Smart Car Parking using PLC and SCADA

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Abstract**—** *This paper demonstrates a prototype development of Smart Car Parking using PLC and SCADA. PLC is one of the mostly used controllers as it is easy to operate and controls task according to the program which is already fixed. In today's scenario where maximum people use cars, the biggest question arises if the car would be safe or not, in addition to that the user wants to park the car at ease without facing problem in finding a vacant and safe parking lot. Therefore, the concept of smart car parking is appropriate enough to make the city smart at an initial level.*
Keywords— PLC, Relay (DPDT), DC Geared Motor, RF-ID Access Control, Proximity Sensor, LED Indicator, LED Strip

I. INTRODUCTION

In this project we have developed a prototype with the help of PLC and SCADA. The parking is smart in the sense that there's no need of any human efforts to provide any security or guide lines to the users [4].

We got motivation from the people who face problems in finding vacant places in a large car parking area. Some people enter in the wrong row and then they reverse their car and face problems to do so. They waste their time for such kind of unnecessary efforts. Also they sometimes get irritated when they don't get a suitable place for their car [1]. In addition to that they get worried about the security of their car.

So for removing the problems and providing relief to the users, we found a solution and the idea of 'Smart car parking' is created.

At the entry of parking there is a RF-ID access control security system. Due to this security system, only those one are allowed to enter the car parking which are registered with their information. So it is completely safe. At the entry of car parking there is also a guiding system consisting of LED indicators, which will indicate the users that which lot is vacant for car parking. In addition to that, there is also a guiding system after the entry. This guiding is done by using LED strip lights. Strip glows according to the location of vacant parking lot. After the entry of the user, these lights guide the users towards the vacant lot. Thus there is nothing which will create problem for the user to park. The same security system is installed at the exit. We have also installed a SCADA display, through which we can control and monitor the car parking [2]. From SCADA, we can also remotely control the car parking and reset it. The opening and closing of gate can also be controlled with the help of SCADA. There is also an emergency mode which locks the car parking at full scale. This mode can be used in any type of emergency situation. During this mode no one would be allowed to enter or exit the car parking.

Besides these features, energy is also used efficiently in this project. All the electric components are in use only when there is a need by any user. At the idol state, these components remain off. So energy consumption reduces.

We have used PLC of Allen Bradley, Micrologix 1000. SCADA is made by using RSView32 by Rockwell Automation. Some NPN proximity sensors, Relays, RFID module are used to catch our aim. For converting 220V AC to 24V DC, we have used Switched mode power supply.

II. BASIC APPROACH FOR SMART CAR PARKING

The main objectives of our model can be summarized as follows:

- To design and develop car parking which is very user friendly.
- To understand the problems associated with the user and to solve them.
- To make a program, which should be easy to understand by an electrical engineer.
- To use the most appropriate hardware components that would make the parking more efficient.
- To develop a user friendly interface on SCADA.

This car parking is fully automated. There is no need of any kind of human efforts. This is associated with a very user friendly environment for the users. It is energy efficient and economical. PLC is used of 32 I/Os.

A. PLC:

A programmable logic controller, PLC is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines etc. It is a solid state user programmable control system with functions to control logic, sequencing, timing, arithmetic data manipulation and counting capabilities. It can be viewed as an industrial computer that has a central processing unit, memory, input output interface and a programming device. The central processing unit provides the intelligence of the controller. It accepts data, status information from various sensing devices like limit switches, proximity switches, executes the user control program stored in the memory and gives appropriate output commands to devices such as solenoid valves, switches etc.[2]

Fig. 1: PLC used for system

In this project we have used PLC with 32 I/Os as shown in Fig. 1. It contains 20 Input terminals and 12 output terminals. 11 input terminals and 12 output terminals are in use.

B. SCADA (Supervisory Control and Data Acquisition System)

It is a type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes that exist in the physical world. SCADA systems historically distinguish themselves from other ICS systems by being large scale processes that can include multiple sites, and large distances [2]. These processes include industrial, infrastructure, and facility-based processes. Through this we can control our whole process from the remote end, analysis & record data for large extent.

C. Power Supply:

We are using Switched mode power supply. This supply converts the 220V AC into 24V DC with the current rating of 2 Amperes. A regulator is also present with the help of which we can control the output value of SMPS [5].

A switched-mode power supply is an electronic power supply that incorporates switching regulator to convert electrical power efficiently. SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy.

Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

D. Relay:

In electrical engineering, relay is an electrical component that can break an electrical circuit, by interrupting the current or diverting it from one conductor to another. The most familiar form of relay is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is non-conducting. Fig. 2 shows the connection diagram of the relay. We have used DPDT *(double pole double throw*) relay. It operates on 24V DC supply which is controlled by PLC.

1) Working of Relay:

In this project, 6 DPDT Relays are used to provide switching action to the components installed. The first 2 relays are used for the entry barrier gate's motor to move it clockwise and anti-clockwise. Likewise, other 2 relays are used for exit barrier gate's motor. There's an LED navigation panel present which is also being switched by the relay. The RF-ID Security Access is being switched for both entry and exit purposes with the help of relay.

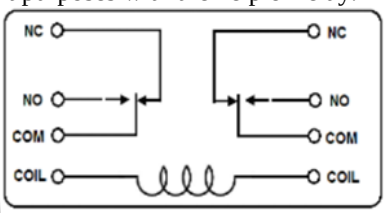

Fig. 2: Connection Diagram of Relay

E. LED:

We've used 6 LED indicators along with LED strips. The LED indicators are used before the entry to give the status of vacant lots to the user. But after taking entry, it might be difficult for the user to remember the vacant lot. To solve the issue, LED strips are used which will navigate the user to park the car at a vacant lot.

F. Proximity Sensor:

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target. An inductive proximity sensor always requires a metal target. The maximum distance that this sensor can detect is defined "nominal range". Its nominal range is 5mm. Some sensors have adjustments of the nominal range or means to report a graduated detection distance. Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between sensor and the sensed object.

1) Working of Sensors:

These sensors are being used in the lots of parking & for entry & exit. It is a sensor able to detect the presence of nearby objects without any physical contact.

G. RF-ID Module:

We have used a RF-ID module for providing security [4]. There are some RF-ID cards present with it. First an 'Adder' card is made as it can be used further for registering the other cards. Then a 'Deleter' card is made as it can be used to cancel any user's registration. There is a relay connected with the RF id output. If any registered user accesses this system then an electric of 24V energies the relay which gives the input to PLC and PLC acts according to the signal.

H. DC Motor:

A DC motor is a class of electrical machines that converts direct current electrical power into mechanical power. This DC motor works on the principle, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has the tendency to move [3]. We have used 2 DC motors having 5 rpm and suitable for a DC supply of 12V.

I. PLC Programming:

Ladder logic is the most common programming language used to program a PLC. Ladder logic was one of the first

programming approaches used in PLCs because it borrowed heavily from the relay diagrams that plant engineers already knew. It is similar to a schematic for a set of relay circuits [9]. The software used for programming is RSLogix 500. Fig. 3 shows the program for entry in car Parking.

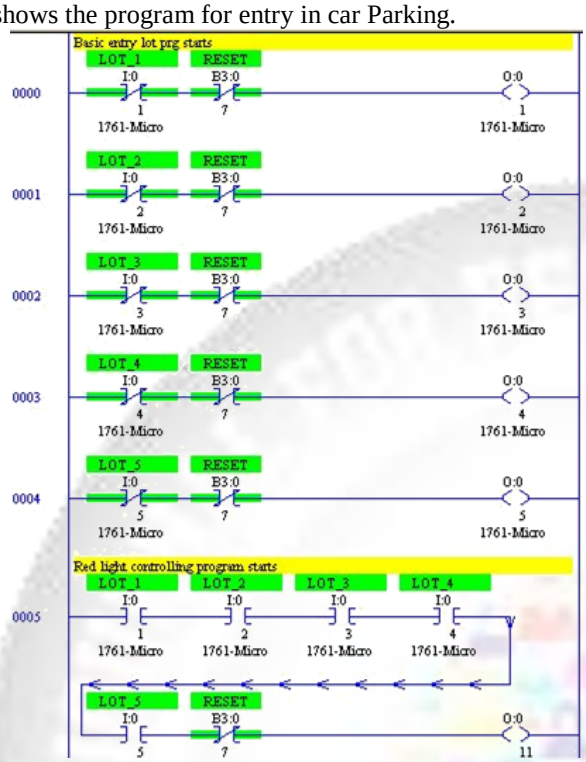

Fig. 3: Program for entry in Ladder Logic

J. SCADA Designing:

We have used RS View32 software for SCADA designing. This software is the product of 'Rockwell Automation'. The SCADA program is interfaced with PLC programming to work accordingly with it. Fig. 4 shows the interface of car parking system.

SCADA contains a feature of emergency lock from a remote location. This lock is designed for abnormal emergency conditions. If the car parking is under emergency lock then no one can enter or exit the car parking.

A reset switch is also provided for removing any type of uncertainties.

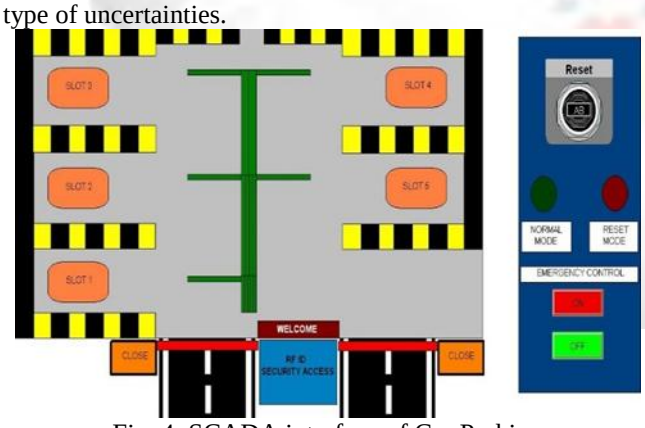

Fig. 4: SCADA interface of Car Parking

III. Block Diagram and Snapshot of Our Model

The basic block diagram of Car Parking system is shown in Fig. 5 and the snapshot of car parking system model is shown in Fig. 6.

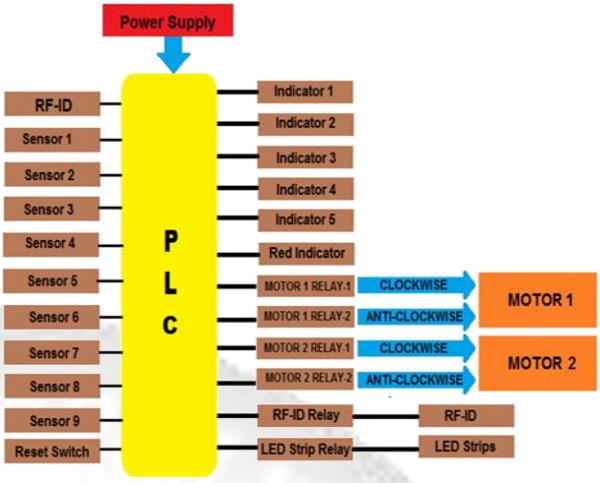

Fig. 5: Block Diagram of Car Parking

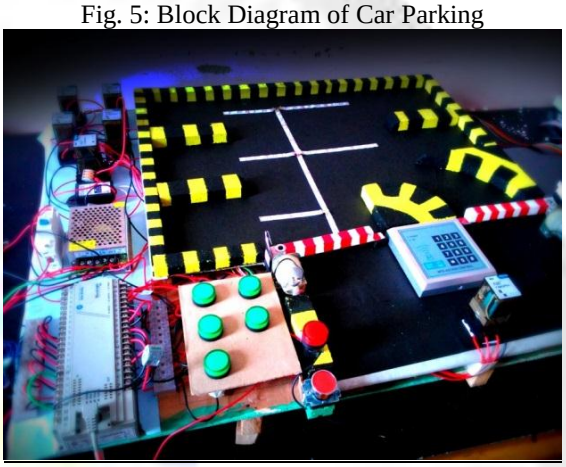

Fig. 6: Snapshot of Car Parking model

IV. Results and Discussion

Smart Car Parking completes the demands of Smart India very efficiently. It provides smart work, energy consumption control, security and ease at the same time. SCADA can be implemented for accessing and monitoring from remote location. Thus it is a completely smart and fully automated car parking and is the future of the car parking.

V. Future Work and Conclusion

We have initialized the project. But this can be updated further. Some features can be added as:

SCADA can be connected to the internet, also a mobile app can be created which connects with SCADA and a display of vacant lot will be shown in mobile of user.

Some parking sensors can also get implemented which will glow red light if a car reaches too close to the wall. An alarm can also get attached with it which will alert the user.

This paper presented a new method for making the parking smart. The project Smart Car Parking Using PLC and SCADA has the advantages of SCADA & PLC. PLC is used for automation and SCADA for controlling and monitoring. This project ensures less maintenance and reduces risk factor and also increases the efficiency. Now the days PLC and SCADA play an important role in industrial automation. In our project we have utilized the application of PLC and SCADA effectively.

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