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Design and Fabrication of Robotic Storage and Retrieval System for Footwears

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Abstract: *This paper aims to design and fabricate of robotic storage and retrieval system for footwear. This is a new concept of designing an ASRS system with the integration of Radio Frequency Identification(RFID). This review paper contains the system that has introduced many advantages in the paction storage, distribution, and customer services. The project has two different directions based on X-axis and Y-axis. ASRS proved its efficient work in world organizations and In this project, we have designed and built ted a prototype. In pilgrim places and in other places where people need to Store their footwear from place another project could have helped them without effort.*

Keywords: Robotic Storage, retrieval system, RFID; Footwear storage

I. INTRODUCTION

It is very difficult for the organization to handle the crowd at pilgrim places, for that we havecreated the Automated Storage and Retrieval System using Arduino and RFID sensors. When people come near the rack they will get a RFID card and a box to keep the footwear, the person will keep the footwear in the box and keep that in place andthen scan the RFID card over the scanner and done they can leave the place, whenever the person wants to retrieve the footwear he/she will again scan the RFID card which with them and he/ she will get their footwears back. This system is very reliable and very complicated to use.

Very less time and no manpower is needed to handle it.

This system is developed to bring some change in society by providing engineering solutions to the problem. [1]

Implementing an ASRS system in large pilgrim places for footwear storage can effectively address space constraints and reduce overall floor space requirements. The ASRS system can optimize storage space by utilizing vertical height, allowing for more efficient useof available space. This can help maximize the storage

capacity of the pilgrim places while minimizing the footprint of the storage area. The automation of storage and retrieval tasks minimizes human errors and increases efficiency, leading to improved overall operations. This can result in quicker and more accurate retrieval of footwear when needed, enhancing the overall experience for visitors However, it's important to note that ASRS systems are complex and require significant investment in mechanical equipment, automation control systems, and computer systems. Proper planning, risk assessment, and maintenance protocols should be in place to mitigate these risks and ensure the smooth operation of the ASRS system.[2]

II. PROBLEM STATEMENT

Most of the Pilgrim places in India provides a safe storage facility for devotees to keep their footwear while visiting the place. The organizations currently relies on many personnel to manage the storage of footwear on racks. However, during peak times with high crowds, this becomes a cumbersome process.

The robotic storage and retrieval system would consist of several key components and features to streamline the footwear management process. Firstly, there would be designated drop-off points where devotees can deposit their footwear upon entering the temple premises. When a devotee wishes to retrieve their footwear, they would approach a designated retrieval point and scan RFID card which would be already with them. Then system would then locate the corresponding pair shelf of footwear using the RFID card and retrieve it from the designated shelf or compartment.

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Fig. Footwears

III. PROPOSED SOLUTION

To address this challenge, a Robotic Storage and Retrieval System could be introduced. We come up with idea of Automation. This system would automate the process of footwear storage and retrieval, eliminating the need for personnel to manually handle the shoes. Utilizing technologies such as RFID and ASRS, the system could efficiently store and retrieve footwear. Additionally, incorporating a face detection system would help locate misplaced footwear, while an automatic box-coming system would provide ease of use for the visitors.

Implementing Robotic Storage and Retrieval System in the pilgrim places in India would bring numerous benefits. It would greatly reduce the manual effort required to handle and store footwear, saving time and resources for the organizations. The system would also improve the overall visitor experience by providing a fast and efficient way to deposit and retrieve footwear, even during peak hours with high crowds.

By implementing a Robotic Storage and Retrieval System, the organizations could significantly improve the quality, speed, and accuracy of the footwear storage process. This would result in greater convenience for the devotees and reduce the burden on the personnel managing the storage facility. Furthermore, a two-way system for storage and retrieval could help control crowds and manage the flow of visitors more effectively.

IV. DESIGN CONSIDERATIONS

Design is an important aspect in every project. This system is designed using 3D model software i.e. Solid-works to visualize the system and ensure that it meets the required specifications. The system is designed to be modular, allowing for easy assembly and maintenance.

In this system, we have used a cartesian coordinate configuration of robotics system. The cartesian plane is a two-dimensional coordinate plane formed by the intersection of two perpendicular lines. The horizontal line is known as X-axis, and the vertical line is known as Y-axis. The Robotic storage and retrieval system for footwear is design and fabricated using various components. A Robotic Storage and retrieval system for footwear assembly using RFID cards is a highly sophisticated system that is designed to streamline the storage and retrieval of shoes. With its precise motion control and RFID tracking capabilities, the system is capable of storing and retrieving shoes quickly and efficiently.

Fig. 3D CAD Model

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The objective of the design is to create a Robotic Storage and Retrieval System for footwear that can:

- Store and retrieve footwear efficiently and accurately.
- To minimize the space required for storage.
- Increase the speed of storage and retrieval process.
- To minimize a cost of storage.
- To reduce a manpower.

Fig. Back View of CAD Model

V. METHODOLOGY

The methodology proposed for the design of a robotic storage and retrieval system for footwears is by using the ASRS system and the RFID. It involves several phases, starting with defining the concept and idea, conducting research, designing software, and fabricating the chassis. The development process also includes the procurement of components, performing control system simulation, and integrating and testing all the components.[3]

The typical configuration of an ASRS system. It is helpful to understand how the system operates, particularly regarding the movement of pallets and the selection of the first pallet in the input queue using an FCFS method. The use of an accumulator conveyor to hold pallets for storage until they can be transported by the ASRS machine is also a useful feature of the system. It is interesting to note that the ASRS machine has three independent drivers for horizontal, vertical, and fork movement, which allows it to travel efficiently and quickly between storage locations. which ensures that the system is operating at optimal speed.it is also useful for understanding the different types of ASRS systems that may be used, including those with different types of cranes, loads, and racks. The inclusion of carousals and mobile racks is also helpful for understanding the different types of storage solutions that may be used in a warehouse or distribution center.[5]

RFID technology is used in a wide range of applications across various industries, including supply chain management, logistics, transportation, retail, healthcare, agriculture, and security, among others. It offers benefits such as improved efficiency, accuracy, and visibility in tracking and identifying objects or entities, without the need for physical contact or line-of-sight communication. However, it also raises concerns about privacy, security, and data protection, which need to be addressed in the implementation of RFID systems**.**

When an RFID tag comes near an RFID reader, the reader emits a radio signal that energizes the tag and enables it to transmit its distinct identifier back to the reader. The reader then collects the information from the tag, which can be utilized for a variety of applications like keeping track of inventory, identifying assets or products, overseeing livestock, or providing access control for individuals.

To store their footwear, the user first obtains an RFID card from the card dispenser and places their footwear inside a box. The box is then put on the robotic arm, which has six available locations that can be adjusted as per the requirement. The user then scans the RFID card, which contains coding for a specific location in the storage rack. The robotic arm then places the box in the corresponding coded location within the storage rack.

When it is time to retrieve their footwear, the user scans their RFID card again, which triggers the robotic arm to locate and retrieve the box from its designated location within the rack. The arm then places the box onto a window where the user can access their footwear.This process streamlines the storage and retrieval of footwear, making it more efficient

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and convenient for users. The use of RFID technology allows for easy tracking and identification of footwear, reducing the chances of loss or misplacement. Additionally, the robotic arm ensures that the footwear is stored and retrieved safely, minimizing the risk of damage or mishandling.

VI. COMPONENTS

- **Arduino Mega**: Arduino Mega 2560ATmega2560 MCU Rev3:-The Arduino Mega 2560 is a microcontroller board that is based on the ATmega2560 MCU Rev3. It features 54 digital input/output pins, 16 analog inputs, 4 UARTs, and a 16 MHz quartz crystal. The board also includes a USB connection, a power jack, an ICSP header, and a reset button. The ATmega2560 microcontroller has 256 KB flash memory, 8 KB SRAM, and 4 KB EEPROM. This board is commonly used for projects that require numerous inputs and outputs, such as robotics and automation systems and is popular among hobbyists, students, and professionals alike for its ease of use and versatility.[7]
- **Stepper Motor**: This particular stepper motor operates at a voltage of 3-6 V and has a torque of 4 Kg-cm. It also has a step angle of 1.8 degrees per step, making it suitable for precise control. The motor has a shaft diameter of 5mm and a shaft length of 10mm.[6]
- **Relay Module**: The 5V Dual Channel Relay Module is an electronic component that is designed to switch high-powered devices using a microcontroller. It has two channels that can control AC or DC devices up to 10A at 250VAC or 30VDC. The module operates on 5V DC power and uses optocouplers to protect the microcontroller from voltage spikes.
- **Motor Driver**: The L298N Motor Driver is a popular dual H-bridge motor driver module used to control DC motors and stepper motors. It can operate at a voltage range of 5-35V and provide up to 2A per channel (4A peak) to drive two DC motors. The module also has built-in protection against overcurrent, over-temperature, and under-voltage
- **Lead Screw**: The lead screw is a type of mechanical linear actuator that converts rotary motion into linear motion. This particular lead screw has a length of 500mm,Coupling(8mm), and Bearing(8mm).

VII. BENEFITS

- Reliable
- Specific storage/retrieving location of each material does not require sorting out
- Provides reduction in labor cost
- Minimum errors
- Better space utilization
- Products are made more secure without being damaged
- Increase in the morale of the workers
- Better inventory control

VIII. RESULT

We have fulfill our objectives by providing proposed solution.

Fig. Actual Model

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IX. FUTURE SCOPE

A robotic storage and retrieval system for footwear is commonly used in pilgrim places, forts, hospitals, and tourist spots to store footwear. The system utilizes advanced technologies such as Automated Storage and Retrieval System (ASRS) and Radio Frequency Identification (RFID) to enhance the quality, speed, and accuracy of the process.To further improve the system in the future, an advanced feature called face detection will be implemented. This feature will assist in locating missing RFID cards, thus helping individuals find their footwear box. Additionally, an automatic box-coming system will be introduced to simplify the usage process.Furthermore, a two-sided system will be fabricated, with one side dedicated to storage and the other to retrieval. This arrangement will help control crowds and reduce congestion. These enhancements will ensure that the system is efficient, accurate, and user-friendly, enhancing the overall experience for all users.

X. CONCLUSION

A robotic storage and retrieval system for footwear in pilgrim places using RFID technology offers several benefits such as a reduction in manpower, space required for storage, increase in the morale of the workers, accuracy, and convenience with a reduction in the handling time of footwear. The use of RFID technology allows for seamless tracking and identification of the exact footwear bin resulting in the elimination of the need for manual tracking. The system also offers a user-friendly interface that enables easy access to stored footwear. The implementation of this system can significantly improve the overall pilgrim places visiting experience for visitors, reducing waiting times and ensuring a smooth and hassle-free process. Overall, the use of RFID technology in an automatic storage and retrieval system for footwear in pilgrim places is a significant step towards modernizing traditional systems and improving the overall visitor experience.

REFERENCES

[1] Jainil Prajapati et al. “Automated Storage And Retrieval System For Educational Purpose”- A REVIEW. Vol.-4, pp. 63-67, Issue-3, Mar – 2017, International Journal of Advances in Electronics and Computer Science
[2] T Ajay et al. “Design optimization and development of an Automated Storage and Retrieval System” 2020 IOP Conf. Ser.: Mater. Sci. Eng. 912 032031
[3] Farah Hanani Mohammad Khasasi et al “Development of an Automated Storage and Retrieval System in Dynamic Industrial Environment” Universiti Kuala Lumpur British Malaysian Institute, Electrical and Electronic, pp 57-60,2015, ICBAPS
[4] ManabendraSaha et al “Automated Storage and Retrieval System” Volume 3, Issue 5, pp 513-515, May – 2018, International Journal of Innovative Science and Research Technology.
[5] Ray Kulwiec et.al. "Reliability of Automated Storage and Retrieval System" pp 343-362, 2009
[6] B.K. Patel et. Al. ” Mobile Robot for Automated Storage & Retrieval System SuyashZagade” Volume-11 Issue-2, July 2022, pp 165-171, International Journal of Recent Technology and Engineering.
[7] J. Zhang, et.al "BFVP: A probabilistic UHF RFID tag localization algorithm using Bayesian filter and a variable power RFID model", IEEE Trans. Ind. Electron., vol. 65, no. 10, pp. 8250-8259, October 2018.