PLC based Mall Automation System

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Abstract: This paper is formed by keeping the power consumed in the malls. As the shopping malls are the global phenomenon where every little outdoor bazaar products are sold. People not only find malls for purchasing goods, it is also known as a cultural hot spot where people of all ages meet up to interact. As everyone of us know malls consume a lot of energy and not all energy are used in an efficient manner. So, to overcome this energy loss, PLC's are used to automate the malls. To start with, the parking system is fully automated so that only a specific number of vehicles can be parked inside. The door of the parking will be opened and closed automatically until the parking is full. When the parking is full the buzzer will beep so that the further incoming vehicles will be directed to another parking area thereby avoiding confusions. Elevator will be present to take customer from basement parking. Once the customer reaches near the elevator the elevator will be directed to basement. Another small way to reduce power wastage is that if elevator is present in two different floors then the elevator will move to the floor which is nearer to the present floor. This process is done by comparing the distance between the present floor and the floor which the elevator is to be moved. The elevator will move to the floor which has less distance from the present floor and therefore a little amount of power and the customer waiting time can be saved. "Saving each penny will help you to build a house one day". Air-Conditioner of the malls are also adjustable according to the temperature. The temperature is constantly being monitored by a Resistance Temperature Detectors (RTD). If there are a lot of people then it would naturally be warm so that the temperature of the Air-conditioner is further reduced so that more cooling takes place and automatically as more people leave out the mall would be cool if the same temperature is maintained, therefore the temperature is raised accordingly. Lights and Airconditioner get turned off when there is no one in the mall. For further development PLC's can be used for theft protection in each shop in the malls. If there is no one inside the shop then all the power coming to the shop will be cut off and then if there is someone who breaks the door or the window then a buzzer is made to make noise.

Keywords : Mall Automation, Man Power Reduction, PLC, Power Consumption

I. INTRODUCTION

Automation is defined as the process in which manual involvement is not required for the task to be completed. Automation can be done by any controller or processor. The most preferable in industries are Programmable Logic Controllers. In many small-scale industries Micro controllers are also used. There are many types of PLC's depending upon the number of inputs and outputs required. In certain process the number of inputs and outputs may vary in future so that specific PLC's are used in which the input and output modules may be added later. PLC's can be used for automating anything in the world. Therefore, it can be used for automating the malls and even power conservation is possible. Saving a small amount of power now can be used for future used in this world of power shortage. There are lot of power being wasted in the lights which are on unnecessarily and also in air-conditioner. Therefore, these can be controlled in an effective manner to save a small amount of power. The number of securities required can also be reduced by indicating that the parking is full or not to the customers and also to the securities. This mall automation can be done by using any type of PLC. For example: ABB, Siemens, Delta, AllenBradley, Omron, GE Fanuc, Keyence, Mitsubishi and so on.

II. PROGRAMMABLE LOGIC CONTROLLER

A Programmable logic controller is a specialized computer used to control machines and processes. It therefor shares common terms with typical PC's such as Central processing unit, memory, software and communication. PLC is designed to survived tough situations and conditions whether a PC does not survive in those extreme conditions. It is very flexible in interfacing with inputs and outputs in the industries. The three main components that make a PLC work can be divided into three core areas such as

- The power supply and rack
- The central processing unit
- The input/output section

PLC comes in different shapes and sizes. They can be so small as to fit in your pocket while more complex systems require large plc racks. Smaller PLC's have fixed I/O points while large PLC's are of modular type, which can accept many different types of I/O modules.

III. PLC LANGUAGES

There are 5 different types of languages grouped into two known as Graphical language and Textual languages. Out of these 5 languages ladder logic diagram is the easiest way to program. There are basically only 5 basic instructions in ladder diagram. They are input, output, memory, timers and counters.

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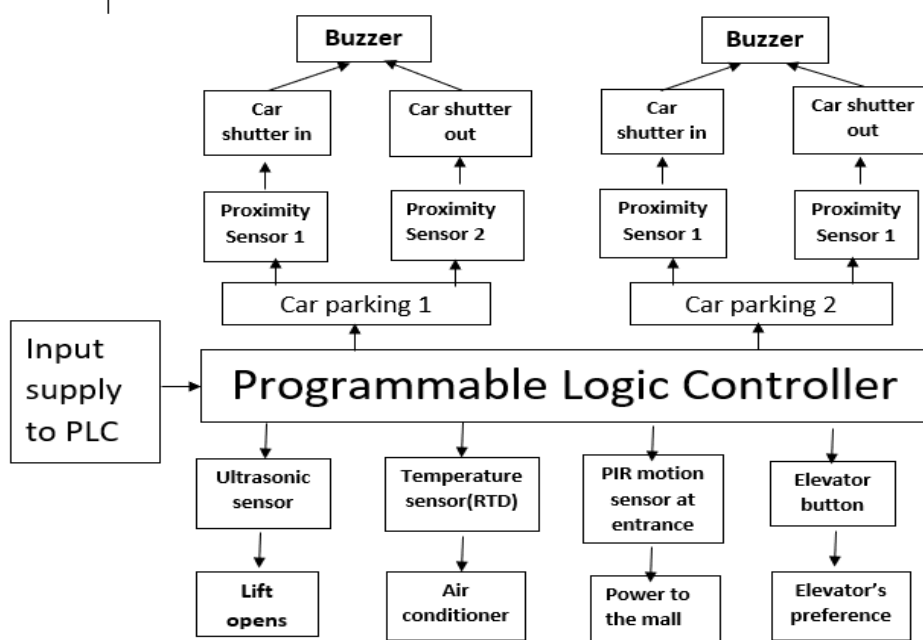
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IV. HARDWARE SETUP AND WORKING

Fig. 1. Block diagram of Hardware Setup for Simulation Working

The above figure shows the hardware setup for the proposed paper. The hardware block consists of Programmable Logic Controller, 4 types of the sensors (IR Proximity sensors, Ultrasonic sensors, Temperature detecting sensors, PIR motion detection sensor), Buzzer or LCD display. In a mall there is separate way for entry and exit. If a car arrives then the IR proximity sensor senses the car arrival and one count is increased. Similarly, as cars keep arriving counting operation takes place. Once the count reaches the set limit the input shutter is closed. For this operation the motor for the shutter is operated for 10 seconds. If a car leaves the parking then the IR proximity sensor at the exit is sensed and the inlet shutter is again opened because there is space left for entry of new cars. If the car parking 1 is full then it indicates that the parking is not empty for parking the car. Therefore, the car which arrives after the carparking is full is diverted to the next car parking slot. This reduces the security at every car parking slot. For further improvement LDR's are used depending on the number of cars which can be parked in the parking. If the car is parked then LDR doesn't give any output. So, this indicates that if LDR is giving any output then that slot is empty for parking. This output of LDR can be transmitted or displayed in the LCD display outside so that the customer is directed to the correct car parking slot. Similarly, it can be done to any number of car parking slots. This can avoid confusion and also reduces the securities needed in each car parking slot. This may also reduce the customer waiting time in the car parking slot and also avoid traffic jam near the entry of the mall since many cars are in queue for parking. As soon as the customer parks his car in the slot and arrives near the elevator, then the elevator starts coming down to the basement and this reduces the time. But, the elevator comes down only if the elevator is not busy. Another cause for power wastage is that air-conditioner. If the temperature is less then it consumes a lot of power because if the temperature is less, the compressor must run little more. Therefore, Temperature

sensor is used for detecting the temperature of the mall and the temperature of Air-conditioner is adjusted accordingly. If the mall temperature is less it indicates that there are only few people in the mall and therefore at this condition the temperature of the Air-conditioner is increased a little therefore the power is saved. If there are more people in the mall then this indicates that there are more people in the mall and so they emit more heat. Therefore, at this condition the temperature of the Air-conditioner is reduced so that the heat expelled by the customers is levelled. Power is important but then we cannot sacrifice customer needs also. Therefore, the temperature is adjusted accordingly. At almost every mall it calculates the number of people entered so therefore if no one is there in the mall or If no one is there in any particular floor then the power is shut down in that particular floor. PIR sensor is kept for calculating the number of people entered or the number of people leaving the mall. In each shop also this PIR motion control switch is installed. This has 180 degrees of sensitivity and if there is any motion in that range then the lights are switched on and it counts the number of times motion is detected and at an exit another motion sensor is kept and if motion is detected at that sensor then the lights will be switched off. This switching off takes place only when the count at entry and exit is equal. This can certainly save a lot of power because there are small lights which are on unnecessarily. Another way of saving the power is controlling the lift circle. If the lift is present in the 2nd floor (say) and people are getting into it and let's assume that someone presses the lift at the 5th floor first and then someone presses the lift at the 1st floor then according to the normal lift structure after the lift at the 2nd floor is closed it moves to the 5th floor first and then to the 1st floor because the button at the 5th floor was pressed first.

Thus, moving from the 2nd floor to 5th floor it travels 3 floors and then from 5th floor to 1st floor it travels 4 floors so totally it travels 7 floors. But then if the lift first moves to the 1st floor and then to 5th floors it travels only 5 floors. Therefore, the power consumed during those extra 2 floors can be reduced and also the light and fan running in those 2 floors will be eliminated. There is also another possibility of lift being run only in the lower half of the mall if the buttons are being continuously pressed in those floors so therefore to avoid this we are giving a priority to the buttons pressed.

V. TESTING WITH LADDER LOGIC
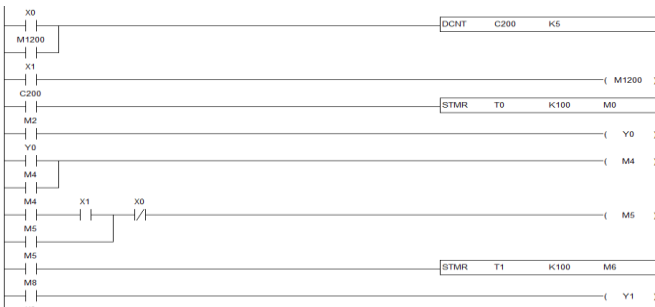
Thus, when the lift is pressed at 5th floor and 1st floor as stated above then these two floors will be given first priority. According to this project if the lift moves to the first floor and people press the button at third other floors it will move to those floors and then move immediately to the 5th floor because customer waiting time is also important.

ASSUMPTIONS
INPUTS
X0=first proximity sensor of car parking 1
X1=Second proximity sensor of car parking 1
X2=first proximity sensor of car parking 2
X3=second proximity sensor of car parking 2
X4=Ultrasonic sensor for lift to come to basement
X5=Temperature sensor
X6=PIR sensor for counting people present

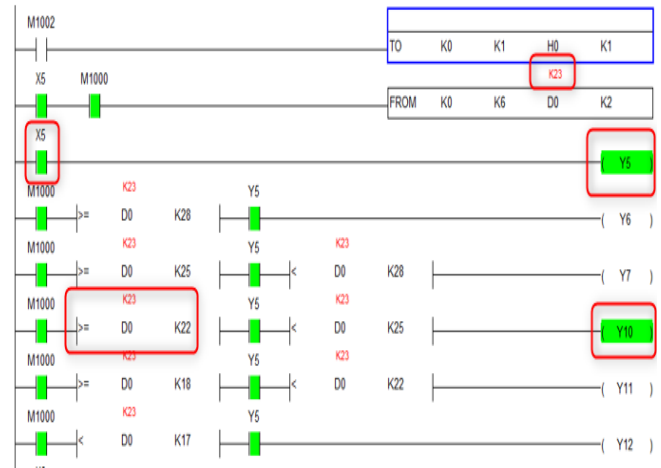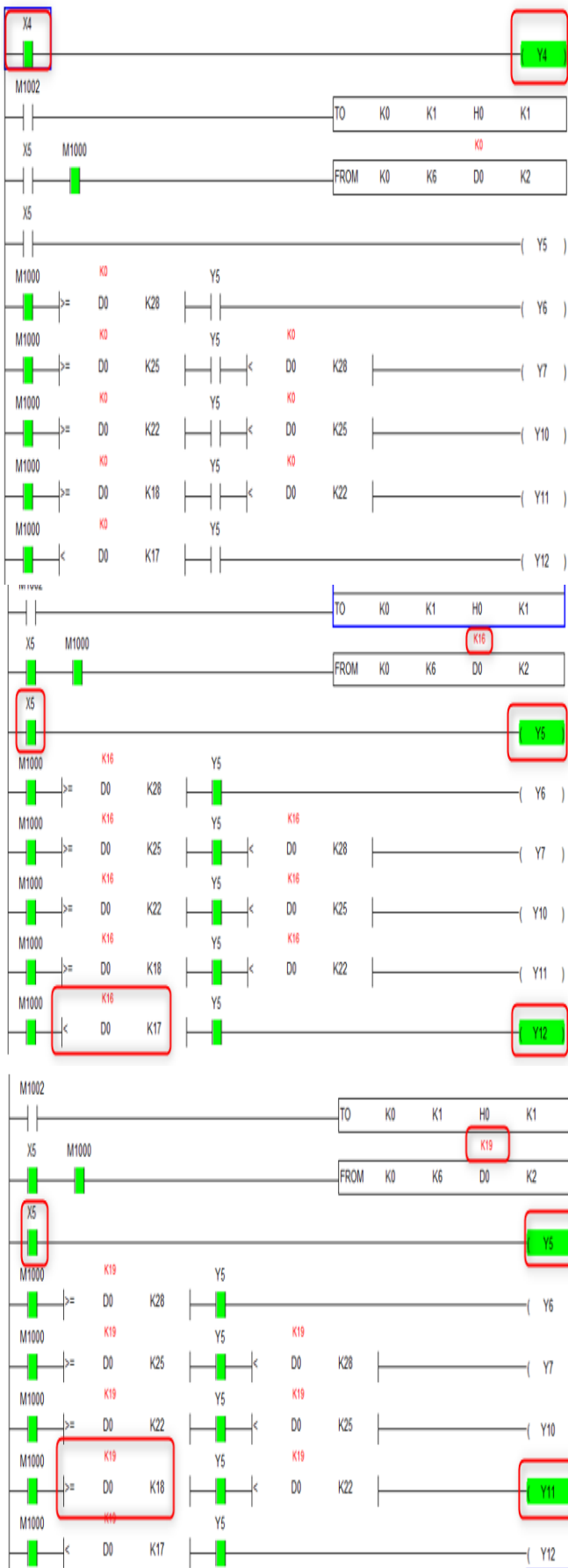*OUTPUTS*
Y0=shutter for inlet for carparking 1
Y1=shutter for outlet for carparking 1
Y2=shutter for inlet for carparking 2
Y3=shutter for outlet for carparking 2
Y4=Lift button to come to basement
Y5-Y13=Temperature to set to Air-conditioner
Y14=Output for turning the power off
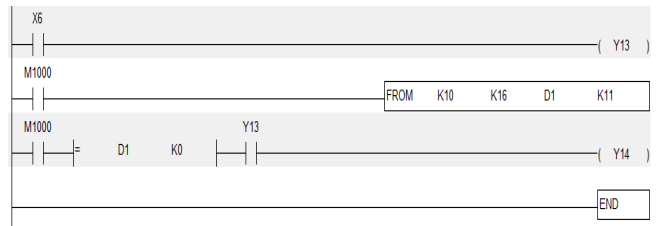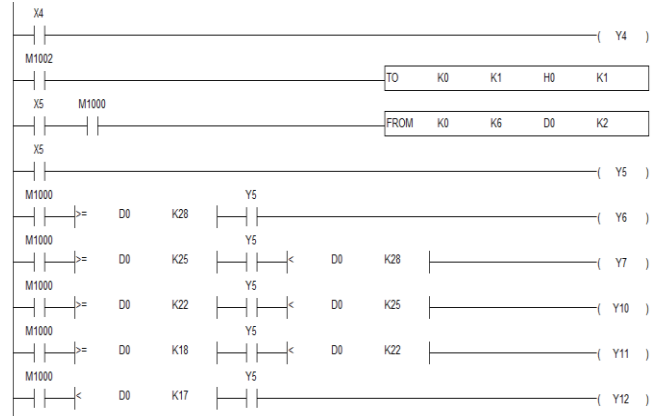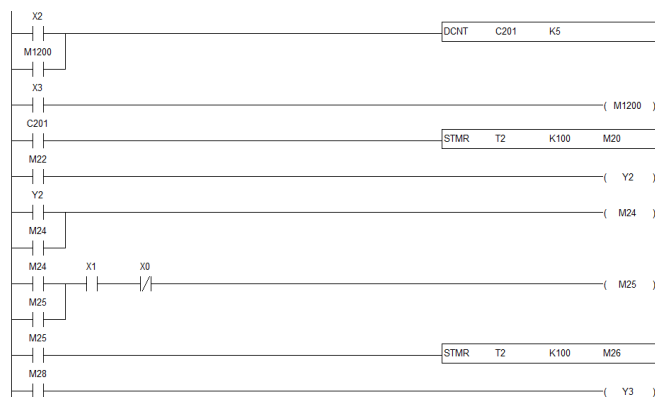
VI. RESULT ANALYSIS
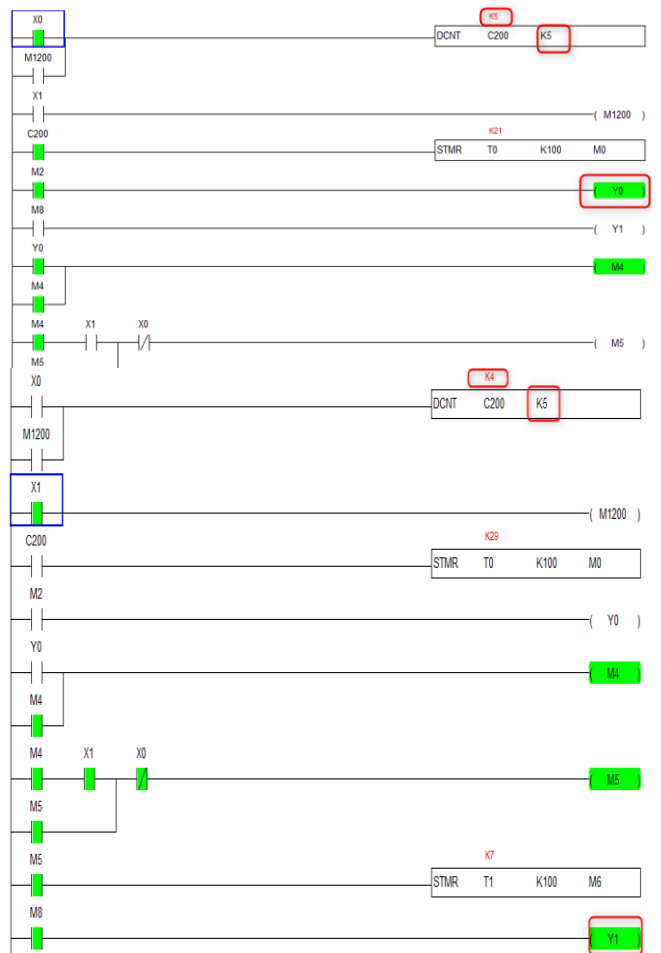
VII. CONCLUSION

Almost everything in malls are automated and it can be made fully automatic by implementing the above ideas. Therefore, by automating a little amount of power will be conserved. Since by the use of PLC a huge amount of power cannot be saved and only a few are saved. The power saved in elevator is minimal and almost 1/10 of the power consumed can only be saved but on continuous usage for every month almost a day's power can be saved. The main problem is that linking all these with the PLC's. It is not possible to do it with single PLC, but it can be done by using wireless communication. Even though wireless communication is done transmitting is limited to certain distance therefore many PLC's may be required. Few sensors are also required which must be in working condition or else it must be replaced frequently.

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