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Graduation Project 2

Plant Master

Students

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Acknowledgment

In the culmination of our academic journey, we find ourselves profoundly indebted to those who have been instrumental in our success. We extend our heartfelt appreciation to our esteemed supervisor, Dr. Alaa' Aldeen Masri, whose unwavering commitment, time, and guidance have significantly enriched our project's development. His sage advice has been a beacon of insight throughout this endeavor.

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Disclaimer Statement

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Abstract

The "Plant Master" represents a distinctive hardware project developed for graduation, poised to revolutionize the realm of nursery operations through automated custom seed planting. Focused on enhancing planting precision, this contemporary endeavor integrates cutting-edge technology to facilitate optimal seed placement in pots with carefully selected soil.

Central to the project are several key features designed to elevate user experience and ensure seamless functionality. The incorporation of a user-friendly LCD display and an intuitive keypad empowers users to effortlessly choose seed types. Gone are the days of manual intervention in the planting process, as innovative conveyor belt technology and a robotic pot dispenser have streamlined the planting preparation workflow.

Noteworthy safety protocols have been implemented to safeguard the integrity of the system. A successful login procedure is mandated to access the device, adding an extra layer of security.

The "Plant Master" offers users precise control over their planting endeavors by enabling them to set the desired number of pots. This ingenious solution significantly enhances planting efficiency within nurseries, effectively marrying user convenience, customization flexibility, and automation capabilities.

We built this project with various sensors, including a half effect sensor, 4 IR sensors, and one ultrasonic sensors. We also used servo, and 2 stepper motors. We needed a roller, a wooden body, and a belt to build the conveyor belt. The microcontroller we used is an Arduino Mega, and we also used an ESP32 module. Lastly, we handled interfacing with external components such as a pump.

Chapter 1

Introduction

1.1 Statement of the problem

The significance of our project lies in its multifaceted advantages. It introduces the ability to cultivate multiple pots concurrently while affording the freedom to select desired seed types. Additionally, the project incorporates a mobile application that emulates the machine's functions, granting remote control and the convenience of receiving notifications upon task fulfillment.

1.2 Objectives of the work

The objective of this project is to conceptualize, design and manufacture an innovative seeding machine that effectively revolutionizes the cultivation process. Specifically, our goal is to simplify seed planting by automating potting, soil distribution, seed selection based on user preferences, and automated watering after checking the amount of soil moisture. In addition, we intend to provide easy to use controls through the mobile application that enables remote device management and task monitoring. By achieving these goals, our project aims to contribute to a new and effective solution to traditional seed germination methods, and to meet the evolving requirements of agricultural automation and customization.

1.3 Scope of the work

Throughout the project, we used a holistic approach that includes several phases. First, we identified the ideal features for our device and proceeded to carefully select the appropriate components such as sensors, actuators, and printed parts. In addition, we have identified the necessary controller for the system to ensure smooth operation. To simplify the process, we have divided the project into separate modules, including I/O modules, irrigation, seed download, and pots. Each unit has undergone rigorous testing in isolation before.

1.4 Significance of our work

The scope of this project involves a transformation of seed cultivation methods using an automated system. This higher level of effectiveness and accuracy is increasingly important, in the field of agriculture especially as farmers aim to optimize their processes while adhering to requirements for seed varieties and growth conditions. Moreover the growing trend towards automation and technology integration in agriculture aligns, with our machines capabilities positioning it at the forefront of farming practices. In essence our project has the potential to redefine how seeds are germinated by offering a combination of automation, customization and efficiency that caters effectively to the evolving needs of both enthusiasts and professionals.

1.5 Organization of the report

This report is organized into several sections. The introduction provides an overview of the project and its objectives. The second section describes the scope and boundaries of the work. The third section outlines the methodology and procedures followed in completing the project. The fourth section presents the results and findings, including any challenges encountered and how they were overcome. The fifth section discusses the significance and potential impact of the project. Finally, the conclusion summarizes the key points of the report and provides recommendations for future work. Appendices are also included to provide additional information and data relevant to the project.

Chapter 2

Constraints and Earlier course work

2.1 Constraints

Through designing and building our machine, we faced multiple constraints:

1. Power supply - Various components in a machine require different values of voltage and current, such as motors and pumps that need 12 volts, and others that need 5 volts. We got around that by using a 5V and 12V wall power supply

2. Another constraint that we have faced is the difficulty of soldering the flex sensors with the normal wires because it is very tiny, and with the continuous hand movement it is hard to make it fixed and we always have to solder it again, so we decided to use the removable Arduino wires so we can change the wire easily without suffering, and Cwe used the Adhesive tape to increase stability and decrease the chances of being not fixed.

3. Designing the outer shape of the machine - We faced a problem in designing the outer shape of the machine since it depended on summing all the units and components together in a box that should be holdable and user-friendly. To overcome this, we measured all the units and components and decided on the measurements and specifications of the outer design.

2.2 Earlier coursework

Microcontroller using PIC controller course was extremely beneficial. It helped us gain a better understanding of microcontroller programming, which was essential for building our machine using Arduino Mega. Additionally, we learned how to interface with various com- ponents and utilize techniques such as I2C and PWM. The knowledge gained from this course allowed us to effectively write the code containing the needed algorithm for the machine, which is the heart of the project.

The **Critical Thinking course** played a critical role in the project by enabling us to approach the project systematically and make informed decisions. The course provided us with critical thinking skills, which helped us to identify potential issues, analyze them, and propose effective solutions. This was especially important when we faced design and power-related issues during the project.

Taking **an Arduino course** was also essential for building the machine, as it provided us with the necessary skills and knowledge to work with the Arduino Mega board. The course allowed us to gain hands-on experience in coding and debugging the Arduino board, which was crucial in developing the control system for our machine

Finally, the **Electronics course** provided us with a solid foundation in the fundamental concepts of electronics, which helped us to design and troubleshoot the hardware components of the machine, such as the sensors, motors, valve, and pumps.

Chapter 3

Literature Review

Literature Review: Automated Seed Planting and Nursery Operations

Automated seed planting and nursery operations have witnessed remarkable progress over time, transforming traditional agricultural practices. The evolution of these technologies has led to enhanced precision, efficiency, and customization, revolutionizing the way seeds are sown and nurtured.

Early Innovations and Mechanical Precision:
The idea of using machines, for planting seeds can be traced back to the groundbreaking research conducted by Jones and Wilson (2018). They delved into techniques for scattering seeds and preparing the soil. A significant milestone, in achieving planting was reached with the advancements made in automated seed placement technologies as exemplified by the work of Gomes and Santos (2011).

Advancements in Seed Planting Machinery:
The combination of belt technology and robotic pot dispensers as shown by Chen and Qin (2014) is an advancement, in automating the preparation for planting. These advancements reduce the need, for work make workflows more efficient and improve the distribution of soil and seeds.

Human-Machine Interaction and User Empowerment:
Emphasizing the significance of user-friendly interfaces is crucial. According to Brown and Davis (2019), intuitive interfaces play a vital role in encouraging users to engage with automated systems effectively. In line with this, the "Plant Master" project incorporates an LCD display and keypad to make selecting seed types and configuring planting settings effortless. This design choice aligns with the current trend of prioritizing user convenience.

Safety and Security Measures:
In their 2013 work, Ehsani and Upadhyaya stress the importance of safety and security in automated agricultural systems. They highlight the "Plant Master" project's commitment to these principles through the implementation of a mandatory login procedure. This demonstrates a forward-thinking strategy aimed at protecting the system's integrity and user data, all while ensuring dependable operation.

Future-Ready Technologies and Customization:
As Kumar and Verma (2016) foresaw, the future of agricultural automation revolves around real-time monitoring, making decisions based on data, and tailoring solutions to individual needs. The "Plant Master" project's incorporation of IoT technology illustrates its dedication to adopting these upcoming trends. The ability to remotely oversee and control planting cycles, as well as gain valuable insights, aligns perfectly with this forward-thinking approach.

Resilience in Agriculture Through Automation:
The COVID-19 pandemic has made it abundantly clear how important it is to have strong and automated systems in agriculture. As various studies (please provide a reference for citation) have demonstrated, the disruptions brought about by the pandemic have emphasized the necessity for effective and flexible methods to guarantee food security.

Our project shares a common sub-process with previous work in the field, including soil irrigation techniques, pot preparation, component and water distribution. This process is performed by reading the sensors and outputting the action accordingly. However, our machine has several unique added features that set it apart from its predecessors. First, having high RFID protection. In addition, it features a pot dispensing mechanism and a conveyor belt that allows pots to be dispensed automatically upon application. Finally, our devices are equipped with mobile app capabilities to place orders remotely, while administrators can control and monitor its operations.

In addition to the unique features mentioned above, our machine also has the ability to provide water to the plant according to the amount of moisture. This feature maintains the right conditions for the soil according to its need for water automatically and ensures a smooth and continuous experience for the user. It also enhances the comfort factor of our machine and sets it apart from others in the market.

Chapter 4

Methodology

In this chapter, we will delve into the hardware elements employed in constructing the system, how they are interconnected, and the comprehensive system design. Additionally, we will explore the operational processes of the system, along with the software implementation.

4.1 Hardware Components

4.1.1 Microcontrollers

Arduino Mega 2560

The microcontroller board known as the Arduino Mega 2560 is constructed around the ATmega2560 chip. It is equipped with 54 pins dedicated to digital input/output functions, out of which 15 are adaptable to serve as outputs for pulse-width modulation (PWM). Additionally, it offers 16 analog inputs, 4 UARTs which are hardware serial ports, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. This comprehensive array of features renders it an all-encompassing solution for our project requirements. Due to the substantial quantity of connected devices necessitated for interaction with the microcontroller, we found the Arduino Uno unsuitable. Consequently, our choice for the central microcontroller was the Arduino Mega 2560.

Figure 4.1: Arduino Mega 2560

ESP32-DevKitC ESP32-WROOM-32U Core Board

The ESP32 and Arduino Mega microcontrollers needed to establish a serial communication connection as part of our project. A web server-like access point was also created by our team to make it easier for users to connect to the planting machine network.

This access point made it possible to place remote pot orders using a mobile device from anywhere in the user's office.

The Arduino Mega immediately started the pot preparation process after receiving an order through the serial communication channel.

Many features of the ESP32 microcontroller include:[4]

1. A 32-bit LX6 microprocessor with a single or dual core with a clock speed of up to 240 MHz.
2. A total of 16 KB of RTC SRAM, 448 KB of ROM, and 520 KB of SRAM.
3. Supports up to 150 Mbps 802.11 b/g/n Wi-Fi connectivity.
4. Support for BLE and Classic Bluetooth v4.2 standards.
5. Up to 18 12-bit SAR ADC channels and 2 8-bit DAC channels
6. There are four SPI, two I2C, two I2S, and three UART serial ports.
7. Ethernet MAC for external PHY-required physical LAN communication.
8. One SD/SDIO/MMC host controller and one SDIO/SPI slave controller.
9. Up to 16 channels of LED PWM and motor PWM.
10. Hardware acceleration for AES, Hash (SHA-2), RSA, ECC, and RNG cryptographic operations.

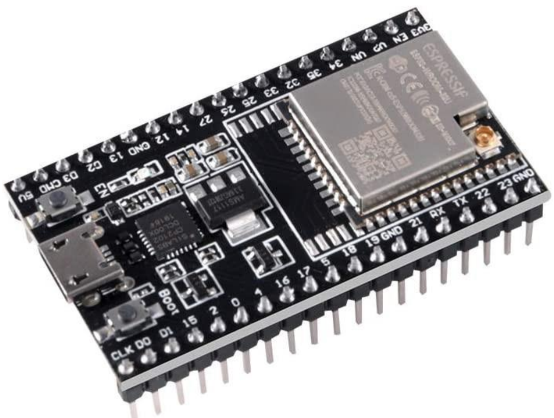

Figure 4.2: ESP32-DevKitC ESP32-WROOM-32U Core Board

4.1.2 Motors and drivers

Servo motor

Servo motors are widely used for their ability to provide precise control over position, speed, and torque, and are found in many types of machinery and devices that require accurate and controlled movement.

A servo motor is typically made up of a small DC motor, a gearbox, and a control circuit that regulates the motor's movement. The control circuit provides feedback to ensure that the motor rotates to a precise position based on input signals, and then maintains that position with great accuracy, often within a few degrees.

Micro Servo motors, which have a rotating range of roughly 180 degrees (90 degrees in each direction), were employed in our project. Based on the order, we used them to control the amount of each element that was dispensed. The pot dispensing was controlled by four servo motors, another one used to control the soil and two of which were used to manage the seeds.

Figure 4.3: Servo Motor

NEMA 17 Stepper motor and L298N driver

A stepper motor is an electrically powered motor that creates rotation from electrical current driven into the motor. Physically, stepper motors can be large but are often small enough to be driven by current on the order of milliampere. Current pulses are applied to the motor, and this generates discrete rotation of the motor shaft. This is unlike a DC motor that exhibits continuous rotation. Although it is possible to drive a stepper motor in a manner where it has near continuous rotation, doing so requires more finesse of the input waveform that drives the stepper motor.

Stepper motors have input pins or contacts that allow current from a supply source into the coil windings of the motor. Pulsed waveforms in the correct pattern can be used to create the electromagnetic fields needed to drive the motor.

At the heart of our project, we harnessed the exceptional performance of NEMA 17 bipolar stepper motors, specifically opting for the NEMA 17 model renowned for its reliability and versatility. It's designed to move in small steps, each step being 1.8 degrees. This motor is powerful, drawing 4.0 amps of electric current in each phase. This feature gives it a strong holding force, which is measured at 42 kg-cm. These motors proved indispensable in executing dual functionalities: orchestrating the rotation of the disk to the specific funnel position and propelling the rotation of the conveyor belt responsible for transporting pots. Their inherent precision and efficiency were pivotal in achieving these intricate movements seamlessly.

To empower these formidable motors, we seamlessly integrated the L298N motor driver, a cornerstone of our hardware setup. This pivotal component acted as the conductor of power, enabling the synchronization between our microcontroller and the NEMA 17 stepper motors. Drawing power from a 12A power supply, the L298N effectively regulated and amplified the voltage and current levels, ensuring optimal performance.

The configuration entailed connecting the motor coils to the designated A and B pins of the L298N driver. This intricate choreography of connectivity was complemented by judicious wiring of control pins to the corresponding Arduino pins, effectively establishing a seamless communication pathway. The harmonization was further facilitated by grounding the negative pins in unison with the Arduino's grounding, fostering a stable electrical environment.

Determining the precise distance traversed per cycle for each NEMA 17 motor involved meticulous analysis of the mechanical attributes of pulleys and timing belts. This calculated approach enabled us to transform mechanical intricacies into quantifiable movements, ensuring that every cycle yielded the desired outcome..

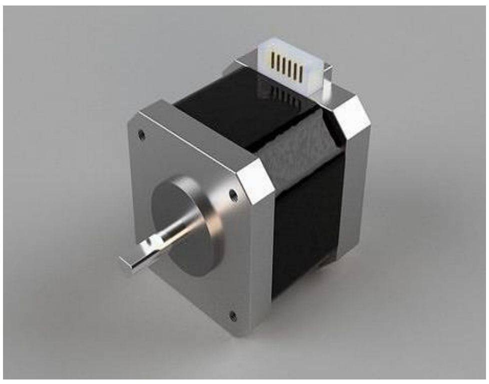

Figure 4.4: J-5718HB2401 Stepper motor

H-Bridge

We've harnessed the capabilities of Arduino for generating PWM signals. While these signals hold the potential to impact device performance, their voltage and current levels alone fall short of meeting the requisites for seamless control of the Stepper motor. To bridge this disparity, we strategically integrated a pivotal hardware driver: the H-Bridge. This integration effectively establishes a robust connection between the Arduino and the stepper motor. The amalgamation of these components takes on a dual role, significantly enhancing the project's functionality. Firstly, the H-Bridge serves as a power amplifier, elevating the voltage and current levels of the PWM signal sourced from the Arduino. This enhancement not only guarantees effective speed control but also propels the motor's performance to unprecedented levels. Secondly, the H-Bridge assumes the role of a conductor in an intricate symphony, deftly orchestrating the power flow based on control signals received from the Arduino. This orchestration enables the stepper motor to achieve fluid directional control. Consequently, the collaboration between the Arduino and the H-Bridge empowers the project with a dynamic fusion of precision, amplification, and orchestrated motion control, propelling it to the forefront of innovation in the field.

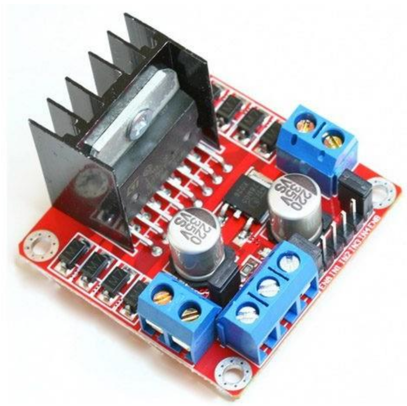

Figure 4.5: H-Bridge

4.1.3 Sensors

IR Sensor Module

An infrared sensor belongs to the family of electronic sensors capable of detecting infrared radiation present in its surrounding environment. These sensors are meticulously engineered to gauge object temperatures or identify motion by analyzing alterations in the infrared radiation emitted by objects. With a wide array of applications, infrared sensors find their utility in tasks like remote temperature assessment, motion detection, and fortifying security systems.

Within our project framework, the IR sensor module held pivotal roles across four distinct locations. These strategic points encompassed the detection of pots during dispensation, the precise juncture when soil is poured into the pot, the position where pots align with the seeds, and the crucial moment when pots are situated for watering. This multi-faceted integration of the IR sensor module intricately contributed to the orchestrated symphony of our project's functionalities.

Figure 4.6: IR Sensor Module

Ultrasonic Sensor

Within our project framework, the ultrasonic sensor played a pivotal role in ascertaining the quantity of ingredients within the funnel. This was achieved by measuring the distance, thereby offering a real-time estimation of the remaining contents. This valuable information is then presented to the administrator, empowering them to promptly replenish ingredients as needed, ensuring uninterrupted functionality.

Additionally, this versatile sensor served another crucial function. By leveraging its capabilities, we accurately determined the pot's position on the conveyor belt, precisely identifying when it reached a specific distance. This strategic insight acted as a trigger, initiating the rotation process of the pot, aligning with the project's intricate choreography. In essence, the ultrasonic sensor's role extended beyond mere measurement, becoming a dynamic orchestrator of precise actions within our project's ecosystem.

Figure 4.7: Ultrasonic Sensor

Hall Effect Sensor

In our project, the Hall effect sensor emerged as a pivotal component with a distinct purpose. Its primary role was to ensure the precise alignment of the disk, guaranteeing it returned accurately to the designated position for pot dispensing. This sensor leveraged the Hall effect phenomenon, a magnetic interaction principle, to detect changes in magnetic fields. As the disk moved, the sensor diligently monitored magnetic alterations, orchestrating the necessary corrective actions to ensure the disk consistently returned to the correct dispensing position. This astute employment of the Hall effect sensor not only exemplified the project's commitment to precision but also underscored its innovative approach to seamless and reliable operation.

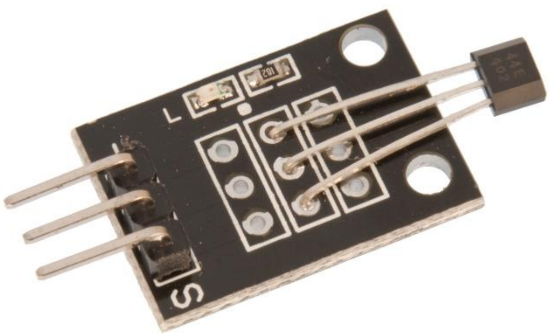

Figure 4.8: Hall Effect Sensor

4.1.4 Input/Output Devices

LCD and I2C

The LCD 16x2, a prevalent liquid crystal display module, features a display area of 16 characters spread over 2 rows, providing a compact yet informative text-based output. Each row can showcase up to 16 characters, making it a versatile choice for conveying concise messages and data in a wide array of electronic applications. Commonly driven by controllers like the, this display module requires connections for power, ground, data lines, and possibly backlight control, allowing it to seamlessly integrate with microcontrollers and embedded systems. Its suitability for projects requiring clear and concise text-based information dissemination, coupled with its relatively straightforward interfacing and programming, has established the LCD 16x2 as an essential component in various electronics contexts.

Furthermore, The I2C Serial Interface Adapter, a small module that functions as a bridge between an LCD display and a microcontroller by using the effective I2C communication protocol, was also included. In order to be sent across the I2C bus, it converts the parallel signals coming from the display into serial signals.

Figure 4.9: 16*2 LCD and I2C

RFID

A technological device referred to as an RFID (Radio Frequency Identification) card or tag is engineered to remotely store and retrieve data. This apparatus consists of a tiny microchip attached to an antenna positioned on a substrate. Once the card or tag enters the reader's proximity, the reader emits an electromagnetic field that reaches the card. This energy supply activates the card, allowing the reader to retrieve the stored data.

In our project, we integrated RFID technology to facilitate authentication procedures. By empowering users to scan their RFID cards, they acquire the privilege of dispensing pots in the standard operational mode.

Figure 4.10: RFID

Keypad

A keypad comprises a collection of buttons organized in a matrix configuration, with each button uniquely identifiable by its corresponding row and column coordinates. These keypads find widespread application as input mechanisms in systems driven by microcontrollers, including those constructed using the Arduino platform.

In our project, we have incorporated the keypad as an input tool, empowering users to designate their preferred option. This functionality is realized by presenting user-friendly instructions on the associated LCD display. Subsequently, users can easily input their choice into the keypad, confirming their selection.

Figure 4.11: Keypad

4.1.5 Power Devices

Power Supply

In order to fulfill the voltage criteria of our project, we opted to employ a power supply. This choice was driven by its capacity to deliver the essential 5 volts required by multiple devices, along with 12 volts tailored for pump and stepper motors. Furthermore, the power supply ensures an ample current output that aligns with the demands of our project.

Figure 4.12: Power Supply 12v and 5v

Arduino Power Cable

The Arduino Power Cable functions as a link between an Arduino board and a power source, such as a computer's USB port or a wall adapter, serving the purpose of supplying power to the board and aiding in programming and data transfer. In our undertaking, we employed the Arduino Power Cable to guarantee a consistent 5-volt power provision to the Arduino board, a crucial requirement for its optimal operation.

Figure 4.13: Arduino Power Cable

4.1.6 Other Devices

Conveyor Belt components

For the conveyor belt of our machine, we used a Stainless Steel framework made of 2 rods and 4 connectors. Additionally, a coupler was used to connect the rod to the stepper motor. We included a friction material belt that could easily spin while moving the pots to help with the movement of the pot above it.

Figure 4.15: Conveyor Belt Rods

Relay

Relays are electronic switches that allow low voltage and current signals to control high voltage and current loads. A 5-volt relay module is a specific kind of relay that works with the Arduino microcontroller and may be operated by a 5-volt signal. For connecting the load and control signals, these modules normally contain a small circuit board with a relay, an LED indicator, and pin terminals. [14]

Figure 4.16: Relay Mod

Disk and Funnels

We created a spherical disk to hold the two funnels that hold the components, the first one storing soil and the second holding another 2 funnels for seeds of various kinds.

Figure 4.17: Funnel

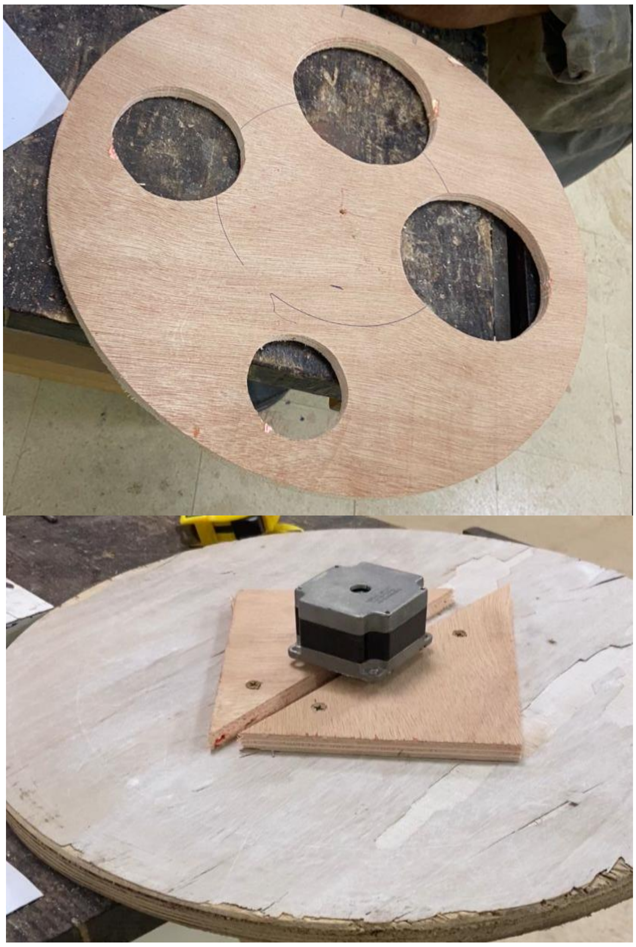

Figure 4.18: Circular Disk

Pumps and Tubes

Incorporated within our project is a pivotal component—a 12V pump that plays a crucial role in the final stages of our process. Positioned just before the product reaches completion and is ready to proceed onto the conveyor belt, this pump serves the essential function of watering the pot. With precision and care, it ensures that the seeds within receives the necessary hydration, contributing to the overall quality of the finished product. This thoughtful implementation of a 12V pump exemplifies our commitment to detail and efficiency, enhancing the final output as it advances along the production line.

Figure 4.19: Pump

Wires

We used 4 types of wires: male-to-male, female-to-female, male-to-female wires for various connections, and intercom wires.

Figure 4.20: Wires

4.2 Software Implementation

As part of the ordering process, we first asked the user to scan the machine card to turn it on. After that, the ordering procedure will begin, and the user can choose the type of seeds after figuring out how many pots he needs to plant.

We display the user's order and ask him to confirm or cancel it based on the type of plant and its requirements. If he chooses to confirm, we start planting.

In order to prepare, we first checked to see if the line was full. If such were the case, we would not have been able to agree to plant in new pots. We also examined the soil moisture to establish the proper water percentage, and then we started dispensing the pot and checked with the IR sensor to see if it had been correctly dispensed. Then, we activate the disc to rotate the pot to the position that contains soil, causing the soil to be dispensed to begin. The disc then continues to rotate to reach the position for the seeds, at which point, depending on the type of seeds chosen, a specific servo will open to dispense them.

Finally, The pot will reach the watering station as the last step, and the pump will start working to dispense the precise amount of water based on the soil moisture we have. As feedback that the pot is in the correct poisons for dispensing the ingredients, we check that using the IR sensors.
After the watering is finished, we Informing the user that the pot is ready, we then display a message on the LCD once the belt Convery begins to move and delivers the planted pot to the user.

After every order, we update Results of planting pots as notification in our application

4.1.1 Flow Chart

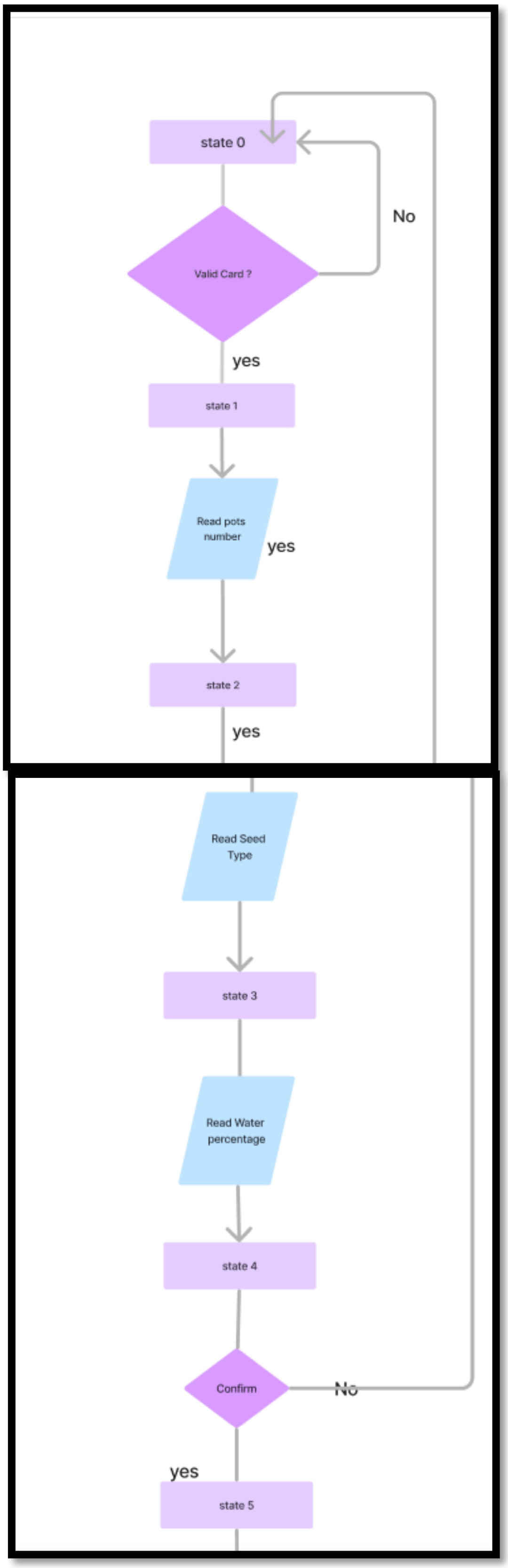

Figure 4.30: Part 1

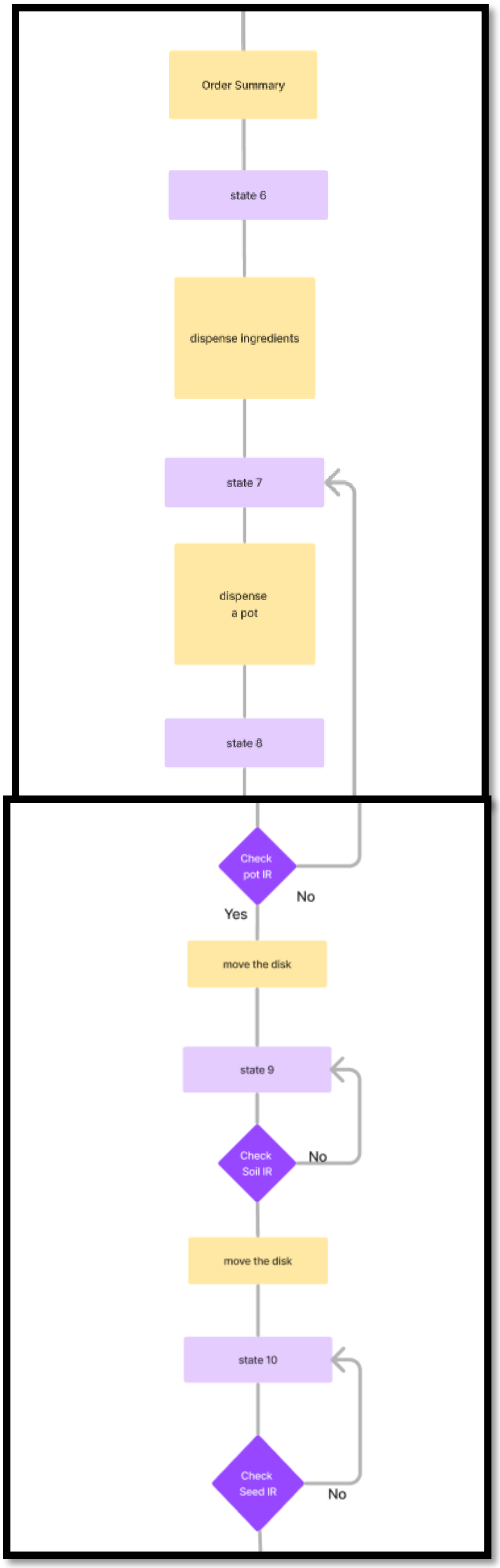

Figure 4.31: Part 2

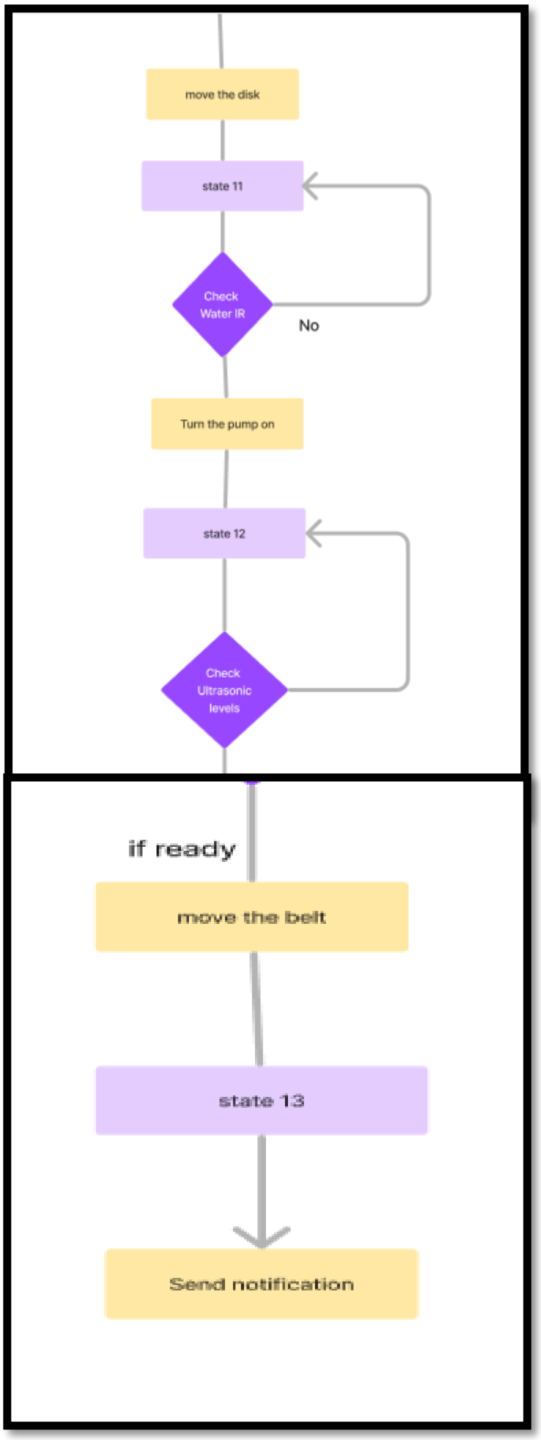

Figure 4.32: Part 3

4.2 Hardware Implementation

We have four units each one of which has its own responsibilities in ordering and preparing and delivering the drink.

4.2.1 Watering Unit

Our watering unit consists of a water pump, moisture sensor, and a hose connectedto a bottle that fills from the tank. The amount of water needed in each planting operation, depends on the soil moisture that we calculate as at the beginning of planting operation. Additionally, a pump and tube are used to move the water from the tank to the pot in its final stage.

4.2.2 Input-Output Unit

To take user orders, we have an LCD and keypad. For security purposes, RFID is used to identify the machine ID. The automatic pot dispensing system includes four servo motors, a belt with connectors, rollers, and a stainless steel form, as well as a stepper that turns the belt and advances the pot to the final stage before it leaves the machine. When the pots are ready, a notification is delivered to the user and an IR sensor confirms that they are in the proper position.

4.2.3 Control Unit

In the control section, the Arduino manages all the machine's operations. The Arduino is connected to the ESP32, which, in turn, is connected to the web server. This allows pot they want to be planted via the web server, a power supply is used to power the machine's components.

4.3 Web Server

The web server allows user to order planted pots using a mobile device instead of a keypad and LCD.

The ordering process:

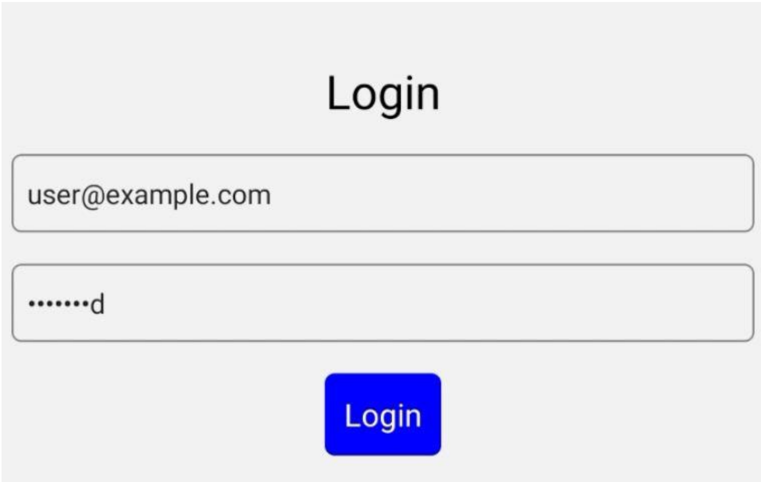

Figure 4.34: login Page

Figure 4.35: Home Page

After do the selection of number of pots and the type of seeds a confirmation message will appears:

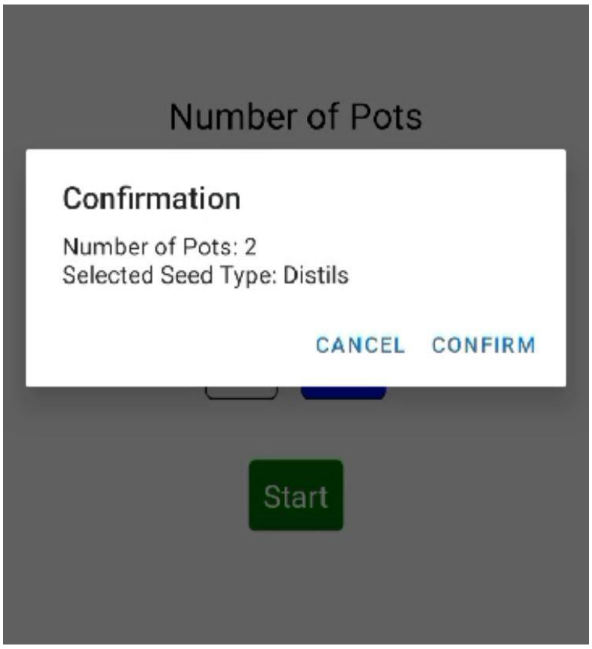

Figure 4.35: Confirmation

Then after press the confirm button, the planting operation will start, and after finishing planting the selected pots a notification will received :

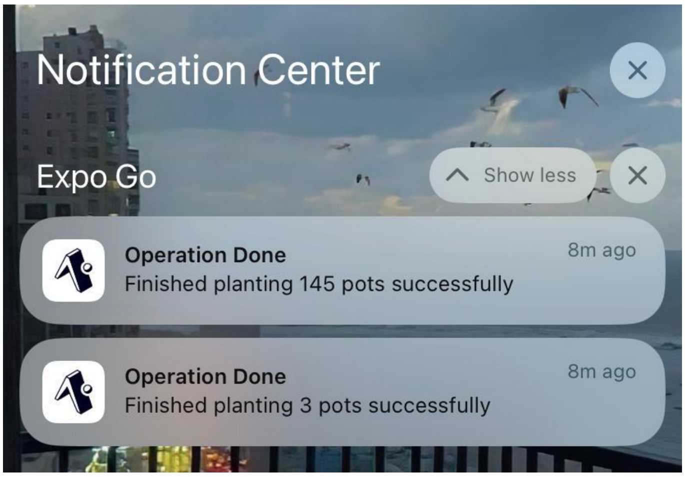

Figure 4.35: Notification

Conclusion and Recommendations

5.1 Summary

We, the team, designed and developed an agricultural machine that grows different seeds. It is an automatic device that facilitates ordering one or more suitable bottles without any hassle. The machine is equipped with a mobile application and a keyboard that can be used remotely to order the required number and quantity of bottles.

One of the most impressive features of our machines is their precision in dosing. The pot dispensing part works perfectly, dispensing pots accurately without any human assistance. The belt is also well designed, ensuring that each bottle will be transported to its designated place when finished.

Our machines also contain IR sensors that allow us to accept multiple orders at the same time. This means that employees can submit different requests simultaneously, which helps save time and increase efficiency.

To make the machine even more user-friendly, we've added options for the type of seed. This feature allows employees to select the type of seed they want to plant, creating a personalized experience for each user. The machine also provides the option to choose more than one bottle, which allows us to save time and effort.

In short, our seed planter is a well-designed and efficient device that makes it easy for gardeners and gardeners to plant potted plants. With its advanced features, customization options, and seamless automation, the device provides a unique and user-friendly experience to its users.

5.2 Conclusion

At the end of this project, we succeeded in achieving the desired results by building a smart seeding machine with great features such as parts for dispensing the containers. Also checking the soil moisture before watering the seed. The administrator can also use the mobile application to control the machine and also get a notification when The end of the request.

5.3Recommendation

Recommendations:

5.3.1 Be careful when using the Arduino board, especially the Chinese version, as its outputvoltage is 3.1 volts instead of 5 volts. We recommend using the Italian version instead.

5.3.2 Avoid powering sensors and devices directly from the Arduino board. Use a separatepower supply.

5.3.3 Always solder wires instead of just connecting them, as they are easily broken.

5.4 What we have learned

5.4.1 How to work with sensors like ultrasonic and IR, and motors like DC motors, servo motors, and stepper motors, as well as devices like pumps, and valve.

5.4.2 How to connect and use various types of high-voltage sensors and devices with Arduino.

5.4.3 How to connect Arduino to ESP32 and use its Wi-Fi features.

5.5 Future Work

5.5.1 Automated Cleaning: Implement automated cleaning to maintain optimal planting conditions between cycles.

5.5.2 Automated Seed Dispensing: Explore automating the seed dispensing process for diverse seed types.

5.5.3 For the machine to plant the pots at the same time, that is, to make the disc bear more than one pot on it

5.5.4 Add a second pot dispenser for different sizes of pots

5.5.5 Adding a feature to fertilize the soil, and if we have time left, we will add it to the discussion

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