Palestine Polytechnic University

College of Engineering & Technology

Electrical and Computer Engineering Department

Graduation Project

Plastic Bottles Collection machine

"Good Eco... Good luck"

Project Team

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Hebron - Palestine

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Graduation Project Evaluation

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According to the orientations of the supervisor on the project and the examined committee is by the agreement of a staffers all, sending in this project to the Electrical and Computer Engineering Department are in the College of the Engineering and the Technology by the requirements of the department for the step of the bachelor's degree.

Project Supervisor Signature

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Committee Signature

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Department Headmaster Signature

……….…..………………

B

Dedication

To Our Beloved Palestine

To our parents and families

To all our teachers

To all our friends

To all our brothers and sisters.

To Palestine Polytechnic University

May ALLAH bless you

And for you we dedicate this project

The Work Group

<div dir="rtl">

الاهداء

لفلسطين الحبيبة

لآبائنا و أسرنا

لجميع معلمينا

لجميع أصدقائنا

لجميع اخواننا و أخواتنا

لجامعة بوليتكنك فلسطين

بارك الله فيكم

و لكم علينا أن نكرس هذا المشروع

فريق العمل

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C

Acknowledgments

We could not forget our families, who stood by us, with their support, love and care for our whole lives, they were with us with their bodies and souls, believed in us and helped us to accomplish this project. We would like to thank our amazing teachers at Palestine Polytechnic University, to whom we would carry our gratitude our whole life. Special thanks to our Supervisor Dr. Raed Amro for his wise and amazing supervision.

Abstract:

The plastic materials are very hard to decompose in the nature, products using plastic package increase rapidly without any official or industrial recycling efforts, and that will leads to spoil the soils and environment.

our project aim is to design and build a Plastic Bottles Collection Machine which motivates people to dispose these bottles in specified places (in the malls, shopping centers, schools...etc), which can be considered as an important step in an entire recycling process.

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Introduction

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1.2 Plastic Consumption in Palestine

1.3 Total Estimated Cost for the Project

1.4   Total Estimated time for the Project

1.1   Overview

Plastic bottles are the most commonly used material in our country, it has become very cheap after the 1960s when high-density polyethylene was used in the industry. They quickly became popular with both manufacturers and customers for two reasons, their lightweight nature and relatively low production costs compared with glass bottles.[13]

The plastic materials are very hard to decompose in the nature, products using plastic package increase rapidly without any official or industrial recycling efforts, and that will leads to spoil the soils and environment.

The project aim is to design and build a plastic bottles collection machine which motivates people to dispose these bottles in specified places (in the malls, shopping centers, schools...etc), which can be considered as an important step in an entire recycling process.

The project aims to : recycling of an important materials , enhancement the environmental , and creation new jobs for people.

The increases of plastic bottles is so obvious without any concern for recycling from any recycling companies or official foundation , that's causes an unacceptable view for environment and will spoil the soils and harm the environment.

The project will help to solve all of these problems without any efforts, the plastic bottles will be collected in one place , it will be ready for recycling in any time.

1.2   Plastic Consumption in Palestine

Plastic is one of the most commonly used materials in the world, it's extremely used for food products, according to the Joint Cooperation Council in Hebron and Bethlehem, the plastic consume in Hebron and Bethlehem is more than 600 ton daily, and according to the statistics of materials since and engineering book the plastic that used in food products (polyethylene terephthalate, PET) is ranked the ninth material that used in the world. [9],[14]

As we see the plastic is one of the most common used materials in Palestine ,according to Palestinian journalist Safa' Ashour statics, there is 165 plastic factories in Palestine, 65 of them in Gaza strip and 100 in west bank, all of them are exist to serve food products, liquids filling, cleaning materials …etc,[10]

This huge number of tons of PET plastic causing many problems in the environmental side, economic side, and they take most of the places in the damps .

According to doctor wade' sultan (a chemical lecturer in PPU) : The environmental problem of the huge number of PET plastic is harmful for marine and wild lives, according to the chemical construction of the PET plastic , after a long time and under heat the PET plastic react with water, it's decompose to return to its starting materials (polyester and ethylene glycol).

The first component in the PET plastic is polyester and it's a synthetic organic textile derived from fossil fuels, and this material is very harmful for air, water and it may causes a problem for human health.

Polyester is made from petroleum, the petroleum industry is responsible for large amounts of carbon dioxide pollution, that is main reason for global warming, acid rain, smog, water pollution and increased human cancer rates.

The second component in the PET plastic is ethylene glycol ,after searching for information about this material had been founded that it's causes many skin illnesses as skin eczema, so when the soil mixed with decomposed plastic touching human hands it could causes hazards for them[13].

Fig 1.1 : Mixed Garbage Damp in East Yatta City.

According to maan news agency the damp in the picture in Yatta city caused fainting for many people because of the gases that emitted from the burned garbage in the area in march 2012 .

For these reasons there's an urgent need for dispose safely from the huge number of plastic that causes hazards for the Palestinian nature.

1.3 Total Estimated Cost for the Project

Table 1.1 : Total estimated cost for the project

Total (NIS)	Price (NIS)	Quantity	Components
112	8	14	Relay 12v
250	250	1	Funduino mega
15	15	1	Bread board
10	1	10 cm	Electronic board
15	1	15	Terminals 2 pins
5	0.5	10	male electronic wires
5	1	5	Female electronic wires
1.5	0.1	15	1KΩ Resistor
2	0.1	20	100Ω Resistor
15	1	15	NPN 337 Transistor
5	5	1	Potentiometer
200	200	1	Effector K15065 sensor
300	60	5	Arduino proximity sensor
160	80	2	Light interrupter sensor
20	5	4	Limit switch
50	2	25m	Cable 1mm*4
450	450	1	Wooden container
15	3	5m	Data cable
45	15	3	PM DC motor
15	15	1	Sliding coupon motor
30	30	1	Separation motor 1
100	100	1	Separation motor 2
50	50	1	Glass (board + box)
100	25	4	Wheels
100	100	1	Posters
21	7	3	220V Lamps
25	25	1	Pushbutton
15	15	1	6 inch pipe
50	50		wooden materials
7	3.5	2m	electric trunk
40	40	1	LCD screen
55	55	1	Big connection box
40	40	1	Small connection box
20	20	1	24v power supply
10	2	5	Female power socket
10	2	5	Male power socket
15	3	5m	3*1.5 cable
4	4	1	connection box PT1
1.5	30	0.5	Bus bar
2	1	2m	Bell Wire
12	4	3	Traffic lamps for power circuit
11	11	1	Circuit breaker
50	50	1	Power supply unit
5	5	1	NC Pushbutton
8	4	2m	Thermal wire
2486.5	Total		

1.4 Total Estimated Time for The Project

Table 1.2: Total estimated time for the project

Time period per week	Activity description	Activity Symbol
2	Wooden body installation	A
3	Installation the mechanical parts and motors	B
1	Installing the electrical sensors	C
3	Welding and installing the electrical circuits needed for controlling the movements	D
1	Installing the microcontroller	E
2	Connection between control circuit ,power circuit and the microcontroller	F
3	Programming the project	G
1	Installing the posters to the project	H

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Chapter Two

Recycling in Palestine

2.1   Facts About Recycling in Palestine

2.2   Problems Facing Recycling in Palestine with Statistics.

2.1 Facts About Recycling in Palestine

According to Hussein Jabari the owner of aplastic recycling factory in Hebron: the plastic recycling costs 2000 NIS for the ton, labor and operating costs, and they can sell the ton in the range of 3500 to 4500 NIS, so the recycling companies can earn 1500 NIS at least for the ton if they sold it for 3500 NIS that is the minimum price for the least good type of plastic, a small recycling factory that visited in the industrial area of Hebron can recycle 3 ton in the day, that means they can earn 4500
NIS in the day at least.

And the factories of making and forming plastic bottles and all plastic applications can save 5000 NIS for one ton if they buy from recycling factories instead of importing the raw material from outside for 9000 to 10000 NIS for the ton, and if they were depends on self-recycling that means they can save other 2000 NIS for the ton, that means totally 7000 NIS for the ton.

For these reasons the concern of plastic recycling in Palestine must be increased by the government and the ministry of the environment.

This project is improving the first stage of recycling that is the collecting of waste plastic for recycling, that's done by encouraging people to separate the plastic after using directly in a special container.

2.2 Problems Facing Recycling in Palestine with Statistics.

As mentioned in chapter one, there is no official concern for recycling plastic, the plastic recycling in Palestine is very little comparing with other materials, as papers. That refers for two reasons, the first reason is the absence of political laws that forces the factories for recycling the plastic waste, or to encourage them for recycling, the second reason is the absence of Palestinian society awareness for the negative impact of solid waste specially what made from petroleum as plastic.

For many reasons the plastic is the least material recycled in Palestine comparing with other materials as papers and wood, that's refers for the high price of plastic recycling machines, and the high price of operating the machines and the labors comparing with other materials, for example the papers waste recycling cost only 500 NIS for ton, and the income papers waste price is 3500 NIS for ton, and they sell the ton in 20000 NIS, according to the Isra' company for papers productions.

The opposite of the papers, the plastic recycling costs 1000 NIS for ton, and the price of one ton of waste plastic is 1000 NIS, and the recycling factories sell the ton in range of 3000 to 4500 NIS it depends on the color and type.

As we see the incoming earn from papers production is greater than plastic, so the concern of the other materials recycling as papers is more than the plastic.

For that reason the plastic always thrown in huge number of tons in the damps and that will leads for two problems:

1- it will lead for the pollution as mentioned in chapter 1 for the environment and human.

2- Another problem come from throwing the plastic waste in damps is the economic side, because plastic raw material costs 9000 to 10000 NIS for ton, in the opposite of recycling, it's sold in range of 3500 to 4500 NIS .

After searching and asking many plastic factories in Hebron, there is no factories depends completely on recycling, all of them depends on importing first material of plastic from Israel, and that's because there is no official concern for recycling in Palestine, the plastic waste is mixed with other garbage and thrown in the damps without any separation for recycling.

Most of the factories in Palestine depends partially on recycling to decrease the income first plastic material price.

But the income waste plastic is very little, they depends on a few cars that collecting plastic waste from streets for the factories for 1NIS for Kg.

The project idea is come from all of the previous problems, collecting plastic bottles is the first step in the recycling process, and The project aim is encouraging collecting The plastic bottles in one place to make the recycling process easier for the factories that depends partially on recycling, then the factories will increase depending on the recycling, that will save the money for them instead of importing the raw material, and it will clean the Palestinian environment from a harmful material, and it will create a good labor in recycling factories.

3

Chapter Three

project structure

3.1   Project Idea and approach

3.2   Mechanical Design

3.3   Electrical Parts

3.4   Electromechanical Parts.

3.5   Electrical and Electronic Elements.

3.6   Electrical Circuits.

3.1 : Project idea and Approach

The project aims to build a plastic collecting machine which can placed in shopping centers , schools universities….. etc. . To motivate the people to use it , the excitation feeling of human being of win or not win will be used.

Similar to the principle of Black-Jack luck machines , inserting of an empty plastic bottle would rotate three wheels with the fruit logos for stochastic different times.

In case of appearance of a three similar fruits and the end of the rotation process, a win coupon is then thrown out.

3.2 : Mechanical Design:

- General Outside Construction

The machine body will be in a cuboids shape, and it will be able to contain up to 300 plastic bottles(two litter size) at the same time.

The machine body contains all the mechanical and electrical elements in the upper half part of the Cuboid shape, and the lower half part of the machine is moveable container for easy removing of the plastic bottles.

The general outside construction is shown in Fig. 3.1:

Fig. 3.1: General Outside Construction of The Machine

The height of the machine is acceptable for all ages and the throwing hole will be not too short, not too long, accessible for all ages, especially children the most important ages that we concern in.

The dimensions in meters are shown in Fig. 3.2:

Fig 3.2 Project Body Dimensions.

- Machine Body Construction

All sides of the machine will be covered by using MDF wood except the bottom front of the machine it will be covered by using transparent glass in aim to give the people a view what is the machine using for before reading what it is used for.

Choosing wood and glass aiming to obtain four good points:

1- Lighter weight comparing with metal.
2- More strong comparing with cartoon or plastic.
3- Easy to move.
4- Safe using for humans, no electrical and mechanical chock.

- Mechanical Structure:

Bottles Separation System

This system was designed to separate and steer the plastic bottles to the plastic container inside the machine, and also to eliminate any other thrown non plastic items to other accessible for all container outside the machine.

This System Consist of Three Parts:
1- the first part is a fixed tube way for bottles, as shown in Fig. 3.3.
2- the second part at the end of the tube there a sliding piece of wood to push the non-empty plastic bottles or any other objects outside of the machine ,as shown in Fig. 3.4 .
3- the third part at the end of the tube there a sliding piece of wood to drop the empty plastic bottles inside the machine , as shown in Fig. 3.5 and Fig. 3.6.

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Fig. 3.3 : Tube Way of The Plastic Bottle

Fig. 3.4:Separator Sliding parts(a)

Fig.3.5: sliding left   Fig 3.6:Sliding right

✓ These three parts of separation system are combatable to each other to obtain a slide movement without any Frictions for a good separation.

Jackpot luck wheels system:

Fig. 3.7 : Jackpot Luck Wheels System.

Inside the machine there is a three luck wheels(jackpot luck wheels) their aims to rotate only when the machine detect that there is plastic bottle thrown inside the machine in aim to award the people if it's stopped on three same fruit pictures that they are posted on it.

They are very simple to design, it designed in a diameter of 15 cm by using wood.

The wheels will be activated to rotate using three electrical permanent magnet DC motors. .

❖ **Wheels Rotation**
o If the previous three wheels that we explained gives after rotating three same fruit pictures (as apple, apple, apple) the machine should award the person who throw the empty plastic bottle inside it a coupon has a written with the gift name, which can be exchanged from the machine installers.

o That done by using permanent magnet Dc motor to slide the coupon that made from paper outside of the machine to the thrower person.

o Using a spring in this mechanism to press the coupons up each time after someone wins, to be ready for the next winning and to make the next coupon ready in case of someone else wins.

3.3 : Electrical Parts

In the machine there is three places needs a detection system using different types of sensors as :

1- Proximity Sensor :

To detect any object existence Arduino proximity sensor was used which detects any objects in a straight line , as shown in Fig. 3.8 :

Fig. 3.8 : Arduino proximity sensor

2- Material Type Detector :

This system was built using capacitive proximity sensor that detects only empty plastic bottles. named Effector K15065 .

Fig. 3.9 : Effector K15065.

Table 3.1: Name Plate of Effector K15065 .

Sensor type	Output voltage	Current consumption	Input voltage
NPN	12 V dc	40 mA	12 V dc

* reference [8] for sensor datasheet.

3- Similarity Detection System :

In the luck jackpot wheels, 6 sensors had been used to detect three same pictures or not in case of someone throw a plastic bottle inside the machine, In aim to award the plastic bottle thrower person.

In this system 6 Arduino proximity sensor had been used to detect holes in the three wheels, the six readings will detect if three of same kind of fruit are occur for the person who throw the plastic bottle .

This sensor is shown in Fig. 3.10 :

Fig. 3.10 : Arduino proximity sensor

The circuit diagram of the Arduino proximity sensor with the rated voltages of input and output:

Fig. 3.11 : Arduino proximity sensor Circuit Diagram.

- This detecting system was built by making two small holes near two different fruit pictures in each wheel of the three wheels as shown in Fig. 3.12:

Fig. 3.12 : The Three Wheels With The Holes and the Arduino proximity sensors.

The signals (zeros and ones) will take from holes and filled area after the wheels   rotates, according to these readings the controller will detect if a three same pictures are occurred or not, the table 3.2 will explain the signals results.

The aim of this idea that the sensor gives 1 reading when hole is between the transmitter and receiver, and it gives 0 when the hole goes away, and Fig 3.13 explains the place of the six sensors and the place of each two holes in the three wheels.

Fig. 3.13 : The Three Wheels With The Places of The Sensors.

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Table: 3.2 : 6 Sensor Readings and Meanings in the Detecting System of Three Same picture

	Sensor 6	Sensor 5	Sensor 4	Sensor 3	Sensor 2	Sensor 1
3 apples	1	1	1	0	0	1
3 pears	1	0	0	1	1	1
3 bananas	0	1	1	1	1	0

- **Each How Many Times the Machine Should Award the Persons After Throwing Plastic Bottles?**

  The answer of this important question is : there is no specific times for winning, the process of awarding the person will be random, and this will be done by vary the time of running for the three DC motors using microcontroller programming code , so maybe 2 persons wins sequentially**,** at the same time it's possible that each 15 time one person wins.

3.4: Electromechanical Parts:

In this Project 6 Permanent magnet DC motors were used , in the follows nameplates and functions:

1 - Two permanent magnet dc motors in the separation system
  _ the first with torque of 3.5 N.M , η=0.7 gears efficiency , a=0.1 gears ratio , to push unknown items out of the machine.

  _ and the other dc motor to put plastic bottles inside the machine with torque of 0.47 N.M without gears. and the two DC motors with the following parameters :

Table 3.3 : Name Plate of 38NM PM DC motor

Name	V input	Rated current	Rated torque	Speed
38 NM	12 v	2 A	3.5 N.M	30 rpm

Fig.3 14 : 38NM PM DC motor

Table 3.4: name plate of jhonson dc pm motor

name	Rated voltage	Rated current	Rated torque	Speed(rpm)
Johnson 65661	24 volt	1 A	0.47 NM	2000 rpm

fig 3.15:johnson dc pm motor

2- One 12V permanent magnet DC motors to slide the coupon outside of the machine in case of someone wins (with torque of 0.1 N.M).as shown in Fig 3.16 .[2,12].

Table 3.5: Name Plate of TN084908 DC Motor.

Speed	Torque	Rated power	Rated current	Rated voltage	Name
500 rpm	0.1 N.M	4W	300mA	12 V	TN084908

Fig. 3.16 : TN084908 permanent magnet DC motor

3 – Three small 12V permanent magnet DC motors to rotates the three jackpot wheels in case of the machine receives a plastic bottle, as shown in Fig 3.16.

3.5 : Electrical and Electronic Elements:

The machine will contain many electrical elements to complete its job, all of them are explained with their rated values and why they are used:-

_ Electrical Elements

1. power supply unit (PSU)

To provide three different values of DC voltages (6,12,24) V, we need power supply unit. We chose it to provide more power, more efficiency, and more pure DC wave [13].

Fig. 3.17 : power supply unit (PSU)

2. Microcontroller :

The controlling unit in the machine is a microcontroller of type ATmega1280, this controller is programmable using Arduino Mega program with a close to C language [1][5].

Fig. 3.18 : ATmega1280 microcontroller with Arduino Mega

• Why Atmega1280 had been chosen to Controlling the Machine?

Atmega 1280 was chosen for the following reasons:

1) It has enough number of digital inputs and outputs(54 I/O).

2) It has analog inputs (16 Inputs) .

3) Less cost comparing with other controllers as PLC.

4) Faster than PLC, it takes 1us to perform one instruction.

5) It's more simple to programming comparing with other microcontrollers as PIC18 family. [1][5]

3. Transistors:

The micro controller provide up to 40mA only for the outputs, and the motor load consumes more than 300 mA, so this high current will damage the microcontroller, so in this case we are going to use 0.8A transistors as a switch to isolate the high current from the microcontroller, and to feed the motors from the main power supply with the needed voltages.

o   337 NPN transistor is a good choice it can hold 0.8 A   [6].

Fig. 3.19: 337 NPN transistor

4.Relay:

This relay was used because that can handle the high power required to direct control an electric motor or other loads.

•   ry5wfz k relay is good choice it can hold from 1 to 2 A [11].

Fig. 3.20: ry5wfz k relay

_ Display Elements:

1. LCD Screen 16*2:

To display the messages and instructions of using to the users, an LCD screen will be used as seen in Fig. 3.21 [7] :

Fig. 3.21: LCD Screen.

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Table 3.6 : The Electrical Characteristic of the 16*2 LCD Screen.

■ ELECTRICAL CHARACTERISTICS (REFLECTIVE TYPE)						
Item	Symbol	Test Condition	Standard Value			Unit
			Min.	Typ.	Max.	
Input "High" Voltage	V_{IH}	—	2.2	—	V_{EE}	V
Input "Low" Voltage	V_{IL}	—	—	—	0.6	V
Output "High" Voltage	V_{OH}	I_{OH}=0.2mA	2.2	—	—	V
Output "Low" Voltage	V_{OL}	I_{OL}=1.2mA	—	—	0.4	V
Supply Current	I_{DD}	V_{DD}=5.0A	—	2.5	4.0	mA

Table 3.7 : Pins Function of The LCD Screen.

■ PIN FUNCTIONS					
No	Symbol	Function	No	Symbol	Function
1	V_{SS}	GND, 0V	10	DB3	Data Bus
2	V_{DD}	+5V	11	DB4	—
3	V_{EE}	for LCD Drive	12	DB5	—
4	RS	Function Select	13	DB6	—
5	R/W	Read/Write	14	DB7	—
6	E	Enable Signal	15	LEDA	LED Power Supply
7-9	DB0-DB2	Data Bus Line	16	LEDA	

2. Traffic Lights

In addition to the LCD , three signal lamps will be added in the front of the machine, in aim to give a message to the person who used this machine.

Fig. 3.22 : Traffic Lights.

Meanings of the Lights:

Table 3.8: Lights Meanings.

All lights are flashing	Red is flashing	Yellow is lighting on	Green light is on Yellow is flashing
You won	*The inserted item is not a plastic bottle. * The inserted item is a plastic bottle but you didn't win	Please wait a few seconds	The inserted item is empty plastic bottle, Please wait a few seconds for your result

o The lights works at 220 volts AC, three similar circuits had been implemented.

3.6 : Electrical Circuits

This section contains electrical circuits control and power, and all protection elements that needed:

3.6.1 : Power Circuits

- **Main Feeder Power Circuit**

According to the rated voltages for the motors, micro controller and sensors, the project needs 3 different values of DC voltages 6, 12 and 24 Volts Dc, so we designed the following circuit in Fig 3.23 that transfer the alternating 220 volt to 6,12 and 24 volts DC using center tap transformer as shown in Fig 3.24 with three varies values of ac voltages as seen on the circuit, and three full wave bridge rectifiers with filter capacitors for smoothing the output waveforms, and regulators to obtain fixed DC voltage.

Fig. 3.23 : Main Feeder Power Circuit

Fig.3.24: Main Feeder Power Circuit in The project

- **Circuits of The Separation System :**

  The PM DC motor in the circuit in Fig. 3.25 is used in the separation system to push non-plastic items and non-empty bottles into container outside the machine , while The PM DC motor in the circuit in Fig. 3.26 is used in the separation system to drop plastic bottles into container inside the machine ,and we used two limit switch to limit the movement of the motor in forward and reverse direction, each motor should be rotate according to the sensor readings and the programming code.

Fig. 3.25 : PM DC Motor in The Separation System Circuit Diagram (a)

Fig. 3.26 : PM DC Motor in The Separation System Circuit Diagram (b)

- ## Jackpot Wheels Motors:

Three permanent magnet DC motors will rotate the jackpot wheels, we implement three similar circuit as shown in Fig3.27.

The microcontroller will control the running periods to obtain randomly rotating, then randomly wining.

Fig. 3.27 : Jackpot Wheels Motors

• PM dc motor for Sliding Award Card Outside of Machine

In case of someone wins after occurring three same pictures, the machine should slides a coupon with the gift name outside the machine using the PM DC motor.

The following circuit explains the hardware connection of this motor:

Fig. 3.28 : PM dc motor for Sliding Coupon System

3.6.2 : Control Circuits
• Main Control Circuit

The control circuit contains the microcontroller with sensors , activation PB, and LCD screen.

Fig. 3.29 : Main Control Circuit With Microcontroller.

Fig. 3.30: over all control circuit

3.6.3 : Protection Elements

For protection, two types of protection in different places must be installed in the machine:

1- The main AC 220 volt feeder should be protected using 6A thermal circuit breaker in aim to limit the current on 6 ampere and interrupt the current in case of short circuit. [3]

Thermal circuit breaker is a device has to bimetals inside, which bends in case of overload current and turn the switch off to interrupt the current on the circuit [3].

Fig. 3.31 : 6A Circuit Breaker.

2- In power supply unit there is electronic fuse , it interrupt the current on the circuit in case of short circuit so the following circuit had been implemented as in Fig. 3.32 to give a notice that there is a problem in the circuits.

Fig 3.32: Protection circuit in case of short circuit

- also a fuses is used to protect the micro controller from the high current consumption to avoid any damaged could be happened to the micro controller .

4

Chapter Four

Flow Chart &Principle of Operation of the Project

4.1 Flow Chart & Principle of Operation of the project

4.1 Flow Chart & Principle of Operation of the project

- The following flow chart describes the control circuit of The project:

Fig. 4.1:- General Flow Chart.

_ The following steps describes the control circuit of The project :

1. First the person inserting a plastic bottle inside the machine through the hole that shown in Fig. 4.2 :

Fig. 4.2:- Throwing Hole.

2. The system will detect if the object is exist or not by using Arduino proximity sensor, and send the signal to the microcontroller.

3. The system will detect if the thrown item is empty plastic or not by Effector   K15065 sensor, and send the signal to the microcontroller.

4. The thrower person must press the green push button , and the signal will send to the microcontroller.

5. If the thrown item is plastic and it's not empty or it's not plastic, the micro controller will send an order to the PM DC motor to rotate to reject the bottle outside of the machine in another container.

6. If the thrown item is plastic and it's empty, the micro controller will send an   order to the PM DC motor to rotate to insert the bottle inside the container in the machine, then:
  a) Activation 3 PM DC motors that carries 3 jackpot wheels, see Fig. 4.3:

Fig. 4.3:- 3 DC Motor and Jackpot Wheels

b) After randomly rotation, if a three similar pictures occurs on the wheels, PM DC
motor should rotate to slide a coupon outside of the machine to award the person.

Fig. 4.4:- The Place Where The Coupon Slides.

o The detecting system of the three similar pictures will done by using 6
  Arduino proximity sensor .

5

Chapter Five

Calculations and Design

_____

5.1 Power Circuit Calculations and Analysis

5.1: Power Circuit Calculations and Analysis

Most convenient way to calculate the ratings currents and power needed for the loads is dividing the loads into four parts:

1- Loads run at **220 volt DC**

2- Loads run at **6 volt DC**.

3- Loads run at **12 volt DC**.

4-Loads run at **24 volt DC**.

Then summing the currents consuming by loads, and the rating power to select the perfect transformer and the perfect bridges rectifiers.

1- Loads run at 220 volt AC

_ six lamps worked at 220 volts and consumes **60 mA.**

2-Loads Run at 6 Volt DC

a – Arduino mega microcontroller works at 6 volts and consumes **50mA**.

 b - 19 digital Output are used each one consumes **40mA**.

c - 12 analog input is used consumes **40mA**.

d – 7 arduino proximity sensors are connected at 6 volt power supply, each one consumes **60mA**.

e- LCD screen works at **6 volts** consumes 50mA.

All of the loads that works at 6 volts consumes maximum **1.7 A**

3 - Loads Run at 12 Volt DC
a – 38 NM DC motor for bottles separation outside the machine, consumes **2A** .

b - 4 TN084908 DC 3 motors each on consumes **300mA** .

c- Effector K15065 for empty plastic bottles detecting consumes **40 mA** .

The loads that works at 12 volts consumes **2.34 A** .

4 - Loads Run at 24 Volt DC

a – NDFB PM DC motor for bottles separation inside the machine consumes 1A .

The Total Current Consumption and The Running Factor.

The total current consumed by all loads = 1.7+2.34+1=5.04 A

The running factor for the loads is 50 % (the loads are works at

the same time so the current after multiplying in the loading

factor is =0.50 *5.04=2.52

The following circuit shows the rated loads power, the voltages, the currents
the fuses values.

Fig 5.1:- The Power Supply Ratings.

_ the total power consumed from the loads in The project is 62 watt, but we used a power supply provides 400 w.

_ **The Main Feeder Cable** 3*1.5 mm square can hold 10 ampere.

Fig 5.2:- 3*1.5 Cable

_ Torque calculation of Permanent magnet DC Motors

a) PM DC motor for push the non-plastic bottles outside the machine

Such that :

T: torque	J : moment of inertia	a: acceleration	w_i: initial speed(rad/sec)	n:speed(rpm)
r: radius	m: mass	t: time	wf: final speed (rad/sec)	

$$T= Ja$$

$j = 0.5\, m\, r^2$

$j = 0.5 * 2 * (0.2)^2 = 0.04\, Kg.m^2$

$a = \dfrac{\Delta w}{\Delta t}$

$\Delta w = Wf - Wi$

$Wf = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 60}{60} = 6.28$

$Wi = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 120}{60} = 12.56$

$\Delta t = tf - ti = 1 - 0 = 1\ sec$

$a = \dfrac{\Delta w}{\Delta t} = \dfrac{6.28 - 12.56}{1} = -6.28\ rad/sec^2$

$T = j\, a = 0.04 * -6.28 = -0.2512$

M =2 kg
Nf =60 rpm
Ni =120 rpm
T =1 sec
R =20 cm

- The convenient choice is Nema 17 PM DC Motor that provides torque equal 3.5 N.M more than wanted.

b) PM DC motor for drop plastic bottles inside the machine

$$T = Ja$$

$j = 0.5 \, m \, r^2$

$j = 0.5 * 2 * (0.1)^2 = 0.01 \, Kg.m^2$

$a = \dfrac{\Delta w}{\Delta t}$

$\Delta w = Wf - Wi$

$Wf = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 60}{60} = 6.28$

$Wi = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 120}{60} = 12.56$

$\Delta t = tf - ti = 1 - 0 = 1 \, sec$

$a = \dfrac{\Delta w}{\Delta t} = \dfrac{6.28 - 12.56}{1} = -6.28 \, rad/sec^2$

$T = j \, a = 0.01 * -6.28 = -0.0628 \, N.M$

$M = 1kg$
$Nf = 60 \, rpm$
$Ni = 120 \, rpm$
$T = I \, sec$
$R = 20 \, cm$

_ The convenient choice is Jihonson PM DC Motor that provides torque equal 0.47 N.M more than wanted.

c) 3 PM DC motor to rotates the three jackpot wheels

$$T= Ja$$

$j = 0.5 \, m \, r^2$

$j = 0.5 * 0.1 * (0.05)^2 = 1.25 * 10^{-4} \, Kg.m^2$

$a = \dfrac{\Delta w}{\Delta t}$

$\Delta w = Wf - Wi$

$Wf = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 100}{60} = 10.46667$

$Wi = \dfrac{2\pi n}{60} = \dfrac{2 * \pi * 500}{60} = 52.333$

| M = 100 gram |
| Nf = 100 rpm |
| Ni = 500 rpm |
| T = 5 sec |
| R = 5 cm |

$\Delta t = tf - ti = 5 - 0 = 5 \, sec$

$a = \dfrac{\Delta w}{\Delta t} = \dfrac{10.46667 - 52.333}{5} = -8.3732 \, rad/sec^2$

$T = j'a = 1.25 * 10^{-4} * -8.3732 = -1.04665 * 10^{-3}$

- The convenient choice is TN084908 PM DC Motor that provides torque equal 0.1 N.M more than wanted.

d) PM DC motor for sliding coupon outside the machine

$$T = Ja$$

$j = 0.5 \, m \, r^2$

$j = 0.5 \times 0.02 \times (0.05)^2 = 2.5 \times 10^{-5} \, Kg.m^2$

$a = \dfrac{\Delta w}{\Delta t}$

$\Delta w = Wf - Wi$

$Wf = \dfrac{2\pi n}{60} = \dfrac{2 \times \pi \times 20}{60} = 2.09333 \, rad/sec$

$Wi = \dfrac{2\pi n}{60} = \dfrac{2 \times \pi \times 30}{60} = 3.14 \, rad/sec$

$\Delta t = tf - ti = 1 - 0 = 1 \, sec$

$a = \dfrac{\Delta w}{\Delta t} = \dfrac{2.09333 - 3.14}{1} = -1.04667 \, rad/sec^2$

$T = Ia = 2.5 \times 10^{-5} \times -1.04667 = -2.61666 \times 10^{-5} \, N.M$

M = 20 gr
Nf = 60 rpm
Ni = 120 rpm
T = 1 sec
R = 20 cm

- The convenient choice is TN084908 PM DC Motor that provides torque equal 0.1 N.M more than wanted.

the reference for these calculation is reference number [2] in the reference page at the appendix.

6

Chapter Six

Challenges & Conclusion

1.1   Challenges

1.2   Conclusion

1.1 challenges

During the executin process of " Plastic Bottles Collection Machine " project, we faced a lot of challenges appears in the following points:

- Unavailability of pet plastic sensor in Palestine , and instead of it we used plastic sensor in general.
- Problems in programming PIC 18f4550 , instead of it we used Atmega 1280.

1.2 Conclusion

During the executing process of "Plastic Bottles Collection Machine" project, we faced a lot of challenges, challenges that we have manage to gain a lot of helpful outcomes from it, and eventually we gain a large experience in the following points:

- The team work of the project put the aims of the project and studied the theoretical part of the project (theories and laws). The team proved that the theoretical methods can be executed in real world and they can be applicable.

- Learn how to work as team and how to distribute duties for the team members.

- Learn how to programming an ATmega1280 microcontroller using Funduino mega software tool.

- Learn how to design electrical circuit to reverse the direction of rotation of dc motor .

- Learn how to interface the Effector Plastic sensor to microcontroller.

- Learn how to interface the Aurduino proximity sensor to microcontroller.

- Learn how to use mechanical workshop in order to build the project.

A

Appendix A

Programing control circuit for the project

Using Funduino Mega

```cpp
#include <LiquidCrystal.h>              // LCD screen library
LiquidCrystal lcd(28, 30, 32, 34, 36, 38); // LCD pins at arduino

int i=0; //defining variable for a counter

int mpb=A0;      // main push button at analog input A
int li=A1;         // Light Interrupter at analog input A1
int pet=A2;        // PET plastic sensor at analog input A2
int ls=A3;         // Limit switch for motor 1 at analog input A3
int sd=A4;

//Inputs initialization first state
int mpbst=0;
int list=0;
int petst=0;
int lsst=0;
int sdst=0;

int m1=8;       // motor 1 of separation system at pin 8
int m2r=7;      // motor 2 right rotation at pin 7
int m2l=6;      // motor 2 left rotation at pin 6

int lg=13;        // green lamp at pin 13
int ly=12;         // yello lamp at pin 12
int lr=11;        // red lamp at pin 11

//

int maf=14;      // motor a of luck wheels forward rotation at pin 14
int mab=15;      // motor a of luck wheels backward rotation at pin 15
int mbf=16;      // motor b of luck wheels forward rotation at pin 16
int mbb=17;      // motor b of luck wheels backward rotation at pin 17
int mcf=18;      // motor c of luck wheels forward rotation at pin 18
int mcb=19;      // motor c of luck wheels backward rotation at pin 19

//

//defining the 6 sensors of luck wheels at analog pins 10-15
int sau=A15;
int sad=A14;

int  sbu=A13;
int  sbd=A12;
int  scu=A11;
int  scd=A10;

//initialization the analog inputs of the 6 sensors of the luck wheels
int saust=0;
int  sadst=0;
int  sbust=0;
int sbdst=0;
```

```
int scust=0;
int scdst=0;

.int ms=9;      // defining the motor of sliding cobon as output

{ void setup()
lcd.clear();

lcd.begin(16, 2) ;          //  defining the lcd
Serial.begin(9600);         //  begin the serial communication between arduino and PC

.//defining the inputs and outputs
pinMode(ms,OUTPUT (;


pinMode(8,OUTPUT);
pinMode(7,OUTPUT);
pinMode(6,OUTPUT);

pinMode(13,OUTPUT)
pinMode(12,OUTPUT)
pinMode(11,OUTPUT)

pinMode (9,OUTPUT);


for(int p=0;p<5;p++(
{
lcd.setCursor(0, 0);
lcd.print("Good Time mr"( ;
lcd.setCursor(0, 0(;
delay(800);
lcd.clear();
lcd.print(" Machine");
lcd.setCursor(0, 1)  ;

lcd.print("starting");
delay (800);
lcd.clear();
}

//
pinMode(maf,OUTPUT);
pinMode(mab,OUTPUT);
pinMode(mbf,OUTPUT);
pinMode(mbb,OUTPUT);
pinMode(mcf,OUTPUT);
pinMode(mcb,OUTPUT);
}
```

```
void loop()
{
mpbst=analogRead(mpb);
list=analogRead(li);
petst=analogRead(pet);
lsst=analogRead(ls);
sdst=analogRead(sd);
if (sdst>500)
{ digitalWrite(lr,HIGH);
lcd.setCursor(0,0);
lcd.print(" Close the Door");
lcd.setCursor(0,1);
lcd.print("   Please");

else}
if (sdst<200 & mpbst<200)
{
lcd.setCursor(0, 0(;
lcd.print(" Enter a Plastic"(;
lcd.setCursor(1, 1);
lcd.print(" Bottle Please"(;
digitalWrite(lr,LOW( ;
}

if(mpbst > 600 & list<200 & petst<200 & sdst<200) // pb and light interrupter and plastic
{
digitalWrite(8,LOW(;

digitalWrite(lr,LOW);
digitalWrite (13,HIGH); // green lamp on
digitalWrite(12,HIGH);  // yello lamp on
// lcd printing

lcd.setCursor(0, 0(;
lcd.print("Thanks alot Sir");

lcd.setCursor(1, 1);
lcd.print("Wait Please"(;

// moving motor 2 to right
digitalWrite(7,HIGH);
digitalWrite(6,LOW);

// start rotating the three luck wheels.
digitalWrite(maf,HIGH);
digitalWrite(mab,LOW);
digitalWrite(mbf,HIGH);
digitalWrite(mbb,LOW);
digitalWrite(mcf,HIGH);
digitalWrite(mcb,LOW);
```

```
delay(1000);
digitalWrite(12,LOW);  // yello lamp on
delay(1000);
digitalWrite(12,HIGH);  // yello lamp on

// moving motor 2 to left
digitalWrite(7,LOW);
digitalWrite(6,HIGH);
delay(800);

// turning off the motor 2
digitalWrite(7,LOW);
digitalWrite(6,LOW);
delay(200);

digitalWrite(12,LOW);  // yello lamp off
delay(1000);
digitalWrite(12,HIGH);  // yello lamp on
delay(1000);
digitalWrite(12,LOW);  // yello lamp off

// turning off the luck wheels
digitalWrite(maf,LOW);
digitalWrite(mab,LOW);
digitalWrite(mbf,LOW);
digitalWrite(mbb,LOW);
digitalWrite(mcf,LOW);
digitalWrite(mcb,LOW);
delay(1000);

digitalWrite(12,HIGH);  // yello lamp on

delay(500);

// reversing the luck wheels.
digitalWrite(maf,LOW);
digitalWrite(mab,HIGH);
digitalWrite(mbf,LOW);
digitalWrite(mbb,HIGH);
digitalWrite(mcf,LOW);
digitalWrite(mcb,HIGH);

delay(500);

digitalWrite(12,LOW);      // yello lamp off

delay(500);

digitalWrite(maf,LOW);
digitalWrite(mab,HIGH);
digitalWrite(mbf,LOW);
```

```
digitalWrite(mbb,LOW);
digitalWrite(mcf,LOW);
digitalWrite(mcb,HIGH);
delay(500);
digitalWrite(12,HIGH);  // yello lamp on

// stopping the luck wheels.
digitalWrite(maf,LOW);
digitalWrite(mab,LOW);
digitalWrite(mbf,LOW);
digitalWrite(mbb,LOW);
digitalWrite(mcf,LOW);
digitalWrite(mcb,LOW);
delay(6000);

digitalWrite(12,LOW);  // yello lamp off
digitalWrite(13,LOW);  // turning off the red lamp

//

saust=analogRead(sau( ;
sadst=analogRead(sad);
sbust=analogRead(sbu (;
sbdst=analogRead(sbd (;
scust=analogRead(scu(;
scdst=analogRead(scd);

if (saust>500 && sadst<150 && sbust<150 && sbdst>500 && scust>600 && scdst>600 ||
saust<150 && sadst>500 && sbust>500 && sbdst>500 && scust>150 && scdst<200 ||
saust>500 && sadst>500 && sbust>500 && sbdst<150 && scust<200 && scdst>600)
{

lcd.setCursor(0, 0(;

lcd.print("Congratulations");
lcd.setCursor(0, 1(;
lcd.print("You're won"");
delay(500);

digitalWrite (ms,HIGH);
digitalWrite(lg,HIGH);
digitalWrite(lr,HIGH);
digitalWrite(ly,HIGH);
delay(500);
digitalWrite(ms,LOW);
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
for (int n=0;n<3;n++)
{
digitalWrite(lg,HIGH);
```

```
digitalWrite(lr,HIGH);
digitalWrite(ly,HIGH);
delay(350);
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(350);
}
for (int m=0;m<3;m++);
{
digitalWrite(lg,HIGH);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(350);
digitalWrite(lg,LOW);
digitalWrite(lr,HIGH);
digitalWrite(ly,LOW);
delay(350);

digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,HIGH);
delay(350);

}
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(350);
for (int o=0;o<3;o++);
{
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,HIGH);
delay(350);
digitalWrite(lg,LOW);
digitalWrite(lr,HIGH);
digitalWrite(ly,LOW);
delay(350);
digitalWrite(lg,HIGH);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(350);

}
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(350);
for (int p=0;p<3;p++);
{
```

```
digitalWrite(lg,HIGH);
digitalWrite(lr,HIGH);
digitalWrite(ly,HIGH);
delay(300);
digitalWrite(lg,LOW);
digitalWrite(lr,LOW);
digitalWrite(ly,LOW);
delay(300


for (int t=0;t<5;t);
{
lcd.setCursor(0, 0);
lcd.print("take you're cobon (;
delay(500(;
lcd.clear ();
}
}
}
else
{


digitalWrite(lg,LOW);
digitalWrite(ly,LOW);
digitalWrite(lr,HIGH);
lcd.setCursor(0,0);
lcd.print(" Sorry!..Try "(;
lcd.setCursor(0,1);
lcd.print("  Again Please" (;

delay(1000);
for (int q=0;q<6;q++);
{
digitalWrite(lr,HIGH);
delay(300);
digitalWrite(lr,LOW);
delay(300);
}
}

//

}
else

if(mpbst>600 & list<200 & petst>600 & sdst<200); // pb and light interrupt and not plastic
{

lcd.setCursor(0, 0 (;
lcd.print("Sorry Sir..empty");
```

```
lcd.setCursor(0, 1);
lcd.print("Plastic only "(;
digitalWrite(7,LOW);
digitalWrite(6,LOW);
digitalWrite(m1,HIGH);      // turning on the motor1
digitalWrite(lr,HIGH);      // turning on the red lamp
delay(900);

}
else
if (lsst<200)
{
lcd.setCursor(0, 0(;
lcd.print("Sorry Sir..empty "(;
lcd.setCursor(0, 1(;
lcd.print("Plastic only"(  ;
delay(20);
digitalWrite(m1,LOW(;
digitalWrite(lr,LOW);     // turning on the red lamp
for (int g=0;g<6;g)
{
lcd.setCursor(0, 0);
lcd.print("Sorry Sir..empty");
lcd.setCursor(0, 1(;
lcd.print("Plastic only "(;
digitalWrite(lr,HIGH);
delay(350)
digitalWrite(lr,LOW);
delay(350);
}
}
}
```

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