Solar Operated Mini Sanitary Pad Vending Machine Using RFID A Review Paper

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***Abstract— The "Sanitary Pad Vending Machine using RFID" project addresses the need for innovative solutions in the realm of women's hygiene. In contemporary times, technology plays a crucial role in enhancing accessibility and convenience. The proposed vending machine leverages Radio-Frequency Identification (RFID) technology to provide a seamless and secure means for women to access sanitary pads. This project aims to contribute to women's well-being by offering a user- friendly, automated, and discreet solution for obtaining essential hygiene products.***

***This project embodies a pioneering initiative at the intersection of technology and women's health. In the contemporary landscape, where technological advancements are reshaping convenience, this project leverages Radio-Frequency Identification (RFID) technology to introduce a transformative solution for women's hygiene. Beyond mere accessibility, the vending machine seeks to enhance user experience by providing a secure, automated, and discreet means for women to obtain sanitary pads. This project contributes to the broader discourse on women's well-being, positioning itself as a user-centric solution that aligns with the evolving needs and expectations of modern society.***

***Keywords: - RFID, Sanitary Pad, Vending Machine, Women's Hygiene, Automation***

1. INTRODUCTION

In the contemporary landscape of technological innovation, where every facet of our lives is being touched by the transformative power of advanced solutions, the intersection of technology and healthcare takes center stage. Among the diverse applications of technology in the healthcare domain, the "Sanitary Pad Vending Machine using RFID" project stands out as a pioneering initiative that transcends mere technological advancement. This project, driven by a vision of addressing a fundamental aspect of women's health and well-being, seeks to redefine the narrative around menstrual hygiene through the integration of Radio-Frequency Identification (RFID) technology Menstrual hygiene has long been a critical aspect of women's health, with access to sanitary pads playing a pivotal role in ensuring the well- being, comfort, and dignity of women during their menstrual cycles. However, despite the recognized importance of menstrual hygiene, challenges persist in ensuring universal and convenient access to sanitary products. It is against this backdrop that the Sanitary Pad Vending Machine project takes shape, aiming not just to provide a technological solution but to revolutionize the entire experience of obtaining sanitary pads. At the heart of

this project is the integration of RFID technology, a cutting- edge solution that goes beyond conventional vending machine models. RFID, a technology that utilizes radio waves to transmit data from an RFID tag to a reader, offers a host of advantages in terms of efficiency, security, and user experience. The decision to incorporate RFID into the vending machine design is grounded in the belief that technology can be a powerful catalyst for positive change, particularly in addressing sensitive issues like menstrual hygiene.

The core functionality of the Sanitary Pad Vending Machine revolves around the RFID system. Each sanitary pad packet is equipped with an RFID tag, ensuring that the machine can accurately track and dispense the desired product. This not only streamlines the vending process but also introduces an unprecedented level of efficiency and customization. Women using the vending machine can simply wave an RFID enabled card or key fob to initiate the dispensing process, eliminating the need for physical currency and promoting a seamless and discreet transaction.

Beyond the technological innovation, this project carries a profound social impact. Menstrual hygiene is not only a biological necessity but also a matter of dignity and inclusivity. By deploying RFID technology in this context, the project aims to destigmatize the process of obtaining sanitary pads. The discreet and contactless nature of RFID transactions ensures that women can access essential hygiene products without undue attention, fostering a culture of respect and privacy around menstrual health.

Moreover, the project aligns with broader conversations surrounding women's health and empowerment. In many parts of the world, the lack of access to menstrual hygiene products has been a barrier to education and economic opportunities for women. By introducing a technologically advanced and user-centric solution, the project takes a step towards breaking down these barriers, contributing to the larger narrative of gender equality and women's empowerment.

In this comprehensive exploration of the Sanitary Pad Vending Machine using RFID project, we delve into the technological intricacies, the societal implications, and the overarching vision that propels this initiative forward. Beyond the mere functionality of a vending machine, this project represents a convergence of technology, healthcare, and social progress, marking a significant stride towards a future where women's health is not just addressed but celebrated through thoughtful and innovative solutions. The subsequent sections will unpack the various dimensions of

this project, from its technological underpinnings to its potential societal impact, offering a holistic understanding of this transformative endeavor.

The primary objective of this project is to design and implement a sanitary pad vending machine that utilizes RFID technology for user authentication and product dispensing. The focus is on creating a user-friendly, automated system that enhances the accessibility and privacy of obtaining sanitary pads. By incorporating RFID, the project aims to provide a secure and efficient mechanism for women to access essential hygiene products in public spaces. The machine's user-friendly design ensures accessibility for women in public spaces, contributing to their convenience and overall well-being. The use of RFID not only enhances security but also modernizes the experience of obtaining sanitary pads, aligning with contemporary technological advancements. This initiative stands at the intersection of technology and women's health, addressing a fundamental aspect with a forward-thinking and inclusive approach.

1. LITERATURE REVIEW

The literature survey for the review paper on "Solar Powered IoT-based Intelligent Sanitary Napkin Dispenser" explores existing research and developments in the field of women's hygiene, particularly focusing on innovations in sanitary napkin dispensing systems. The study by K. Samba Siva Rao and colleagues proposes an automatic napkin dispenser equipped with IoT capabilities, aiming to address the challenges faced by women, especially in public places like schools and colleges. The survey covers various aspects of the existing and proposed systems:

1. *Importance of Women's Hygiene*

The survey highlights the significance of women's hygiene, emphasizing the need for accessible and discreet solutions for menstrual hygiene management, especially in educational institutions and public spaces.

1. *Existing Coin-Operated Systems*

The limitations of existing coin-operated napkin dispensers are discussed, including the lack of real-time monitoring of napkin availability and vulnerabilities to coin manipulation*.*

1. *Proposed IoT-based System*

The study proposes an innovative solution using IoT technology, integrating components such as PLC, RFID, and sensors to create an intelligent napkin vending machine. This system aims to provide automated dispensing and real- time monitoring of napkin availability

1. *Functional component*

Detailed descriptions of the functional components of the proposed system are provided, including the use of RFID readers, PLC controllers, relays, and spring mechanisms for dispensing napkins based on user inputs.

1. *Integration of Solar Power*

The survey discusses the integration of solar panels and rechargeable batteries to power the IoT-based dispenser, ensuring sustainable and energy-efficient operation.

1. *Future Directions*

Future enhancements and potential expansions of the system are suggested, such as integrating additional features like napkin disposal units and optimizing the design for larger napkin capacities.

1. THEORETICAL STUDY

The theoretical study of the solar-operated sanitary pad vending machine involves a comprehensive exploration of fundamental principles and concepts that underpin its design and functionality. Beginning with solar power generation, the focus is on the photovoltaic principles governing the solar panel's conversion of sunlight into electrical energy. Factors influencing solar panel efficiency, including sunlight intensity, angle, and shading, are examined. Moving to energy storage, the study delves into the characteristics of lithium-ion rechargeable batteries, encompassing energy storage capacity, voltage, and the role of battery management systems in optimization. The microcontroller, Arduino Nano, is a critical component, and the theoretical study encompasses its basic functionalities, such as processing input signals, controlling outputs, and interfacing with other elements of the system. The programming logic governing the coordination of the RFID module, pump, and relay for user authentication forms a key aspect of understanding the microcontroller's role. RFID technology is elucidated with a focus on its working principles, including how RFID tags and readers communicate for secure identification. The study delves into the authentication protocols ensuring authorized access to the vending machine. Exploring the product dispensing mechanism, attention is given to the operation of the 5V DC pump and the control function of the 5V DC relay in managing pump activation and deactivation. The block diagram, a visual representation of the system architecture, is analyzed to comprehend the interconnection and communication between various components. Understanding the functional flow from solar power generation to sanitary pad dispensing aids in visualizing the seamless sequence of operations. The working principle is elucidated, emphasizing the electrical-to-mechanical conversion that transforms electrical energy generated from solar power into the mechanical motion responsible for dispensing sanitary pads. The user authentication process and control flow are detailed, outlining the sequence of events triggered by user RFID authentication, culminating in the dispensing of sanitary products.

1. Historical Context of Sanitary Pad Dispensing:
   * Traditional methods often involve manual transactions or interactions with attendants in public spaces like

restrooms or commercial establishments.

* + Challenges include limited accessibility, as women may face difficulties obtaining sanitary pads discreetly and

promptly

1. Integration of Technology in Women's Health:
   * Recent technological advancements are being harnessed to address challenges in women's health, particularly in

the domain of menstrual hygiene.

* + Innovations at this intersection aim to enhance overall well-being and address the unique needs of women.

1. RFID Technology in Vending Machines:
   * RFID (Radio-Frequency Identification) technology is known for its efficiency in tracking and authentication.
   * Its integration in vending machines, including sanitary pad dispensers, provides enhanced security, quicker

transactions, and a contactless user experience.

1. Privacy and Dignity in Sanitary Pad Dispensing:

* Privacy and dignity are paramount concerns for women during the menstrual hygiene process.
* RFID contributes to a more discreet and confidential experience, mitigating potential discomfort or embarrassment

associated with the purchase of sanitary pads.

1. User Authentication and Access Control:
   * RFID ensures secure user authentication, allowing only authorized individuals to access the vending machine.
   * Access control mechanisms based on RFID technology enhance the safety and reliability of the sanitary pad

dispensing system.

1. Efficiency and Convenience:
   * The automation of sanitary pad dispensing through RFID streamlines the process, making it quick and efficient for users.
   * Convenience is a key aspect, enabling women to access essential hygiene products with minimal effort and time,

promoting a more seamless experience.

1. Technological Modernization in Women's Health:

* The project aligns with the broader trend of leveraging technology to modernize solutions related to women's health.
* The use of RFID in sanitary pad vending machines represents a contemporary approach to addressing age-old challenges and improving the overall experience for women.

1. Social Impact and Empowerment:
   * Beyond the technological aspects, the project holds societal implications in challenging norms surrounding women's health and empowerment.
   * By providing an advanced and user-centric solution, the project contributes to breaking down barriers, fostering

inclusivity, and empowering women.

1. Challenges and Opportunities:
   * While RFID technology brings numerous benefits, challenges may include initial implementation costs and technical complexities.
   * The project also presents opportunities for further research and development in the intersection of technology and women's health, exploring potential improvements and innovations.
2. Global Perspectives on Menstrual Hygiene:
   * Menstrual hygiene is a global concern, and various countries have explored innovative approaches to address it.
   * Understanding global perspectives on menstrual health helps contextualize the project within a broader discourse

and opens avenues for collaboration and knowledge

exchange.

1. Challenges and Future Directions:

* Technological Hurdles:
  + Overcoming initial challenges in RFID technology implementation, including hardware compatibility and system

integration.

* + Ensuring RFID tag durability and reliability in diverse environmental conditions.
* Cost Considerations:
  + Addressing the initial setup cost concerns for widespread adoption.
  + Exploring cost-effective solutions and potential partnerships.
* Maintenance Focus:
  + Emphasizing regular maintenance for uninterrupted functionality.
  + Establishing a robust maintenance system and personnel training.



1. PROPOSED METHODOLOGY

The working principle of the Solar-Operated Mini Vending Machine for Sanitary Pads is rooted in the integration of various components, each contributing to its seamless operation. The solar panel harnesses sunlight to generate electrical energy, which is then stored in the Li-Ion rechargeable battery through a charge controller. This sustainable power source ensures continuous functionality, emphasizing energy efficiency and environmental consciousness. The Arduino Nano, functioning as the brain of the system, receives and processes information from the EM18 RFID module. When a user presents an RFID tag for authentication, the Arduino Nano verifies the credentials, granting access to the vending machine. This RFID- based user authentication adds a layer of security, ensuring that only authorized users can dispense sanitary pads. Upon successful authentication, the Arduino Nano activates the 5V DC relay, controlling the 5V DC pump responsible for dispensing the sanitary pads. This intelligent mechanism guarantees precise and hygienic product delivery, emphasizing user convenience and promoting health and well-being. The user-friendly interface, combined with the thoughtful integration of RFID technology and precision-

controlled dispensing, exemplifies the Solar-Operated Mini Vending Machine's commitment to accessibility and privacy in acquiring essential hygiene products. The working principle, characterized by solar energy utilization, intelligent processing, and secure user authentication, positions the vending machine as x`an innovative and inclusive solution for diverse settings

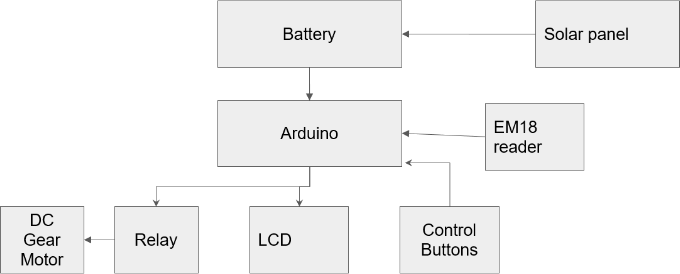


Figure1. Block diagram of Solar Operated Mini Sanitary Pad Vending Machine Using RFID

In the block diagram of the Solar-Operated Mini Vending Machine for Sanitary Pads, each component plays a crucial role in ensuring seamless functionality and user satisfaction. The solar panel, acting as the primary power source, symbolizes the commitment to sustainability and eco- friendliness. Connected to a Li-Ion rechargeable battery through a charge controller, it signifies efficient energy storage and management. At the heart of the system, the Arduino Nano serves as the central processing unit, illustrating the intelligence that drives the entire operation. Interfacing with the EM18 RFID module, the diagram highlights the security features implemented for user authentication. The inclusion of a 5V DC pump, controlled by the Arduino Nano through a relay, showcases the precision and reliability of the dispensing mechanism.

1. Solar Panel: Captures sunlight to generate electrical energy for sustainable power.
2. Li-Ion Rechargeable Battery: Stores and manages the generated solar energy for continuous functionality. (Battery Lithium ion cell 12V 1.2AH, Rechargable)
3. Arduino UNO: Serves as the central processing unit to control and coordinate various components. (Arduino NANO Version 3 is the open source smallest Embedded Development board launched by Arduino based on Atmega328 SMD Package Microcontroller)
4. EM18 RFID Module: Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. This RFID Reader is a Tiny, simple to use RFID reader module. With a built in antenna, the only holdup is the 2mm pin spacing. Power the module, hold up a card, and get a serial string output containing the unique ID of the card. It has TTL output.( Operating Voltage: 5V, Reading Distance: 1 to 4 cm, Read frequency: 125 kHz)
5. DC Pump (5V): Dispenses sanitary pads with precision and hygiene.
6. DC Relay: Controls the activation of the DC pump, ensuring controlled and efficient dispensing. (SPDT, 230V / 7A - AC support SWITCHING, 28V / 10A - DC support switching)
7. LCD: Arduino IIC/I2C interface was developed to reduce the IO port usage on Arduino board , 16 characters wide, 2 rows . Single LED backlight included can be dimmed easily with a resistor Supply voltage: 5V

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CONCLUSION

In conclusion, the development of a solar-operated sanitary pad vending machine using RFID technology represents a significant stride towards addressing the challenges surrounding accessibility and privacy in obtaining essential hygiene products. The integration of solar panels not only promotes sustainability but also ensures autonomy in power supply, making the vending machine suitable for diverse environments. The incorporation of an Arduino Nano microcontroller, RFID tags, and a dispensing mechanism powered by a 5V DC pump and relay adds a layer of technological sophistication, facilitating secure user authentication and efficient product dispensing. This project caters to the pressing need for a user-friendly, automated solution that empowers women to access sanitary pads conveniently, especially in public spaces. The theoretical study encompassing solar power generation, lithium-ion rechargeable batteries, Arduino Nano functionality, RFID technology, and the block diagram analysis provides a robust foundation for understanding the underlying principles. The practical implementation of this project

aligns with the vision of leveraging renewable energy sources and advanced technological solutions to enhance the well-being of individuals. As a future scope, the project could be further refined with additional features, such as real-time monitoring, remote access, and integration with smart technologies for data analytics. Overall, the solar- operated sanitary pad vending machine stands as a testament to the fusion of renewable energy and innovative technology to address a crucial aspect of women's health and well- being. This endeavor contributes not only to hygiene accessibility but also to the promotion of sustainable and inclusive solutions in public spaces.

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