Vertical Lift Module Using Arduino Nano for Warehouse Automation

Nishant Parmar
21bec085
Dept. of ECE,
Nirma University,
Ahmedabad, India

Meen Patel
21bec091
Dept. of ECE,
Nirma University,
Ahmedabad, India

Abstract— Vertical Lift Modules (VLMs) represent a significant advancement in warehouse automation, offering space-saving storage solutions that optimize picking speed and worker comfort. In this project, we present the design and implementation of a VLM system utilizing Arduino Nano microcontrollers. The system utilizes trays that vertically move to deliver items efficiently, thereby minimizing floor space usage. By adopting a "goods-to-person" approach, our VLM implementation aims to enhance warehouse efficiency and productivity.

Keywords: VLM, Vertical Lift Module, Arduino Nano, Warehouse Automation, Goods-to-Person System.

I. Introduction

A Vertical Lift Module (VLM) is a vertical automated storage and retrieval system (AS/RS). It comprises trays in the front and back and an inserter/extractor system that runs down the center. Trays are automatically retrieved and delivered to a pick window for picking. When complete the inserter/extractor will retrieve and store the tray in either the designated position or automatically assign a position based on using the least amount of space or fastest/slowest accessibility (all user-defined). Trays can be stored based on utilization, size, weight, or another custom parameter. Its modular design and construction make it easy to modify and change heights, and locations and pick windows anytime.

II-Working of VLM machine

- Initially the tray is on the floor where the user can access the tray
- VLM will take 2 inputs 1-floor number 2-Side
- Extractor will go to the floor chosen by the user and take the tray to the access point
- User completes his work
- The machine will wait for the user to give instructions to go back
- Then the extractor will go back to its place
- This complete 1-cycle, when user will again give input extractor will be on the floor where he last accessed the material

[Fig. VLM Machine]

III. System Components

A VLM module consists of a microcontroller, a keypad as an input, 7-segment display, motors, a few LEDs, registers, and a power supply.

A. Microcontroller

A Microcontroller plays a crucial role as the central processing unit or ”brain” of the system. Arduino Nano is used here for this purpose. The microcontroller interfaces with all the components, collects input, processes, and provides the output accordingly.

B. Keypad

We have interfaced the 4x4 matrix keypad with Arduino nano board in order to take inputs from the user. Users can select the floor number and rear-front options through the keypad.

C. Output

1. 7- segment display: it'll show the current floor number of the tray.
2. LEDs: 4 LEDS are used to notify about the directions up, down, front, and rear.

D. Power Supply

1. A 9V volt battery is utilized to power the system. This makes it low-cost.
2. Voltage Regulator, 7805 is used to bring down 9V from battery to 5V, to supply to the microcontroller.

E. Registers

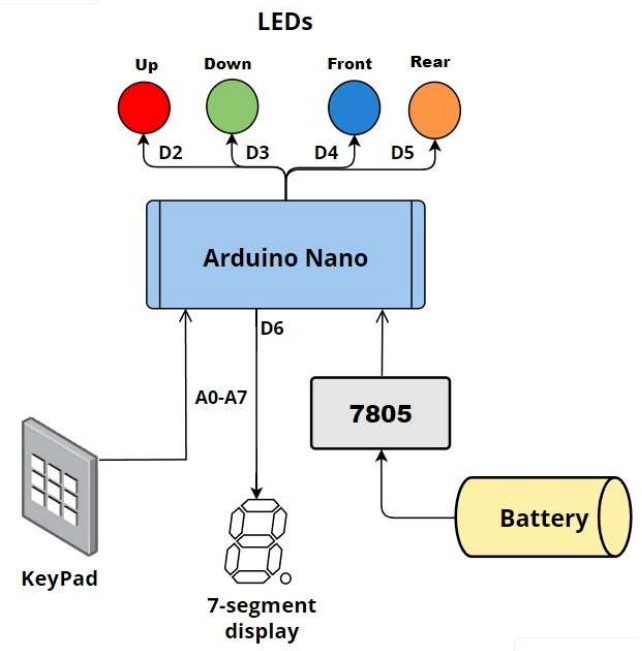
- 1K-ohm-8 register(7-segment pins)
- 1K-ohm-1 register(for LEDs)

IV. SOFTWARE

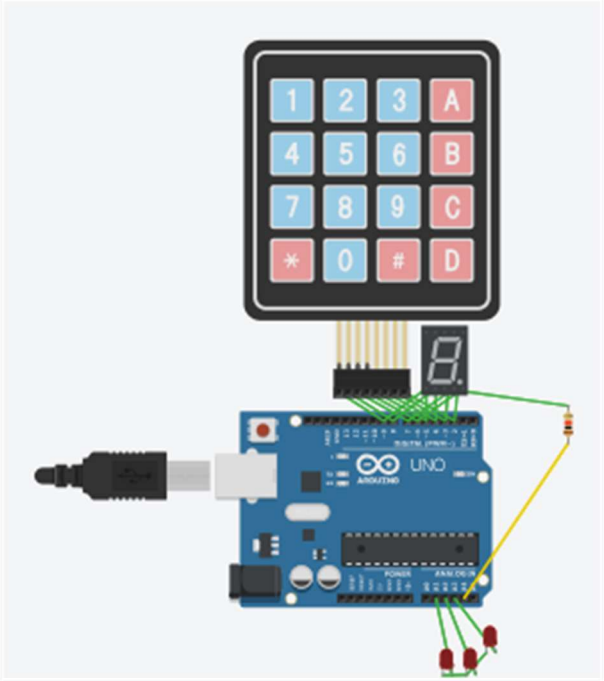
➢ **Arduino IDE**

The Arduino Integrated Development Environment (IDE) is a popular open-source software platform widely used for programming and developing applications for Arduino microcontroller boards.

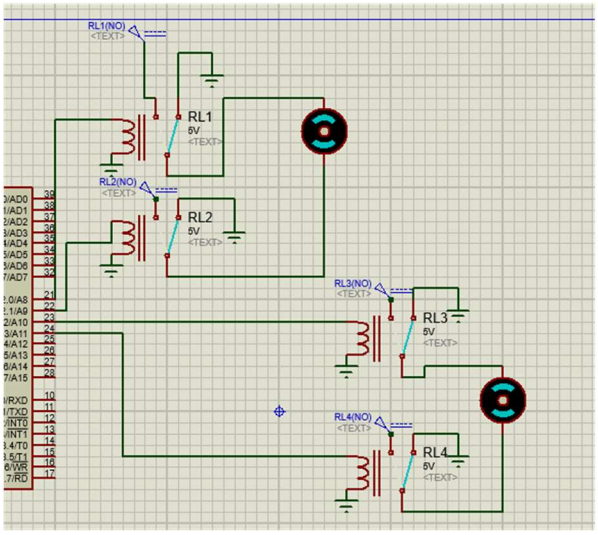
V. BLOCK LEVEL DIAGRAM



VI. CIRCUIT DIAGRAM & PIN CONNECTIONS

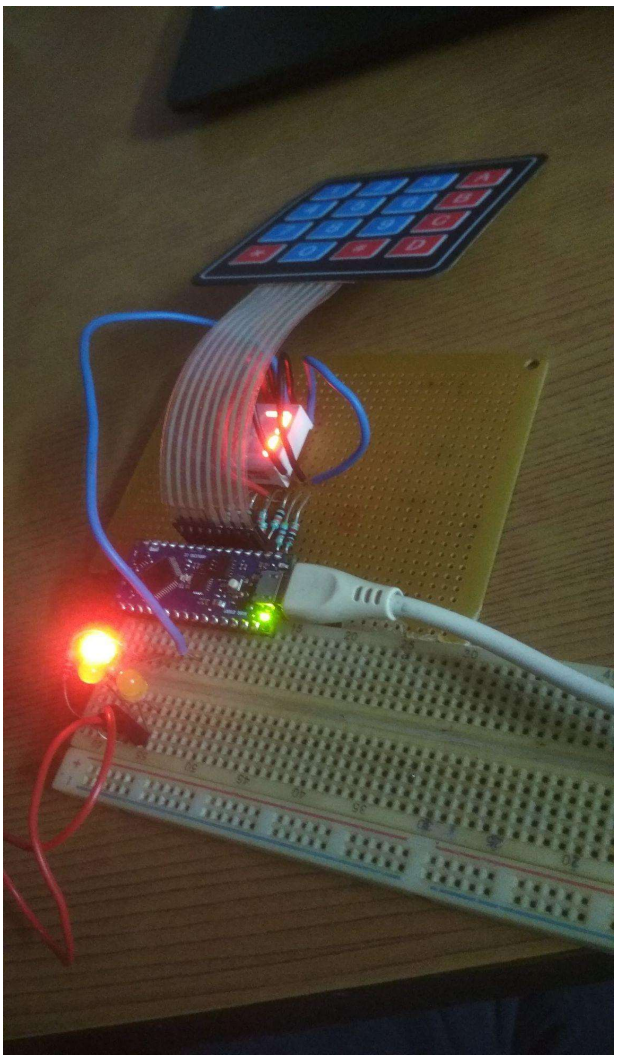


- Keypad and 7-segment are connected to Arduino by A0-A7 pins of the microcontroller
- The common cathode pin of the 7-segment is connected to D6 which acts as enable pin for 7-segment
- 4 LEDs showing a moment of the extractor are connected to D2-D5 of the microcontroller



[fig. Relay to microcontroller connections]

VII. Hardware Implimentation



VIII. Results

When user enters the desired floor and direction, the extractor goes to the floor chosen by the user from the base and brings the tray to the access point. User empties/fills the tray and once the user is done with his work, he gives a confirmation through "#" using the keypad. And then the extractor returns to its place. Throghout the process the location of the tray is ensured by the floor number which is indicated on the 7-segment as well as its direction from the LED's status.

IX. Applications

VLMs provide space, labor, and efficiency benefits to aid organizations in a wide range of applications, such as:

- Warehousing and Distribution Centers
- Manufacturing Facilities
- Retail and E-commerce Fulfillment Centers
- Automotive Industry
- Pharmaceutical and Healthcare Facilities
- Aerospace and Defense Sector
- Document and File Management

X. Conclusion

VLMs offer significant advantages in terms of time savings, labor efficiency, and overall warehouse productivity in terms of space. They streamline operations and enhance order fulfillment by automating storage and retrieval processes. It's important to consider factors like cost, space requirements for the machine itself, and potential integration challenges with existing warehouse management systems. Overall, for facilities with high-density storage requirements and a focus on efficient order fulfillment, VLMs can be a game-changer.

XI. References

[a]https://www.youtube.com/@midasmetconsprivatelimited4233/videos

[b] https://vidirsolutions.com/products/vlm