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Programmable Logic Controller based Automatic Car Washing System

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Abstract

Technology is best interconnecting channel in each part of world with the means of transportation or communication or business which led to a highly increase in the number of cars. Time consumption is essential for cleaning these vehicles or cars etc. Time management is directly proportional to reduction of cost for maintenance.

The automatic way is used for man to perform tasks at higher speed. Automatic car washing system is very common in developed countries. It consists of large machines with automated brushes controlled by programmable logic controller (PLC). Automatic car washing system is fully automated with different stages of washing, foaming, brushing, washing, drying. This system has used various components such as PLC SIEMENS, conveyor belt, sensors, dc motors, brushes and dry fans. These components are controlled by programmable logic controller (PLC). In this system, ladder diagram is written for using PLC. Indexed Terms - DC motors, Ladder Diagram,

As well as automation has become a basic requirement in this developing world. Today in this present era, automation helps us to save time, expense as well as manpower. It is significant to have a smooth and effective system to sustain the cleanliness of the vehicle. The automatic vehicle washing machine concentrates on the car washer system using PLC. The automatic vehicle washer

system has three capital processes namely washing, cleansing, and drying. Hence the external of the vehicle will be washed by detecting the vehicle on a conveyor belt and further controlled by PLC. An automatic vehicle washer is served with the usage of a conveyor belt which carries the vehicle. Proximity sensors are used for detecting the vehicle, which is placed in their positions according to the functioning of the washer. As soon as the vehicle is sensed, the functioning of the conveyor assembly invokes. With the predefined time delay, the conveyor gets suspend. Vehicle washer technique is the combination of different functions that performs scattering the solution of detergent water, then cleaning with normal water and finally wiping the wetness using cotton brushes. Vehicle washing can be done where vehicles are parked for a long time and washing cars can be done easily like fuel filling stations, supermarkets, hospitals, government buildings, railway stations and can also be widely used in service stations and manufacturing units. The type of PLC used in the design is LSIS G7MDR20U

Introduction

In today's modern industrial environment, the surface of a vehicle is subjected to daily abuse. Automatic car washing techniques vary amongst individual car owners. Automatic car washing is an essential function of preventive maintenance. There are many types of car washes like manual car wash where the vehicle is washed by employees, self-services car wash where the customer has to perform the washing and chemical car washes which use chemicals to wash and polishing the car surface and etc. In all

automobile Industries manual car washing need more labor to carry out work which effects in time consumption and also the results may or may not be satisfactory to the customer that depends. So as to overcome these issues, automatic car washing can be done automatically using Programmable Logic Controllers (PLC).

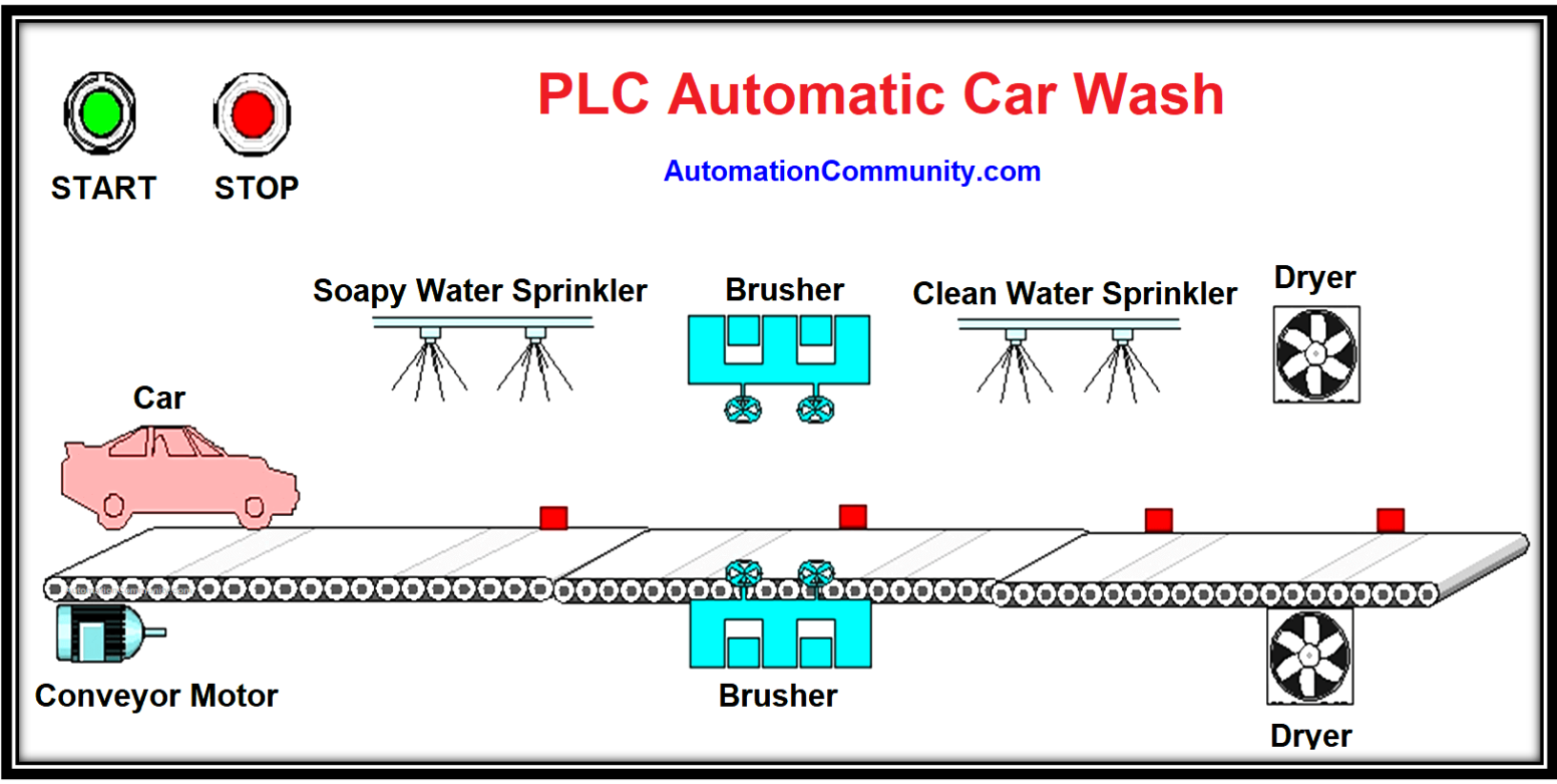
The main objectives of this paper are to study the function of the PLC, the programming language for PLC to control the system and the operation of automation car washing machine. And then, there are five programming language for PLC.

PLC based Automatic Car Washing System The vehicle washing system is the simple technique of preventive maintenance or to keep the exterior of the vehicle clean. To prevent rust, oxidation, and reduce the occurrence of fine scratches, the exterior of a vehicle must be kept clean. This system helps clean the vehicle automatically with the help of a Programmable Logic Controller (PLC). This process is done in two steps namely washing and cleaning. Washing also involves three processes where the clean water is sprayed over the vehicle initially then the detergent water is sprayed and again, the normal water is sprayed. This is then followed by cleaning. In the cleaning process

Tools used in this project

1. PLC
2. IR Sensor
3. Push-Button Switches
4. Conveyor Belt and motor
5. Contactors L DC Motor
6. Relays

7. Water Pump
8. Soap Tank
9. Water Tank
10. Soap Pump
11. Brushes
12. 24V 2A DC Power supply – SMPS
13. Dc motor
14. Cooling fan

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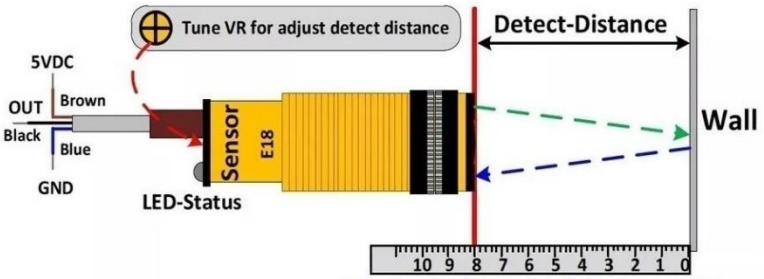
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Detect-Distance
5VDC
OUT
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Black
Blue
GND
Sensor
E18
LED-Status
Wall
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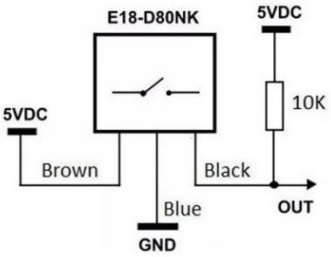
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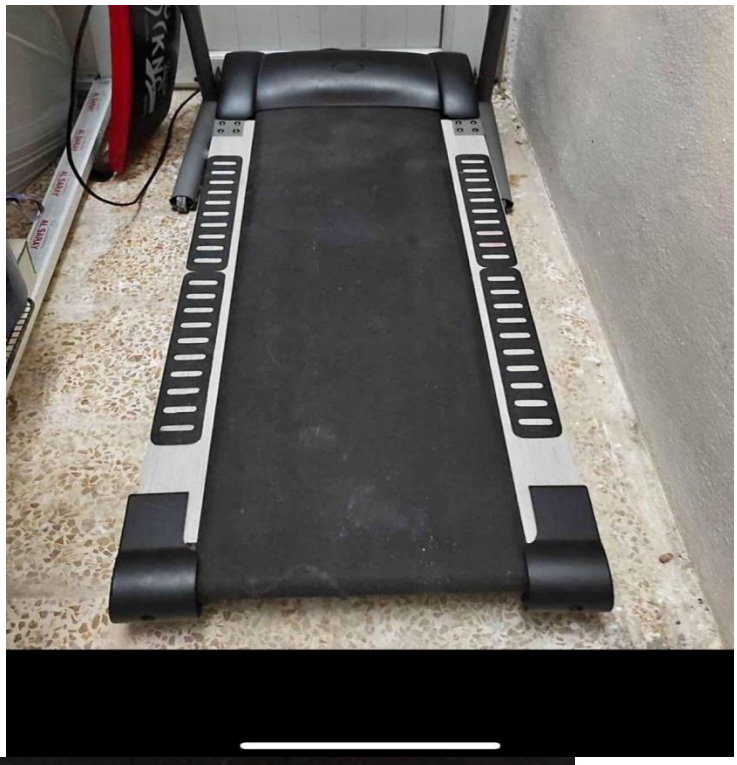


AUTOMATIC CAR WASHING SYSTEM

With the modern convenience of automatic car washes, it may be difficult to remember that the industry was not always so high-tech. Though, other commercial car washes came before it, the first semi- automatic car wash in the United States made its debut in 1946, and from there, the industry has grown in both size and sophistication. The start of the history of car washing dated back into 1914. The first semi-automatic car wash was active for the first time in Detroit, Michigan using automatic pulley systems and manual brushing. Many things had occurred within 1955 regarding car washing history. In 1957, he formed the Hanna Enterprises and eventually reached about 31 car washes in America. In 1959, Hanna operated his wash rack until he made the first mechanized car washing system. As the news spread throughout the city, so did his business. In 1960s, Hanna Enterprises had established itself as the main source innovator and the manufacturer of car washing equipment and materials. Over time, Hanna had made several machines that will be the first to do the main requirements over car washing, this includes the Wrap-Around Brush, Roller-on-demand Conveyor belt, soft cloth friction washing, several ways to wash the tires, and a recirculating water system. With that said, Hanna Enterprises have become the largest vehicle washing equipment manufacturer. In the 1970s it was a difficult time for the car washing industry, as the result of the gasoline prices increasing rapidly.

PLC

A Programmable Logic Controller, or PLC for short, is simply a special computer device used for industrial control systems. They are used in many industries such as oil refineries, manufacturing lines, conveyor systems, and wherever there is a need to control

devices the PLC provides a flexible way to " soft wire" the components together.

The basic units have many input and output pins, a CPU (a computer processor Unit) that is dedicated to run one program that monitors a series of different inputs and logically manipulates the outputs for the desired control and memory (RAM and ROM) for stores status information for input and output devices, along with values for timers, counters, and internal devices. PLCs require a Programming device to upload data onto the CPU like a computer. They are meant to be very flexible in how they can be Programmed while also providing the advantages of high reliability (no Program crashes or mechanical failures), compact and economical over traditional control systems.

➢ Principle of Operation

The operation of the programmable controller is relatively simple. The system is physically connected to the field device that is encountered in the machine or that is used in the control of a process. These field devices may be discrete or analog input/output devices such as limit switch pressure transducers, push buttons, motor starters, solenoids……etc.

The I/O interfaces provide the connection between the CPU and information providers (input) and controllable device (output). During it is an operation, the CPU completes three processes • It reads or accepts, the input data from the field devices via the input interfaces.

• It executes or performs, the control program stored in the memory system

• It writes, or updates, the output devices via the output interfaces This process is known as scanning, Figure below illustrates a graphic representation of the scan

PLCs versus Other Types of Controls The industrial control system or ICS comprises of different types of control systems that are currently in operation in various industries. These control systems include PLC, SCADA and DCS, and various others.

HARDWARE IMPLEMENTATION

Fig. 2 shows the overall circuit diagram of the purposed system. The Programmable Logic Controller (PLC) is the main part of the system. In this system, PLC ( ) is used to control the function of automatic car washing system. It has input 10 pins and output 14 pins.

The main objectives of this paper are to study the function of the PLC, the programming language for PLC to control the system and the operation of automation car washing machine. And then, there are five programming language for PLC.

➢ PLC Advantages for this project

• Flexibility: One single Programmable Logic Controller can easily run many machines.

• Correcting Errors: In the old days, with wired relay-type panels, any program alterations required time for the rewiring of panels and devices. With PLC control any change in circuit design or sequence is as simple as retyping the logic. Correcting errors in PLC is extremely short and cost-effective.

• Space Efficient: Today's Programmable Logic Control memory is getting bigger and bigger this means that we can generate more

and more contacts, coils, timers, sequencers, counters, and so on. We can have thousands of contact timers and counters in a single PLC. Imagine what it would be like to have so many things in one panel.

• Low Cost: Prices of Programmable Logic Controllers vary from a few hundred to few thousand. This is nothing compared to the prices of the contact and coils and timers that you would pay to match the same things. Add to that the installation cost, the shipping cost, and so on.

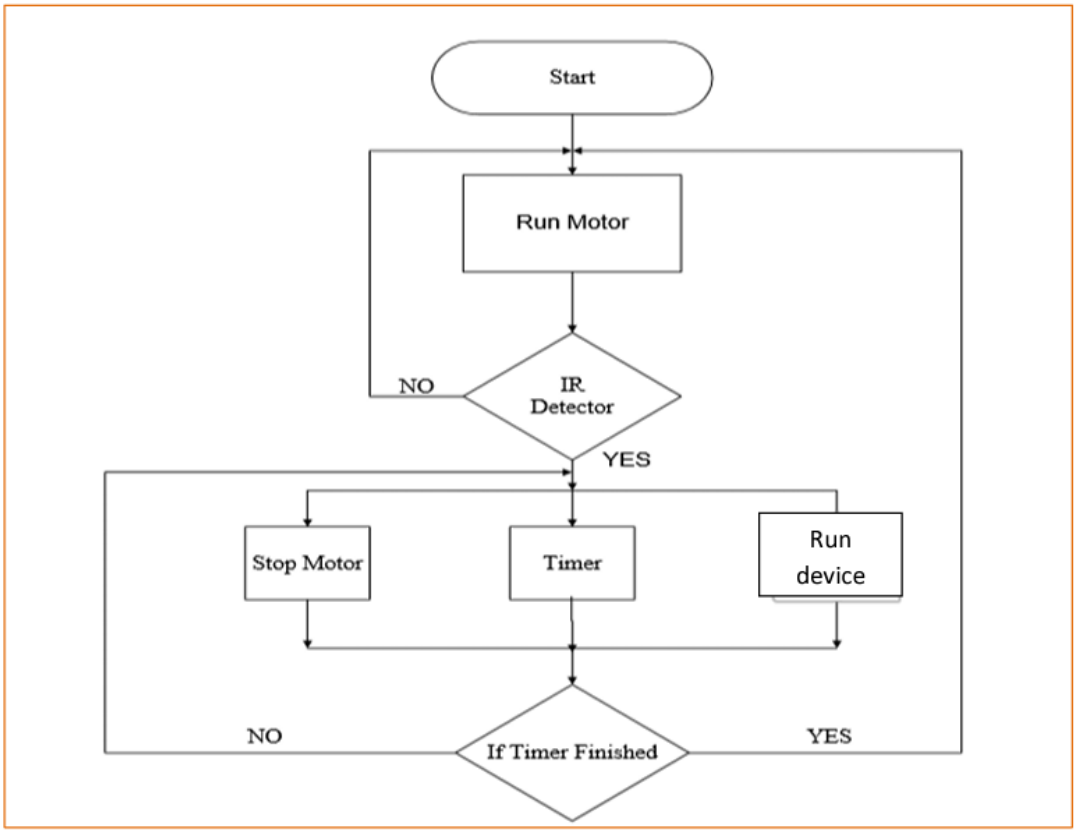


Fig. 2: flow chart of the project

➢ PLC Programming Language

• (LD) Ladder Diagram

• (LI) List Instruction

• (SFC) Sequential Function Chart This project will be talking about LD only, because it is the language that we used to program the PLC unit, by using GMWIN Software.

➢ Ladder Diagram

Ladder logic was originally a written method to document the design and construction of relay racks as used in manufacturing and process control. Each device in the relay rack would be represented by a symbol on the ladder diagram with connections between those devices shown. Besides, other items external to the relay rack such as pumps, heaters, and so forth would also be shown on the ladder diagram. Ladder logic has evolved into a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. Ladder logic is used to develop software for programmable logic controllers (PLCs) used in industrial control applications. The name is based on the observation that programs in this language resemble ladders, with two vertical rails and a series of horizontal rungs between them.

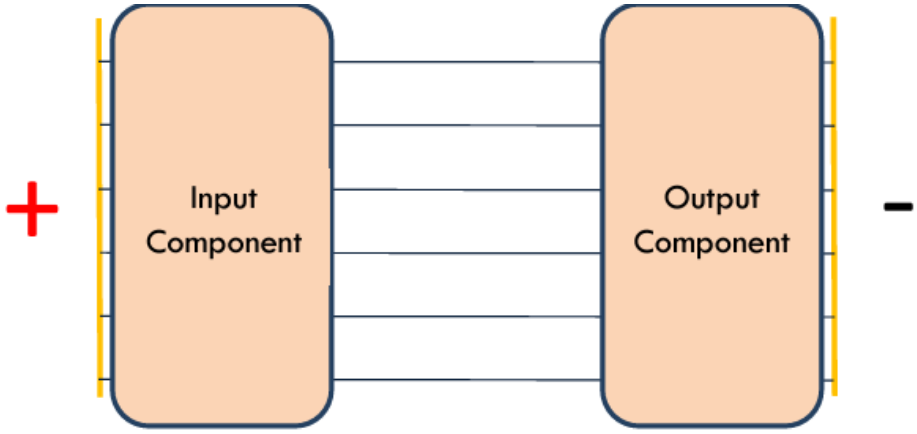


Fig. 3: LD

IR Obstacle Avoidance Proximity Sensor E18-D80NK

Description:

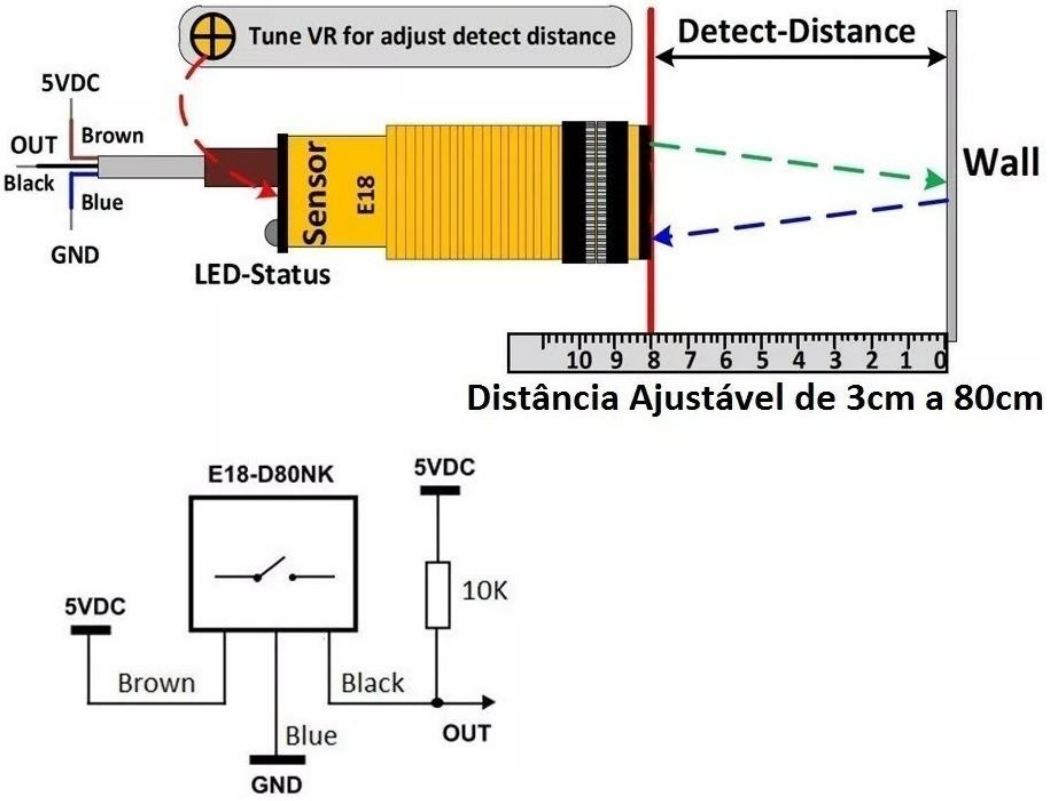
E18-D80NK IR Obstacle Avoidance Proximity Sensor E18-D80NK adjustable IR Infrared Proximity Sensor Switch features an IR sensor.

The E18-D80NK adjustable IR Infrared Proximity Sensor Switch features an IR sensor that can measure distance between 3 to 80 cm. It features an easy to mount chassis, making prototyping much simpler.

The infared proximity switch module is a reflection-type photoelectric sensor which integrates transmitting and receiving infared beams function. Infrared proximity switches work by sending out beams of invisible infrared light.

A photodetector on the proximity switch detects any reflections of this light.

These reflections allow infrared proximity switches to determine whether there is an object nearby.



Specification:

Diffuse reflective type

Light source: Infrared

Sensing range: 3cm to 80cm (depends on obstacle surface)

Input voltage: 5VDC

Current consumption: 100mA

Dimension: 1.7cm (D) x 4.3cm (L)

Type :DC 3 Wire NPN-NO (Normal Open)

Sensory distance regulator and output LED indicator

Control signal level: High2.3V≤Vin≤5V Low-0.3V≤Vin≤1.5V

TESTS AND RESULTS

1/washing the car with water. When car reaches in front of the sensor 1, sensor 1 detects the car and conveyor will stop. Water pump motor 1 will operate and water sprinkle will open 10 seconds.
After 10seconds, sprinkle will close automatically and conveyor is driving to the next section.

2/washing the car with soap water. When car reaches soap wash section, sensor 2 detects the car and conveyor will stop. Soap water pump motor will operate and water sprinkle will open 10 seconds. After 10 seconds, sprinkle will close automatically and conveyor is driving to the next section (Brush).
Fig. 16 shows car brushing with brushes. When car reaches brush section, sensor 3 detects the car and conveyor will stop. Brush motor 1 and 2 are operated 10 seconds. After 10 seconds, conveyor drives to the next section.
3car washing with water again. When car reaches final wash section, sensor 4 detects the car and conveyor will stop. Water pump will operate and water sprinkle will open. After 10 seconds, sprinkle will close automatically and conveyor is driving to the next section.

4shows drying the car with dry fans. When car reaches dry section, sensor 5 detects the car and dry fans will operate. Start drying for 10 seconds. After 10 seconds conveyor is driving to the exit gate.

CONCLUSION

After working on the automatic car wash system, this system can come to conclusion that such automation system is quite beneficial and saving time of operation and also man power is reduced, improving the economy of the system. In the future, such type of automated systems will have more demanded. In this paper, SIEMENS PLC is used as the main component to control the washing parts of the system. It is necessary to known the function of each pin of PLC. PLC can perform many functions higher than the other integrated circuit. This PLC has many programming languages that can be accessed. Ladder diagram language is the most usable programming language for PLC. In this paper, Ladder diagram is used to program the PLC. The system that has built is a working on PLC controller, which should be compact, fast and accurate. This system may not have the features and reliability of the original designs. It is only being developed to ensure that the design is feasible, not impractical and can be implemented on a much larger scale in a more efficient way. The automatic washing system can be used in interior wash, and coin or token system. Also this system can implement a counter which will be allowing the number of cars washed to be counted.