International Journal of Scientific Engineering and Technology (ISSN : 2277-1581)
Volume No.2, Issue No.9, pp : 857-860 1 Sept. 2013

Design and Fabrication of Prototype of Automated Smart Car Parking System using Programmable Logical Controllers (PLC)

S.Sarayu, Sri. Sree Rajendra, V.V.Bongale
Malnad College of Engineering Hassan-573201, Karnataka
Email: sarayu88@gmail.com

Abstract--- ***This paper proposes a novel, secure and intelligent parking system, which greatly reduces fuel consumption of the vehicle, traffic congestion and environmental pollution with the use of Programmable Logical Controllers (PLC) in automation. The main advantage of this technology is space optimization, cost effectiveness, security, environmental protection, low maintenance and operating cost and safety of the vehicle. PLC has been used in the design of the prototype model because it is more reliable and faster in operation. Demonstration at the internal evaluation gave expected results.***

Keywords--- Automated parking system, Programmable Logical Controller, space optimization, intelligent parking system.

1. Introduction

The smart parking system implemented mainly in the **Europe, United States and Japan** is developed with the incorporation of advanced technologies and researches from various academic disciplines. With its deployment in the car park, it is hoped that it would solve the aforementioned problems faced by the patrons within the car park. Time and cost are two important factors of human life, whether for an individual or a business. As quality of life increases, more and more people are inhabiting cities. Shopping complexes are an important point of interest both for a city's inhabitants as well as for visitors. Hence, more shop owners prefer to locate their business in shopping complexes to target more customers and increase revenue.

Providing sufficient parking for visitors is one of the main issues in developing shopping complexes. Offering and paying attention to handicapped drivers are a few of the factors which can increase customer loyalty and attract customers to visit a shopping mall more frequently.

1.1 Project Objective

a) The aim of this project (under an M.Tech. programme) is to design and build a prototype car park control with PLC integration since it gives more structured approach rather than conventional approach.
b) To develop an intelligent, user friendly automated car parking system which reduces the manpower, traffic congestion and fuel consumption of the vehicle.
c) To offer safe and secure parking slots within limited area.

1.2 Statement of Parking Lot Problems

1.2.1 Difficulty in Finding Vacant Spaces

Quickly finding a vacant space in a multilevel parking lot is difficult if not impossible, especially on weekends or public holidays. Finding spaces during weekends or public holidays can take more than 10 minutes for about 66% of visitors. Stadiums or shopping malls are crowded at peak periods, and difficulty in finding vacant slots at these places is a major problem for customers. Insufficient car park spaces \ lead to traffic congestion and driver frustration.

Fig: 1.2.1 Difficulty in finding vacant spaces. This parking is bound to affect someone else's passage, inconveniencing others..

1.2.2 Improper Parking

If a car is parked in such a way that it occupies two parking slots rather than one, this is called improper parking. Improper parking can happen when a driver is not careful about another driver's rights. This is tackled by the development of automated parking system.

Fig: 1.2.2 Improper parking

This is a more serious example of improper parking. The car is obviously blocking the sidewalk but more importantly, it is also obstructing street traffic.

1.2.3 Parking Fee Payment

Parking fee payment can be a time consuming activity for people. Since many current payment machines just accept small notes and coins, finding the exact amount and queuing for payment is not pleasant for drivers. Therefore, providing services that make payment convenient is desirable. One survey showed that queuing up for payment and finding coins for parking fee payment is troublesome. Moreover, most respondents agreed that using the Touch 'n' Go (a system that allows simply swiping a card and deduct fees from inside credit) is useful and will decrease queue up time.

2. Material and Methodology

2.1 Components of the Design

2.1.1 Hardware Part:

2.1.1.1 DC geared motor (6volts):

It's a mechanically commutated electric motor, powered by direct current (DC). Generally DC geared motor runs in both directions, but in this prototype model it is fixed uni-directionally to avoid vibrations of the systems.

2.1.1.2 Chain drive and sprockets

There are 4 sprockets in the prototype model, two at the top and two at the bottom which is attached to the chain at both ends. It is driven by 6 Volts DC geared motor to run the system. Trays are moved by the movement of chain and sprocket.

2.1.1.3 Inductive Sensors

Inductive proximity sensors are used for non-contact detection of metallic objects. Metallic objects such as washers are placed on the cars and trays. In this prototype model totally 8 inductive sensors are used, 1 for sensing cars and remaining 7 for sensing trays that carry cars.

2.1.1.4 Pushbuttons (8 nos.)

A push-button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. There are totally 8 pushbuttons, 1 for placing empty trays and remaining 7 for retrieving the cars.

2.1.1.5. Ball bearings

Ball bearings are used in this system to avoid slippage of the rays and to make system smooth operation.

2.1.2 Software Part:

2.1.2.1 Indralogic L10 PLC

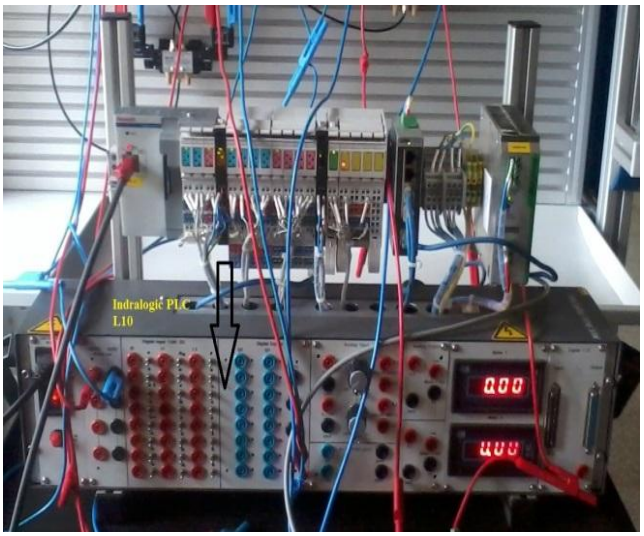

Fig 2.1.2.1 Indralogic l10 PLC

Programmable logical controller is a device that is capable of being programmed to perform a controlling function. The PLC was designed to provide flexibility in control based programming and executing logic instruction. PLC allowed for shorter installation time and faster commissioning through programming rather than wiring. The PLC has in recent years experienced an unprecedented growth as universal element in industrial automation. It can be effectively used in applications ranging from simple control like replacing a small number of relays to complex automation problems. Today the PLCs are used for control and automation job in a single machine and increases up to full automation of manufacturing / testing process in a factory. The advantages involved in PLC's are:

- PLCs are more reliable and faster in operation.
- They are smaller in size and more readily can be expanded.
- They require less electric power.

- They are less expensive compared to electromechanical relays for the same number of control functions.
- PLCs have very few hardware failures when compared to electromechanical relays. Special functions like time delay actions and counters can be easily performed using PLCs.

The applications of PLC's in industries includes:
The PLC controls industrial machines and processes. In different areas of industry PLC are being applied such as for material handling, packaging, palletizing, milling, boring, grinding, filling, sorting, weighing etc.

3. Design and Fabrication

3.1 Design

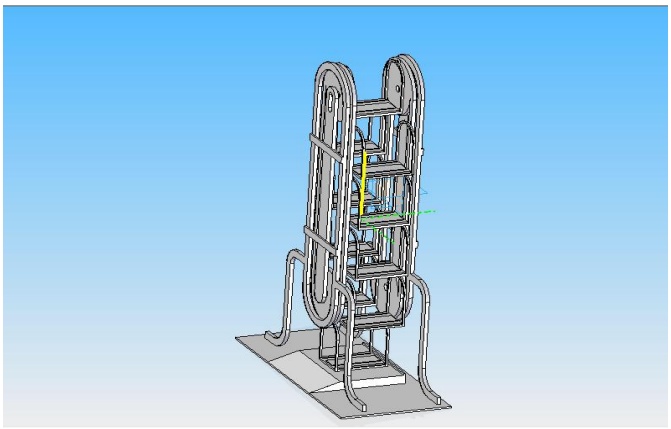

Fig 3.1 Assembly of automated smart parking system generated in solid edge software

The project work has been completed up to the assembly of the total model and simulation of the working of the model through PLC for all sample input conditions, the programming of the model having been done. The desired output has been obtained.

3.2 Fabrication of the model

Fig 3.2 Final Prototype model according to the selection of materials.

By selecting materials with standard dimensions, the project work is aimed to develop a car parking system shown in the figure: 7.2 for parking more number of cars within a reduced parking area. The chain and sprocket mechanism is used for driving the parking platform and a 6V DC geared motor is implemented for powering the system and indexing the platform. The platform is fabricated to suit the working model.

4. The Model Configuration And Working

Fig 4 represents the automated car parking system. The system consists of hardware components such as a 6 Volts DC motor, inductive sensors, sprocket and chain, pushbuttons, beeper and ball bearings. The main principle of automatic parking system is to place the car on the seat and retrieve the car from the seat using sensors and motors. In this prototype model there are totally 8 pushbuttons, 8 sensors and 1 unidirectional motion DC motor. Sprocket and chain mechanism is used which is driven by the DC motor. When the car comes and is placed on the tray, the inductive sensor senses the car after the tray is already sensed. When both the tray and the car are sensed, the counter is incremented by one. The user comes out of the car and presses the pushbutton. The motor starts to run and the filled tray moves upward and the next empty tray will be sensed and stops in the bottom position. The process continues and in the meanwhile when a user comes to retrieve the car and presses the pushbutton, the car is retrieved and the decrement of 1 takes place in counter. When the counter reaches the maximum count, the motor stops. When the next user comes and presses the pushbutton, the motor will not run and beeper will beep to indicate that all trays are filled.

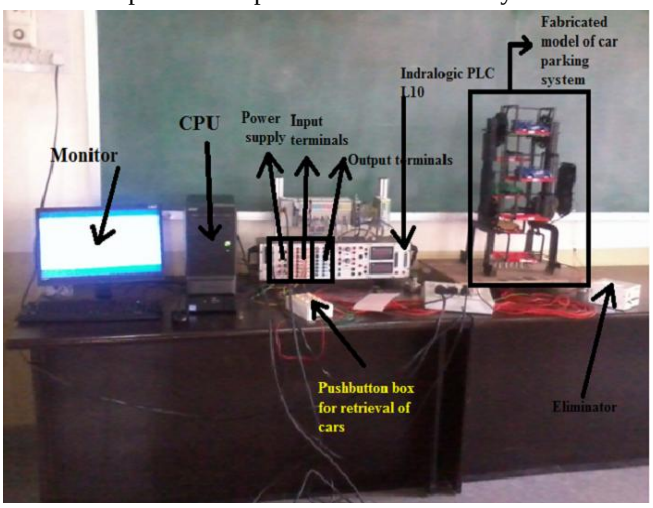

Fig 4 Interfacing of hardware with PLC

The final assembly of the project work done is shown in fig 7. The fabricated model is interfaced with PLC and CPU. The system has been tested for various relevant input conditions using PLC software.

5. Conclusions

The design and development of a prototype of an automated parking system has been done under the scope of an M.Tech project. A demonstration has been done for seven cars which has yielded expected output conditions for sample input conditions. Here, PLC is used in the control of the prototype of the automated parking system. Inductive sensors, relays, DC motors are used to provide movements to transport the vehicle in the parking system. The main advantages are space optimization, cost effectiveness and security.

Acknowledgements

I would like to acknowledge Sree Rajendra(Associate prof.) for his guidance, Sri Dinesh, and Sri H.S. murali of MCE Hassan for their key help in the project. Thanks are also due to Dr. S.R. Jayaram (HoD Mech. Engg), and Dr. M.V Satyanarayana, Principal, MCE Hassan for the opportunity provided to me.

References

i. *Automated parking system by Lina Lo in 2012.*

ii. *Smart Parking System with Image Processing Facility by M.O. Reza, M.F. Ismail, A.A. Rokoni, M.A.R. Sarkar in 2012.*

iii. *Smart Parking System (SPS) Architecture Using Ultrasonic Detector by Amin Kianpisheh, Norlia Mustaffa, Pakapan Limtrairut and Pantea Keikhosrokiani, International Journal of Software Engineering and Its Applications 2012.*

iv. *Smart Parking Applications Using RFID Technology by Zeydin PALA and Nihat INAN in 2009 IEEE explore.*

v. *Smart Parking by Gongjun Yan Weiming*

vi. *Yang Danda B. Rawat Stephan Olariu in 2010.*

vii. *Patrascu, Daniel (2010), "How Automated ParkingSystems Work", Autoevolution, retrieved 2012-11-16.*

viii. *Sanders McDonald, Shannon."Cars, Parking and Sustainability", The Transportation Research Forum http://www.trforum.org/.Retrieved on 16 October 2012.*

ix. *Hamelink, Ir. Leon J. (2011), The Mechanical Parking Guide 2011, ISBN 1-466-43786-3*

x. *Srikanth S.V Design and Implementation of a Prototype Smart PARKing (SPARK) System Using Wireless Sensor Networks, Centre for Dev of Adv. Comput. (C-DAC), Bangalore, India, May-2009.*

xi. *Chih-Yen Wu, Shih-Hao Huang, Gwo-Jia Jong, Automatic Vehicle Parking System using Gyroscope, University of Applied Science, Kaohsiung, Taiwan, ROC, 2009*