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Automatic Car Washing System using PLC and SCADA

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ABSTRACT: The automatic car washing system explained in this project utilizes the PLC(DELTA DVP 14SS2) for its control and SCADA is installed on operator panel so the operator can monitor and control the whole process. This system minimizes the use of water and also manpower requirement. There are four process involved in this system- washing with foam, cleaning with brushes, washing with water and drying using fan. Using this automatic car washing system, many cars can be washed and it will save time, energy and manpower. Such systems can be installed anywhere such as malls, airports, railway stations, residential buildings etc.

KEYWORDS: Automation, PLC(DELTA DVP 14SS2), Relay module, IR sensor, SCADA.

I. INTRODUCTION

Car washer is single activity done in order to keep the exterior of the car clean. Mostly it is done manually in locomotive garage, this manual way of cleansing car arise in more waste of water, manpower and time. The automatic car washer system diminishes the utility of water and also manpower need. Our car washer system utilizes control using PLC. There are four procedures involved in our car washer system namely wash with foam, cleansing through brushes, final cleaning and drying. A PLC is a controller which can control most of the machines very easily. Installing a program and setting it up is very easy in a PLC. The programs written in ladder language can be authenticated and checked before ultimate installation and also it can be edited at any time without disturbing any physical apparatus of the project. The best part of using a PLC is that it does not need any typical wiring and rewiring if some changes are made in the previously installed program. A programmable logic controller performs mainly three functions which are continuously repeated in a proper sequence. The three main functions are (1) Testing the input (2) Execution of the program (3) Updating the output. In a PLC there is a provision of input terminals for connecting the input devices and output terminals for connecting the output.

II. BLOCK DIAGRAM

The main components of Automatic Car Washing System using PLC consists of :

- PLC(Delta DVP 14SS2)
- 4 channel relay module
- IR sensors
- Conveyor
- Soap Pump(Solenoid valve)
- Brushes
- Water pump(Solenoid valve)
- Drying Fan
- 24v Adapter for PLC
- 5v Adapter for sensor and relay module

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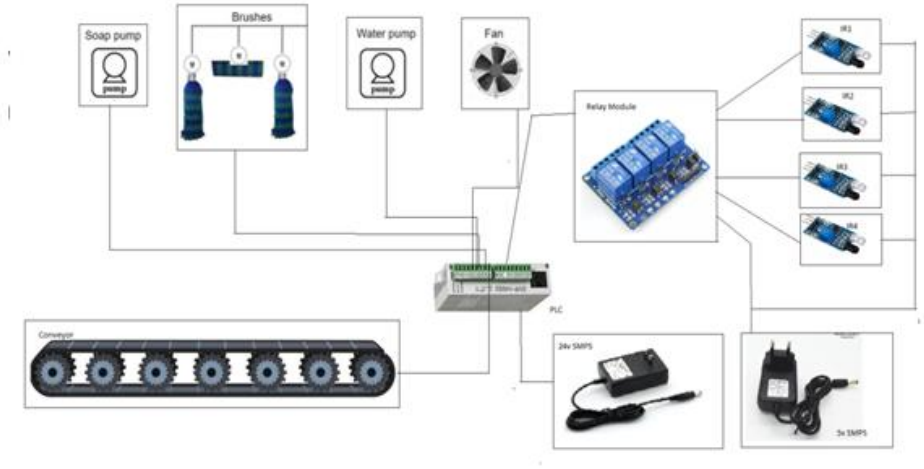

Figure 1: Block Diagram of Automatic Car washing System using PLC

A 230V AC Supply is given as input to the SMPS for obtaining 24V DC, since PLC can operate at 24V DC. Terminal Block is used for multi inputs and outputs. PLC is connected to PC through RS-232 communication cable for downloading or uploading the program. Conveyor is used for shifting the car through various stages of washing. We use 100 rpm DC motors for driving the conveyor belt via pulley and for driving brushes When conveyor`s components are in good condition and well aligned, it will operate properly. Proper clamping of car wheels on the conveyor is needed in order to avoid displacement. Generally brushes are now either cloth (which is not harmful to a cars finish, as long as it is flushed with plenty of water to remove the grit from previous washes), or a brush, which does not hold dirt or water. Thus it does not harm any painted finish. It provides a gentle polishing effect to leave the paint much shinier. High pressure nozzles are pointed at various position for spraying soap solution and water to clean difficult to reach parts of the vehicle. At the end, hot steam air is generally used for drying the car. Construction of this system is depends upon the requirement. A visual programming language known as the Ladder Logic was used to program the PLC. An Infrared sensor is used which emits radiation in order to sense presence of car at the entry level. Once the Infrared radiation is cut by the car an input signal is given to PLC. Switches are present in the HMI screen. As an input signal is received, PLC starts executing the Ladder Program. First the conveyor moves by fixing a timer for few sec. After that, it stops at the stage of washing. In general process, Car is cleaned by spraying soap solutions, rinsing, brushing, drying, waxing, etc. Depends on the requirement of customer. We have chosen spraying water, Brushing and finally drying for cleaning the car. Each activity is carried out for a certain time period. Water is sprayed for few sec and nozzle is closed. Then four brushes rotate for few sec and stops. Now the conveyor starts moving to next stage. After few sec, it stops for drying. Two fans are used for drying the car up to few sec. Then the conveyor carrying car moves to the exit level. Again an IR sensor senses the car and sends an input signal to Programmable logic controller. Timings are set by using timers in ladder programming. These timings can be varied depending upon the requirement.

1. PLC(Delta DVP 14SS2):

The PLC can be classified as a solid-state member of the computer family. A programmable controller is an Industrial Computer in which control devices such as limit switches, push buttons, proximity or photoelectric sensors, float switches or pressure switches and few incoming control signals called Input. Input interact with instructions specified in the user ladder program, which tells the PLC how to react to the incoming signals. The user program also directs the PLC on how to control field devices like motors, solenoids etc. A programmable controller, as illustrated in Figure, consists of two basic sections:

• CPU (Central Processing Unit)
• Input/output interface system

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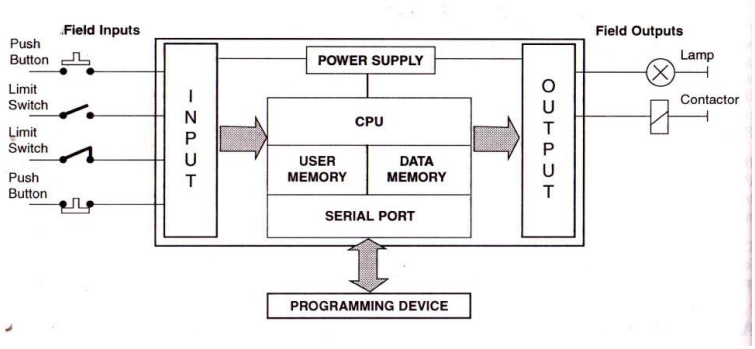

Figure 2: Block Diagram of PLC

For this project we are using the 2nd generation DVP-SS2 series slim type PLC keeps the basic sequential control functions from the DVP-SS series PLC but with faster execution speed and enhanced real-time monitoring capability.

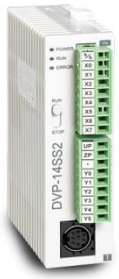

Figure 3: Delta DVP 14 SS2 PLC

2. 4 Channel relay module:

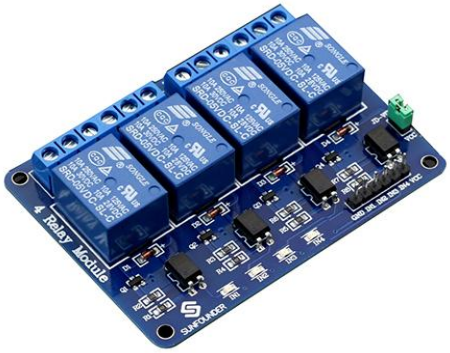

Figure 4: 4 channel relay module

This is a 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller.

Pin Description:

Input:
VCC: Positive supply voltage
GND: Ground
IN1--IN4: Relay control port

Output:
Connect a load, DC 30V/10A, AC 250V/10A

Features:

- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Weight: 61g
- PCB Color: Blue
- There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm
- High quality Single relay is used with single pole double throw, a common terminal, a normally open terminal, and a normally closed terminal
- Optical coupling isolation, good anti-interference.
- Closed at low level with indicator on, released at high level with indicator off
- VCC is system power source, and JD_VCC is relay power source. Ship 5V relay by default. Plug jumper cap to use
- The maximum output of the relay: DC 30V/10A, AC 250V/10A

3. IR sensor:

An infrared sensor is an electronic device which is used to sense fixed characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also efficient of measuring the heat being eject by an object and detecting motion. This sensor basically runs on 5v supply so a relay is connected in order to give that 5v signal to PLC. So, whenever a car is detected this IR sensor gives the signal to PLC hence while further application i.e., a drizzle of water and drying is done automatically

Figure 5: IR sensor

Pin Configuration

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

IR Sensor Module Features

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

4. Conveyor Belt:

That moves materials starting with one area then onto the next. Transports are particularly helpful in applications including the transportation of substantial or massive materials. Transport frameworks permit snappy and productive

transportation for a wide assortment of materials. In this project conveyor belt is used in order to reach car in different stages of washing.

Figure 6: Conveyor Belt

5. Solenoid Valve:

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid. There are many valve sketch variations. Ordinary valves can have many passageway and liquid paths. A 2-way valve, for example, has 2 ports; if the valve is open, then the two ports are joined and liquid may flow between the ports; if the valve is closed, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is name normally open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed normally closed.

Figure 7: Solenoid Valve

6. Dryer:

Fan is used for drying purpose. Car wash utilizes a soft water that has been filtered of chlorine and others. Drying machine are used with force to dry the washed car. We can also use Heat to get a dry car fast.

Figure 8: 24v DC Fan

7. Power Supply:

Any system works on the electric supply and this supply is deliver from the power supply .For automatic car washing system we requires a three specified voltage supply like 5v, 12v and 24v SMPS .first 5v supply is required for relay, IR sensor and 12v power supply is used for the working of RELAY and dc motors which are driving assembly as conveyor belt, shower operation, cleaning brushes, solenoid valve and it is parallel with the small pipes used to spray the water from bottom side to clean the car from its bottom side. 24v SMPS used to operate relays of PLC as well as switches to on and of the overall system.

Figure 9: 24v SMPS

III. HARDWARE MODULE AND WORKING DESCRIPTION

Figure 10: Hardware Module

The above figure shows the hardware module of Automatic Car Washing System using PLC. There are four procedures involved in our car washer system namely wash with foam, cleansing through brushes, final cleaning and drying. The system follows these steps and cleans the exterior of the car with less man power and utility of water. The flowchart for the system is shown in below figure.

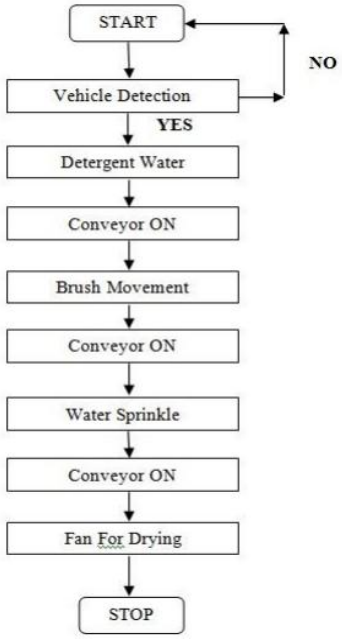

Figure 11: Flowchart

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Working of system:

Input-IR sensor:- When car comes on IR-sensor, sensor sense and conveyor starts moving with the help of motor until it will reach to the next IR sensor section As car reached to next IR section then entry gate start to open for 2sec.
Pre-Wash Section:- As the car reaches in pre-wash chamber, shampoo water falls on the car by opening valve (V1).Valve will remain on for 5 sec. After 5sec. valve will close automatically. Again conveyor starts moving until it will reach to the next IR sensor section(Brushing section).
Brushing Section:- As the conveyor stops vertical brushes starts brushing the car for10sec. and stop. Again conveyor starts moving until it will reach to the next IR sensor section(Clean wash section).
Final Wash Section:- Valve (V2) gets open for 5 sec. and get closed. Again conveyor starts moving until it will reach to the next IR sensor section(Drying).
Drying:- Start dryer for 10 sec. and stop. Exit:- After drying stage completion open exit gate with the help of motor for 2 sec. and stop. Again conveyor starts moving until it will reach to the next IR sensor section. Close the gate.

IV. SCADA

A Supervisory Control and Data Acquisition (SCADA) is a computer-based software service that offers the ease of monitoring of sensors placed at distances and controlling various industrial processes, from one central location. The SCADA for our project is shown below. It contains the conveyor belt, control valve, IR sensor, Tanks, Dryer and electric motors with the different washing sections namely prewashing, brushing, wheel brushing, washing and drying.

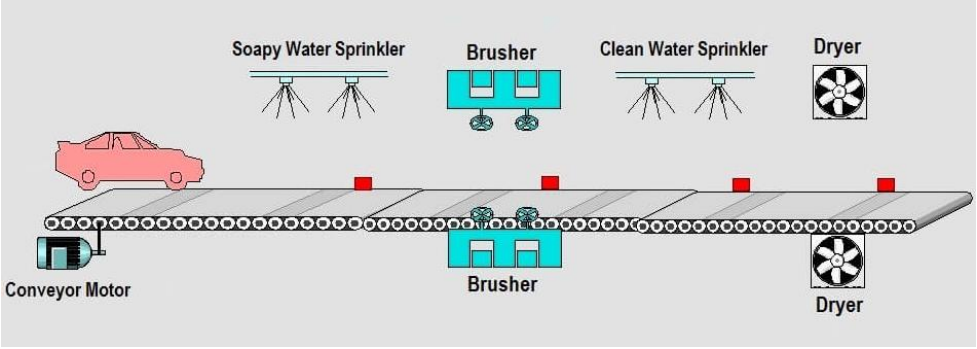

Figure 12: SCADA mimic

V.ADVANTAGES AND APPLICATION

5.1. Advantages

1. The entire system is automatic therefore, no need of manpower. The PLC entirely works digitally, it needs only mechanical assembly.
2. Can be use in domestic service stations, as there is no compressor & number of loud noise: At the domestic workstation if no compressor is there then this will also with the no sound pollution.
3. Very less maintenance: As we uses the PLC this is more durable than other electromechanical system.
4. Comparatively cost of system is less: if his system is more durable then its life is also as higher and as per the consideration of life this system have cost effective then other.
5. No. more space required. No. environmental pollution: the module of PLC is very small, so it does not require large space.

5.2. Application

1. In car manufacturing companies. After final assembly of car.
2. In service stations.
3. Car replacing and maintaining stations.
4. Car body building industry.

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VI.CONCLUSION

After fulfillment of the project car washer and dryer, we can conclude that such automation system is completely profitable, and preserving time of operation and also diminishes man power requirement, improving the economy of the system the future such example of system will have more demanded, Also the system is pollution free so it is implementable in market easily, and thus from this project we can conclude that the overall working of the system plays an essential role in smart city development ideas as for the city becomes smart the system gets easier and cost efficient as well as it has long life to become and look serviceable and effective for the washing center. The future enhancement can be done in this project is that the water which is wasted in car washing can be collected in the chamber under the conveyor and the same water can be used for further washes by filtering it.

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