

B. Conceptual 3D Design of Model

From all the parts, the assembly of the model is created.

Fig. 10.**Assembly of Model.**

Table- IV: Various components of model

Sr. No.	Component	Material	Quantity
1.	Base frame	CRCA	1
2.	Door panel	CRCA	1
3.	Spring holding member	CRCA	2
4.	Motor holding bracket	CRCA	2
5.	Mask collecting tray	CRCA	1
6.	Sanitizer bottle holder	CRCA	1
7.	Coil spring	Mild Steel(MS)	2

VI. WORKING MODEL

The following are the steps of working for the Mask Vending Machine:

- Enter the coin in the coin acceptor, the acceptor then detects and verifies whether the coin is appropriate ornot with the help of sensors.
- A pair of magnets is used to slow down the coin on insertion due to hysteresis effect.
- Coin passes through the optical gates and blocks continuity of light thereby generating

interrupts to theArduino unit. If the time measured between these interrupts match the pre-set value, then the coin is validated.

- On validation Arduino issues a signal to a gatewaymotor on its output pin. Thereby coin is accepted intothe collection box else it is sent to the rejection box.
- Then as soon as the coin is accepted, Arduino issues a signal to start the roller mechanism and supplies it to the servo motor.
- Now the servo motor receives the signal and thus, it makes one complete rotation.
- Coil spring which is attached to the motor also rotates.
- Now, the masks which are held in the pockets of the spring, gets released and fall down due to rotation of spring. Thus, we can collect the mask from the window near which the mask falls.

VII. ADVANTEGES AND DISADVANTAGES

A. Advantages of Mask Vending Machine:

- The whole process is automated such that one can be able to use it when the transaction is done in the correct way according to how the machine is programmed.
- It gives the clients a free choice to purchase products atany time of the day. One can shop for his or her intended product on 24x7 hours, throughout the year.
- Diversity in terms of the products can be handled by thevending machine.
- Most vending machines are stationed at such places, which makes it convenient and time saving because ofthe surety of getting what the customer wants.
- It is a one-time investment on the side of the owner whodoesn't need a lot of running expenses to operate. Reduction of overhead costs by not hiring of staff onlyincreases the profit margin for the owner making it a success bound venture.

B. Disadvantafe of Mask Vending Machine:

- Vending machines since is used to be displayed inpublic areas it can suffer vandalism.
- Logistics can also be challenging, as a coin vending machine requires someone to empty the machine eachday as the coin holder can fill rather quickly.
- Some older coins are not easily readable by themechanisms.
- If product is out of stock, then also the vending machinewill accept the money but the client will get their money back after processing in the coin acceptor.
- If a fake coin of same thickness, metal, and weight ismade then, the coin detector might accept it, but it won't have 100% efficiency.
- Due to the nature of spiral dispensing system, productscan get stuck sometimes if the products are not positioned correctlyor just by accident.

VIII. FUTURE SCOPE

Referring the objectives of our project, by adding or by doing some modifications, the future scope of machine can be increased as follows:

1) We designed this mask vending machine for safety fromCovid-19 pandemic, but after covid-19 pandemic this mask vending machine can be installed in hospitals wherein the necessity of mask will be there forever.

2) Currently, the machine can dispense only one type of mask. But we can increase its capacity by

adding moremotors & springs sets so that it can be implemented ingeneral stores, supermarkets, etc. to dispense variety of masks of different quality and cost.

IX. CONCLUSION

When the world is running rapidly with advancement, timeis the undoubtedly the most crucial and vital resource of all. Itbecomes unpreventable to save time by all possible ways. This vending machine can offer variety of product. When a coin is inserted in the Vending machine the electromagnetic sensor senses the coin. After sensing, if the coin turns out to be suitable then the product gets released. And if a inappropriate coin is inserted, the coin comes out of the machine.

The vending machine is capable of detecting any type of coin which can even be changed after modification of the coin acceptor. Thus, the desired output is achieved. Thetesting for fake currency has also been done so that possibility of frauds gets reduced.

In the current time, digitalization is increasing speedily ona daily basis due to its accuracy and feasibility. Due to its time saving feature, vending machine can be installed and used in populated areas like airport, station, bank, office, etc. This machine is portable, affordable, requires less power andcan be made easily available so that the user can use this system whenever and wherever. This system offers rapid response and is simple to use by common people. The designed system can be used for various applications and wecan enhance the variety of selections. Thus, we attempted andtried our best to modify the present-day complicated vendingmachines into a user- friendly vending machine.

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