Intelligent Toll-Tax System using PLC

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Abstract— Now a days there is a huge rush in the toll plazas in order to pay the toll tax. Therefore in order to reduce the traffic and to save time this paper mainly focuses on to make an intelligent toll-tax system using PLC. In this system sensors are provided which able to sense the type of vehicle. It also provides over speeding fine collection which automatically added to toll tax of vehicle and amount of money that user have to pay will automatically displayed on operator's screen. This system can be used on highways for collecting toll tax and provides more efficient toll collection.

Key words: PLC (AB SLC-500), Photo Electric Sensors, Toll Collection, PLC To Excel Conversion, Rslogix500

I. INTRODUCTION

The Intelligent Toll tax system is an electronic automatism toll collection system that was designed for the highway, bridge and tunnel. It's easy to collect fine from over speeding vehicles and managing traffic on each toll lane. [1]

The major problem of toll collection is heavy traffic congestion due to the rush of the two wheelers, cars etc. This problem can be solved by making intelligent toll tax system using PLC.

This system includes automatic vehicle sensing feature in which when vehicle arrives at toll tax it sense the type of vehicle and tax is displayed on operator's screen. This is done by PLC to excel conversion.PLC is interfaced with computer using DH485 coupler.

Now days many people ride the vehicle in over speed and it's difficult for police to catch the vehicle and take the fine from person. But in this system if vehicle arrives in high speed, sensor automatically measures the speed of vehicle and tax is added to his toll tax.

II. BLOCK DIAGRAM IMPLEMENTATION

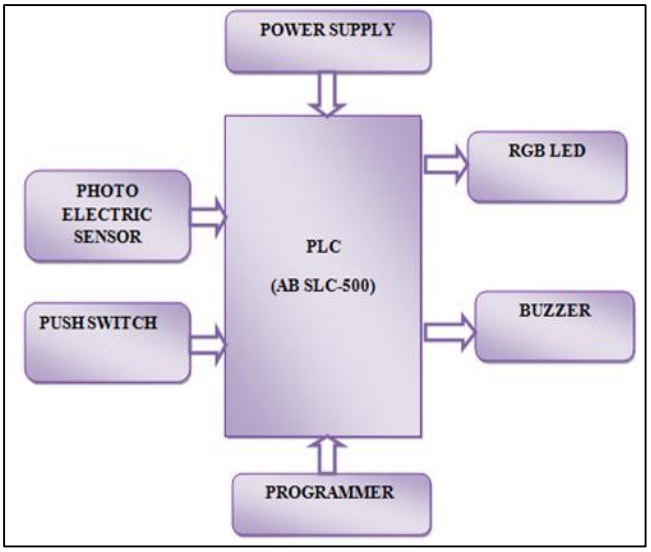

Fig. 1: Block Diagram

A. PLC

A Programmable Logic Controller, PLC or Programmable Controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise and resistance to vibration and impact. Programs to control machine operations are typically stored in battery-backed-up or non-volatile memory [2]. A PLC is an example of a hard real time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

The SLC 500 programmable controller has features that previously could only be found in large programmable controllers. It has the flexibility and power of a large controller with the size and simplicity of a small controller. The SLC 500 controller offers you more control options than any other programmable controller in its class.These programmable controllers make up a technologically advanced control system having inherent flexibility and advantages characteristic of other programmable controllers.

B. Photo Electric Sensors

Photoelectric Sensors detect photo-optical work pieces. It provides many varieties of Sensor, including diffuse-reflective, through-beam, retro-reflective, and distance-settable Sensors, as well as Sensors with either built-in or separate amplifiers or Fiber Units.

Fig. 2: Photoelectric Sensors

Photoelectric Sensors detect objects, changes in surface conditions, and other items through a variety of optical properties. A Photoelectric Sensor consists primarily of an Emitter for emitting light and a Receiver for receiving light. When emitted light is interrupted or reflected by the sensing object, it changes the amount of light that arrives at the Receiver. The Receiver detects this change and converts it to an electrical output. The light source for the majority of Photoelectric Sensors is infrared or visible light (generally red, or green/blue for identifying colors).In this system sensors are used for vehicle speed measurement and vehicle detection (fig:2).

C. DH-485 Link coupler

In normal operation with the programmable controller connected to the link coupler, the processor powers both the link coupler and peripheral device (DTAM, PIC, HHT) if connected through the C11 cable. If you do not connect the processor to the link coupler, then use a 24 VDC power supply to power the link coupler and peripheral device.

Below are three options for externally powering the 1747–AIC:

- If the link coupler is to be installed in an office environment, you can use the wall mount power supply or global desktop power supply. The link coupler would be powered through either the 1747–C10 cable or by hardwiring from the supply to the screw terminals on the link coupler.
- If you use the AC chassis power supplies (1746–P1 or 1746–P2), you can use the 24 VDC user power supply (200mA maximum) built into the power supply. The link coupler would be powered through a hard–wired connection from the screw terminals on the power supply to the screw terminals on bottom of the link coupler.
- You can use an external DC power supply with the following specifications:

1) Operating voltage: 24 VDC + 25%
2) Output current: 190mA
3) Rated NEC

Fig. 3: Dh-485 Link Coupler of 1747-L40c(Ab Slc-500]

III. IMPLEMENTATION

We have implemented this system by interfacing hardware with PLC and after interfacing PLC with Computer for communication using DH485 coupler.

Fig. 4: Interfacing between Hardware Computer and Plc

A. Speed Measurement System

Intelligent toll tax system keep eye on overspeeding vehicle.It consist vehicle speed measurement by photo electric sensors.This sensors are placed at 1 to 2 kilometers from toll tax.When car arrive across the sensor it informs the PLC and from output provided to PLC,speed is calculated.(fig5)

$$\text{Speed} = \frac{\text{Distance between sensor 1 and sensor 2}}{\text{Time taken to reach sensor2 from sensor1}}$$

If the speed of the car exceeds the speed limit then vehicle driver have to pay the fine[1].Now when the car reaches the toll booth the driver has to pay a toll tax and also a fine for over speeding.Advantage of this system is that,overspeeding fine is automatically added with tax of vehicle so vehicle driver can not pass without paying fine.This makes a system very effective and time saving.

Below (fig:5) shows car is passing from sensor and it is indicated by red light then car pass out automatically speed mesured in Rslogix500 and automatically implemented in excelsheet.(fig7)

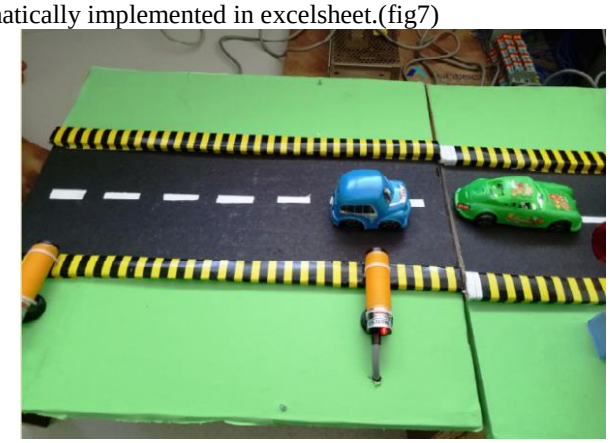

Fig. 5: Speed Measurement System

B. Vehicle Detection System

There is heavy rush of vehicles on toll booth and each vehicle have to pay toll according to its vehicle type.This system includes automatic detection of the vehicles.It consist of three photo electric sensors.If small vehicle arrives then one sensor detect the presence of vehicle other two sensors are off.If medium vehicle arrives then two sensors detect and if vehicle is big then three sensors detect(fig:6). When sensor detects which type vehicle (small,medium,big)arrive and accordingly update the tax in excel sheet and when vehicle drives in over speed fine is automatically added to his toll tax(fig:9).

Fig. 6: Vehicle Detection System

IV. SOFTWARE SIMULATION

The RSLogix family uses ladder logic programming packages helps us to maximize performance, save project development time, and improve productivity.

RSLogix 500 programming package is compatible with programs created with Rockwell Software DOS-based programming packages for the SLC 500 and Micro Logix families of processors, making program maintenance across hardware platforms convenient and easy.

The software simulation includes the measurement of vehicle speed, class of vehicle (small, medium, big)and over-speed fine collection which updated to receipt.

We implement program in RSlogix500which used ladder language implementation and after that we can run the program.

Below (fig:7) shows the simulation of vehicle speed measurement in RSlogix500.

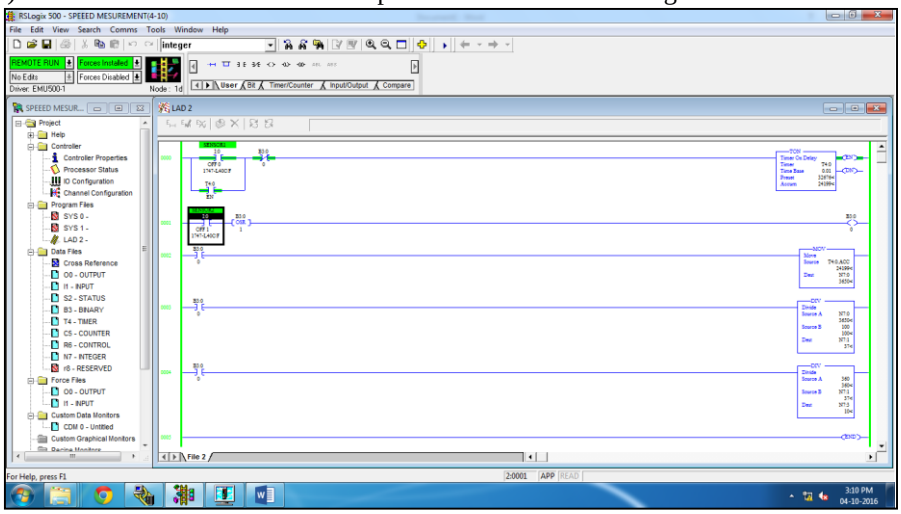

Fig. 7: Vehicle Speed Measurement In Rslogix500

Below (fig:8) shows the simulation of detection of class of vehicle.

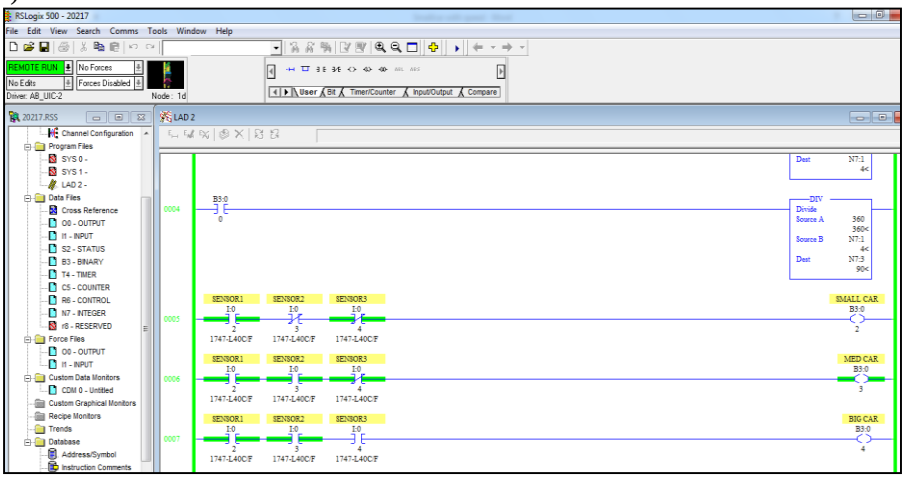

Fig. 8: Class of Vehicle Detection in Rslogix500

	A	B	C	D	E	F	G	H
1			Toll Tax Receipt					
2								
3	Journey From:			Check		Go		
4	Journey To:							
5								
6	Receipt No. :	0003						
7	Vehicle No. :	gj01rs7171						
8	vehicle Class:	Medium		Print				
9	Tax :	100						
10	Over Speed Fine:	150						
11								
12	Total Amount :	250		Emergency Vehicle Detect On Highway				
13								
14	Amount in word :	Two Hundred Fifty Rupees						
15								
16								

Fig. 9: Receipt for Toll-Tax

When operator enters the last four digits of vehicle number in receipt then vehicle class, tax, over speeding fine, total amount in digits and word all the data automatically added in receipt.

V. CONCLUSION

The main objective of this paper was to develop an Intelligent Toll tax system based on certain specifications. This was successfully implemented. We considered this paper as a journey where we acquired knowledge and also gained some insight into the subject which we have shared in this report. A lot of additional functions like vehicle detection using sensor, vehicle speed measurement and over speeding fine collection in our work and the desired result were obtained.

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