Classifyo

Contents

1 Abstract

With the development of the world and the existence of huge number of products we have huge supermarkets. As if you enter one of these supermarkets you will find everything you need, anything in every sense of the word, and you find section for every category with products arranged in their assigned shelves, and usually the one who arranges these shelves is a human element and in deed this process is expensive and tiring.

So we need to develop a machine or a robot that takes this duty or process from humans' shoulders by arranging products in an easy, practical and cheap way.

The most important aspect of this prototype is that it works without any human intervention while the machine is moving in a precise motion to achieve a full coverage.

The main goal of the project is to use it in any supermarket, whatever it is size, regardless of the obstacles and goals that lie in this supermarket

The idea is based around a machine that has a connected motor and a sensor that reads the barcode on the product and decides the next movement

2 Acknowledgment

We, Amjad Dardouk, Anas Salem and Mohammad Damen would like to show our gratitude to everyone helped us accomplishing this project, mentioning our dear supervisors Dr. Haya Samaneh and Dr. Osaid Abdulfattah who directed us through the phases of creating this project and provided us with all the necessary information and support. We don't forget our precious friends and families who assisted us morally and helped us in solving some challenges who without their support we couldn't finish this project. Furthermore, we are very thankful and fortunate enough to get encouragement and support from all the teaching staff of Computer Engineering and Mechanical Engineering Departments.

3 Introduction

3.1 Overview

Today's world tends to replace humans with robots and automation systems And giving it the main role in daily life. From industry to household help, even selling is now automated. The purpose of this project is to develop a robot that can help Humans in ordering and arranging supermarkets and making shopping easier. This robot can be controlled by a micro-controller.

3.2 Problem

The main problem is that the size of supermarkets is increasing rapidly, which required more effort in term of ordering and arranging. The arrangement process often takes a lot of time and effort and here comes the benefit of our project.

The supermarket is divided into corners and sections that are difficult for a human being to memorize and remember the products in each section.

3.3 Objectives

The main goal is:

- 1. Make a robot that reaches all the shelves.
- 2. Reads the barcode from all products.
- 3. Accommodating various weights and being able to carry them.

3.4 Scope

This robot can be used in any supermarket or storehouse in accurately arranging the items, and since this operates on its own without the help of humans, this eases and optimizes the process.

3.5 Report Organization

First in chapter five, we will talk about other similar projects that were done by other people. In chapter six, we will talk about the hardware components that were used to build the robot, then we will talk about the mechanical parts, then we will discuss the algorithm we wrote to read input signal and manage the motor using output signal. In chapter seven, we will talk about the benefits that we earned from working on this project. In the last chapter, we will list some ideas and features that can be added in the future.

4 Earlier Work

Some courses were needed to make the project alive such as:

- 1. Arduino-C course to learn how to program the Arduino micro-controller, reading from sensors and control the output ports.
- 2. Computer Engineering Department hardware courses that helped us to know how to deal with hardware components and micro controllers.

5 Literature Review

In recent years, robots have been used in many systems and are doing tasks instead of humans since robots have become more accurate and tireless.
Our robot is not unique in its speciality, but has some additional and useful features in a specific area that we will explain in this chapter. We have seen a lot of smart classifying machine projects from different students in different universities. They are not smart enough to achieve their intended goal.

6 Methodology

6.1 Hardware:

6.1.1 Arduino Mega Chip:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino chips are designed to give the ability to users to read inputs from sensors, buttons for instance, so that the user can do some processing on this input signal and turn it into an output to perform an action such as lighting a LED, rotating a motor or even sending instructions or messages to another chips or devices[1].

The Arduino Mega 2560 is one of Arduino Chips/Micro controllers. It has a large number of digital IOs, 54 digital IO pins (15 of them can

Figure 1: Figure 6.1: Arduino

be used as PWM), with 16 analog inputs, 4 UARTs, It also has a 16 MHz crystal oscillator, a USB connection. It contains everything needed to build any project with the micro controller. It's applications are countless, and what's great is you just need to connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery and you're ready to start writing the code.

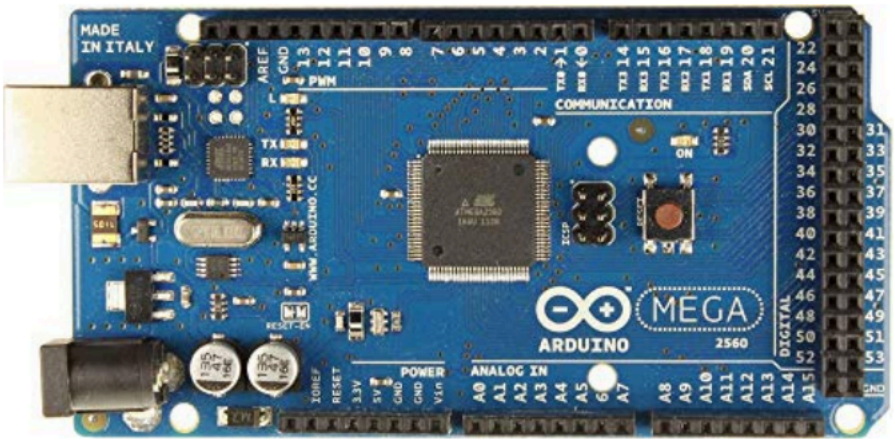

Figure 2: Figure 6.2: Arduino mega chipe

Why Arduino?

Because it's easy to use and it's compatible with the sensors and motors that the robot consists of.

Why mega?

Because number of bins in this chip is sufficient with our robot needs while UNO's pins are not.

6.1.2 DC motor:

A DC motor one of the motors that runs using electrical power. This type of motors converts the electric power (electric current passes through the motor) to mechanical power which results from the magnetic field resulted from the passing current, it works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position (Faraday's law)[2].

Figure 3: Figure 6.3: DC motor

Why DC motor ?

Because we only need to move the belt constantly and it's more powerful than the stepper.

6.1.3 DC Motor Driver

The DC motor drive is a type of power modulator that mediates between the DC motor and its controller. It amplifies the low current and converts it into a high current which is passed to the motor. Rolling Belt is an example of DC motor drives application[3].

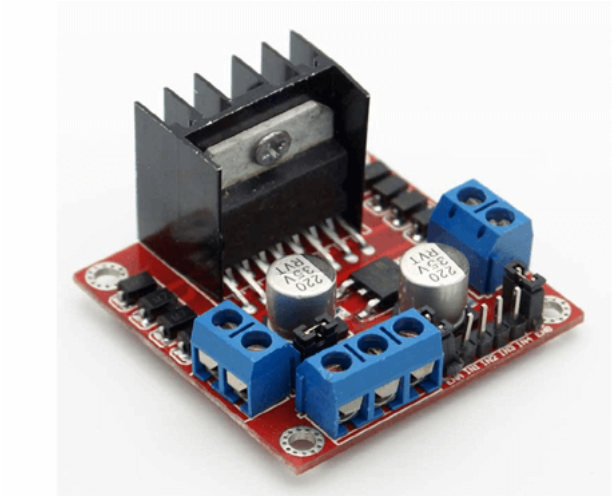

Figure 4: Figure 6.4 : DC Motor Driver

Why use DC motor driver?

To control the direction for the motor, where if the barcode wasn't read successfully the belt will rotate in the opposite direction to discard the item.

Driver uses PWM to manage the speed and to manage the direction it gives negative or positive power to the motor depending on its inputs.

6.1.4 Stepper Motor:

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time.

With a computer controlled stepping we were able to position the elevator in the correct shelf position in both axes X and Y.

Stepper motors come in many different sizes and styles and electrical characteristics. The one we used is strong and capable of lifting the elevator and good weights[4].

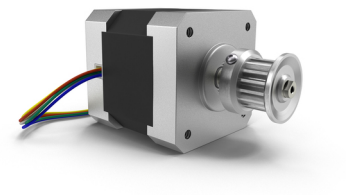

Figure 5: Figure 6.5 : Stepper Motor

6.1.5 Stepper Motor Driver :

A Stepper Motor Driver is a circuit or device that provides the necessary current and voltage to a Stepper Motor so that it performs smoothly[5].

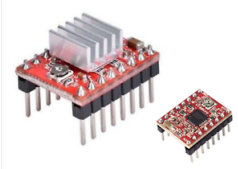

Figure 6: Figure 6.6 : Stepper Motor Driver

6.1.6 Servo Motor:

A servomotor (or servo motor) is a simple electric motor, controlled with the help of servomechanism.

We used the servo motor to push the item into the shelf once the elevator and the shelf are aligned[6].

Figure 7: Figure 6.7 : Servo Motor

6.2 Software :

6.2.1 Arduino IDE:

Arduino IDE is the official editor of Arduino Chips used to write C++ code that controls Arduino chips inputs and outputs to manage the robot movement depending on the input from the sensors that read the environment which the robot work in.

Choosing this IDE is a result of choosing Arduino as the robot microprocessor since it's the official IDE

6.2.2 Arduino Libraries:

Libraries are c/cpp files, provide an abstraction for Arduino Chip users. they also provide extra functions which give the ability to drive and read inputs from sensors and control a LED and more.

6.3 Design

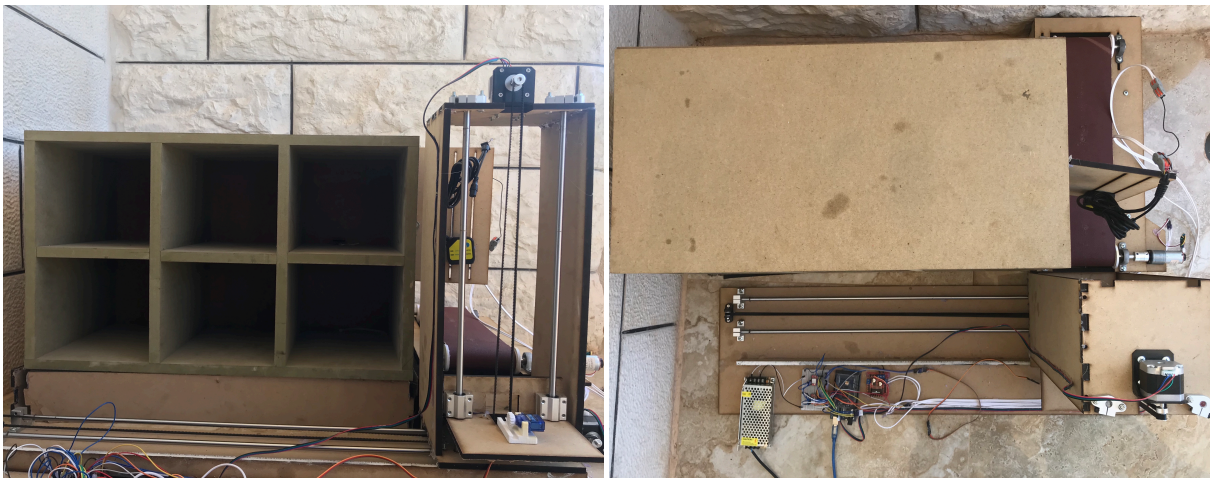

Figure 8: Figure 6.8 : Machine Design

The design consists of:

- 1. Wooden matrix shelf (2x3).
- 2. Belt to move the items to the elevator.

- 3. Barcode reader to read the bar code from the product.
- 4. Elevator to carry the item from the belt to the shelf.
- 5. Aluminum rails to work as axes of the moving elevator.
- 6. Stepper motors in both axes to move the elevator to the destination point.
- 7. The arm (servo motor) to push the item to its final destination (shelf).

Figure 9: Figure 6.7 : Servo Motor

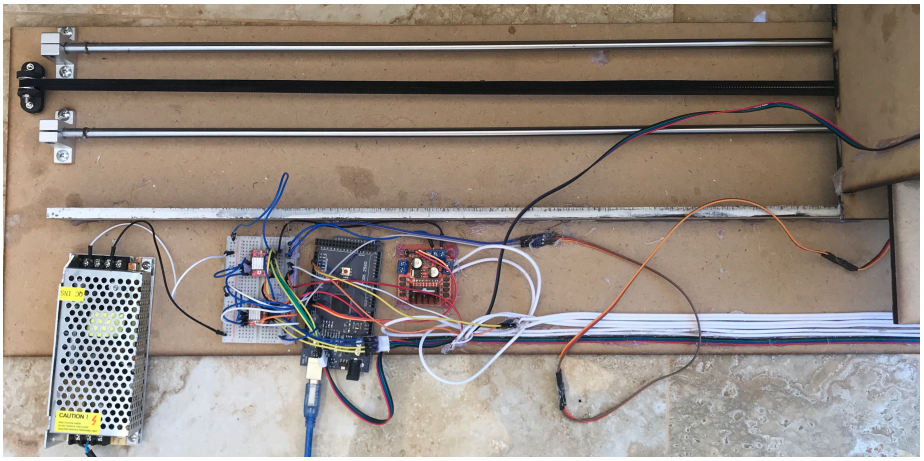

Figure 10: Figure 6.9 : Arduino

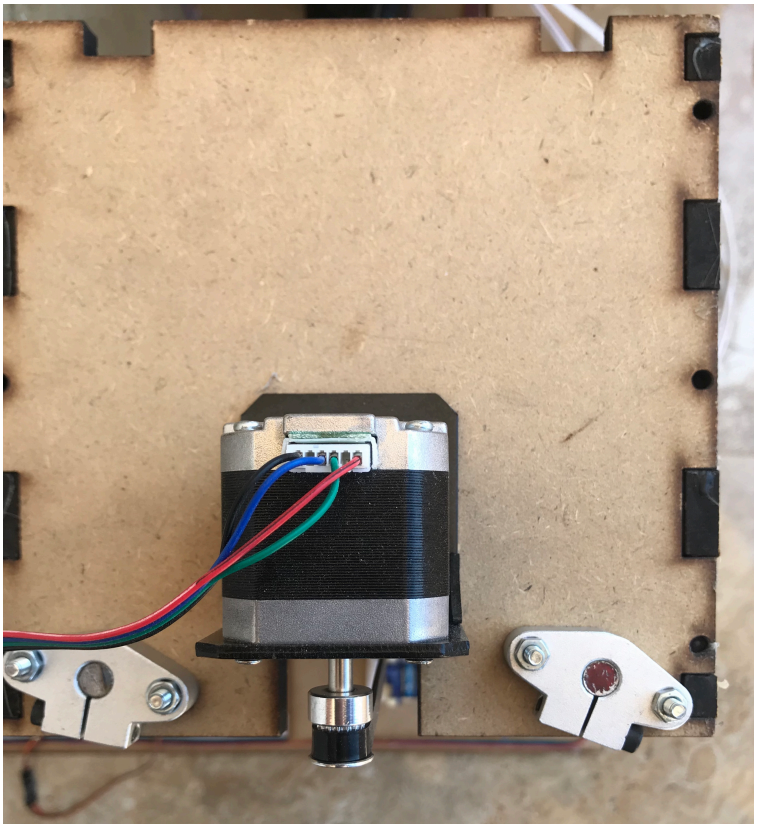

Figure 11: Figure 6.10 : Stepper Motor

Figure 12: Figure 6.11 : 3D Printer

Figure 13: Figure 6.12 : Barcode Reader

Figure 14: Figure 6.13 : elevator

6.4 Algorithm

- State 0: moving product on belt.
- State 2: reading the barcode.
- State 1: moving the elevator.
- State 3: return back to the origin point.

State 0:

put the item on the belt and the belt will move the item to the barcode to read the barcode that on the item to detect the position

State 1:

read the barcode on the item and save it on array in arduino to detect the product

State 2:

moving the elevator to the correct position by moving the stepper (X,Y) to the right shelf and when it arrived the position the servo will run and push the item to the shelf . State 3:

return back the elevator to the origin point where even it was by saving the steps and revers it.

7 Conclusion

By the end of this project, we were able to achieve this prototype and we have a machine that is capable of classifying items and placing them in their assigned shelves without the help of a human begin.

We also learnt a lot of things such designing circuits, buying the needed components, connecting the component together, how to deal with the micro-controller, reading inputs from sensors and analyze it to manage outputs that control the motors

8 Future Work

- Sensor to check if the shelf is empty or full.
- Develop the project to be suitable for warehouses.
- Add a camera to analyze the image if there is no barcode on the product
- Add a sensor on the shelf to calculate the number of products on the shelf

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