RFID and GSM based Automatic Dispensing and Monitoring of Sanitary Napkin Vending Machine for Menstrual Hygiene among Women

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Abstract. The availability of Sanitary napkin pads is very much essential for the menstrual health of women in India. The cultural taboos associated with the menstrual health as well as the cost of the pads prevent many women to adapt to home-made cloth pads which are unhygienic and uncomfortable. Research has been going on in the manufacturing of low cost sanitary pads. The timely availability is more important than the cost of the napkins. In schools and colleges or in public places like railway stations, airports, bus stations while travelling people might find it difficult to find the stores or shops selling the napkins. Hence it is necessary to have a vending machine for easy access and availability at all times. The drawback of the system is that once the stocks are used up there is a time lag before the refilling of the stock. This can be solved by having a vending machine which accepts non cash transactions as well as that can inform the maintenance people the stock position. This helps in timely replenishment of the stocks to ensure round the clock availability.
Keywords: Machine, Automatic, Sanitary Napkin, Manufacturing

1. Introduction
Sanitary napkin pads play an important role in maintaining the menstrual health in women and also have a psychological role in the development of women empowerment. The cost of napkin pads has always been higher and has not been affordable for most of the users. This has led to use of cheap and unhygienic clothes resulting in health problems. Though government and NGOs are trying for manufacturing low cost pads the reach has been less among rural population. Even for urban population, though the cost might be affordable, the timely availability is a problem. The problem becomes more acute for people in transit. The alternative suggested has been providing pad vending machines in schools, colleges, hospitals and public places. Though this has been largely welcomed and appreciated, the disadvantage has been that of the replenishing of the machines when stocks get depleted.
There have been instances where the vending machines have run of stock and people getting disappointed. In the long run frequent non availability would result in people neglecting the machines. Our suggested alternative is to have machines which would dispense pads and update the stock availability to a central authority, so that the replenishing can be done in time, without running out of stock. The driving factors of global sanitary napkin market are, (a) rising popularity of disposable sanitary napkin, (b) increase in population of working women and purchasing power and (c) awareness created by various non-profit organizations [1]. Figure 1 displays the global sanitary napkin market—regional overview.

Figure 1 Global Sanitary Napkin Market – Regional Overview
The figure was adopted from https://industryprobe.com/pr/Global-Sanitary-Napkin-Market

2. Literature Survey
The proposed design discusses with a liquid flow sensor based on the measurement of the pressure difference across a flow restriction integrated between 2 silicon pressure sensors [2]. The proposed design discusses about automatic process control for vacuum dispensing equipment with control on pressure and temperature [3]. The article discusses about the challenges such as package sizes decrease, under fill materials advance and tolerances tighten in automating the under fill dispensing process for robust production. The best practices for automated under fill dispensing are discussed for various types of under fill packages [4].

GSM network based Wireless Vending machine was designed based on USSD platform. It also manage sale information, logistic information and consumer information on-line [5]. The proposed prototype discuss about designing and application for automated medicine depositing and dispensing system of pharmacy. Total design of medicine depositing, hardware of control system, application of multithreading technology and analysis of control requirements, control methods for actuating equipment’s were discussed [6]. The article discusses about smart coffee vending machine using sensor and actuator networks. A sensor and actuator network and install it inside a vending machine to monitor the indoor environment of the machine and it adjusts the coffee taste [7].

The article discusses about automatic medicine dispensing machine design for the benefit of people in remote tribal areas where Government/agencies struggle in distributing to the need on emergency. The prototype consists of a microcontroller and motor based system to dispense
the medicines when accessed by the user through an input event [8]. The article discusses about automatic vending machine based on short message payment. It describes about the design of vending machine and the method to use short message payment [9].

Liquid dispensing system for various liquids of different viscosity elaborated with real-time automatic control by using an analytical balancer reading. The design results in higher accuracy and precession in shorter duration [10]. The article discusses about automatic ration material dispensing system to reduce interventions of human and to achieve efficiency and transparency. RFID tag and plays a major role in the implementation for distribution of materials. It also detects tampering as well as fire accidents and gives an alert to provide safety [11]. The proposed design detect the soil nutrients and it dispenses the fertilizer automatically in the soil instead of manually fertilizers added by the farmers. The proposed system measures the amount of macro and micronutrients and pH in soil. The system leads in avoiding excess or inadequate fertilizers in soil [12].

3. Objective

Ignorance and superstition prevented young girls on significance of menstrual tidiness. A recent studies states that only 18% use sanitary protection and 70% of women detected with infection in reproductive tract due to poor menstrual cleanliness. The ladies are not aware about the unclean practices will take to. To overcome the existing problem, sanitary napkin vending machine is the best solution. With the help of sanitary napkin vending machine the young ladies will be worry Free State. Also, the prototype machine makes them stress free and ensuring comfort for them. Using sanitary napkin vending machine, young girls can avail napkins at any time and overcome the menstrual emergencies. The vending machine can be placed in appropriate location in Hostels, Colleges, Schools, common places, apartments and hospitals.

4. Proposed Design

The proposed system consists of a simple spiral coil, on which the pads are loaded. On rotation of the coil the pads get dispensed continuously, one at a time. The coil is rotated by means of a DC motor, which can be controlled using a PIC microcontroller, through a relay. One can program it be switched ON using a RFID reader or barcode scanner. The Barcode scanner can be used where the school students/ college students/employees can be issued with barcode for identification. Their existing ID cards can be used for the purpose with no additional cost. But the initial cost of having a barcode reader installed would be there.

**Figure 2** Block diagram

The barcodes of all expected users need to be stored which requires memory. Any new users would not be able to use the machine due to lack of barcode. The barcode scanners
cannot be used in public places where you cannot expect the users to have barcodes. Hence we have gone for RFID reader based system, where the user has to use a common RFID card which can be given to the custodian or can be attached to the machine. This reduces the memory needed to store the barcodes. Whenever a pad is dispensed a message is sent to a number through the GSM module. This gives an idea of the availability of the stock in the machine to ensure that the machine does not go out of stock. Figure 2 displays the block diagram of proposed system.

5. Hardware Design

In the proposed system we are using a PIC microcontroller for authenticating the RFID card through the RFID reader, rotating the spiral coil through the DC motor relay and sending message through the GSM module. The development board consists of PIC 16f877a microcontroller, LCD display and I/O ports. The PIC16f877a is a user friendly controller with easy programming. Since it uses flash memory program can be written, erased and rewritten any number of times. The program can be written using a PIC microcontroller USB programmer. Figure 3 displays the Microcontroller development board.

The coil bearing the pads should be rotated when proper identification is presented. Several methods are available for identification of the user. One direct and easy method would be to use coin dispensing. The drawback is the unavailability of coins of right denomination. We are proposing to use an RFID tag that can be read by a reader in the machine. The RFID tags can be given to all employees/students or can even be attached to the machine. It can also be replaced by a barcode scanner which can be programmed to scan the identity card and authorize the dispensing. We can also program the system to store the number of pads dispensed against a card and amount can be recovered from the users during month end. Figure 4 displays the RFID reader.
A DC motor is used to rotate the coil so that the pad at the end of the coil falls down in the slot. The motor is controlled through a relay that is connected to the Microcontroller. Whenever the coil is rotated through the relay a message is also sent by the GSM module to the store number, so that the supervisor can keep count of the number of pads that have been issued and the number of pads that are remaining. This helps in timely replenishing of the pads so that there is no shortage of pads in times of emergency. The whole purpose of the vending machine would fail if the machine goes out of stock. Hence this module is of much importance for the successful implementation of the idea. Figure 5 displays the DC motor relay.

Figure 5 DC Motor Relay

6. Results and Discussions

Figure 6 displays the Controller circuit board and Figure 7 shows the Final connected setup. A modified vending machine developed from basic vending machine with the help of using low cost materials and also by using modern techniques like 3D printing for reducing the cost of manufacture. When user swipes the RFID reader, IR sensor detects it and sends a signal sent to PLC. In turn PLC turns on the relay and it switches on the motor which rotates the spring and the sanitary napkin is dispensed immediately. Once the sanitary napkin is dispensed, the count is been updated in PLC and a SMS is sent to a number through the GSM module.
With mass production, the cost can be brought down further. Sanitary napkin vending machine contributes significant support for the society. Additional features such as accepting coins, Barcode, Credit card can also be added depending on the requirements and the place of installation. The automatic dispensing of sanitary napkin is easy for implementation in educational institutions and hostels, which can be easily accessed by using their unique identity card details. The automatic dispensing equipment can be implemented in common places, which can be utilized by coins or by UPI payments too.

7. Conclusion

A modified vending machine developed from basic vending machine with the help of using low cost materials and also by using modern techniques like 3D printing for reducing the cost of manufacture. With mass production, the cost can be brought down further. Sanitary napkin vending machine contributes significant support for the society. Also, the prototype promotes digital mode of payment which is easy for usage with less cost and minimum maintenance. The proposed prototype takes care of women hygiene and it caters to meet the menstrual emergencies instantly. The prototype creates a large business opportunities for installation of automatic sanitary napkin vending machine in public places globally, which is expected to be sustainable and everlasting as the sanitary napkins are mostly used by every woman.

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