

# Apartment Automation and Security System Using PLC

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**Abstract-** The most important source of motivation in continuity of technological developments is to upgrade human living standards. The technological development provides and increases human-beings' safety and comfort directly and indirectly. Developing technologies for this purpose directly affects the life standards by means of smart home systems design. In this paper the implementation of apartment automation and security system using PLC is proposed. The control of the ventilation, lighting and security units in the smart home were carried out. The output from the different sensors is given to PLC which in turn controls the system by switching ON or OFF the actuators.

**Keywords-** Parking lot, Apartment, Indra Logic, Ladder logic, PLC

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## I. INTRODUCTION

In modern world everything may be controlled and operated automatically. One such field is apartment automation. Apartment automation itself includes home automation and parking lot automation. Security provides the protection against damages, danger, loss and crime. The security system provides the protection and safety for the assets and for human beings.

As technology advances most of the people would like to take its advantage. Most of the industry uses automation. Specially manufacturing industries are almost automated. Nowadays automation used in many fields. Home automation is an integral part of modern lives that help to monitor and control the home electrical devices as well as other aspects of the digital home that is expected to be the standard for the future home. A Programmable Logic Controller (PLC) is an example of a hard real time system. In hard real time system output results must be produced in response to input conditions within a limited time. PLC reads the status of the external input devices, e.g. keypad, sensor, switch and pulses, and executes by the microprocessor logic, sequential, timing, counting and arithmetic operations according the status of the input signals as well as the pre-written program stored in the PLC. The generated output signals are sent to output devices such as the switch of a relay, motor drive, electromagnetic valve.

If parking is done at the sides of the streets more time is consumed during parking. Traffic jam during

parking kills the most productive time. The land prices are also increasing day by day. The multistory parking system is the solution to this problem. To realize a multiple floor parking system a lift is to be installed to place the vehicles in the parking lot and to retrieve them. Conventional parking systems employ only to track the number of vehicles currently occupying the parking area. Although the multi level parking system facilitated parking to a great extent but to increase the security of parked vehicles as well as to reduce the manual work and time consumed during parking.

## II. RELATED WORKS

Wireless security system in the absence of home owner is presented in [1]. Design and PLC based home security system based on GSM module is discussed in which the automatic controlling is achieved by PLC instead of embedded controllers. The real time data acquisition monitoring and control system has been developed [2] using Programmable Logic Controller. PLC can handle various appliances of a home like Lights, Smoke sensor, Water level detector and various other appliances. A system for controlling electrical appliances using power line communication and monitoring data is proposed in [3]. Control messages are sent over Wi-Fi network from Wi-Fi device to personal computer which then couples the message to power line using micro controller with serial port interface. The microcontroller o/p is transmitted using DSSS. The receiver consists of PLC. License Plate Recognition (LPR) process is one of the key elements of modern intelligent garage security setups, a design of an

automated secure garage system featuring LPR process is presented in [4]. The paper focused on LPR method interfacing with an automated garage system. A prototype design is also provided with performance evaluation. A study of templates matching approach by using Optical Character Recognition (OCR) is implemented to carry out the LPR method. Home automation using PLC and SCADA has been proposed in [5]. The control of HVAC and Lighting is achieved by using various electronic circuitries. The basic multi-level car parking system with three floors is proposed [6]. The control strategy for the traffic flow to the multi level car parking system was carried out using the PLC.

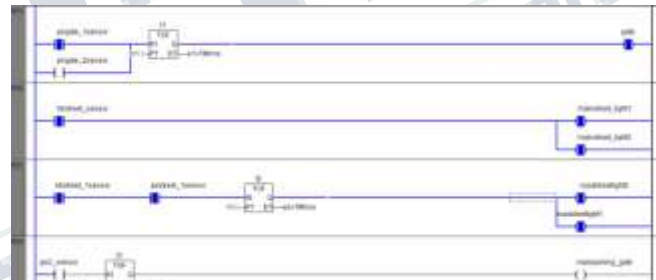
### III. SYSTEM DESIGN

The main aim of this paper is to propose an apartment automation and security system. The ladder program is written and implemented on PLC. Using PLC various parameters like temperature, light intensity fire and smoke detection, LPG detection, motion detection in apartment were monitored. Password based security system is also proposed in this paper.

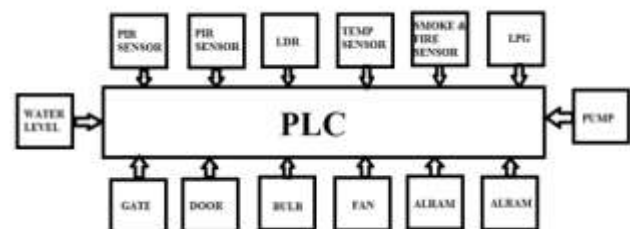
The proposed system provides and increases human beings safety, comfort and to upgrade living standards which also includes power saving. It is a real time model in which the sensors such as PIR motion sensor, chlorine detection sensor, light detection sensor, smoke and fire detection sensor, LPG detection sensor, temperature sensor, humidity sensor and soil moisture sensor senses different conditions and gives the appropriate information to the PLC which in turn maintains various parameters and the smooth functioning of the apartment [7]. The PLC is an industrial computer. It is capable of storing instructions to implement control functions such as sequencing, timing, counting, arithmetic data manipulation and communication. The I/O interfaces provide the connection between the PLC and the information providers (inputs like push buttons, sensors) and the controllable devices (outputs like valves, relays, lamps) [8].

PLCs are specifically designed to survive in the harsh conditions of the industrial environment. A well-designed PLC can be placed in an area with substantial amounts of electrical noise, electromagnetic interference, mechanical vibration and non-condensing humidity. The hardware interfaces for connecting field devices are actually part of the PLC itself and are easily connected. There are different types of PLC like Indra Logic L10, L20, L25, and L65. Indra Logic L20 PLC has been used. The PLC logic is software program, which runs on the processor in the PLC. The software used is "Indra works and Indra Logic" and the programming language is "Ladder Logic".

The ladder diagram has and continues to be the traditional way of representing electrical operations. These diagrams represent the interconnection of field devices in such a way that the activation or turning ON, of one device will turn ON another device according to a predetermined sequence of events. The original ladder diagrams were established to represent hardwired logic circuits used to control machines or equipment. Due to wide industry use, they became a standard way of communicating control information from the designers to the users of equipment. As programmable controller were introduced, this type of circuit representation was also desirable because it was easy to use and interpret and was widely accepted in industry. Programmable controllers can implement all of the "old" ladder diagram conditions and much more. Their purpose is to perform these control operations in a more reliable manner at the lower cost. A PLC implements, in its CPU, all of the old hard wired interconnections using its software instructions. This is accomplished using familiar ladder diagrams in a manner that is transparent to the engineers or programmers. A part of ladder logic used is shown in Fig.1. Fig.2 shows the block diagram of the apartment automation and security system using PLC.

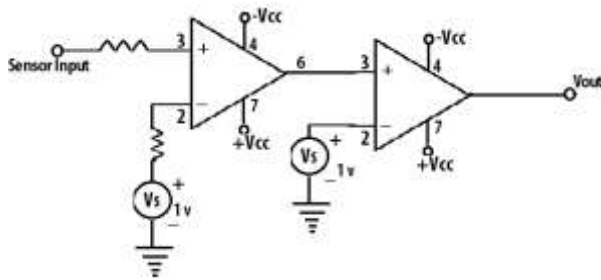


**Fig.1 Ladder logic**



**Fig.2 Block diagram of the system**

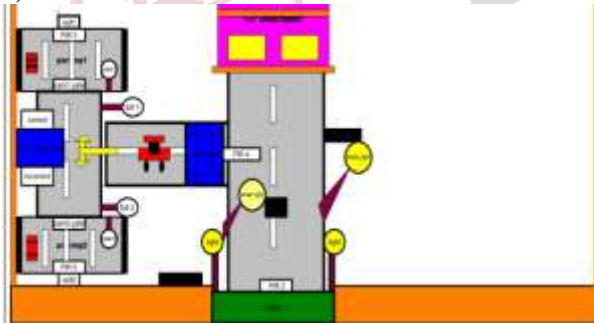
Simulation is carried out using ladder logic considering various parameters like temperature, light intensity. Necessary circuit blocks were built and tested individually. The program is uploaded to the PLC through Standard Ethernet. The interface between the PLC and respective sensor output is done through the I/O port with the help of comparator circuits. Comparator circuit used with amplifier is shown in Fig. 3.



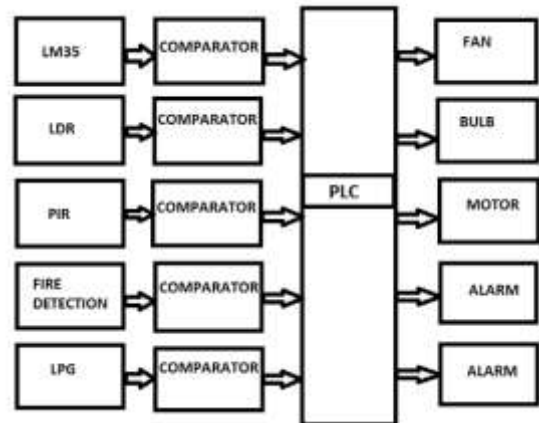
**Fig. 3 Comparator circuit**

#### IV. RESULT AND DISCUSSIONS

The system was initially designed for the simulation as shown in Fig 4. Graphical user interface or GUI is a type of interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, as opposed to text-based interfaces, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces (CLIs), which require commands to be typed on the keyboard. The term "GUI" tends not to be applied to other low-resolution types of interfaces with display resolutions, such as video games (where HUD is preferred), or not restricted to flat screens, like volumetric displays because the term is restricted to the scope of two-dimensional display screens able to describe generic information. It was simulated and after verifying simulation results the code was downloaded in PLC for physical verification. The PLC's outputs are given to the corresponding actuators as shown in figure 5(a), 5(b) and 5(C).



**Fig. 4 GUI for apartment automation**



**Fig. 5(a) Interfacing sensors and actuators to PLC**



**Fig. 5(b) Model prototype**



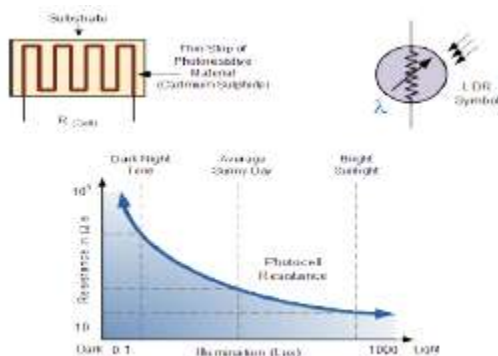
**Fig. 5(c) Model prototype with PLC**

Different sensors are used in the proposed system. LM35 is a temperature sensor calibrated to an accuracy of 1 °C. Its measurement ranges from -55 ° C to 150 ° C. The output is linear and each degree Celsius equals 10mV. The LM35 does not require additional circuitry to calibrate externally. The low output impedance, its linear output and precise calibration integrated enables this to be easily installed in a control circuit. Due to low supply current of self-heating effect is produced greatly reduced. It is found in different types of encapsulation, the most common is the TO-92, used by low-power transistors. Also this sensor if it is connected to one but an overall gain and output is obtained [9].



A Light Dependent Resistor (LDR) is also called a photo resistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits. Figure.6 shows the typical LDR symbol and LDR characteristics.

The value of 'a' depends on the CdS used and on the manufacturing process. Values usually range between 0.7 and 0.9.



**Fig.6 LDR symbol and LDR characteristics**

The presence of dangerous LPG leakage in the cars, service station or in the storage tank environment can be detected using the Ideal Gas Sensor which is shown in figure 7. This LPG gas leakage detector unit can be easily integrated into a unit that can sound an alarm or give a visual suggestion of the LPG concentration. The sensor has both admirable sensitivity and rapid response time. This sensor can also be used to sense other gases like iso-butane, propane, LNG and even cigarette smoke. The output of the sensor goes LOW as soon as the LPG sensor senses any gas leakage from the storage. This is detected by the microcontroller and the LED & buzzer is turned ON. After the delay of few milliseconds, the exhaust fan is also turned ON for throwing the gas out [10].



**Fig.7 LPG detection sensor**

HC-SR501 is motion sensor used in prototype which works based on infrared technology, which has automatic control module, using Germany imported LHI778 probe design, high sensitivity, high reliability, ultra-low-voltage operating mode, widely used in various auto-sensing electrical equipment, especially for battery-powered automatic controlled products. Fig 8 shows the typical motion detection sensor.



**Fig.8 HC SR501 Motion detection sensor**

Different types of actuators are also used in the system. Actuators are electrically operated devices. They are responsible for moving or controlling a mechanism or a system. It is operated by a source of energy, typically electric current, hydraulic fluid pressure, or pneumatic pressure. It converts that energy into motion [11]. An actuator is the mechanism by which a control system acts upon an environment.

## V CONCLUSION

Apartment automation and security system using PLC is simulated and implemented successfully. This method will help in automatic control and monitoring of different parameters inside the apartment using PLC without human interference. The prototype for automation of an apartment with smart home and a parking lot was successfully implemented.

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