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Research Article

AUTOMATED RFID-BASED SOLAR-POWERED VENDING MACHINE FOR MEDICAL AND STATIONARY SUPPLIES

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Abstract

In recent years, various vending machines have been developed to dispense a range of products, including beverages, chocolates, and medications. Despite these advancements, access to first aid kits remains limited in public spaces such as stations and schools. This paper proposes the implementation of a solar-powered, RFID-based vending machine designed to provide essential first aid supplies and stationary items. The system integrates an Arduino Uno microcontroller and an RFID reader for secure and automated dispensing. The proposed machine aims to enhance accessibility and efficiency while leveraging renewable energy sources. Recent developments indicate a transition towards automatic and solar-powered vending systems, reducing manual intervention and increasing energy efficiency (Kumar et al., 2020)

Keywords: RFID, Vending Machine, Solar Power, IoT

INTRODUCTION

Vending machines are automated devices that dispense items such as beverages, snacks, and lottery tickets. These machines significantly reduce human effort and save time. There are two primary categories: IoT-based and non-IoT-based vending machines. Non-IoT vending machines operate through cash or credit transactions and rely on microcontrollers for operation. In contrast, IoT-enabled vending machines allow for cashless transactions, remote monitoring, and inventory management (Haxhimehmeti & Besimi, 2020). The integration of IoT and machine learning enhances customer experience and operational efficiency. This paper presents a solar-powered vending machine that dispenses stationary and first aid supplies, catering to the needs of students and professionals.

PROPOSED SYSTEM

The proposed system utilizes an Arduino Uno as the primary control unit, supported by an RFID reader and tag for authentication. Additional peripherals, such as a keypad and display, are connected to the Arduino. The vending process is initiated when a user scans an RFID card, selects a product, and the corresponding item is dispensed via a motorized mechanism. Due to the limited current output of the Arduino, an external motor driver circuit is incorporated. The motor is connected to a spiral ring that holds the products, ensuring smooth dispensing (Chavan et al., 2020). This vending machine is designed to be solar-powered, utilizing stored energy when required, reducing dependency on conventional power

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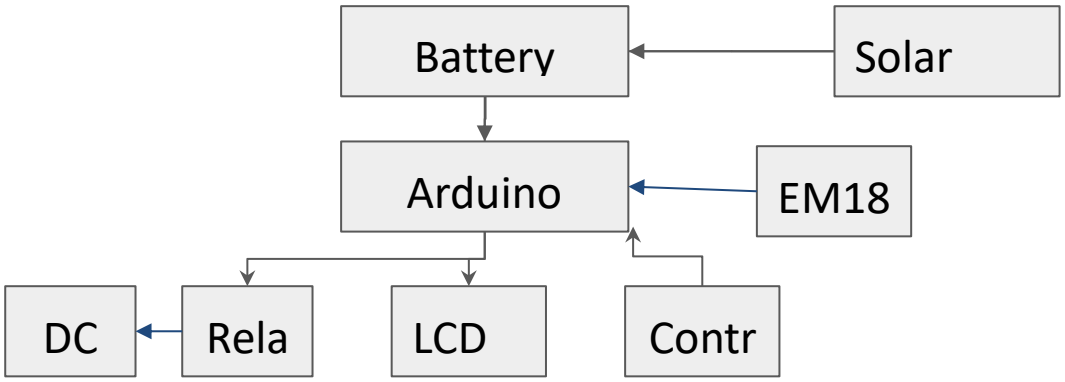

Fig..1Block Diagram

EXISTING SYSTEM

Traditional vending machines primarily use microcontrollers or processors for operation. They validate transactions through coin slots, which poses a security risk due to the possibility of counterfeit coin acceptance (Srihari & Sivakumar, 2020). Moreover, existing systems involve complex coding and require significant maintenance. The proposed vending machine overcomes these limitations by integrating RFID authentication, making transactions secure and seamless. Additionally, solar energy integration addresses power concerns, ensuring uninterrupted operation in locations with limited electricity access.

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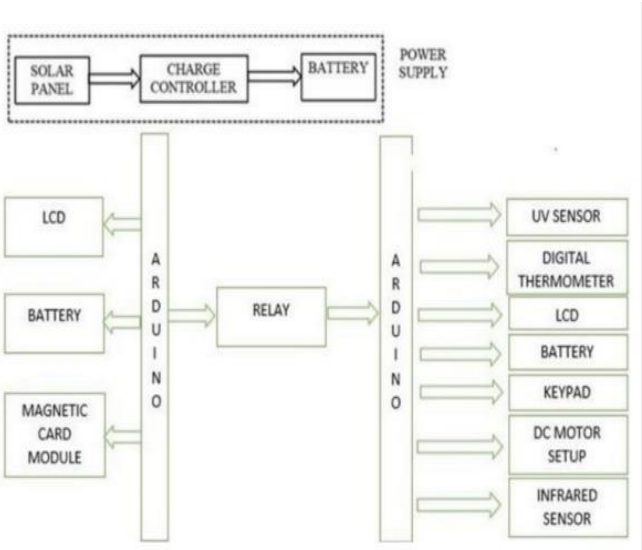

Fig.2 Exsting System

ARDUINO

The Arduino Uno is an 8-bit microcontroller board based on the ATMega328P processor. It features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, USB connectivity, and an ICSP header. The microcontroller processes user inputs and controls the motorized dispensing mechanism. A customized DSIBINO_V1 Arduino clone is used in this system, which operates on AC or DC 12V power supply and includes built-in debugging LEDs (Marques Ximenes et al., 2020). This implementation ensures cost-effectiveness and operational reliability.

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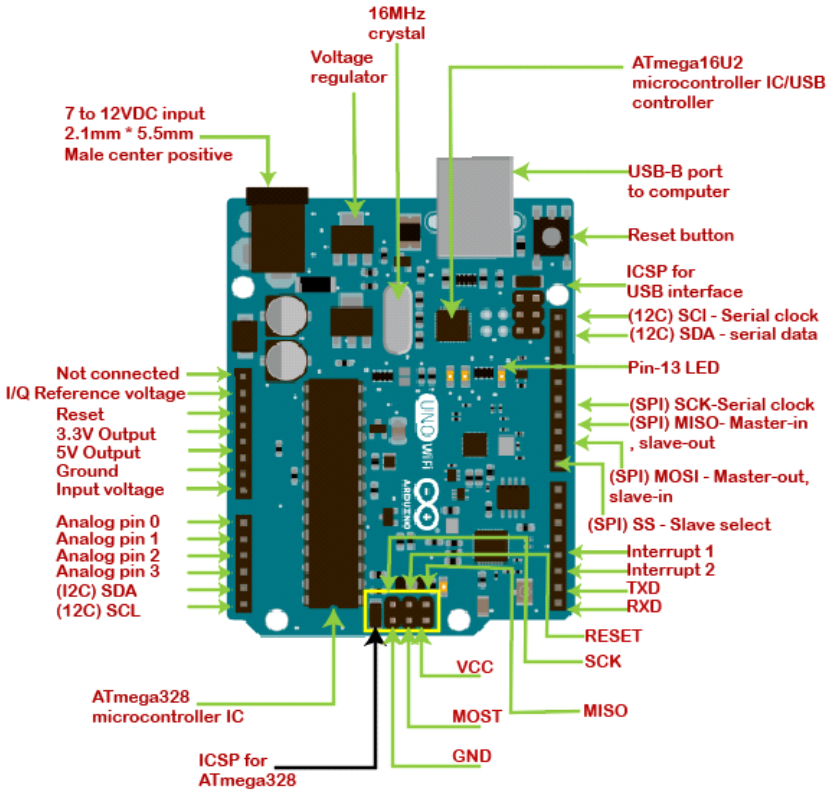

Fig.3 ARDUINO

Arduino Uno is a 8-digit microcontroller board dependent on the ATMega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple sources of info, a 16 MHz quartz gem, a USB association, a force jack, an ICSP (In Circuit Serial Programmer) header and a reset button. In this framework, Arduino microcontroller circuit fills in as an information processor that controls the engine associated with twisting spring. DSIBINO_V1 is the clone Arduino board. Which means it's all the features of Arduino is included with some special feature like

1. It can be operated from AC or DC 12v power supply.
2. It's come with 2 in-built led for various debugging and testing.
3. Price is lesser because USB programming replaced by FTDI232 PGM facility.

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Fig.4. Circuit Diagram

RFID READER

An RFID reader is used to authenticate users by scanning an RFID tag. The reader transmits radio waves to the tag, which responds with its unique identification data. The read range is influenced by various factors, including frequency, antenna gain, and tag placement (Villarejo et al., 2020). In this system, an MDRC522 RFID module is employed, interfaced with the Arduino through a level-shifting circuit to ensure compatibility. The RFID module allows seamless user authentication and transaction logging.

Fig.5 RFID Reader

FRAMEWORK DESIGN

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The vending machine is designed to dispense two types of products, such as first aid supplies and stationary items. Users can select their desired item by pressing a corresponding button. After selection, the RFID card is scanned, and the LCD displays the item's cost and availability. The microcontroller then activates the motor driver, dispensing the item while updating the inventory status. The remaining balance is displayed on the LCD screen (Naveenraj et al., 2020). The system utilizes an RFID-based authentication mechanism to ensure secure transactions and prevent unauthorized access.

ADVANTAGES

1. Ease of Use: The vending machine eliminates the need for human assistance, allowing users to access products independently.
2. Energy Efficiency: The integration of solar power reduces operational costs and enhances sustainability.
3. Secure Transactions: RFID-based authentication prevents unauthorized transactions and enhances security.
4. Time-Saving: Users can obtain necessary items without waiting in long queues.

CONCLUSION

The proposed RFID-based vending machine provides an efficient solution for dispensing first aid and stationary supplies in institutions and public areas. Users authenticate their transactions using RFID cards, and items are dispensed through an automated motorized system. The machine is designed to be portable, cost-effective, and energy-efficient, making it a viable alternative to traditional vending systems. By integrating solar power and RFID technology, this system ensures accessibility, security, and sustainability. Future advancements may include the incorporation of machine learning algorithms to predict demand and optimize inventory management (Mitrofanov et al., 2020).

AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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