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TECHNOLOGICAL ADVANCES IN VEHICLE AUTOMATION USING PLC

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ABSTRACT

Advances in the world of automation are thoroughly catching up in significance to the rising necessity in innovation. Programmable logic controller (PLC) being the fulcrum of automation, indeed propagates the growing demand in automation.The current work focuses on development of PLC program in conjunction to vehicle automation. This PLC program enables numerous applications like wiper system, power window system; automatic head light control and center lock etc. Practical studies have been carried out using this PLC program in order to prove that automation is clearly integral part of the rising trend in vehicle technology.

KEYWORDS: AUTOMATIC WIPER SYSTEM**,** CENTRE LOCK**,** HEAD LIGHT CONTROL**,** PLC**,** VEHICLE AUTOMATION.

1 INTRODUCTION

It is essential for every engineering firm to increase its production rate and quality in order to sustain in present days competition which is possible mainly through the automation. As today's industrial scenario is changing fast and becoming more competitive. The automation serves both the purpose of increasing the production rate as well as reduces the human effort. Programmable logic controllers (PLC) have been widely used in industrial process control, due to their low cost, high reliability and integrated logic functions. In today's era, the systems in vehicle are controlled manually. In the present project we are going to make system automatic using PLC.

PLC programming is done with the ladder logic. Ladder logic reduces the length of program. Troubleshooting a PLC system is much more technician friendly and very easy to adapt change**.** In the present practice in vehicle automation, numbers of applications are controlled by PLC. Such as wiper system, power window system, automatic head light control and center lock etc. In order to control this applications water sensor, light sensors, on/off switches are used. Because of sensor, system works automatically and even we can control it manually by on/off switches. PLC is a specialized computer used for the control and operation of manufacturing process and machinery. It uses a programmable memory to store instructions and execute functions including on/off control, timing, counting, sequencing, arithmetic, and data handling. The development and testing ground for this new means was the U.S. auto industry the time period was the late 1960s and early 1970s, and the result is Programmable Logic Controller or PLC. In above context, literature survey has been done in order to find out different technologies used in vehicle automation. After doing literature survey we found the following solutions. In modern industries, industrial automation was inevitable, which means if it doesn't move quickly enough in competition with others it will lose. Many factories use programmable logic controls (PLCs) in automation processes to diminish production cost and to increase quality and reliability [1, 2]. In the case of PLC and its application in industry due to advances of science and technology done extensive researches can be done as yang and his colleagues noted in 2003 in the field of PLC automation [3]. The proposed method for control reduces the number of components because the microcontroller can integrate in one package all the functions. Thus, the proposed technique suited for industrial applications [4]. This paper gives a reliable, durable, accurate and efficient way of speed control of two DC motors [5].General, block diagram of vehicle automation using PLC as shown in Figure 1.

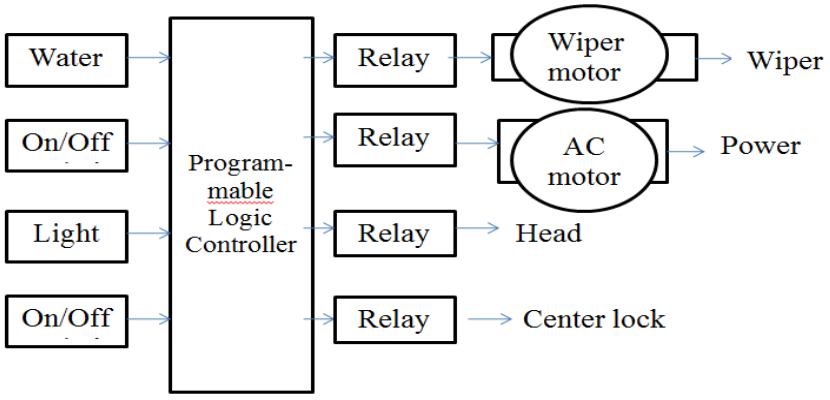


Figure 1. Block diagram of vehicle automation using PLC

2 MATERIALS AND METHODOLOGY

2.1 Hardware used in study

Hardware details	Specific function
ABB PLC 3D-500	Controlling of all operations
Relay	switch
Wiper Motor	To operate wiper
AC Motor	To operate a window
Serial Communication Bus (RS 232)	Communication cable
Water Sensor	To sense moisture/ water
Light Sensor	To detect light

2.2 Internal circuit of ABB PLC kit

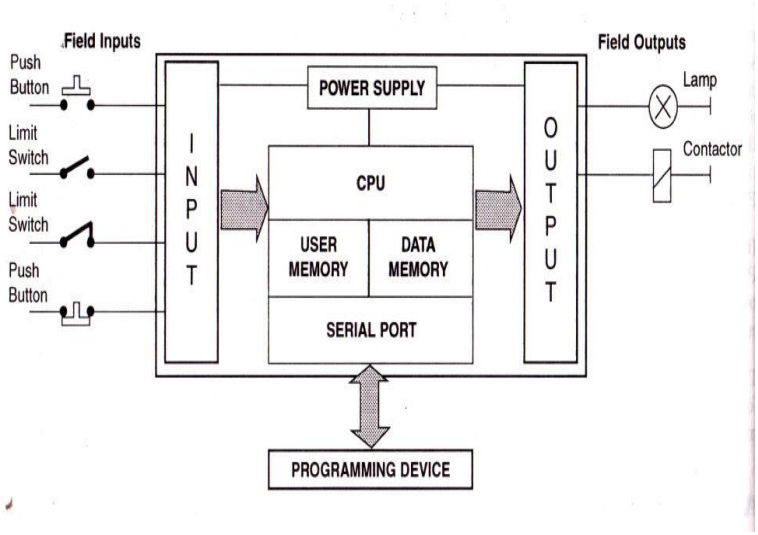


Figure 2. Internal circuit of ABB PLC kit

As shown in Figure 2 PLC scans the states of inputs and controls the states of outputs through a CPU. The user program that has the control logic for CPU is stored in program memory. Examples of inputs are switches, push buttons, and sensors like those used to sense proximity, temperature, pressure, etc. Examples of outputs are relays, valves, solenoid, actuator, motor, fans, alarm, etc. There may also be a communication interface to other terminals in the system.

Most of the industrial automation PLC systems that control the machine operation are real-time systems since the output results must be produced with response to the input conditions within a finite interval time. If the output is delayed, unexpected operation will result which will directly affect productivity and negatively impact revenues.

2.3 Working Principle of PLC kit used in study

In vehicle automation numbers of applications are controlled by PLC as shown in Figure 2. Such as wiper system, power window system, automatic head light control and center lock etc. Water sensor is used to detect water drop when it falls on the glass. Without people to manage; Adjustable sensitivity adjusts the digital potentiometer.If water content is less than a set threshold value then the D0 port output high, when water exceeds the threshold value is set, the module D0 output low; Small plate's digital outputs D0 can be directly connected to the PLC. Light sensor is used to on on/off head lamp and tail lamp automatically depending on intensity of light. LDR's are light dependent devices whose resistance decreases when light falls on them and increases in the dark. That is when light falls on LDR then light sensor will not get activated and in the dark sensor get activated. The output of sensor is given to PLC.ON/OFF switches is used to control the motion of window glass and to lock/unlock the doors of vehicle. The output of switch is given to the PLC. If the outputs of sensors and on/off switches are high then PLC updates the input image register by storing the values of the input on terminals. Then it solves the ladder diagram according to the way it is drawn based on the contents of input image register. When it has completed solving the entire program, it performs another update. This update transfers the contents of output image register to the output terminals. Then the output of PLC is given to the relays. Relays are used as switch and also to isolate the two voltage levels. If the relay is in on condition then output of each relay is given to the wiper motor, head lamp, power window and center lock system.

2.4 PLC Specifications used in study

Basic units 500eco offer ample configuration range. Each basic unit incorporates a specific number of binary inputs /outputs. It is possible, depending on the basic unit, to increase the number of inputs /outputs, to add 6 extensions connected directly to the basic units or remote input /output units via the CS 31 twisted pair. Kit can be configured as: 110 binary inputs /outputs or 48 analog inputs /outputs for series 40 basic unit or remote unit.

Model : UI PLC-3D

PLC Make : ABB, Siemence, Delta or Equivalent.

Digital Input/Output : 8 DI-24V, 6DO-24V

Inbuilt Power Supply : 24V @ 1A, ±15V-0-15V@500mA

I/O simulation : 4 No. Push button, 4 No. toggle switch, 6 No.LED

I/O termination : 4mm banana socket

PC Interface : RS232 Serial Port with cable

Power : 230V ±10% @50Hz

Enclosure : Powder coated metal box 300W X 250D X 150H

Accessories : 20 Nos 1 meter Patch cards Rs232 Communication Cable

: Ladder Programming & PLC Communication software

2.5 Working components of the Design

2.5.1 Design, working principle and specification of wiper motor

Wiper motor is a combination electric motor and worm gear reduction as shown in Figure 3 which provides power to the wipers. A neat linkage converts the rotational output of the motor into the back-and-forth motion of the wipers.

Figure 3. Wiper motor with combination electric motor and worm gear reduction

Table 1. Specifications of wiper motor

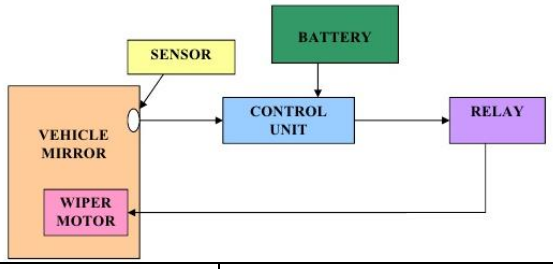
Specifications	Values
Current Limit Setting	20 Amps
Duty Cycle	0 to 99.9%
PWM switching rate	15 Khz
Digital Input Low	0 to 0.8V

Digital Input High	3.5 to 5 V
Speed	70 rpm at 12V
Rotation Degrees	360 degrees
Position Resolution	10 bits
Reversing Delay Time	0 sec (depends on ramp rate)
Operating Voltage	10 V to 24V

Figure 4. Working principle of wiper motor

2.5.2 Design, working and specification of water sensor

The Figure 4 shows simple water sensor can be used to detect water drop when it falls on the glass. Without people to manage; Adjustable sensitivity adjust the digital potentiometer (shown in blue)Operating Voltage 3.3V-5V; Module Dual Output mode, a simple digital output, analog output more



Pin	Description

accurate; with fixed bolt hole for easy installation; small PCB board size: 3cm * 1.6cm; power indicator (red) and the digital switch output indicator (green); using LM393 comparator chip, stable; Small plate interface specification (4-wire): VCC external 3.3V-5V; GND External GND ;DO small board digital output interfaces (0 and 1) ;AO small board analog output interface.If water content is less than a set threshold value when the D0 port output high, when water exceeds the threshold value is set, the module D0 output low; Small plates digital outputs D0 can be directly connected to the plc, plc to detect high and low, and thus to detect

Water drop.

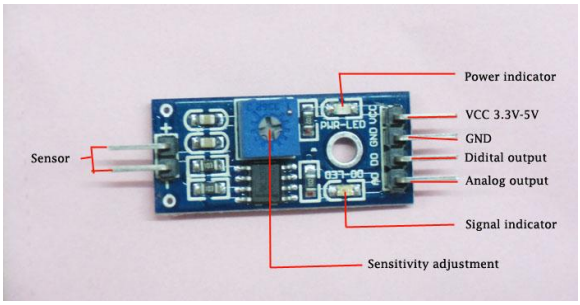


Figure 5. Water sensor

VCC	5V
GND	GND
D0	Digital output interface(0 and 1)
A0	Analog output interface

Table 2. Pin description of LM393

2.5.3Design, working principle and specification of Light Dependent Register

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the Figure 3. The arrow indicates light falling on it.

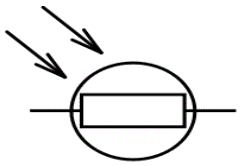


Figure 6. Symbol of LDR

Software and Language used in study

1. Software used : Codesys Version : 2.3
2. Language used : Ladder Diagram

3 Flowchart and PLC program

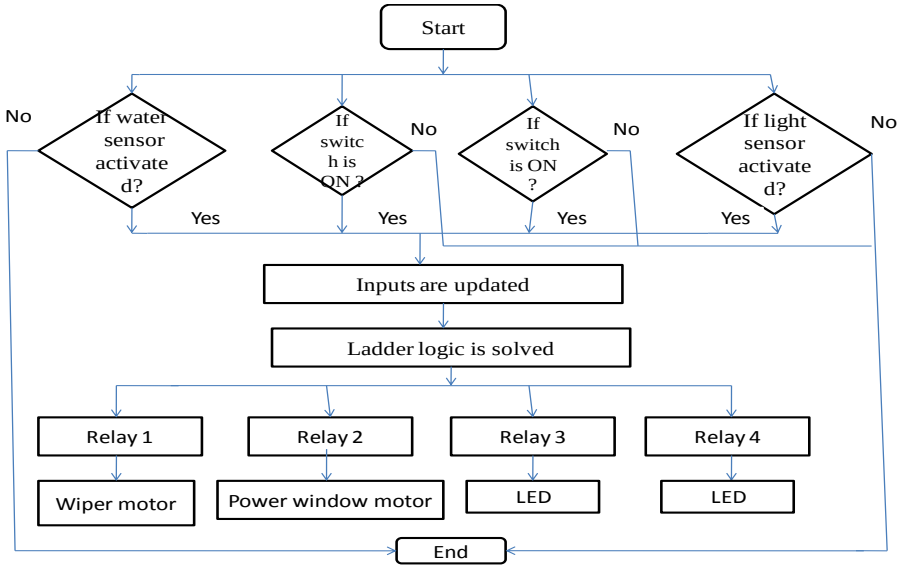


Figure 7. Flowchartof vehicle automation using PLC

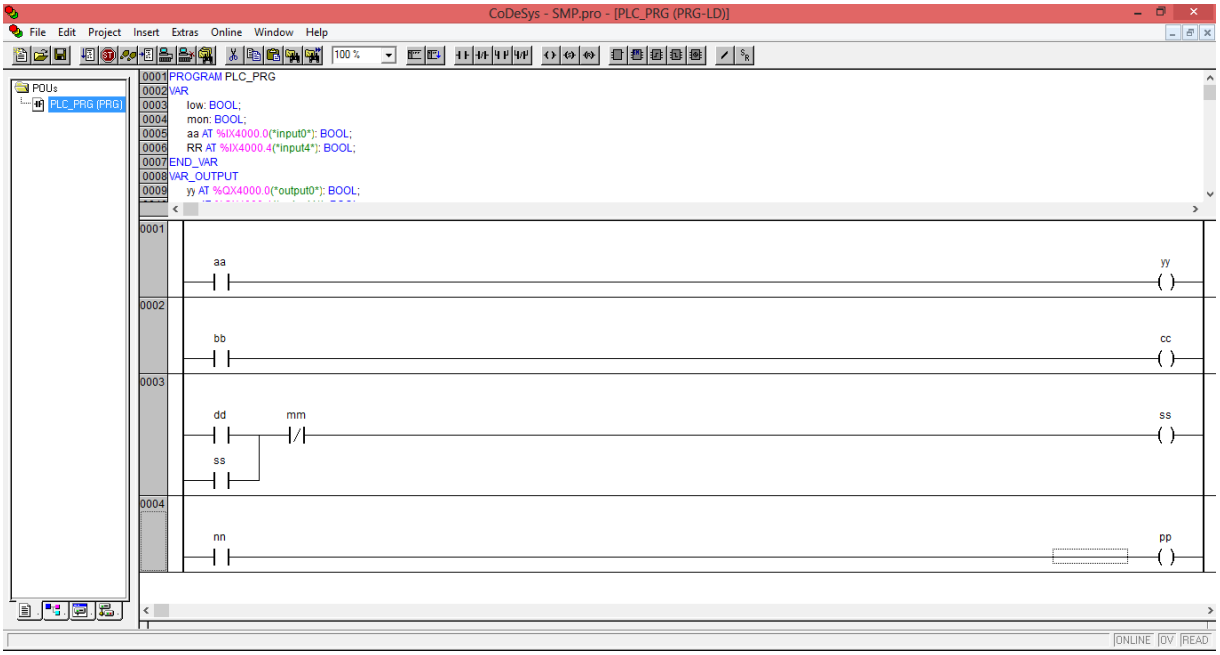


Figure 8. PLC Program for automation of vehicle

4 RESULTS AND DISCUSSION

In this project vehicle automation is done using plc. And we have controlled wiper system, power window, head lamp, center lock system. We have tested these parameters and we got result as shown in Table 3.

Table 3. Result and efficiency

Parameter	No. of times tested	Correct result	Efficiency
Wiper	5	5	100%
Power window	5	5	100%
Head LIGHT	5	5	100%
Center lock	5	5	100%

5 ADVANTAGES AND APPLICATIONS

5.1 Advantages of vehicle automation using PLC

Less wiring: As there are internal relays in PLC, no external relays are required hence less wiring.

Easy to operate: as writing ladder program is easy. We could easily debug the program.

It reduces human efforts: All the systems in the vehicle works automatically without human effort.

Less complexity: As there is less wiring because of internal relays, hence compexicity of the system decreases.

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.

Correcting Errors: In old days, with wired relay-type panels, any program alterations required 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 extremely short and cost effective.

5.2 Applications of vehicle automation using PLC

1. **Wiper control:** Wiper is operated automatically when water falls on the glass.
2. **Power window:** Motion of the window glass is controlled by on/off switch.
3. **Head lamp control:** In the dark head lamp and tail lamp will be on automatically.
4. **Center lock:** We can lock or unlock all doors of vehicle using one switch.

6 CONCLUSION

The project vehicle automation using PLC is better because all applications can run at a time. PLC makes it even more sophisticated, fast and accurate. The main intension is to reduce human efforts which consecutively results in elimination of wastage of time. Troubleshooting a PLC system is much more technician friendly and very easy to adapt change**.** Implementation is easy due to integrated logic functions and internal relays.

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