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**Designing of windshield wiper system using
microcontroller**

Electrical and Electronic Engineering

**A project submitted in partial fulfilment for the
Degree of BEng. (Hons) Electrical and Electronic Eng.**

**In the
School of Applied Computing Faculty of Architecture
Computing & Engineering**

**By: Buthaina Aljarrah
Supervisor: Dr Gareth Jones**

23/04/2021



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DECLARATION

I, Buthaina Aljarrah declare that I am the sole author of this Project; that all references cited have been consulted; that I have conducted all work of which this is a record, and that the finished work lies within the prescribed word limits.

This work has not previously been accepted as part of any other degree submission.

Signed:

Date:



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Form of consent

I Buthaina Aljarrah hereby consent that my Project, submitted in candidature for the BEng Electrical and Electronic Engineering degree, if successful, may be made available for inter-library loan or photocopying (subject to the law of copyright), and that the title and abstract may be made available to outside organisations.

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Abstract

The aim of the project is to design something interesting and useful, for this reason the idea of designing a windshield wiper has come up. The aim is to design an automatically operation windshield wipers with different speeds. There is different sensing method that can be used to detect the rain. However, the IR sensor. The problem was that the author could not be able to build it in reality because of the time and not having the full components.

The report includes:

- Comparing different rain sensor
- Selecting best method to detect the rain.
- Method that is used
- Designing the system using proteus
- Microcontroller Programming language (MikroC)
- Analysis
- Evaluation



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The software that been used to design, analysis and planning are as follow:

- Proteus:

to design the system

- Microsoft word:

the Microsoft word is used to write up the proposal and report

- Microsoft Excel

The Microsoft excel is used to create the Gantt Chart.

- Microsoft PowerPoint: been used for presenting the viva

The Microsoft PowerPoint is used to represent the interim and final Viva.

- MikroC

It has been used for the microchip programming.



Figure 1

Figure 2 was taken from [1]



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Acknowledgement

I have always been dreaming of this year, where I graduate from university with course that I like. I went through a lot in my life, but I was very insisted to finish my studies. This year have been so difficult generally, having lecturers from home was not easy and not best situation for student to have.

I would like to thank to my supervisor DR. Gareth Jones, for the great support that he gave through the year. Also, thanks to my university for giving me the opportunity to excel in this course.

Without the great support of my mother, I would not have been able to accomplish this project. I cannot express my gratefulness to have her by my side, thanks to my siblings, to my grandfather who always used to say that my degree is my weapon and finally to my fiancé and his encouragement.



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Chapter 1:

1.1) Introduction

The aim of this project is to design a windshield wiper system using microcontroller. Today there are various problems in the weather, we have been having more rain than sun. Before, most of the car wipes were manual, so you would have to turn it on. By designing this project, it will help customers automatically turn it ON when it is needed.

Automatic windshield wiper will not be needing a manual intervention, by creating this project it will work when rain hits the windscreen. The system will be created using a software called proteus. There is a procedure that need to be followed before it can be created.

The UK is known for its rainy weather and this is because of the moderate sea climate which allows rainfall through the year. Due to the high amount of rain in the UK, this project would add more safety measures. In the past 30 years in the UK, it has rained an average of 156.2 days a year. It mostly rained in Wales, Scotland, the Pennines in Northern England, and the Moors of South West England mountains, which is considered to be the rainiest places in Europe. This demonstrates more challenging weather conditions for drivers around the UK.

Furthermore, the windshield wipers help drivers minimize the time when the driver has to take hands of the wheel, which can cause a serious danger specially on motor way.



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1.2) Project background

The title of the project is designing of windshield wipers system using a microcontroller. The windshield wiper plays an essential role for drivers as well as the environment.

The weather can be very distracting for the driver; hence the idea of windshields was first introduced by Mary Elizabeth Anderson. It was first invented as 2 brushes that goes up and down on the windshield in 1903.

Later, on the same year, a device with a swinging arm to clean the rain off the windshield, controlled by a lever that the driver had to move was invented. As mentioned, the driver had to steer the lever in one hand without any power.

In 1905 a rubber strips replaced the brushes to clean the windshield wipers. Then, the electrical motors came up to control a single rubber to clean the windshield back and forth instead of the lever that had to be controlled by the driver.

By installing an electric motor in the top center of the windshield, the automatic wiper was invented so that the wiper arced down over the car hood in a semi-circular or rainbow shape.

The windshield washers were added to the I/ O lever which required a spray nozzle in front of the windshield and tank of the fluid in the engine compartment. Other invents came up such as intermittent wipe with intervals and speeds that the driver could change, the wipers connected with the front light, a sensor to detect the rain.

[2]



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1.3) Aims and objectives

The project's aim is to research and produce a useful and safe system as well as something that could be interesting, which is electrical windshield wipers that operates automatically when there is rain by using an IR sensor and motor to control the wipers. This system is very important for safety reasons, it helps the driver to get clear view and safe driving. as well as other people and environment.

The system is required to design a circuit connecting to a PIC that should be programmed. Also, the system is including a water (wash) pump.

In addition, the objective of this project is to develop the old windshield wipers that is already set on the car which has to be controlled manually to an automatic windshield wiper that operates when there is rain without a manual control.

i. Research

Research is important to nurture the idea of the project. It helps to use best method and best designing. This is done by using different sources.

ii. Planning

The planning is of vital importance, as it enables good project organisation and effective time management. A Gantt chart will be used to reach this.

iii. Designing

The designing is further step of the project, where proteus is going to be used.

iv. Analysis

To analysis the research and designing that has been done on this report using a Microsoft word.



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1.4) Planning

1.1.1 The project handing dates are:

Interim Viva	Jan 20th/21st/22nd
Final Report	Friday 23rd April 3pm
Final Viva	Wed 28th/Thurs 29th/Fri 30th April
Exhibition materials	Tuesday 4th May 3pm

Table 1

The table above shows the handing date of each task.



1.1.2 Search

	Start date	End date	Duration
Project idea research	9/30/2020	10/7/2020	7
Search/ select the best method	10/7/2020	1/21/2021	106
Project title	10/7/2020	12/2/2020	56
microcontroller research	1/23/2021	2/15/2021	23
looking for components needed	1/20/2021	1/21/2021	1

Table 2

1.1.3 Planning

Tasks time management	12/2/2020	1/21/2021	50
Designing a Gannt chart	12/02/2020	1/21/2021	50

Table 3

1.1.4 To Produce

Proposal	11/28/2020	12/2/2020	4
Interim Viva 1	1/21/2021	1/22/2021	1
Final report	23/04/2021	23/04/2021	1
Final Viva	4/29/2021	4/30/2021	1
Exhibition	5/3/2021	5/4/2021	1

Table 4



1.1.5 Designing

Virtual circuit design	3/3/2021	3/31/2021	28
------------------------	----------	-----------	----

Table 5

1.1.6 Implement

Developing the idea	12/15/2020	1/21/2021	37
Working on PowerPoint	1/5/2021	1/21/2021	16
Program the microcontroller	2/15/2021	3/2/2021	15

Table 6

1.1.7 Analysis

Errors check	3/31/2021	4/2/2021	2
Analyzing the working of the project	1/25/2021	4/23/2021	88

Table 7

The tables above (2,3,4,5,6 and 7) is showing the Author time management of the project, this helps the author to save time, availability to success the project and fault finding. As well as handing the tasks on time.



Tasks	Description
Project idea research	Choosing the right idea of the project is very helpful to success
Search/ select the best method	There are many methods to implement the project, so this need to select best method to give an accurate output.
Project title	The title that given by the author is the key for the reader to know the general idea of the project
Project history	Searching about the systems and methods that is already exist.
microcontroller research	Search the different microcontroller chips and choose the one that suitable for the design
looking for components needed	In order for the author to build the circuit a right component has to chosen
Tasks time management	Splitting the tasks into specific time helps the author to finish on time
Designing a Gannt chart	This showing how long each task
Proposal	What needs to be included in the proposal also what is the reason for the project and how project would be involved.
Interim Viva 1	Present a PowerPoint of different ideas by other people who already did the project and presenting the first idea of the project.
Final report	This will present the outcome of the project design



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Final Viva	Present the finished product and answer questions
Exhibition	Present the finish project
Virtual circuit design	Build a sensor using schematic design which was created using proteus.
Developing the idea	Develop the idea which was already in the market
Program the microcontroller	Code created and used in microcontroller to use on the circuit.
Errors check & analyzing the working of the project	Check for the error to see if anything needs improving

Table 8

Table 8 is describing each task on the time management.



1.1.8 Gantt chart

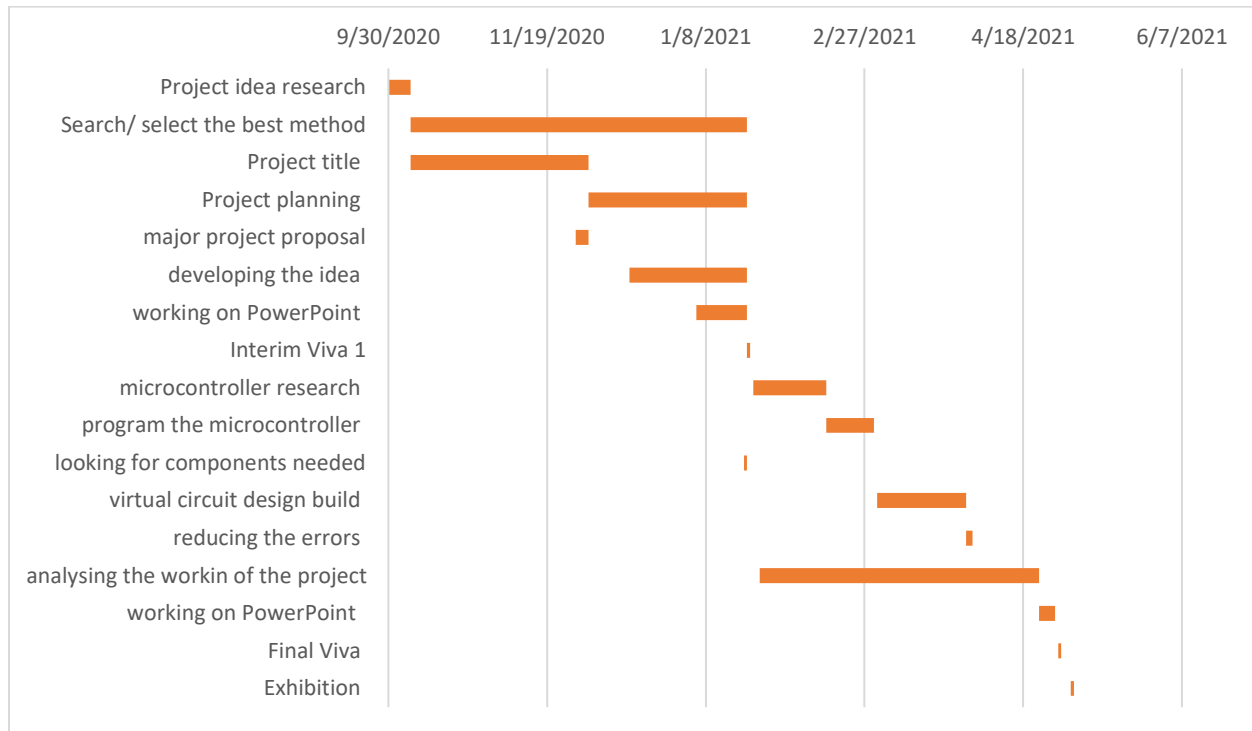


Figure 2

On figure 2 is Gantt chart made according to the planning of the time management for this project. This has been done with a guide from the lecturer.

2 Chapter 2: Methodology

2.1 The research onion

The research onion is shown in figure 1 below:

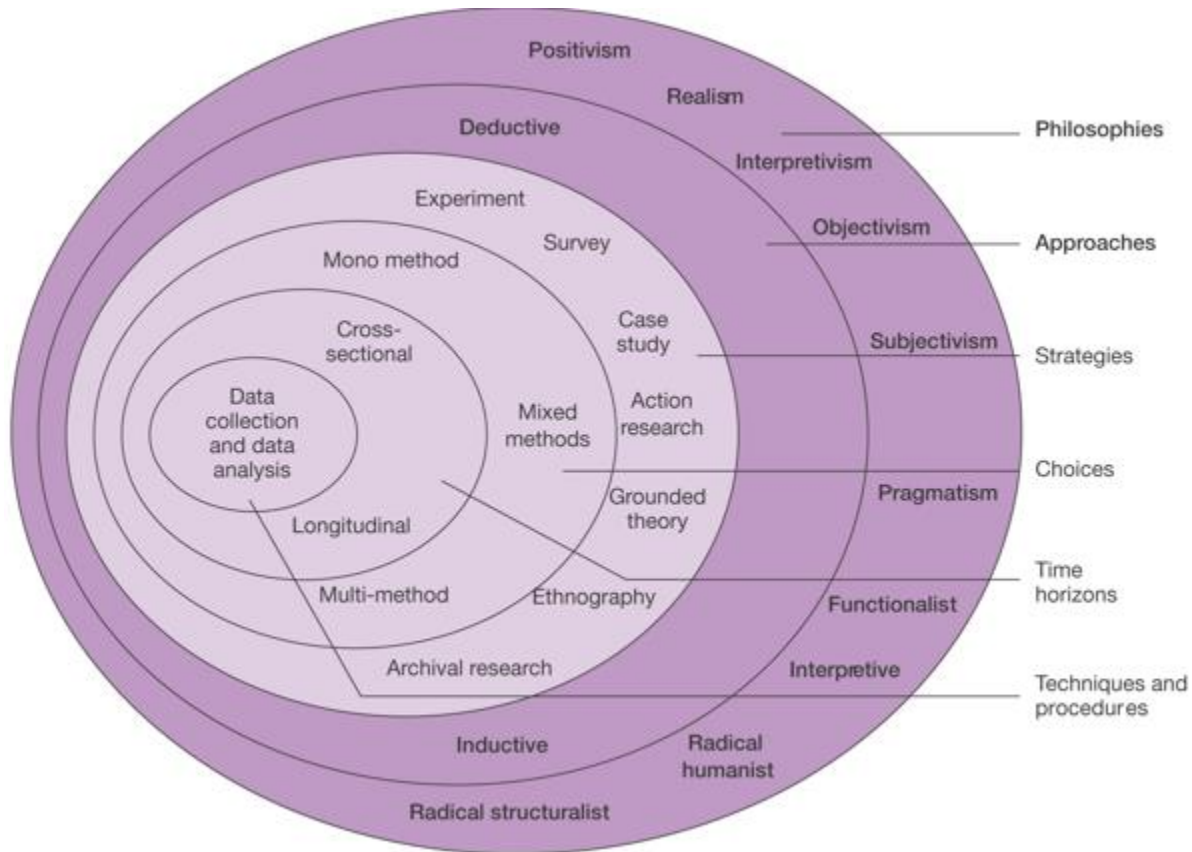


Figure 3: research onion

This shows the aspects of research that will be utilized in the project.



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2.2 The research philosophy

It is an important part of the research methodology. Ontology, epistemology, and axiology are the three categories of research theory. These philosophical methods make it possible to determine which approach the researcher can take and why, based on the study questions. [3]

Epistemology is the study of what constitutes acceptable knowledge in each field of study. There are two types of researchers: resource researchers and feeling researchers. The resource researcher explores data from the perspective of a natural scientist. The 'feeling analyst,' on the other hand, is concerned with the employees' emotions and behaviors toward their employers. [3]

The nature of reality is the foundation of ontology. Objectivism and subjectivism are used to classify it. Objectivism, the first aspect of ontology, is the belief that sociological situations exist outside of social agents. Second, subjectivism is concerned with social processes that arise from the experiences and effects of certain social agents that are involved in their existence. [3]

Another methodological field of epistemology concerned with scientific inquiry is realism. The central characteristic of realism is that it seeks to show the essence of experience and the nature of things that occur separately of the human imagination. Direct realism and vital realism are two types of realism. Direct realism describes what our senses feel and what the researcher discovers. Essential realism, on the other hand, argues that what we interpret by our senses are representations of the natural world, not reality. [3]

In this project, epistemology research philosophy will be used. This is because the project will be based on knowledge that will be gathered through experimental study. This is an example of positivism [4].



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2.3 The research approach

It is the second layer of the onion research methodology. This layer contains of 2 research approach which are the inductive and deductive.

A detailed reading of secondary data is used to extract principles, patterns, and models in an inductive approach. Therefore, it is generally used to evaluate qualitative results. This starts with the selection of a research topic and progresses to the creation of a hypothesis.

Quantitative research often involves the use of mathematical analysis to close the difference between what is understood and what can be discovered by research. As a result, understanding the relationships among variables using descriptive or inferential statistics is required when using quantitative techniques to analyze data.

Deductive research will be carried out. This is because an experiment will be conducted that to determine the mathematical model that describes the system.

[5] [6]



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2.4 The research strategy

Experimental modelling will be key for this project. This is because there are currently no mathematical relationships characterizing the absorption of infrared radiation by rain droplets on car windscreens. [7]

2.5 The data collection method

Data for modelling will be collected experimentally and mathematical modelling tools used to develop a mathematical model that will be used to program the microcontroller.

[8]

2.6 Time horizons

The longitudinal approach will be used as it is desired that the system to be designed will work through all times, and at all locations. [9]

2.7 Conclusion

The system is much more reliable and efficient when compared to normal uncontrolled wipers. It is very difficult to optimally control the speed of a wiper manually so that the speed is neither too fast nor too slow for wiping. This is the motivation for this project.



3 Chapter3: Research & Review of Literature

3.1 Project history

3.1.1 1902

This project was first invented by Mary Elizabeth Anderson while she was in New York city during a rainstorm while she released that the driver is struggling to drive causing him to open the window and his head out.

This manual mechanism drives a combination of wooden and rubber arms with a winch, helping to remove snow, rain, and debris.

3.1.2 1917

Charlotte Bridgewood is the first invented of the automatic windshield wipers and it was called "Storm Windshield Cleaner". However, this invention has not achieved a commercial success because it was still not safe enough. The driver had to steer the stalk in one hand or 2.

3.1.3 1919

William M. Folberth who is an inventor of electrical windshield wipers which is a vacuum-powered system to clear the windshield, that became standard equipment on automobiles.

3.1.4 1912

Dr Ormand wall was the first inventor of the electrical windshield wipers which was made by placing a motor on the windshield, so the wipers move in a semi-circle or rainbow shape.



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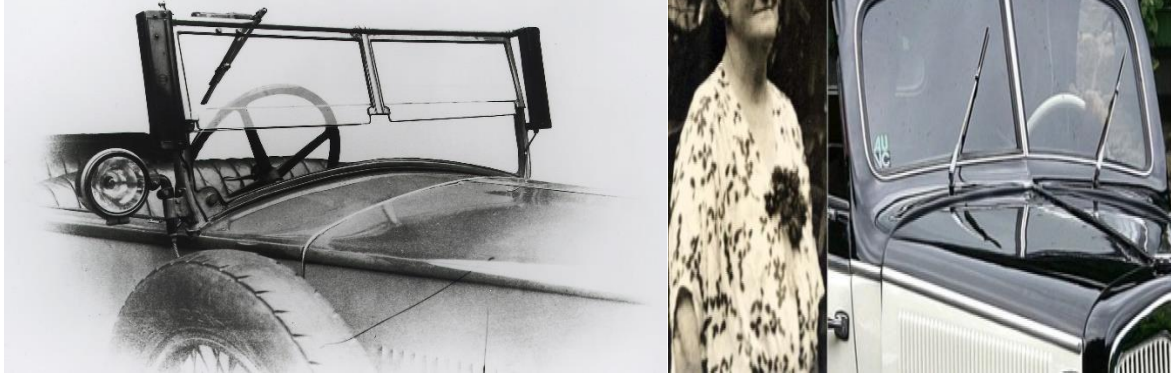


Figure 4

Figure 4 is picture of Mary Elizabeth Anderson and old car windshield wipers which was taken from [10]
[11]



3.2 Weather and driving condition

In this section the author would like to talk about how the weather affecting the driving condition. The harsh weather can make difficulties for the driver. For example, their ability to see will be reduced in extreme weather such as rain, fog, ice, snow, and dust.

It will not just affect the driver, but it will also affect other drivers on the road as well as the environment.

These are potential causes of distraction to the driver and results in more responsibilities to the driver. Therefore, the Automatic windshield wipers will reduce the number of expected actions of the driver.

[12]



Figure 5

Figure 5 is an example of how the rain can affect the driver sight and it was taken from [13]



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3.3 Importance of automatic windshield wipers

Although the windshield wiper comprises a very small part of the car, it is of pivotal importance and can affect the driving quality. The manual windshield wipers normally need to be switched on and off manually, which can affect the driving quality and can potentially result in the disturbance of the driver.

Nowadays, automatic/modern windshield wipers demonstrate advanced features. They are particularly designed to offer more flexible and easy options for drivers, while being effective. Automatic windshield wipers help maintain accurate and clear vision while driving. [14]



3.4 Rain sensor on the market

3.4.1 W2S5 rain sensor

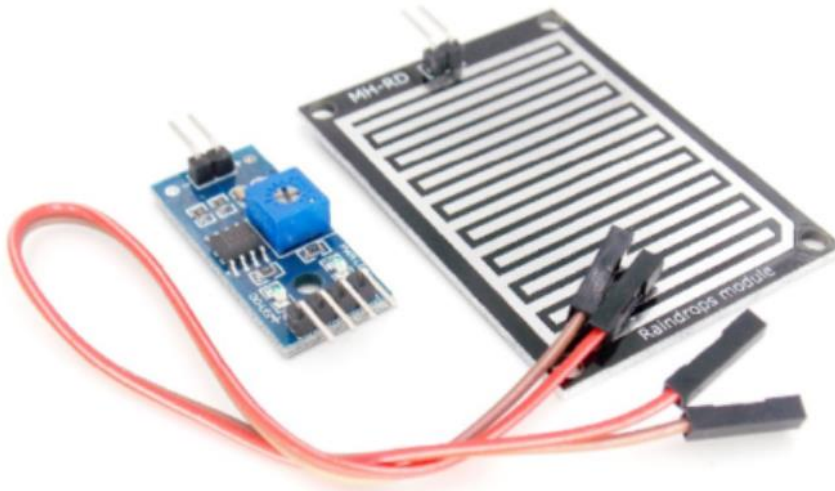


Figure 6

This rain sensor has two parts, one is the black board where it collects the rain and the electrical board that compares the analog value and converts it to a digital value. When the rain drops into the collect board the resistance will be low, therefore the voltage is low using OHMs law. Hence, there is no rain and therefore the resistance and voltage is high. [15]



3.4.2 PIR sensor



Figure 7

PIR sensor, is short form of the Passive InfraRed, it has 2 slots on it that is sensitive to IR radiation. When there is nothing to detect both slots detect same amount of IR. When something pass through it causes a positive differential change between the two halves but When the thing leaves the sensing area, the opposite happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

[16]



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3.4.3 TRws214



Figure 8

This device is to measure different types of precipitation with wide temperature range, harsh conditions, and wind. This device is very sensitive and accurate rain gauge. Also, it is very reliable and easy for maintenance. This information was supplied from [17]



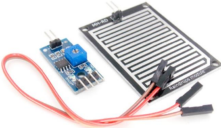
Type	W2S5 rain sensor	water level sensor	TRws214	PIR sensor
Image				
Operating voltage	3.3 ~ 5.5v DC	DC3-5V	5/ 30VDC / MAX	3 to 6 VDC
Output	digital output (DO) (0 and 1) and analogue output (AO) voltage	Analog		
Current	15mA	less than 20mA	4mA @ 12V	o 12 mA @ 3 V, 23 mA @ 5 V
Dimensions	32mm x 14mm		360 *540mm	35.8 x 25.4 x 20.3 cm
Features	-It has a potentiometer to adjust the sensitivity -With bolt holes for easy installation -Anti-oxidation, anti-conductivity, with long use time	It is easy to use and easy to detect the water	• It is very expensive. • It has rating IP65	Detect a person up to about 30 ft away, or could be up to 15 ft away in reduced sensitivity mode. ☐ the voltage and current supply ☐ Small size makes it easy to conceal. ☐ Easy interface to any microcontroller
Price	£2.99	£2.92	£2575.00	£11.66
Reference	[18] [19]	[20]	[21]	[22] [23]

Table 9

Table 10 comparing between the rain sensors that is already available on the market. All of them the prices are quite good and affordable except TRws214 is very expensive. Also, the table includes the references of the sources.



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3.5 Rain sensor module

Rain sensor is an object that is designed to detect the rain. It is the main component of the project, It can also be designed to detect the intensity of the rain. In this project the sensor will be attached to a microcontroller as an input.

Basically, the sensor will give a signal to the microcontroller as input. The output on the microcontroller PIC is the servo motor that moves to 180 degree and go back to 0 degree to drive the windshield wipers back and forth. Building the sensor in the car is going to save the driver a number of tasks while driving. It is known that driving on a heavy rainy day can be really uncomfortable and stressful, hence having automatic wipers will ease the drivers experience and result in an improved vision.



3.6 Sensor selection

There are several methods can be used to detect rain. This is mentioned below:

Type	Optical sensor	Humidity sensor	piezoelectric
Name	RS45	DHT11	WXA100-ZRG
Image			
Voltage	24v DC – 230v	3.3 V-5 V	12...24VDC
Output	60 V/2A	digital output	RS232/RS485 Digital output
Operating temp			-40 ... +85 °C (-40 ... +185°F)
Ip rating	Ip65		
Dimensions	80mm x 80mm x 55mm (W x H x D)	3.1 cm * 1.4 cm	
Price	£75.00	£2.57	£170.84
Referencing	[24] [25]	[26]	[27]

Table 10

Table 11 showing the differences between 3 sensors which are optical, humidity and the piezoelectric sensors. The optical sensor is chosen to sense the rain and these for number of reasons. One of them the humidity sensor the author was thinking that it could not work because UK is island and surrounding of the beach so the weather could be mostly humid. Also, the piezoelectric sensor is expensive comparing with optical sensor. The other reason that the author have is familiar with it.



3.7 Optical sensor

This sensor is used to convert the rays of light into electrical signal. The aim of an optical sensor is to quantify a physical quantity of light and then convert it into a shape that can be read by an integrated measurement device. The optical sensor has 2 light sources which are the detector and the receiver.

The optical sensor could be either internal or external. Internal sensors are typically used to measure curves and other small changes of direction, whereas external sensors collect and relay a specified amount of light. [28]

Name	Infrared sensor TCRT5000L	PIR Sensor	Photosensitive Sensor Module
	 2X		
Voltage supply	Reverse Voltage 5V Collector Emitter Voltage: 70V. Emitter Collector Voltage: 5V	12 VDC	3.3V-5V
Output		Alarm output: (Rx) relay (NO/NC) 1 A / 120 V AC; tamper output: (Tx/Rx) NC contact 1 A / 120 V AC	Digital Switch Output (0 and 1)
Operating temperature	-25 ° C ~ + 85 ° C		



Range of detection	12mm	20 m	
Dimension		(WxHxD) 46x95x34 mm	32mm*14mm*5mm /1.25*0.55*0.19"
Price	£1.20	£37.60	£2.28
Reference	[29]	[30]	[31]

Table 11

The Infrared sensor will be choosing for this project, it looks the cheapest comparing with other 2 sensors. As well as it is familiar for the author.



3.8 Infrared Sensor

It is an electronic device that detect the IR radiation that falls in it. The emitter circuit and the receiver circuit make up an infrared sensor, which are the IR LED and photodiode [32]

3.9 PIC selecting

3.9.1 Pin count

IR sensor	1 pin
Servomotor	1 pin
DC motor	1 pin
Thump switch	2 pins
Crystal capacitors	2 pins
Total	6 pins



Name	PIC18F25J11	PIC16F1788	PIC18F24J10
Image			
Program memory size	16 KB	28	16
SRAM Bytes	3800	2048	1024
Pin count	28	28	28
Max CPU Speed MZ	48	32	40
ADC Input	10	11	10
Max ADC Resolution (Bites)	10	12	10
UART	2	1	1
Price	£1.36	£1.09	£1.03
Reference	[33]	[34]	[35]

Table 12

The table 13 is a selection of microchip controller that was found by using [36] this source. These microcontrollers non- of them is used as the author do not have any experience of using them before. However, the table 14 is showing the specification of the microchip that is used.



Name	PIC16F1517
Image	
Program memory size	14
SRAM Bytes	512
Pin count	40
Max CPU Speed MZ	20
ADC Input	28
Max ADC Resolution (Bites)	10
UART	1
Price	£1
Reference	[37]

Table 13

Table 14 is a specification table for the microchip that is used which is PIC16F1517. The PIC was used because it meets the requirement of the project. Also, the author has done a research and was familiar with using this one.



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3.10 Components

The components are the main part of the project. Choosing the right components is crucial in determining the success rate of the project, as it needs to meet the optimal requirements. Additionally, cost effectiveness is another control measurement that will influence the effectiveness of the project.

the author is simulating IR sensor and motors in order to control the output by using proteus. However, the components that is needed are:

- Microchip
- IR LED
- Photodiode
- Green LED
- LM358
- DC motor
- Servo motor
- Resistors
- Capacitors
- Relay



3.10.1 IR LED

It is a semiconductor or a type of diode. With the IR LED the electric current flows in only one direction. Electrons fall from one section of the diode through holes in another as the current flows. Electrons must drop energy in the form of photons in order to fall through these holes. [32]

The package of infrared diodes is invisible to visible light but transparent to infrared. The demand for the IR LEDs has caused to reduce its cost on the market. [32]

The IR LED is like normal LED and it operates the same. invisible because its wavelength is higher than the normal light range. So, when the IR led sends the IR radiation the photodiode going to receive it.



Figure 9

This figure is a photo of an IR LED, it costs **£1.20** which is cheap, and it was taken from [38] it consumes 2 A and 3V.



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3.10.2 Green LED

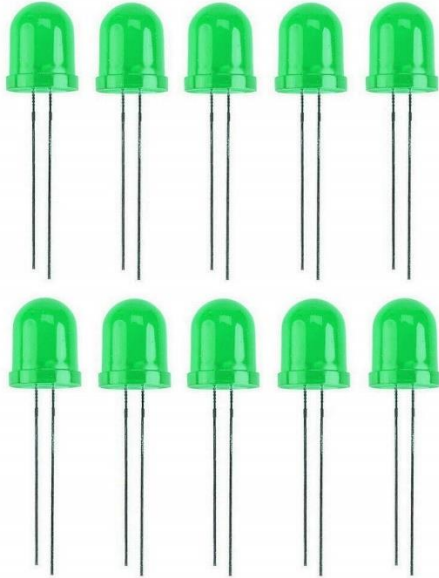


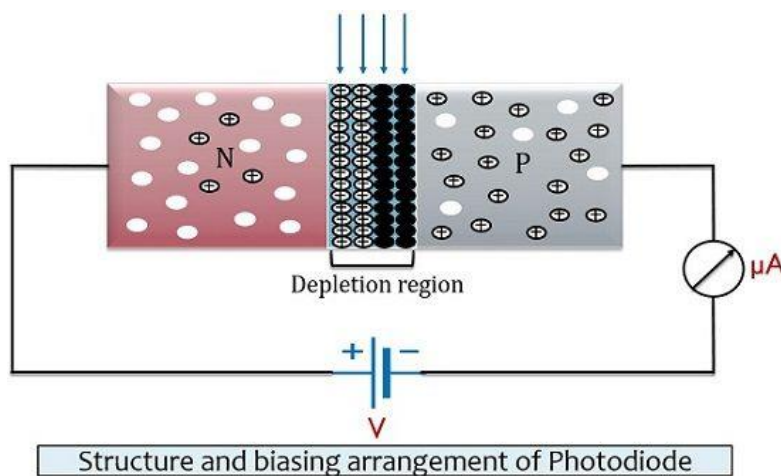
Figure 10

The green LED is to be used to check that the sensor is working. It costs £0.22. [39]



3.10.3 Photodiode

It is a PN junction device that conduct current when light when exposed light. It also known as photosensor. The photodiode transforms light energy into electrical energy in a reverse biased mode. A small reverse current flow through the photodiode [40]



[40]

The minority carriers are the electrons on the p side and the holes on the n side. When a certain reverse-biased voltage is applied, the positive potential of the battery repulses the minority carrier, holes from the n-side. [40]

In one hand, the photodiode it gives a quick response when light reflect, it has a fast-operating speed, provide a linear response as well as it is low-cost device. [40]

On the other hand, it is a system that is influenced by temperature. Also, it has a low temperature stability. Furthermore, amplification is needed when low illumination is available. [40]

When it detects the light from the IR LED the resistance of it become low and the opposite which means the resistance is high when there is no light. It is a semiconductor device, it operates in reverse bias, this meaning that the current flow in reverse direction when it detects the light.



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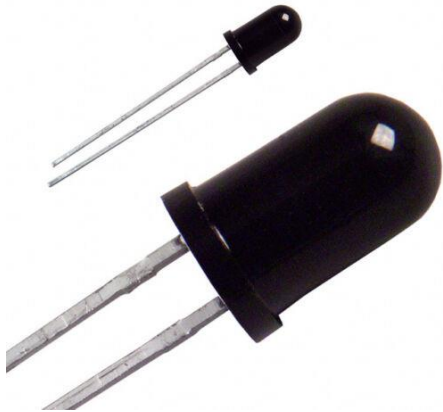


Figure 11

The figure above is a picture of photodiode which costs **£0.99** and it was taken from [41]



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3.10.4 LM358



It is One type of dual-channel operating amplifier. Two operational amplifiers are built into the LM358 comparator IC (Op-Amp). Negative inputs of Op-Amp 1 and Op-Amp 2 are connected to IC pin 4, while positive inputs are connected to IC pin 8. The non-inverting input of the Op-Amp 1 is connected to IC pin 3, while the inverting input is connected to IC pin 2. The Op-Amp 1's output is attached to IC pin 1. [42]

As mentioned above, the LM358 has two inputs, which re the inverting and non- inverting inputs. If the voltage at non- inverting which is the positive is higher than the voltage of the inverting input, then the output of the comparator is high. And the opposite.

It costs **£0.99**. [43]



3.10.5 DC motor

it is a motor that transfer the current energy into mechanic energy.

it has 2 part which are the stator and the rotor. The rotor is located inside the motor. Whereas the stator is located outside it. Coil windings driven by DC current are in the rotor, while permanent magnets or electromagnetic windings are found in the stator. The magnetic field is occurred in the stator when the motor is DC current powered, attracting and repelling the rotor's magnets the rotor begins to rotate as a result of this. A commutator is used in the motor to keep the rotor spinning. The rotor would cease rotating as it aligned with the magnetic field, but the commutator would reverse the current through the stator, reversing the magnetic field. This allows the rotor to continue rotating. [44]

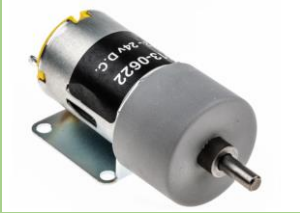
Name	Brushed geared	EsportsMJJ FEVERWORK	Metal Gear Box Motor
Image			
Voltage	12 V dc	12V-36V	5-12 (V)
Power	1.31 W		3.5
Current rating	190 mA		0.06 (A)
Output speed	82 rpm	3500-9000RPM	Optional
Dimensions	51*27 mm		
Price	£11.11	£11.99	£14.87
Reference	[45]	[46]	[47]

Table 14

Table 14 is a selection of DC Motors that is available on the market and from different manufacturers. The DC motor is an important part of the project. The brushed geared dc motor was chosen and that because of its cheap price and the small Amps.



3.10.6 Servo motor

Name	5 Nm Servo Motor	MG996R	ES08MA
Image			
voltage		5V	4.8V~6.0V
Power	1.5KW		
Current	6A	3A	200mA/60o
Rotation Rate:	3000PRM	0.5ms—0 degrees; 1.0ms—45 degrees; 1.5ms—90 degrees;	
Operating speed		0.17sec / 60 degrees (4.8V no load) 0.13sec / 60 degrees (6.0V no load)	0.12sec/60o at 4.8V; 0.10sec/60o at 6V
Dimensions		40mm x 19mm x 43mm	32* 11.5* 24 mm
Resistance	1.03 OHMS		
Costs	£201.99	£20.99	£11.09
Reference	[48]	[49]	[50]

Table 15



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The table 14 is a selection of different servo motor manufacturers. The **ES08Mais** chosen to be used as the operating voltage is perfect for the microchip controller output as well as it is a small and quite cheap comparing with other two servo motors.



3.10.7 Microchip

Name	PIC16F1517
Image	
Program memory size	14
SRAM Bytes	512
Pin count	40
Max CPU Speed MZ	20
ADC Input	28
Max ADC Resolution (Bites)	10
UART	1
Price	£1
Reference	[37]

Table 16



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3.10.8 Resistors

3.10.8.1 120 ohms resistor



***** VAT Invoice *****

Figure 12

In figure 13 is 120 ohms resistor which is going to be used in the circuit to keep the IR emitter save and do not blow up. It costs **£2.99**. [51]



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3.10.8.2 12k ohms



Figure 13

It costs **£0.43** it was taken from [52]



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3.10.8.3 330 Ohms



Figure 14

This resistor is used for the LED to not blow up it is for **£1.29** and was taken from [53]



3.10.8.4 Variable resistor

Bright Components

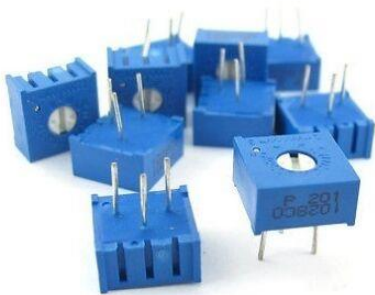


Figure 15

Variable resistor was used in the circuit for simulation in Proteus. It costs **£1.84** and it was taken from [54]

3.10.9 Capacitor



Figure 16

The capacitor cost £5.99 and it was taken from [55]



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3.10.10 Thump switch



Figure 17

Figure 20 is showing the thump switch that is chosen. It costs **£17.99.**

Figure 20 was taken from [56]



3.11 Total cost

Components	Quantity	Price
Microchip	1	£1
IR LED	1	£1.20
Green LED	1	£0.22
Photodiode	1	£0.99
LM358	1	£0.99
DC Motor	1	£11.11
Servo motor	1	£11.09
120 ohms resistor	1	£2.99
12K ohms resistor	1	£0.43
330 ohms resistor	1	£1.29
Variable resistor	1	£1.84
Capacitors	2	£11.98
Thump switch	1	£17.99
Total price		£63.12



4 Chapter 4: designing

4.1 Basic Diagram

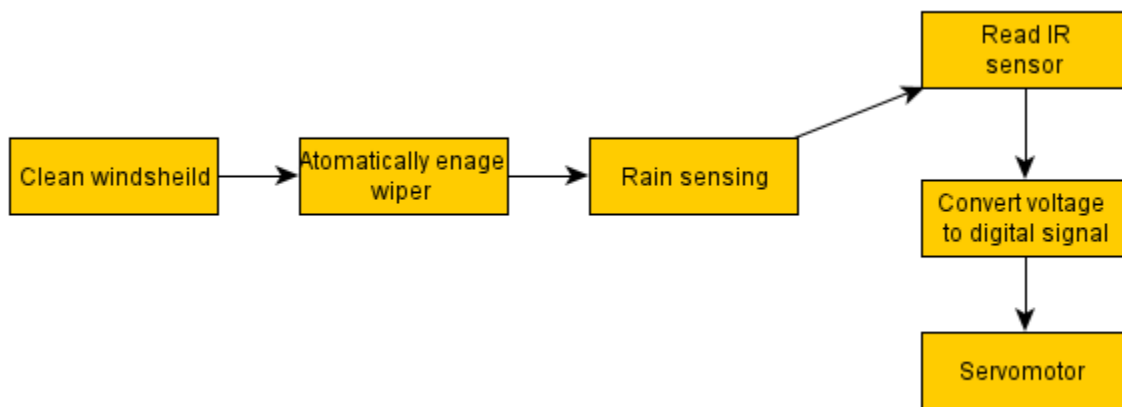


Figure 18

Figure 10 shows the first diagram that Author was to do. later on, this idea was found out that it is not correct.



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4.2 Proteus

The circuit is designed using a schematic design that build on proteus. Proteus is a design software and simulation, that is containing of simulation, schematic, and PCB design. The proteus is very versatile environment to design that includes full support for design reuse, assembly versions, and a complete BOM reporting subsystem.

It has all the electronic modeling resources that is needed, whether making PCBs or simulating embedded systems.

The author would like to mention that this project has helped them to design a circuit and simulate it.

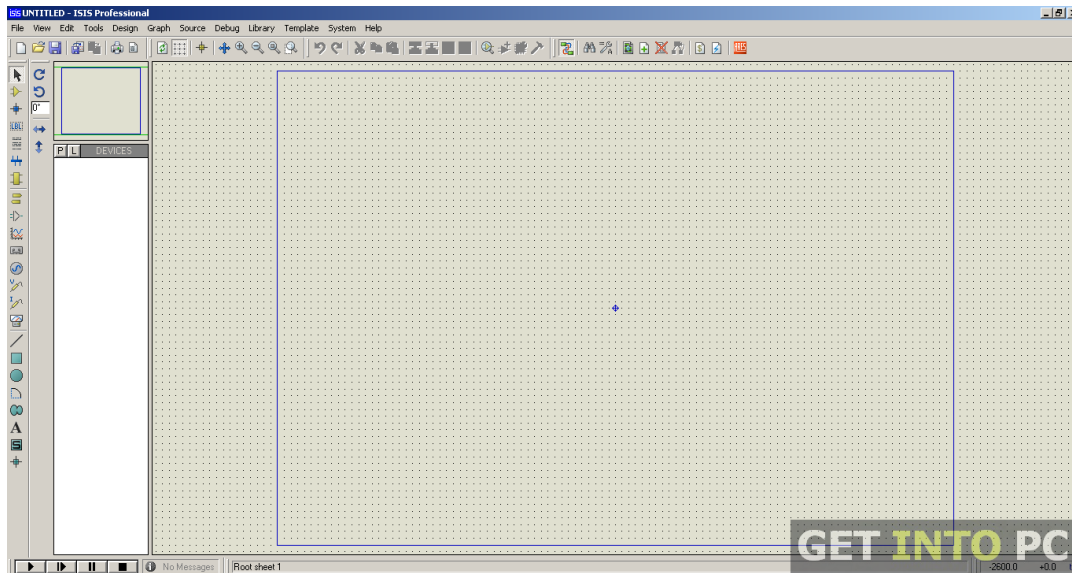


Figure 19

The figure 11 was taken from [57].

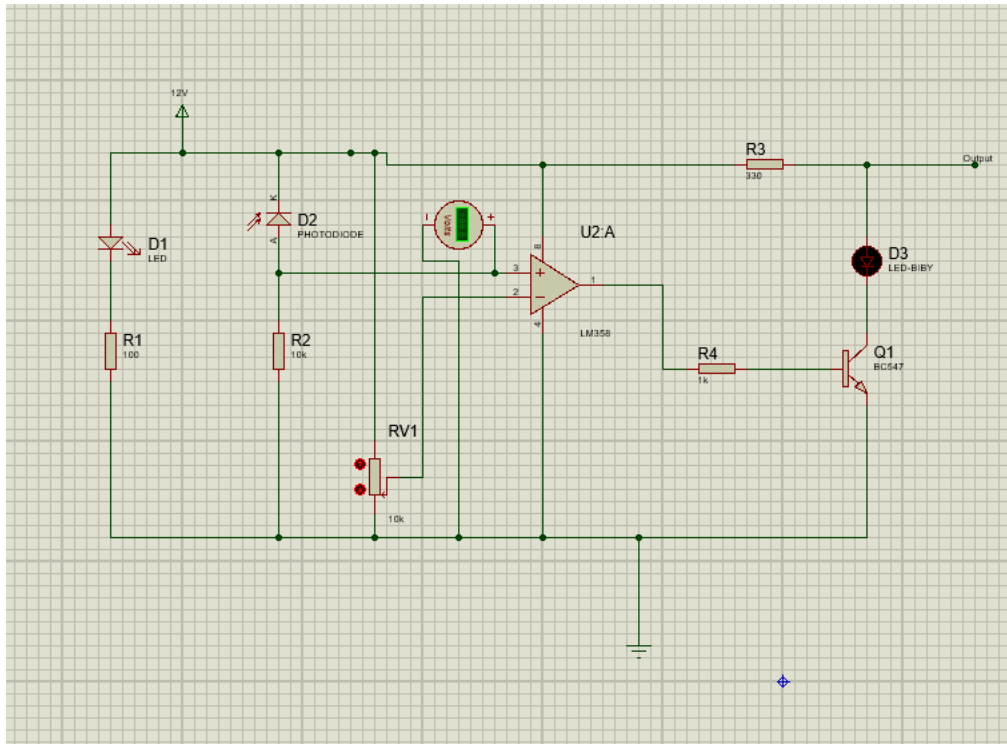


Figure 20

Figure 20 shows the first attempt of building the IR sensor. Also, this has been tested and it was working.

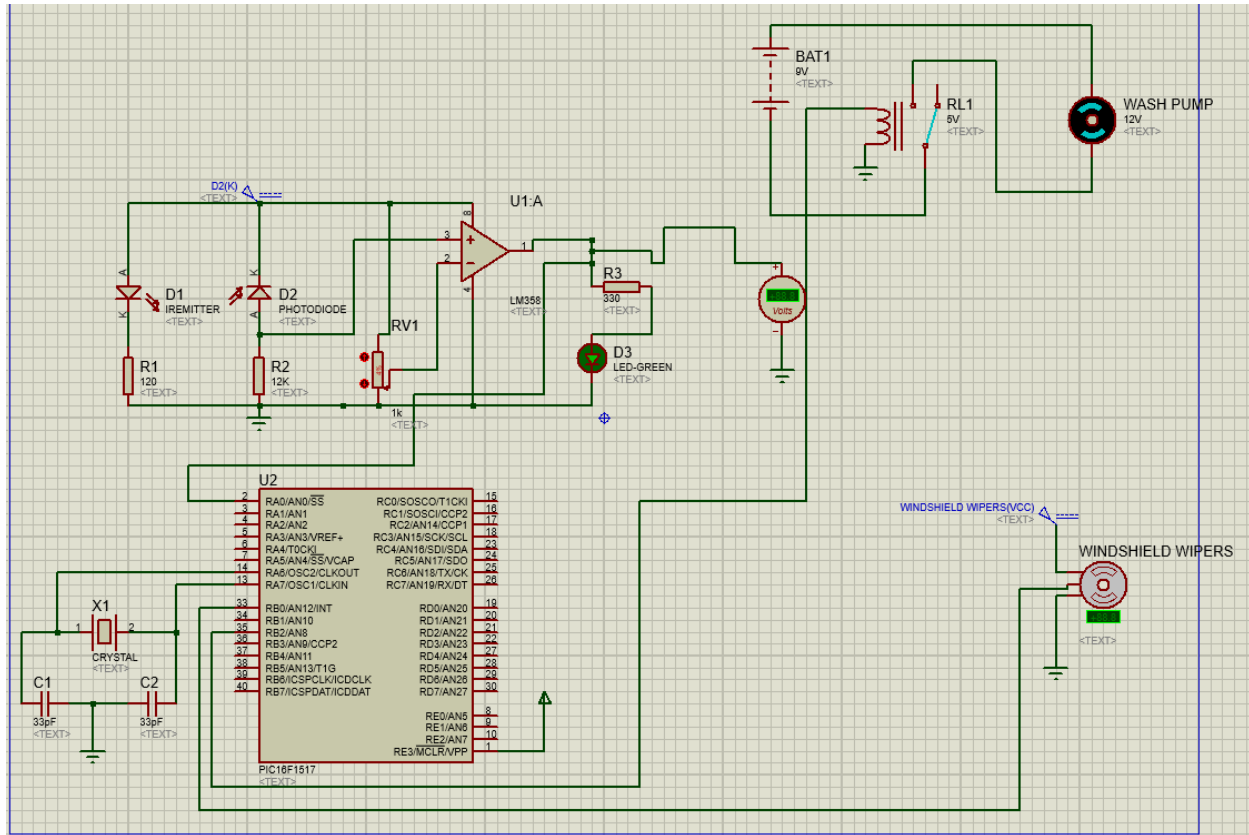


Figure 21

The figure above shows how the circuit was first build. The idea of this circuit is to only have Electrical windshield wipers that works automatically when there is rain by using IR sensor which is the input of the microcontroller and the output is the servo motor which is controlling the movement of the wipers, as well as the DC motor which is working as the water pump for the windshield wipers to clean it.

the DC motor connected to the microchip through a relay switch as well as it connecting to the battery of the car because the DC Motor needs 12V and the voltage coming from the microchip is 5V, so it will not be enough to operate the DC motor.

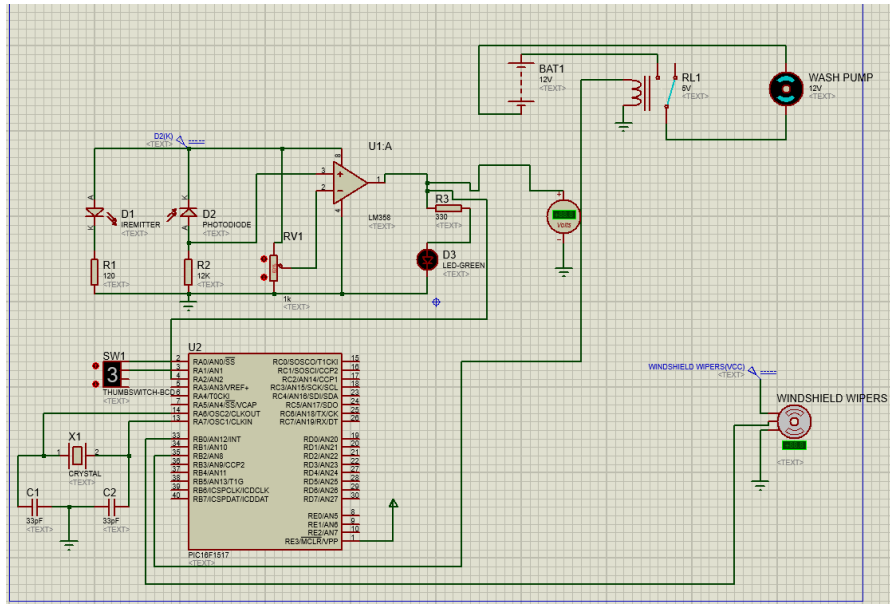


Figure 22

Then the last idea of designing is as its showing in figure 22. Is to have 4 positions for the windshield wipers which are:

4.3 First position (0)

At this stage, the windshield wipers are off and not in operation.

4.4 Second position (1)

4.4.1 Components

- DC motor
- Servo Motor

This can also be called the cleaning position; it can be used to clean the windshield wipers. Practically, when the driver chooses second position (1) by pressing the thump switch. The wash pump will be on, when it goes off the servo motor will reach 180 degrees and will return to the 0 degrees, twice. Then, it will stop for a while and operate once more. This will result in clean windshield wipers.



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4.5 Third positions (2)

4.5.1 Components

- Servo motor

The third position is the manual position. The windshield wipers will remain on until the driver changes it.

4.6 Fourth position (3)

4.6.1 Components

- IR LED (the emitter)
- Photodiode (the receiver)
- Resistors
- Variable resistor
- LM358
- Green LED

This position is the Automatic windshield wipers which means activating the IR sensor. Once rain is detected, the wash pump will operate for one second. This will be followed by the windshield wiper operating four times. This is a recurring cycle.

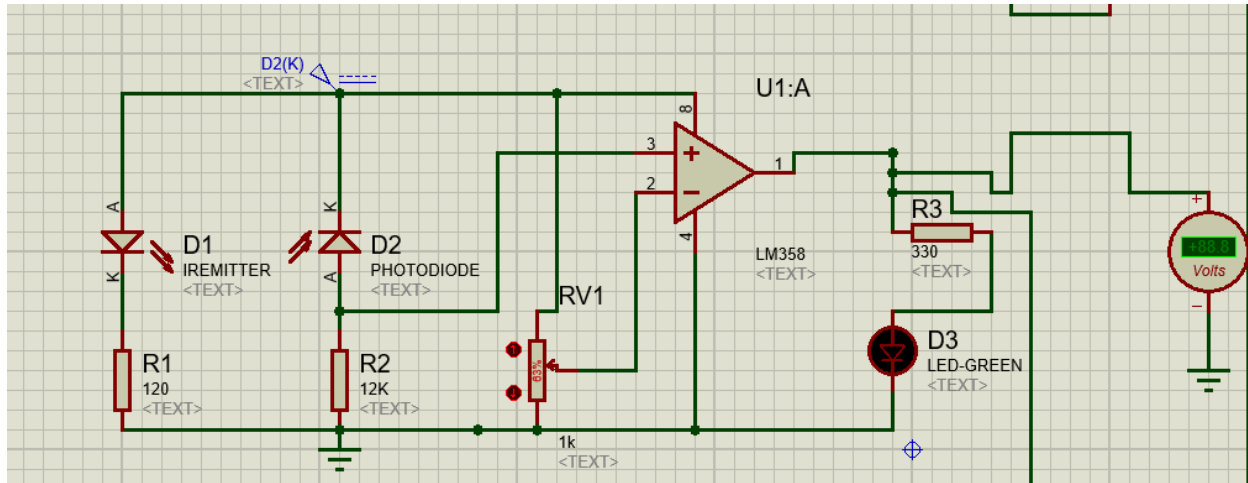


Figure 23

Figure 23 is the IR sensor circuit that was built by using proteus. The circuit components are:

- IR LED (the emitter)
- Photodiode (the receiver)
- Resistors
- Variable resistor
- LM358
- Green LED

The photodiode is connected in reverse bias and the variable resistor is to adjust the sensitivity of the sensor is connected to the inverting end (pin2) of the LM358. Also, pin 3 is connected to the junction of photodiode and resistor.

When there is rain on the windshield the IR LED is going to reflect to the photodiode then the resistance of the photodiode will be low and the current flowing in reverse bias.

When the reflection of the light falls from the IR LED to the photodiode, the voltage across the photodiode drops and across the R2 increase which is connected with the non- inverting pin of the comparator, then the output of the comparator becomes high or 5V and light up the green LED.

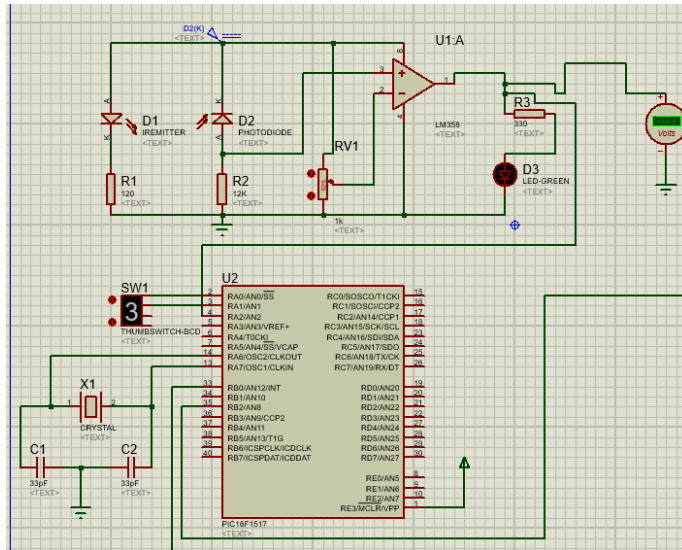


Figure 24

This figure is showing how the IR sensor is connecting with the microcontroller. The IR sensor is connected with pin4 of the PIC16F1517 as input. To simulate the IR sensor on proteus, the variable resistor can be adjusted, the green light will remain green (output) until the windshield has been cleaned in reality or the variable resistor is adjusted again.

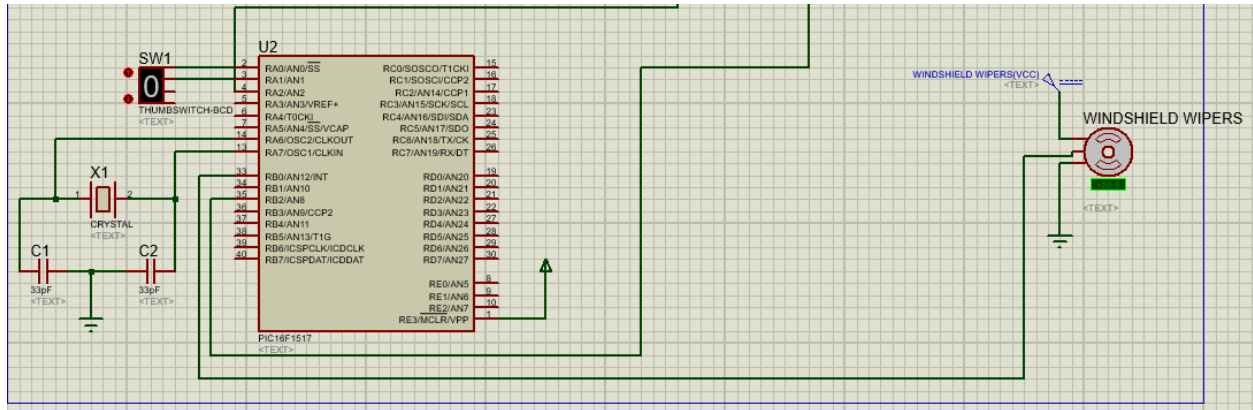


Figure 25

Figure 25 is of how the servo motor is connected to the microchip in pin 33. The servo motor is controlling the movement of the windshield wipers.

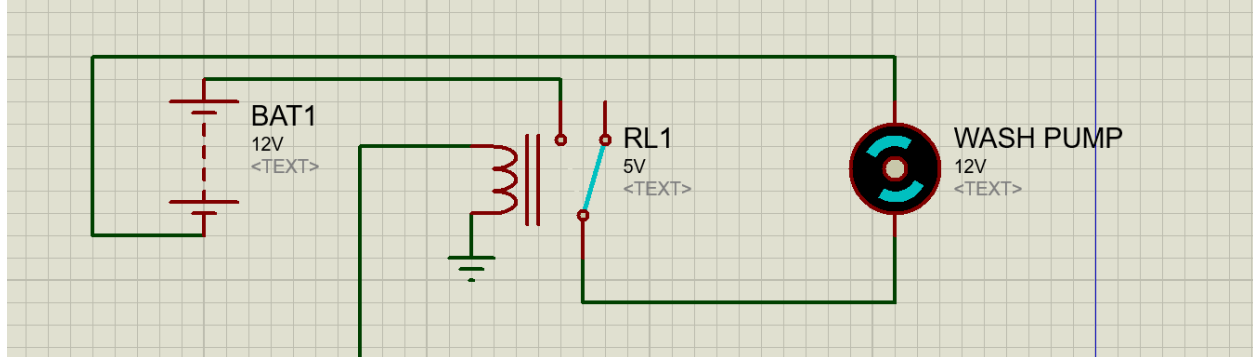


Figure 26

Figure 26 is the DC motor or the wash pump. The DC motor is required a 12V whereas the output voltage from the pic is 5v, for that reason the motor is connected to the pic through relay and battery.



4.7 MikroC PRO

The Mikro C has been used to program the PIC microcontroller. A fair amount of research was done to gain the understanding of using this programming language. The PIC microcontroller is used to set the IR sensor or the rain sensor as input. Therefore, the motors are the outputs.

4.8 Pic programming

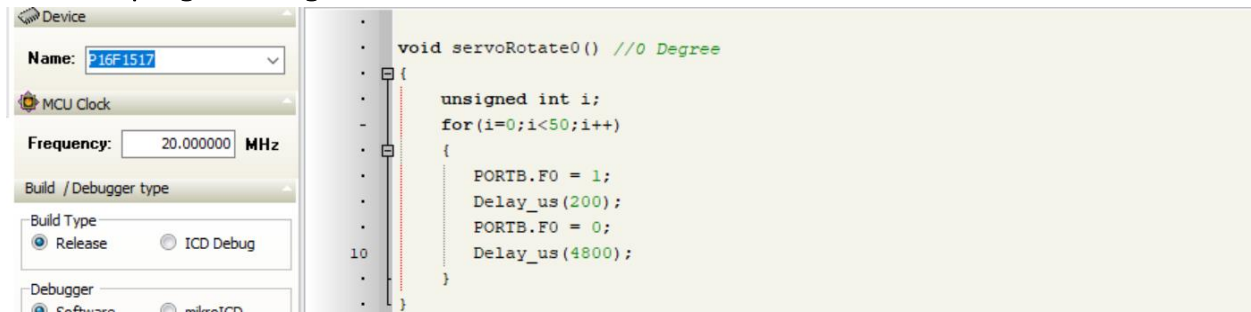


Figure 27

Firstly, Pic16f1517 is the one is used and programmed. In figure 27 is showing the 0 defining function to the microcontroller or when the servo motor is on 0 mode.

PORTB.F0 is the pin that is going to the servo motor.

When **PORTB.F0** equals 1 then the voltage on the motor is high for two hundred us, otherwise if **PORTB.F0** equals 0 it stays on zero for four thousand and eight hundred us then it goes back to mode one. This is to resume for fifty times.



```
13  . void servoRotatel80() //180 Degree
    . {
    .     unsigned int i;
    .     for(i=0;i<50;i++)
    .     {
    .         PORTB.F0 = 1;
20     .         Delay_us(2200);
    .         PORTB.F0 = 0;
    .         Delay_us(17800);
    .     }
    . }
```

Figure 28

This step is defining the mode when the servo motor is on one hundred and eighty degrees.



```
- int i =0;
. int state = 0;
. void main()
. {
.     TRISB = 0b00000010;
30     TRISA = 0xff;
.     ANSELB = 0;
.     ANSELA = 0;
.     PORTB.B2 = 0;
.     while(1)
- {
```

Figure 29

Int i and int state are variable memory.

Void main means that it is a loop function.

The **TRISB = 0b00000010**; means line B of the pic microcontroller is all output pins except of one input and it has not been using.

The **TRISA = 0xff**; that line A of the pic microcontroller is all inputs pins.

ANSELB = 0; and **ANSELA = 0**; these two are if condition.

PORTB.B2 = 0; portB2 is the dc motor pin and in this function is when the dc motor is off.



```
while(1)
{
    state = (PORTA & 0x03);
    if(state == 0)
    {
        servoRotate0(); //0 Degree
        PORTB.B2 = 0;
    }
    else if(state == 1)
    {
        PORTB.B2 = 1;
        Delay_ms(1000);
        PORTB.B2 = 0;
        for( i = 0 ; i<2; i++)
        {
            servoRotate0(); //0 Degree
            delay_ms(500);
            servoRotatel80(); //180 Degree
            servoRotate0(); //0 Degree
            delay_ms(500);
        }
        delay_ms(2000);
        servoRotate0(); //0 Degree
        servoRotatel80(); //180 Degree
        servoRotate0(); //0 Degree
        delay_ms(500);
    }
}
```

Figure 30

while(1)

{

state = (PORTA & 0x03);

The state or the memory is = to pin three or the thump switch

if(state == 0)

{

servoRotate0(); //0 Degree

PORTB.B2 = 0;

}

Which means when the thump switch that is connected to port A pin three is on zero means that the servo and DC motor are off.



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```
else if(state == 1)
{
    PORTB.B2 = 1;
    Delay_ms(1000);
    PORTB.B2 = 0;
```

The DC motor is to stay on for one thousand ms and go off again.

```
for( i = 0 ; i<2; i++)
{
    servoRotate0(); //0 Degree
    delay_ms(500);
    servoRotate180(); //180 Degree
    servoRotate0(); //0 Degree
    delay_ms(500);
}
delay_ms(2000);
servoRotate0(); //0 Degree
servoRotate180(); //180 Degree
servoRotate0(); //0 Degree
delay_ms(500);
}
```

This means that if the thump switch is on mode 1 then the servo motor will wait on the 0 degrees for 500ms then goes to 180 degrees and go back to 0 degrees for 500ms and this action will repeat 2 times.

Then the servo motor will be off or on 0 degrees for another 200ms and go on again to 180 degrees then 0 degrees and wait for 500ms if the state or the mood is still same, then it will repeat doing same procedure.



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```
else if(state == 2)
{
    PORTB.B2 = 0;

    servoRotate0(); //0 Degree
    servoRotatel80(); //180 Degree
    servoRotate0(); //0 Degree
    delay_ms(500);
}
```

Figure 31

If the thumb switch is on the 2 mode or the manual mood, then the DC motor will be off and the servo motor will be moving from 0 to 180 and back to 0 degrees. And the 500ms delay is to check if the state still the same then keep repeating the same thing or change to the next mood.



```
else if(state == 3)
{
    if(PORTA.B2 == 1)
    {
        PORTB.B2 = 1;
        Delay_ms(1000);
        PORTB.B2 = 0;
        for(i = 0;i<4;i++)
        {
            servoRotate0(); //0 Degree
            servoRotatel80(); //180 Degree
            servoRotate0(); //0 Degree
            if(PORTA.B2 == 0){
                break;
            }
        }
    }
    else if(PORTA.B2 == 0){
        servoRotate0(); //0 Degree
        PORTB.B2 = 0;
    }
}
```

Figure 32

Then this is the last mode or state which is number 3

if(PORTA.B2 == 1)

If it was on mode 3 and PORTA.B2 which is the IR sensor was on, then the DC motor will be on for a second then the servo motor will start moving from 0 to 180 degrees back to 0 for 4 times and go again and do the procedure.

break;

however, if the IR sensor is off or PORTA.B2 is zero then the servo and DC motor is off as well.



1. Press on the PIC microcontroller

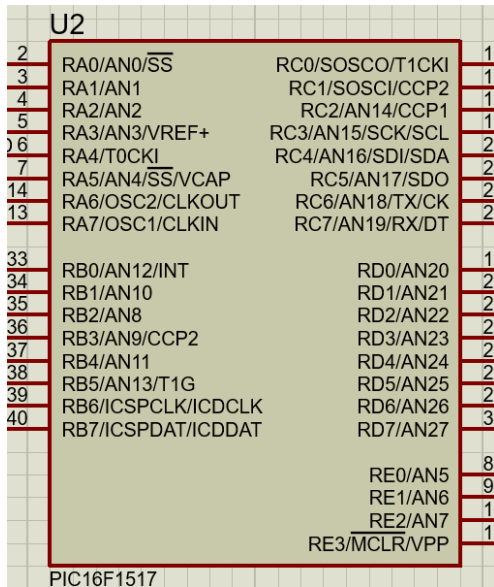


Figure 33

2. Upload the hex file on the program file and press ok.

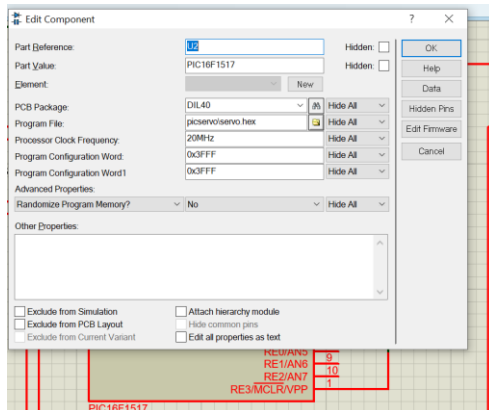


Figure 34



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5 Chapter 4 Analysis

5.1 Wiping action

There is 4 position for the windshield wiper system that have been designed with different speed and they are the zero position, or when the windshield wiper is off. The second position which is known as number 1 position on this system or the windshield cleaning position. The third position is the manual position. Finally, the automatic position.

In order to avoid “false operations” or triggers, the driver will have to switch on the system anytime they want it to operate. This is because if the system is left to be autonomous, then the infrared transmitter will be sending out signals all the time. The signal will then be reflected off the surface of the windscreen and will reach the sensor. If this happens, then the wipers will be activated even though there is no rain. Therefore, the system should only be switched on when required. Sometimes, the driver may need to wash the windscreen using water that is poured on it. In order to wipe it, the wipers can be switched on as well so that they can assist in the cleaning process. This is the reason why the activation of the system is solely left to the driver so that he or she may choose when to enable the wiping action.

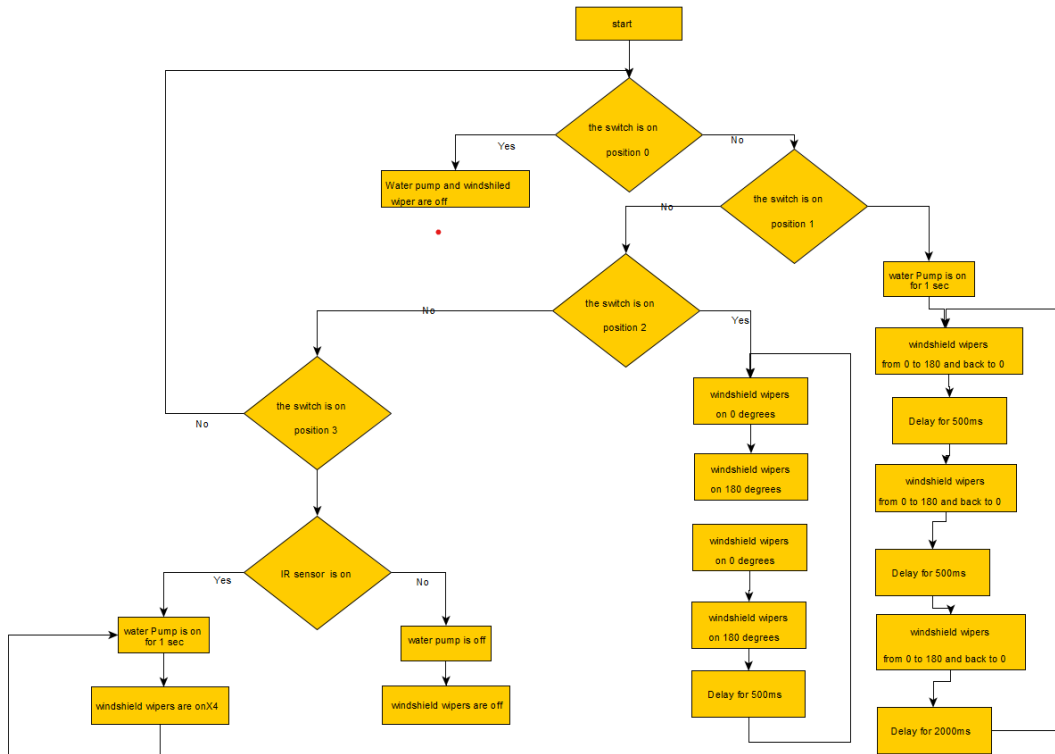


Figure 35

Figure 34 is showing the flowchart that was created for the wiping action.



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5.2 Recommendation

In the beginning the idea of the project was aiming to adjust the speed of the wipers by determining the thickness of the liquid film. To do this, infrared light will be allowed to fall on the windscreen of the car. It will be placed at such an angle that the reflected beam goes directly into an infrared sensor, which is still going to be done in the current project. The sensor generates a voltage signal that is directly proportional to the amount of infrared light falling on it. The voltage signal is then measured by a microcontroller.

In order to determine the relationship between the amount of voltage generated by the infrared sensor and the thickness of the water film, an experiment would be performed to characterize the voltage generated as a function of the depth of a water film. A mathematical model would be derived from the experiment. Then, to program it using a microcontroller so that the depth of the water film can be calculated from the voltage generated by the infrared sensor.

This system could be much more reliable and efficient when compared to normal uncontrolled wipers. It is very difficult to optimally control the speed of a wiper manually so that the speed is neither too fast nor too slow for wiping. This is the motivation for this project.



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5.3 Conclusion

In conclusion, the report was divided into 6 sections. First section is the introduction section, this is including the history and background of the project as well as basic idea of the what the reader going to aspect to see in the report. As well as including the planning by creating a Gantt chart to divide the project into time scale that could help the Author to stick on date and do it in time and more relaxed.

The second section is methodology, this section is going to define the different methods and the methods that has been used.

The third section is the Research & Review of Literature. This including all the research that was done to sensor available on the market by comparing them and choose the one that work best for this purpose and including a brief about them. Also, including selection of components and highlighting the one that meet the requirements to be used. Furthermore, it is including the cost of the full project.

The fourth suction is the designing section, which is including the designing that was done by using proteus and giving a description of the principles of working for the designing.

The analysis section which included the result and description, recommendations, the evaluation and finally conclusion.

The last section is the reflection of the project.



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5.4 Evaluation

There are certain components and module that is used for the windshield wipers system. Most of them have worked well and as planned such as the servo and DC motors.

The IR module worked as required. However, the downside of this type of sensor it can detect any object pass through the windshield and this could cause a damage in the windshield and the wipers. Therefore, the water pump will operate before the windshield wipers.



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Chapter 6 Reflection

In the beginning I did not have any idea of what to do and I was a bit concerned but one I thought of something can be interested to me I thought of my car and came up with idea of designing Automatically operation windshield wipers using microcontroller. Working on whole project was not easy. This year was not normal year for me, and I think for all students as it was fully online. I also thought in the beginning of the year, it would be much harder than how it went in reality because I do not have any experience of presenting project or working on a product.

The system works well using the IR sensor and PIC16F1517. It has 4 modes, they are the off mode, cleaning, Manual and Automatic mode. This seems to be well-accepted and useful in practice, in my opinion.

The knowledge of using the proteus have helped me to design the circuit easily. Also, that I would like to mention that Before starting the design I did not have idea of how to program the microchip, doing the research helped a lot to get knowledge of using MiKroc programming language.

The project could be improved by building the circuit, but I was not able to do it because I did not have the enough components.

Finally, I am happy with what I have done so far and feel proud of it.



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