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Dispensing Innovation: A Comprehensive Survey of Diverse Vending Machines

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Abstract - This survey report offers a thorough analysis of vending machines, looking at their development and range of uses. Vending machines have evolved greatly from simple snack dispensers to sophisticated systems catering to industries like electronics and healthcare. The integration of cutting-edge technologies like IoT, AI, and machine learning is examined in this study, with an emphasis on how these technologies affect user experience and operational effectiveness. In-depth discussion is given to methodologies like RFID and coin sensors, demonstrating how these technologies improve the security and operation of vending machines. The poll also looks at sustainability, covering eco-friendly options and the industry's part in reducing environmental effect. From a holistic standpoint, viable solutions are taken into consideration alongside challenges, such as security and regulatory constraints. This survey provides a comprehensive analysis of both existing and future trends in the vending machine sector, making it an invaluable tool for scholars, practitioners, and enthusiasts interested in the dynamic and ever-changing vending machine landscape.

Key Words: snack dispensers, sophisticated systems, cutting-edge, RFID, coin sensors.

1.INTRODUCTION

A vending machine is a machine that dispenses a variety of products to customers without the need for direct human intervention. These machines are commonly found in public places such as offices, schools, airports, train stations, and shopping malls, where they provide convenient access to a wide range of goods and services. Snacks, beverages, cigarettes, lottery tickets, personal hygiene items, electronics, and other items can be dispensed by vending machines. Users usually start a transaction by inserting coins, bills, or tokens into the machine, or by using more modern payment methods like credit cards, mobile payments, or QR codes. The machine will release the selected product once the payment has been processed. Vending machines are well-known for their ease of use and 24-hour availability, making them a popular option for on-the-go purchases.

Vending machines, once associated with the distribution of snacks and beverages, have undergone a transformation, now encompassing a wide range of products and services from a variety of industries. The purpose of this survey paper is to provide a comprehensive overview of the current state of vending machines, including their historical progression, applications, and integration of cutting-edge technologies. Vending machines have evolved from traditional coin-operated mechanisms to the implementation of advanced systems such as RFID and artificial intelligence[6]. They have become sophisticated hubs of technological innovation. Understanding the evolution and impact of these automated systems is critical as they continue to diversify, catering to sectors such as healthcare, electronics, and beyond. This introduction sets the stage for a detailed examination of the methodologies and technologies shaping the modern vending machine landscape, promising insights into their future.

2. LITRATURE STUDIES

In the existing system, Radio-Frequency Identification (RFID) technology has emerged as a pivotal component, revolutionizing the traditional landscape of vending machines. RFID is a wireless communication technology that employs electromagnetic fields to automatically identify and track tags attached to objects. Within vending machines, RFID technology is implemented to streamline transactions and enhance user experience. Users can interact with the machine by simply waving or placing an RFID-enabled card or device near the reader, facilitating a swift and contactless payment process[2]. This not only expedites the vending process but also contributes to a more convenient and hygienic transaction experience, aligning with the evolving expectations of modern consumers.

RFID technology strengthens the security of vending machines. The system can improve authentication processes and protect against unauthorized access by uniquely identifying each user via RFID cards or other RFID-enabled devices. This feature not only ensures secure transactions, but also helps to build a more robust and dependable vending infrastructure. The effectiveness and versatility of RFID technology in the context of vending machines stand out as a significant advancement in the literature survey, providing a glimpse into the transformative potential of integrating RFID into the vending ecosystem.

As previously stated, RFID technology plays a critical role in facilitating seamless and contactless transactions. Users can interact with the vending machine using RFID-enabled cards or devices, making the payment process more efficient and

user-friendly. This contactless payment option not only meets today's demand for easy transactions, but it also improves the overall user experience, fostering a more technologically advanced and accessible vending environment.

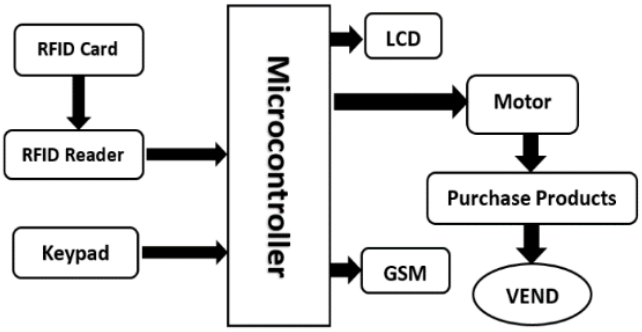

Fig. 1.1: Block diagram for RFID based SSB

The above figure 1.1[5] shows the mechanism flow of the vending machine that uses the RFID cards.

3. COMPONENTS USED IN EXISTING SYSTEM

i. Arduino UNO

The Arduino UNO is a microcontroller. The Arduino UNO is a microcontroller board based on the ATmega328 microchip. It has 14 digital I/O pins, 6 analog I/O pins, a USB port with a power jack, and a 16 MHZ crystal oscillator with an ICSP header and a reset button. The Arduino UNO is distinguished from all other boards by the absence of the FTDI USB serial driver chip. "UNO" is the name given to the upcoming Arduino 1.0 release, UNO meaning "one" in Italian. The UNO is the platform's most recent USB Arduino board. This Arduino UNO can be powered either by USB or by an external power supply. AC or DC power can be used as an external power source.[4]

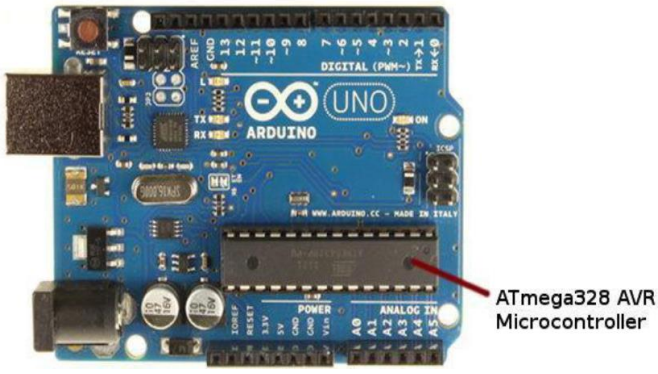

Fig. 2.1

ii. RFID CARD

Radio frequency identification (RFID) (fig 2.2) used the electromagnetic fields to transfer data, to find object attached to the tracking tag. The information is stored electronically in the tag. RFID has two types. The first one is active tag, that may operate hundred meters apart from the reader by using low power source and the other type is Passive tag. It collects energy from RFID by using radio waves. Automatic Identification and data capture method is one of the types of Radio frequency identification.[4]

Fig. 2.2

iii. GSM

GSM is an abbreviation for Global System for Mobile Communications. This digital cellular technology is used for mobile voice and data transmission. A customized Global System for Mobile Communication (GSM) module is developed for wireless radiation monitoring of Short Messaging Service (SMS). This module may send text SMS data to a host server after receiving serial data from radiation monitoring devices such as survey meters and area monitors. A GSM modern, also known as a GSM module, is a device that uses GSM mobile telephone technology to connect to a network wirelessly. Mobile phones and other devices that communicate with mobile telephone networks use GSM modems. Sims must register their device with the network. [7]

Fig. 2.3

4. DATA FLOW DIAGRAM

RFID VM solves all of the problems (including security) mentioned in the introduction. The RFID security system flow chart is shown in Figure 3.1. Following system and GSM module initialization, RFID UID provides input to the system. The proposed methodology's key parameters for providing security are the GSM module, UID, and four-digit password stored against the RFID UID of the consumer card. The system compares the information to the UID, and if that UID is stored against that specific RFID card, it prompts for the password. Consumer is authorized to vend after password validation. Following each successful vend, an additional

integrated SMS facility uses a GSM module to send an SMS to the respective consumer informing them of their current and post-transaction balance. So, if he hasn't used the product, he can report it to the company.[5]

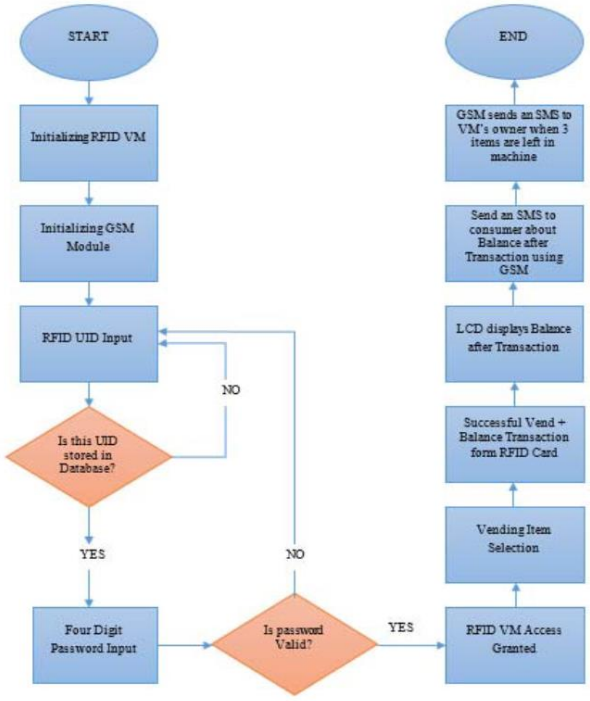

Fig. 3.1

5. PERFORMANCE OF THE MACHINE

Figure 4.1 depicts a graph illustrating the relationship between the type of vending item and percentage precision. Chocolates achieve a level of accuracy of 100 percent after 60 iterations.

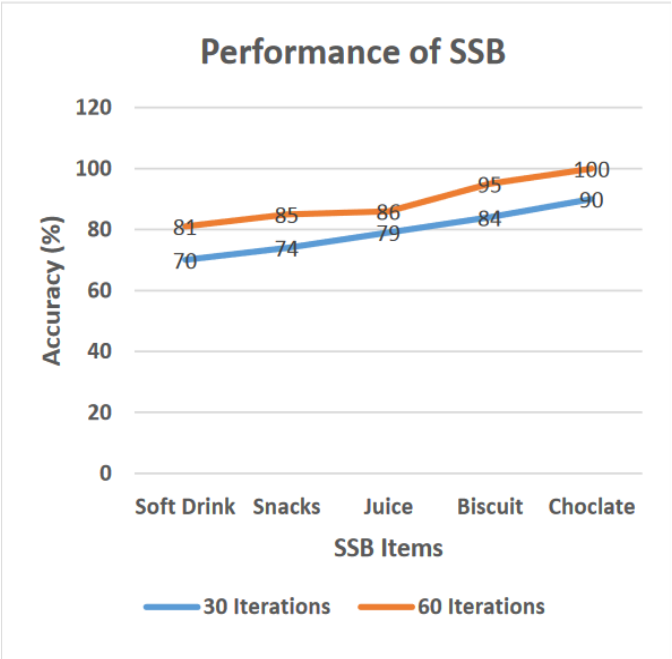

Fig. 4.1

6. LIMITATIONS OF EXISTING SYSTEM

The existing vending machine system, while incorporating RFID technology, faces notable limitations. For starters, relying on a limited number of RFID cards necessitates the use of dedicated personnel for authentication, which introduces scalability issues and potential delays. In high-traffic scenarios, this manual authentication process may result in inefficiencies [3]. Furthermore, a lack of integration between hardware and software components impedes seamless data processing and real-time monitoring within the system, negatively impacting both user experiences and operational efficiency[8]. Furthermore, the lack of a dedicated medium for stock calculation is a significant impediment to effective inventory management, risking inaccuracies and operational disruptions. These limitations, combined with the lack of a stock replenishment notification system, impede the system's ability to scale, optimize operational processes, and provide a dependable and responsive vending experience. Addressing these issues in future work is critical for progress.

7. FUTURE WORK

A compelling avenue for advancing vending machine technology in future research is the integration of QR scanners, a feature poised to improve user convenience and transaction security. Further research should concentrate on the seamless integration of both hardware and software components to simplify stock calculation processes. This entails not only developing and implementing sophisticated systems that use QR scanning technology to facilitate efficient and secure transactions, but also automating the monitoring and calculation of stock levels within vending machines. An integrated approach like this would not only improve operational efficiency but would also contribute to a more dynamic and responsive vending ecosystem. Investigating the practical implications, usability, and real-world impact of this integrated hardware-software solution is critical to ensuring its efficacy and viability in improving

8. CONCLUSIONS

In conclusion, this survey sheds light on the varied development and uses of vending machines, with a focus on the incorporation of cutting-edge technologies like RFID, IoT, machine learning, artificial intelligence, and coin sensors. Researchers and industry professionals will find this paper to be a useful resource as it addresses issues and highlights sustainability initiatives. The approaches that have been discussed highlight how technology plays a critical role in determining the current and future state of vending machines, spurring continuous innovation and enhancing their pervasiveness across industries.

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