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# Implementation of Smart Car Washing Using GSM PLC

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**Abstract:** The main objective of this paper is to perform exterior car washing automatically using Programmable Logic Controller integrated with GSM modem. GSM-PLC sends information like entry, exit of car, emergency conditions to the customer or operator through SMS. After acquiring the information from PLC, the operator can able to act upon it. Car washing includes Spraying of soap solution, cleansing with water, wiped by brushes and finished with forced air drying.

**Keywords:** Car wash, Programmable Logic Controller (PLC),GSM, Ladder Logic, HORNER PLC,SMS.

## I. INTRODUCTION

There are many types of car washes. Some of them are Hand car wash where the vehicle is washed by employees, Self services car wash where the customer performs the washing, Chemical car washes which use chemicals to wash and polishing the car surface etc., Nowadays automation has extended its hands in various fields. In automobile services manual car washing requires more labour effects, time consumption and also the results may not be satisfactory to the customers. In order to overcome this, car washing can be done automatically using Programmable Logic Controllers (PLC). PLCs are used for the purpose of industrial control as they are flexible and easy installation. Changes in programming can be made easy whenever required. In older systems, many electromechanical relays are used which was replaced by PLC. GSM PLC (Global System for Mobile communications) provides short message service (SMS) type of communications process that enables the transmission of short text message and data transfer to and from mobile devices such as cell phones. Hence by using this feature, the user can be notified in case of any emergency or about the completion of the process. This report presents how car can be washed automatically using PLC. Car washing requires components like conveyor, brushes, sprayers, driers which are driven by DC motors. Control of these components is made through PLC.

Research reports shows that the first automatic car wash appears in the late 1930s in which computerized POS mechanism is used. After paying the car is put into a line-up often called the stack or queue. The stack moves sequentially. After pulling up to the tunnel entrance, an attendant usually guides the customer onto the track or conveyor[3]. Later car washes includes some functions and control sequences. Till now no research activity was done on full automatic car wash based on GSM service. SMS communications provide an affordable and convenient means to send and receive data using mobile devices such as cell phones. Businesses and industry often require 24-hour coverage of their operations and have personnel to handle work-related issues and emergencies. There are operators who are responsible for the proper functioning of car washing systems. So they need to be notified of significant events[4]. So this research was carried out to attract the customers through GSM service.

## II. BENEFITS OF USING PLC

PLC can easily run many machines. When running a PLC program, a visual operation can be seen on the screen. Hence troubleshooting a circuit is quick, easy and simple. A PLC program can be tested, validated and corrected saving very

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valuable time. With wired relay type panels, any program alteration requires time for 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 short and cost effective.

### **III. WORKING OF PLC**

PLC is a microcontroller system that are specially designed to survive in harsh situations and shielded from heat, cold, dust and moisture etc. PLC can be used for storing instructions for the execution of logic, sequencing and timing to control various digital and analog inputs and outputs. The programs are written on a PC and then download by a cable over a network to the PLC and stored in non-volatile flash memory.

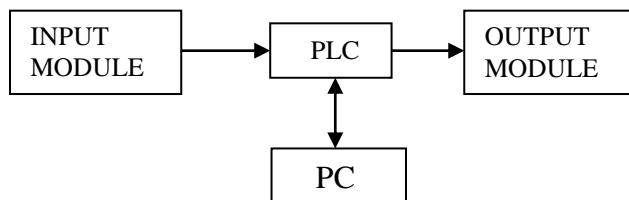


Fig. 1 Basic Block Diagram of PLC

The basic function of PLC is continuous scanning of a program. The scanning can be done in three steps. Testing the input, Execution of the program and Updation of the output. The PLC check each input to about its status whether it is ON or OFF. The input can be switch or sensor. When the input is activated, the information is stored in the memory. Program instructions are executed based upon the input status and an appropriate action is taken. The action is activation of outputs.

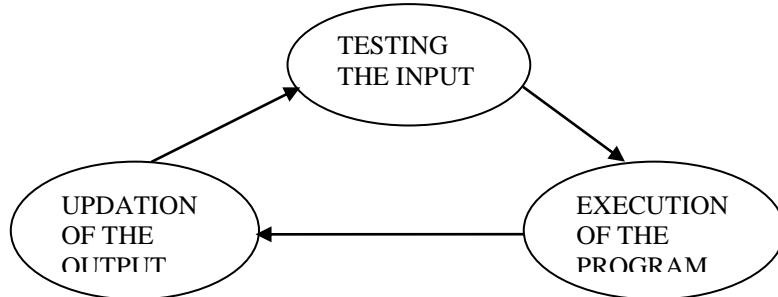


Fig. 2 PLC Scanning

### **IV. HORNER PLC**

For our application we are using HORNER XLE-103 with inbuilt human machine interface(HMI). It has 12 dc inputs and 12 dc outputs and 2 analog inputs. It is integrated with the GSM Modem Module HE-GSM04. Upto 32 messages can be send and receive with 20 variables per message. We can also able to control the process via SMS. The Software used is Cscape.

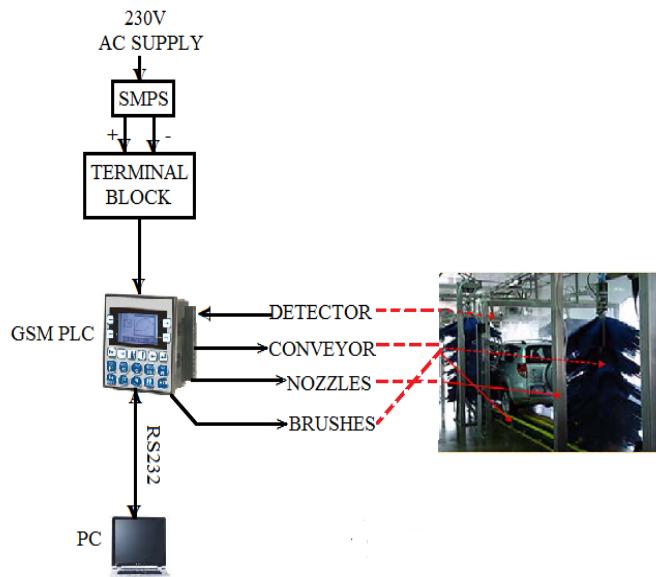
### **V. AUTOMATIC CAR WASHING SYSTEM**

The fig.3 shows the block diagram of Automatic Car Washing System. 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.

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**Fig. 3 Block Diagram of Automatic Car Washing System**

HORNER 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 car's 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 positions 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 depends upon the requirement.

A visual programming language known as the Ladder Logic was used to program the PLC. There are four symbols that are used in Ladder Logic; an Open contact, a closed contact, an open output or relay coil and a closed output. PLC can also include items such as Counters and Timers for programming.

The Fig.4 shows the sequence of the process. 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. PLC sends message to customer and operator to intimate that car is ready for washing using GSM modem. Operator can able to control the PLC through SMS and start the process. The options can be made such as starting the process through manual switch operations or by sending a message 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 30sec. 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.

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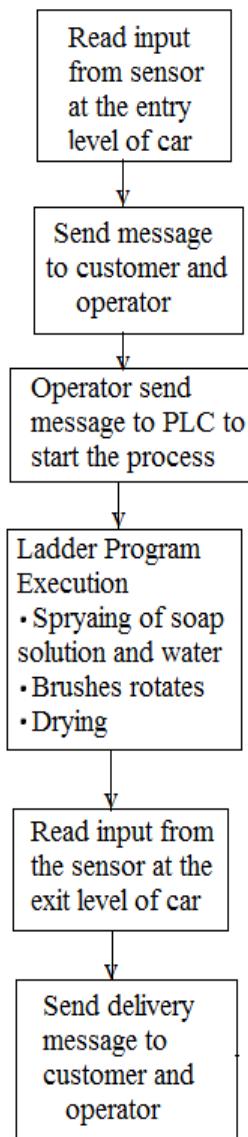


Fig.4 Flowchart for Main Program

Each activity is carried out for a certain time period which can be explained in Fig.5. Water is sprayed for 50sec and nozzle is closed. Then four brushes rotates for 50sec and stops. Now the conveyor starts moving to next stage. After 50sec, it stops for drying. Two fans are used for drying the car up to 30sec. 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.

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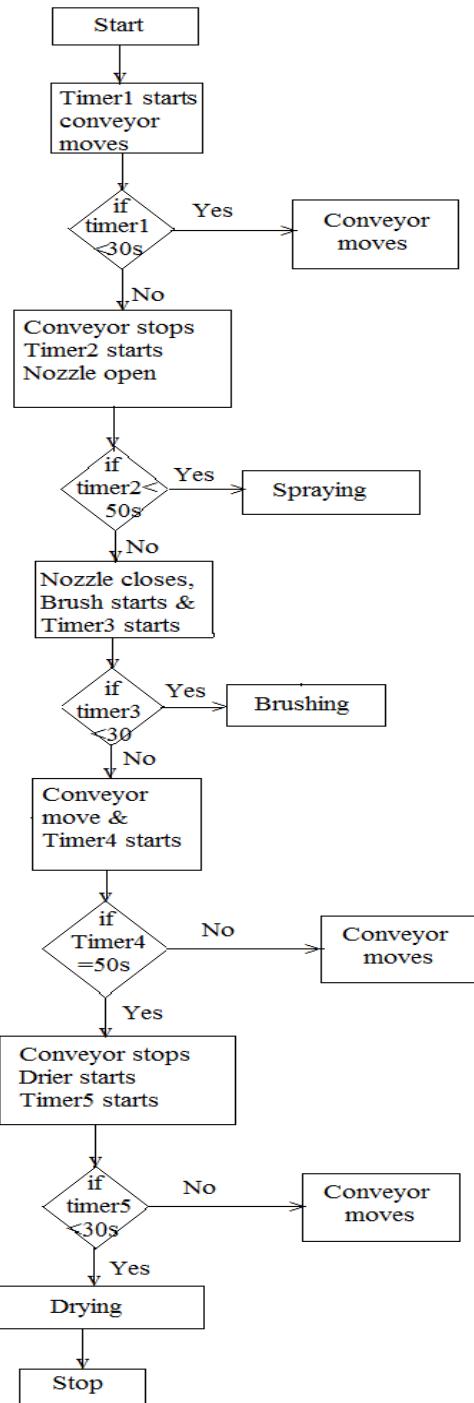


Fig.5 Timer Flowchart

Now the conveyor is stopped and messages are sent to customer and operator. In this way car washing can be made automatically using PLC. Again the process is started for a new car to wash.

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### **VI. COMPONENTS SPECIFICATION**

We use four DC motors for rotating the Brushes and two DC motors for moving the conveyor belt. A water suction motor is used to pump the water from tank and sprayed to nozzles. Two fans are used as driers. The complete hardware setup is interfaced with PLC. Total number of inputs and outputs are shown in Table1.

INPUTS	OUTPUTS
IR SENSORS-2	BRUSH MOTORS-4 WATER MOTOR-1 FAN-2

Table.1 Inputs and Outputs

### **VII. SMS CONFIGURATION**

GSM is a network used for connecting two devices and exchanging data. It is used with Horner using an internal modem HE-GSM04 to communicate to other devices connecting to GSM network. A sim card is fixed in the modem. GSM data call can be used to connect to Cscape for downloading or uploading and debugging the applications. We can set the idle time after which SMS should be serviced. There are settings for incoming and outgoing messages as shown in Fig.6.

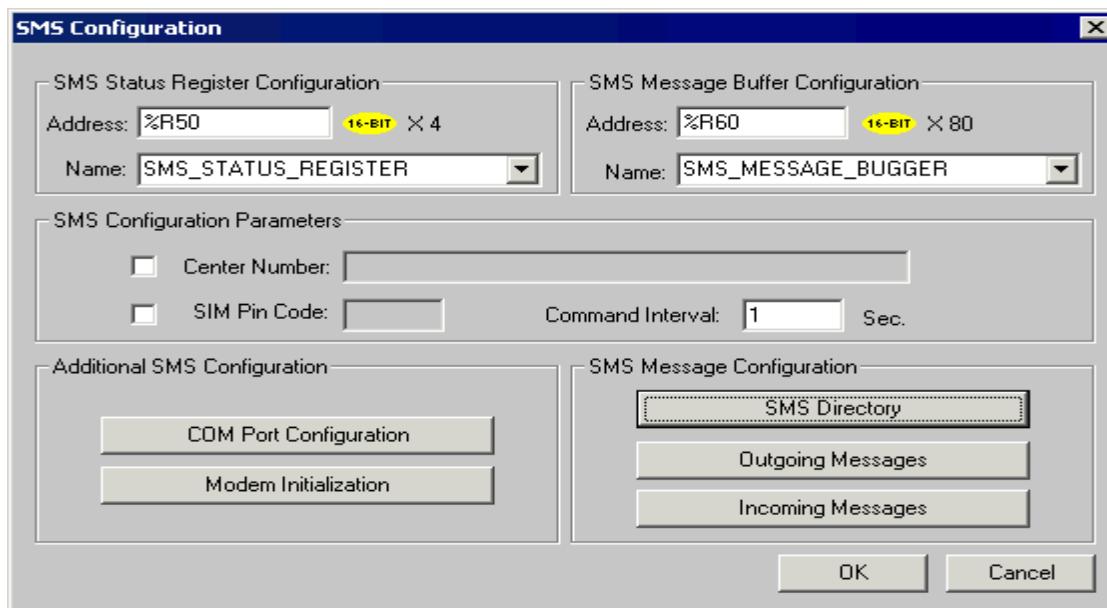


Fig.6 SMS Configuration Window

.The Status Register contains a status bit indicating the condition of the SMS communication. The Message Buffer Register holds the latest SMS message string sent or received by the controller. An individual SMS message can have up to 160 characters. Address should be provided for SMS status register configuration and also for SMS message buffer configurations. There are settings like SMS directory, Outgoing messages and Incoming messages.

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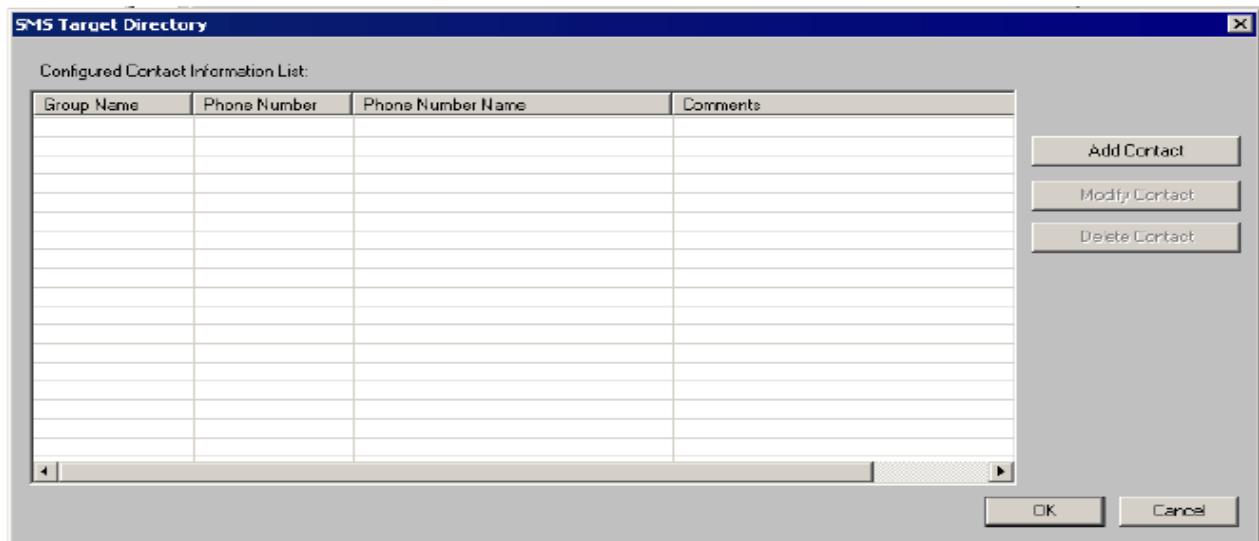


Fig.7 SMS Target Directory Window

SMS directory is opened for entering the contact details of customers and operator. The SMS target directory is used to create a directory of phone numbers before creating send or receive messages as shown in Fig.7. Click Add Contact to add a member. To modify the member listing, click Modify Contact. Click Delete Contact to remove a member. In New Contact Information window, the Group Name, Phone Number and Comments are entered.

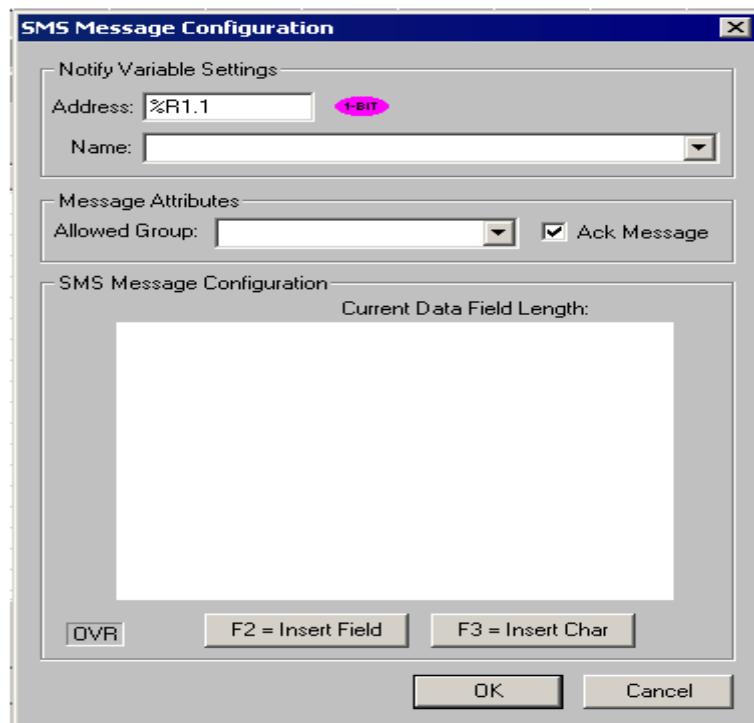


Fig.8 SMS Message Configuration

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In Incoming Messages Settings, messages are sent from groups to the controller. In Outgoing Message settings, messages are sent from controller to groups. Both incoming and outgoing message settings are done using SMS Message Configuration window as shown in Fig.8. After settings are finished, Ladder Logic is executed to check the messages.

### VIII. CONCLUSION

This prototype will help to perform car washing automatically results in high quality end product. The process is tested with sending and receiving messages. Thus it will be User-friendly as customers are notified by frequent messages at start and end of process.

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