Automatic Vehicle Washing System using Programmable Logic Controller

Dr. M. Ponni Bala, M. Dharanidharan, K. Janani, S. Kalaianbumani, S. Magima Shree

Abstract: Automation has become the 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 smooth and effective system to sustain the vehicles cleanliness. Automatic vehicle washing machine concentrates on car washer system using PLC. 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 conveyor belt and further controlled by PLC. 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 are placed in their positions according to the functioning of the washer. As soon as the vehicle is sensed, the functioning of conveyor assembly invokes. With the predefined time delay, the conveyor gets suspend. Vehicle washer technique is the combination of different functions which 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 car can be done easily like fuel filling stations, super markets, hospitals, government buildings, railway stations and can also be widely used in service stations and manufacturing units.

Index Terms: Automation, Ladder Logic, Programmable Logic Controller, Proximity Sensor, Sprinkler, Vehicle Washing System

1 INTRODUCTION

Vehicle washing system is the simple technique of preventive maintenance or to keep the exterior of the vehicle clean. In order to prevent rust, oxidation and reduce the occurrence of fine scratches, the exterior of a vehicle must be kept clean. This system is helpful in cleaning the vehicle automatically with the help of 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 cleaning process, the wetness in the vehicle is wiped using cotton brushesPLC is a specialized computer for the purpose of control and operation of process which functions using a programmable memory to store many instructions and execute functions including timing, counting, on/off control, etc. In existing systems, many electromechanical relays are used which was replaced by PLC, where the information of completion and emergency is informed efficiently. In automatic vehicle washing machine using PLC, the ladder logic is developed according to the functioning of the washer using timer delays. Manual way of car washing required plenty of time and also needs more water. This can be avoided using this automatic vehicle washing system where vehicle can be washed in lesser time with less consumption of water. Also, they can be setup in some places like residential, departmental stores, etc., where the vehicles are parked for long period and cleaning can be done there. This can also be widely used in manufacturing units.

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2 MATERIALS AND METHODS

2.1. Proximity sensor

A proximity sensor is a sensor which is able to detect the presence of close objects with no physical contact i.e., non-contact type metallic detection. A proximity sensor typically emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and appears for changes within the field or return signal. Their operating principle is predicted on a coil and oscillator that makes an electromagnetic field within the close surroundings of the sensing surface. The presence of a metallic object (actuator) within the operating spaces causes the oscillation in amplitude. The increase or fall of such oscillation is known by a threshold circuit that changes the output of the sensor. The operating distance of the sensor depends on the actuator's shape and size and is strictly joined to the character of the material.

2.2. Programmable Logic Conrtoller (PLC)

PLC is programmable controller device want to control any system from remote area unit. PLCs are programmed using application software on personal computers that represents the logic in graphic kind rather than dynasty character symbols. The program is kept within the PLC either in battery-backed-up RAM or another non-volatile flash memory. Often, one PLC is also programmed to modify thousands of relays. PLC trainer consists of a PLC, Demonstration panel and programming software system to develop the program in ladder language. PLC hardware consists of C.P.U, input & output module. A point to point interface communication cable provided to interconnect PLC with computer. In automatic vehicle washing system, GE Fanuc versaMax VPNST-03 PLC is used and the programming is done here using VersaPro software. This PLC consists of eight inputs and eight outputs. The ladder logic is developed according to the working of the system.

2.3. Dc motor

The DC motor could be a machine that transforms electrical energy into mechanical energy in form of rotation. Its movement is formed by the physical behavior of electromagnetism. DC motors have inductors within, that

produce the magnetic field used to generate movement. It works on the principle of Lorentz Law, which states that "the current carrying conductor placed during a magnetic and electric field experience a force". And that force is called the Lorentz force. The Flemming left-hand rule offers the direction of the force.

Before understanding the operation of DC motor initially, we have to grasp concerning their construction. The armature and stator are the two main elements of the DC motor. The armature is the rotating part, and thus the stator is their stationary part. The armature coil is connected to the DC supply. The armature coil consists of commutators and brushes. The commutators convert the AC induced with the armature into DC and brushes transfer this current from rotating a part of the motor to the stationary external load. The armature is placed between the north and South Pole of the permanent or electromagnet. In order to supply one-way force (or torque) on the armature conductors of a motor, the conductors below any pole should carry this current within the same direction at all times. The function of commutators and brush gear in an exceedingly dc motor is to cause the reversal of current in a conductor because it moves from one side of a brush to the opposite.

2.4. Conveyor system

A conveyor system could be a common piece of mechanical handling instrument that moves materials from one location to different. Conveyors are particularly helpful in applications involving the transportation of significant or large materials. Conveyor systems enable fast and economical transportation for various kinds of materials.

2.5. Sprinklers

Sprinkler is that the technique of applying water in a very controlled manner in means the same as rainfall. The water is distributed through a network that will consist of pumps, valves, pipes, and sprinklers. Irrigation sprinklers are often used for residential, industrial, and agricultural usage.

3 BLOCK DIAGRAM

The block diagram of the proposed system includes PLC which is used as the controller unit, start switch, proximity sensor which is used for the detection of the vehicle. The output module includes the conveyor belt, nozzles for fresh water flow, detergent water flow and again fresh water flow to clean the vehicle and the brushes to clean the wet over vehicle. The controller unit i.e., PLC is programmed for the timer operation throughout the process. Whenever there is a signal from the proximity sensor, it indicates that the vehicle is "ON" and the conveyor is in position to start the process. Immediately the input of the proximity sensor actuates the output of the conveyor motor to move and with this the vehicle also moves. Then the vehicle will undergo the process of washing with clean water, washing with soap water and again washing with clean water. This process happens according to the predefined time delay as per the logic implementation. After completion of all the processes such as washing with clean water, soap water and clean water, the vehicle is cleaned with cotton brushes with predefined time interval. The time interval is calculated based on the type of vehicle and the amount of dust present in the vehicle. Also, the type of vehicle is indicated by the length of vehicle. The block diagram of the Automatic Vehicle Washing System is shown in Fig.1.

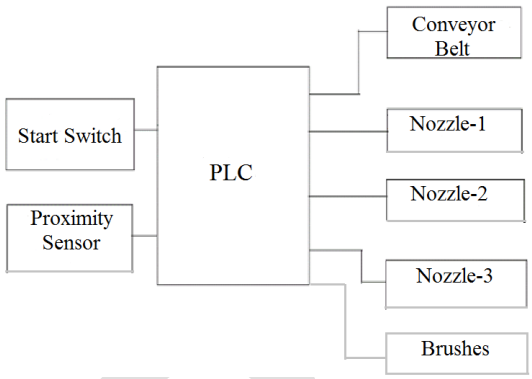

***Fig. 1**: Block diagram of Automatic Vehicle Washing System*

4 PROPOSED METHODOLOGY

4.1. Washing with clean water

Initially the vehicle is placed in the conveyor belt. A proximity sensor is placed in the starting point and when the sensor senses the vehicle, the conveyor starts to rotate and the vehicle will also move along with the conveyor. When the vehicle is sensed by proximity sensor fixed at the entrance of the system, the conveyor stops its movement and the sprinkler will start to sprinkle water over the vehicle. Here the dust particles present over the vehicle is removed using spraying water over the vehicle. Also, the mud which will be present in the areas of wheels can also be removed in this method. Time delay of 50 seconds is given which is required to spray the water over the vehicle to clean the vehicle. After the predetermined time interval, the conveyor starts to move. The time delay can be adjusted based on the vehicle size and dust.

4.2. Washing with soap water

In this process after the removal of the dust from the surface of the vehicle, the conveyor moves along with the vehicle at a distance of 30cm, and is programmed by a time delay of10s. Now the water along with the soap or detergent is sprayed over the vehicle which is used to completely wash the vehicle cleanly. After the programmed time delay the conveyor will be stopped for this process. Also, here the time delay of 10s is required to spray the soap water over the vehicle to clean the vehicle completely. This process will be very much helpful in making the vehicle brighter and cleaner. It will be helpful in giving the best finishing for the cleaning process. After the given time delay the conveyor starts to move.

4.3. Washing with clean water

When the time delay is reached, the vehicle after the completion of spraying of detergent water the next process get starts i.e., the spraying of clean water over the vehicle which will remove all those soap and foam present in the vehicle and also the remaining dust particles that remains in the vehicle after washing. This process will make the vehicle completely clean. Immediately after completing this process of washing with clean water for 10 sec, the conveyor starts to move with vehicle. In this process, initially the supply will be given to the system i.e, the process is turned and only then supply goes to the hardware setup. The vehicle will be placed in the conveyor and when the process begins the conveyor rotates which moves the vehicle and the vehicle will also stops in certain

regions where the water has to be sprayed over the vehicle with respect to the time delay of 50 seconds for fresh water, 10 seconds for detergent water, 10 seconds for fresh water given in the PLC programming. The inputs for the process are Push button switch and proximity sensors. The outputs for the process are conveyor motor, nozzle-1 for fresh water, nozzle-2 for detergent water, nozzle-3 for fresh water and the motor for brushing. When the supply is given the sensor will get actuated, and also the other components will get actuated along with the sensors. The vehicle will be placed in the conveyor and when the proximity sensor senses the presence of the vehicle, the signal will be send to the controller (PLC). Whenever there is a signal from the proximity sensor, it indicates that the vehicle is “ON” and the conveyor is in position to start the process. Immediately the input of the proximity sensor actuates the output of the conveyor motor to move and with this the vehicle also moves. Then the vehicle will undergo the process of washing with clean water, washing with soap water and again washing with clean water. Finally the vehicle is cleaning with cotton brushes. This process happens according to the time delay as per the logic.

5 LADDER LOGIC

The ladder logic used for the overall process of Automatic Vehicle Washing System is shown in Fig.3 and the sequential steps of operation are given below.

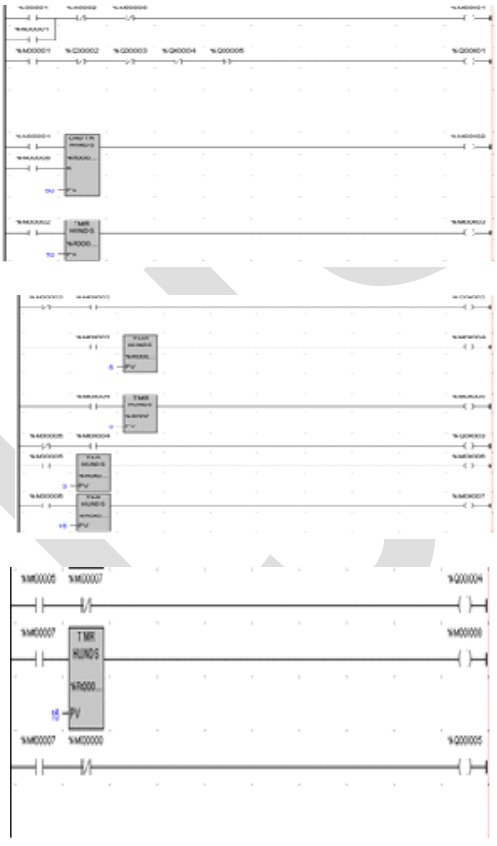

FIG. 3 *LADDER LOGIC FOR AUTOMATIC VEHICLE WASHING MACHINE*

Step-1: When the start switch (I1) is energized, the conveyor (Q1) starts rotating.
Step-2: The conveyor stops rotating when the proximity sensor (I2) is sensed.
Step-3: The fresh water (Q2) starts to flow for a time period of 10seconds once the conveyor is stopped.
Step-4: The conveyor moves for a time period of 4 seconds. Detergent water (Q3) sprayed for 5 seconds.
Step-5: Again, there is a movement of conveyor for 2 seconds following the flow of fresh water (Q4) for 15 seconds.
Step-6: Once the flow has stopped the brushing process (Q5) is carried over for 20 seconds.

6. RESULTS AND DISCUSSION

On reaching the preset value of the timer given in the PLC ladder diagram, the conveyor stopped at the locations of the respective nozzle. Once the accumulator reached the preset time of washing process the conveyor starts running and thereby moving the vehicle at the next nozzle location for the following process. The washing time can be varied accordingly with respect to the dust quantity.

Fig.3 *Snapshot of Automatic Vehicle Washing System*

The prototype model setup of automatic vehicle washing system is shown in Fig. 3.

7. CONCLUSION

Vehicle washing automatically is a high-quality end product. Hence, it will be easy and capable to clean multiple vehicles at a time. Additionally, less man power requirement, time and less pollution, it can be introduced for potential customers.

8. FUTURE SCOPE

In future it may be through with the assistance of solar power, geothermal heating, and variable-speed drive vacuum pump. And additionally, it may be extended to interior wash, underneath chases system, coin or token system and additionally it is possible to implement a counter which can count the quantity of vehicles washed.

9 ACKNOWLEDGMENT

We wish to express our deep sense of gratitude to our beloved Correspondent Thiru.P.Sachithanandan and all the trust members of the Kongu Vellalar Institute of Technology Trust (KVITT), for having provided us with all the necessary infrastructure to undertake this projectsWe wish to express our profuse thanks to our beloved and eminent Principal Dr.V.Balusamy B.E.,(Hons) M.Tech., Ph.D., for providing an opportunity to carry out the project work. We would like to thank Dr.U.S.Ragupathy M.E., Ph.D., Head of the Department of Electronics and Instrumentation Engineering for his valuable suggestions while working on this project.

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