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Implementation of Building Management System using Renewable Energy Source (Solar), PLC and SCADA

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Abstract - *Automation is used to improve quality and quantity of desired work not to reduce manpower. There are growing expectations for comforts and services in commercial places/Residencies, so Building Management System helps for fulfilling these expectations. Every day it is a challenge to manage multiple networks, systems and control components in buildings with maximum efficiency and comfort in future. A good building automation system can help to reduce operating cost. BMS is a controller used to manage and control the various applications in buildings, ensuring reduction in operating cost as well as energy conservation in building. In the current topic, control of various applications is done by using PLC and SCADA, for various applications like:*

1. *Window Shutter*
2. *Fire Alarm and Fire sprinkler*
3. *Lighting control (Internal & External)*
4. *Garden system*
5. *Smart underground Parking*
6. *Elevator*
7. *Electrification system (Solar)*
8. *Reuse of water*
9. *Segregation of Plastic waste*

Key Words: **Building Management, PLC and SCADA, Renewable Energy Source, Solar**

1. INTRODUCTION

Automation is used to improve quality and quantity of desired work not to reduce manpower. There are growing expectations for comforts and service in commercial places/Residencies, so Building Management System helps for fulfilling these expectations. Every day it is a challenge to manage multiple networks, systems and control components in buildings with maximum efficiency and comfort in future. A good building automation system can help to reduce operating costs. BMS is a controller used to manage and control the various applications in buildings, ensuring reduction in operating cost as well as energy conservation in building.

Under this project title, there will be implementation of the proposed applications listed above in the prototype model of building. The working of each application depends on the particular sensor.

2. LITERATURE REVIEW:

"Building Management System Using PLC and SCADA" by Suresh Kumar, Jitendra Prasad Rajwar, Abhay Kumar Thakur: The controlling unit in building management system automation is a PLC. Every device in an installation is connected to the PLC. When a user wants to interact with a system an operator terminal, which is attached to a cabinet where the PLC is installed, is used. With this solution the user needs to be in front of the cabinet to interact with the system.

BUILDING MANAGEMENT SYSTEM USING PLC AND SCADA There are various technologies available nowadays that can help reduce energy consumption and cost of existing buildings The project "Building Management System using PLC AND SCADA" has the both advantages of SCADA & PLC.

3.1 WINDOW SHUTTER (SENSOR USED: GAS SENSOR MQ2)

In this application the working of sensor is done when there is any leakage of gas is detected and then a closed shutter of window gets opened the exhaust fan beside the window shutter gets start automatic to throw out the leaked gas at faster rate. After particular time period shutter goes at its original position i.e. closed position.

3.2 FIRE ALARM SYSTEM AND FIRE SPRINKLER. (SENSOR USED: SMOKE DETECTOR, FIRE SPRINKLER)

In this system, there is smoke detector which will alert when there is fire in building/ floor. When smoke detector detects the smoke, which is present at particular area before catching fire and the signal goes to fire alarm and after getting signal it indicates detection of fire. The fire sprinkler is used to extinguish this fire. It burst when the temperature goes above preset value and pressurized water sprinkled on that particular area only, (the minimum area of 10ft *10ft and maximum of 50m *100m is covered by one sprinkler) at that time the command goes to the water tank to keep continuous water supply. There are three pumps namely Jockey pump, Main pump, Diesel pump (Supportive pump). The operation of these pumps is according to the pressure of

water in the pipe. The operating range of pressure for each pump is,

1) Jockey pump - Pressure - 5kg to 7kg

2) Main pump - Pressure - 3kg

3) Diesel pump - Pressure - 2kg

3.3 LIGHTING CONTROL (SENSOR USED: LDR, MOTION SENSOR)

LDR (Light dependent resistor) used here is to control the intensity of the light in the room. According to the intensity of sunrays in the day time the intensity of light in the room is controlled.

The motion sensor is used for the staircase lighting. If there is presence of human being on stairs, the lights become turned ON until a person reaches on the last step. Also, there is timer used to turn off the light after particular time e.g. 15-20 seconds.

3.4 UNDERGROUND PARKING SYSTEM (SENSOR USED: MOTION SENSOR)

When car/bike comes near the entrance gate the inductive sensor which is used to detect the metal things, senses the car and gate gets opened automatically. After passing the car from the gate it gets closed. Entrance of underground parking consists of speed breaker which acts as a sensor in the parking. When car touches the speed breaker the lights in the route of car turned on, and after some time lights become off. When car gets parked the indication on the entrance gate blink Red indicating the parking is full, it become Green when there is space to park.

3.5 ELEVATOR (SENSOR USED: MOTION SENSOR)

The elevator is mainly used for transportation purpose (like goods transportation) in any commercial/residential buildings. In this project, the special use of elevator is for medical emergency.

Consider on second floor there is a medical emergency and there are some persons wanted to go on first floor, pressing the medical emergency switch in the elevator it directly goes to second floor at the first time indicating medical emergency. Then it attends other floor applications.

The use of motion sensor is for opening and closing of the door of the elevator as the person detects by the sensor.

3.6 REUSE OF WATER:

The building consists of water tanks. Here, there are two tanks, tank A and storage tank. The water from these tanks is also used for fire sprinkler system and garden system.

When water supply is given to the tank A, after filling the particular percentage of tank water is pumped into storage tank. The storage tank always remains full. When fire system is working the supply of water is from storage tank and for the garden system also water from storage tank is used.

3.7 SEGREGATION OF PLASTIC WASTE:

Pyrolysis is a technique is used for segregation of plastic waste.' Pyro' means 'heat' and 'lysis' means 'break down'. In this process plastic waste is not burned, but instead plastic is chemically broken down into Pyrolysis oil, the hydrocarbon gas and carbon black. Plastic to oil is environment friendly technology for disposal of plastic waste.

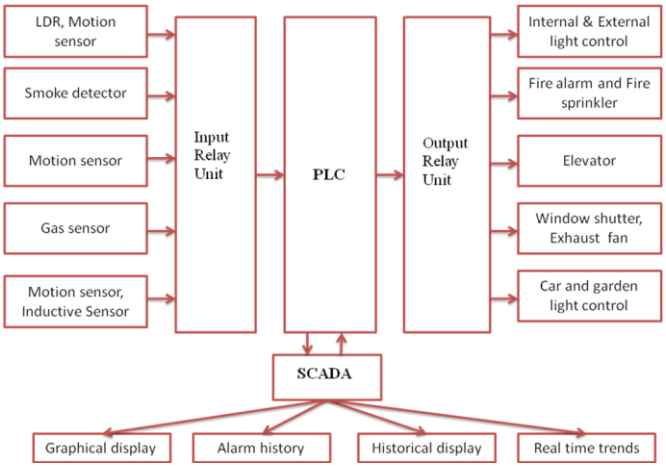


Figure 1: A block diagram of BMS using PLC and SCADA

4. WORKING PRINCIPLE

Under this project title, there will be implementation of the proposed applications listed above in the prototype model of building. The working of each application depends on the particular sensor.

The control of the system is done by using PLC and SCADA. The electrical power required for the controlling system is by using solar.

4.1 HARDWARE

Gas sensor:

Figure 2. Gas sensor MQ2

Analog gas sensor MQ2 is used here for window shutter application. It is used in gas leakage like smoke methane and liquefied flammable gas. It has wide detecting scope, fast

response and high sensitivity, simple drive circuit, stable and long life. The sensitivity can be adjusted using the potentiometer.

The sensor detects the concentrations of combustible gas in the air and output is analog voltage. It consumes less than 150 M Amp at 5 V (only sensor current consumption). A digital output is also provided which is useful to trigger an external module when the threshold is crossed. For example, a relay can be triggered when gas or smoke threshold crosses a certain level. Sensitivity can be adjusted by the potentiometer.

4.2 FIRE ALARM SYSTEM AND FIRE SPRINKLER

Figure 3. Fire alarm

In fire alarm system there is fire detector which will alert when there is fire in building/ floor. When fire detector detects the fire, the signal goes to fire sprinkler, and it burst and pressurized water sprinkled on that particular area only, at that time the command goes to the water tank to keep continuous water supply. To maintain pressurized water flow jockey pump can be used. The temperature of agent used in the sprinkler is set at particular value (normally it is 58 deg Celsius), which will burst out when temperature goes above the set value.

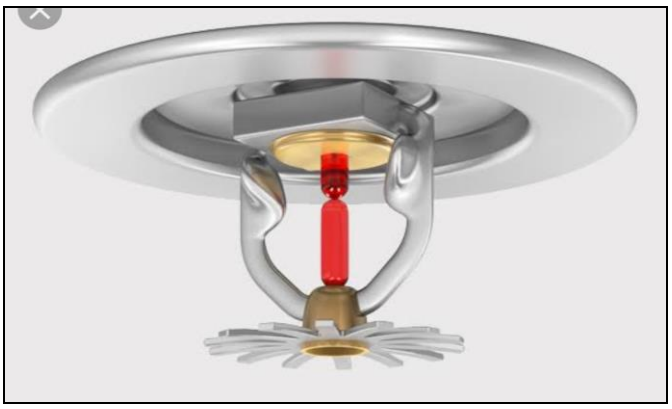


Figure 4. Fire Sprinkler

4.3 LDR (LIGHT DEPENDANT RESISTOR):

LDR is special type resistor used to sense the light. They can be connected in any direction. When the light intensity increases the resistance decreases and according to that the output is obtained. The output here is lamp and the light intensity is of sunrays.

The operating voltage is 5 volts and current is in milliamps. The resistance is varied from kilo ohms to mega ohms.

4.4. PYROELECTRIC INFRARED (PIR) MOTION SENSOR:

PIR infrared sensor module based on infrared technology,

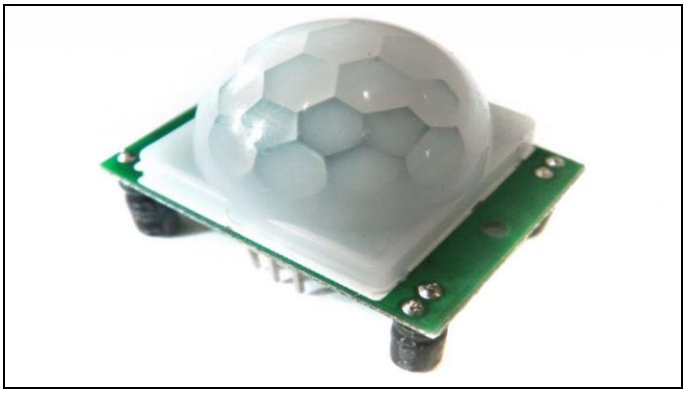


Figure 5. PIR sensor

automatic control products. It has high sensitivity, high reliability, low power consumption, low voltage operation mode. In this project, this sensor is mainly used for garden system, light control (staircase light), elevator application.

PIR sensors are used to detect motion from pets or humanoids from about 20 feet away.

Operating Voltage Range: DC 4.5-20V

Quiescent Current: <50uA

Level Output: High 3.3 V or low 0V

Wide operating voltage range: default voltage DC 3.6V - 20v.

4.5 INDUCTIVE SENSOR:

The inductive sensor used here is for detecting the cars which comes in the parking section. Using the output of the sensor the lighting control in parking area is done. The indication about parking condition i.e. is it full or vacant is also taken from this sensor output which is obtained after car gets parked.

4.6 SOLAR PANEL:

20W Solar Panel can be used for variety of functions.

Aluminium body makes the panel Robust.

Rated Power (Pmax) - 20W+- 3%

Open Circuit Voltage (Voc) - 21.5V

Short Circuit Current (Isc) - 1.30 A

Voltage at maximum power (Vmp) - 17.7 V

Current at maximum power (Imp) - 1.13 A

Maximum system voltage - 600V.

Dimension520 X 350 X 22 mm.

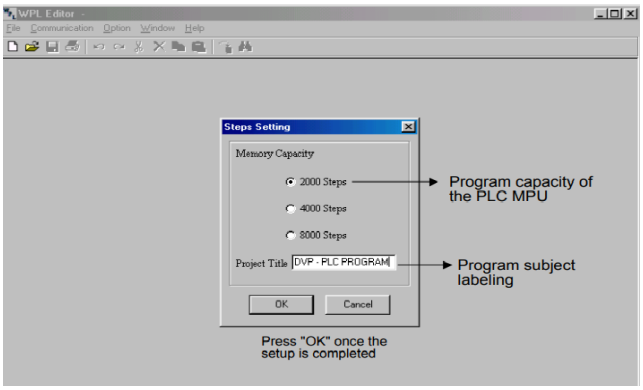
Figure 6. Solar Panel

5. SOFTWARE IMPLEMENTATION:

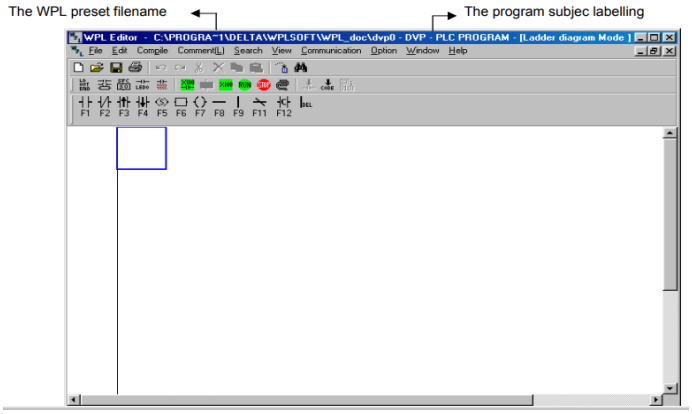
The Software used for the PLC here is WPLSoft and For SCADA it is DIA view.

The steps in operating WPLSoft are listed shortly below.

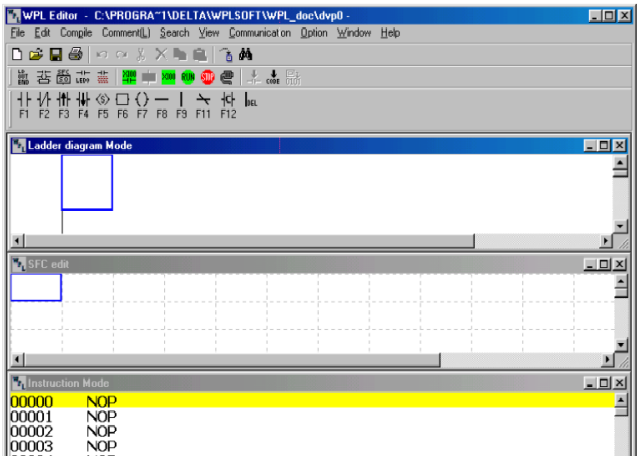
After WPLSoft is activated, we are to undertake the creating of new documents, the step numbers (please refer to the program capacity of the MPU in use) of the designated programs, and the initial setup of the subject labeling within the program.



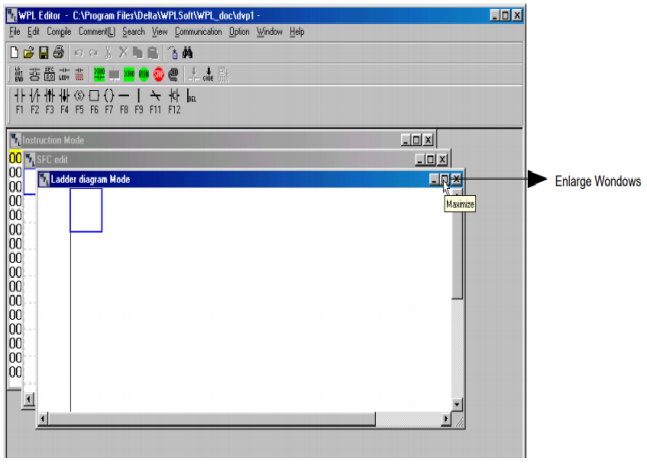
Then Choose the Ladder Diagram Mode: (after the ladder diagram is edited, convert the ladder diagram to the command mode and the SFC diagram through compiling)



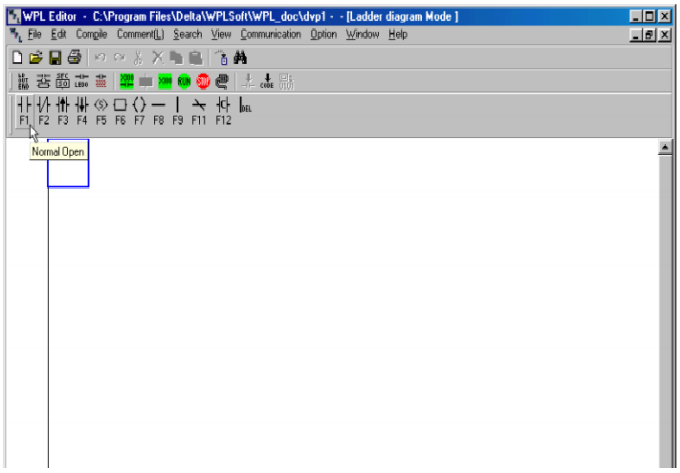
Click on "New" under "File", and the following image will show up; there will be some other selections listed on the function panel: Edit (E), Compile (P), Comment (L), Search (S), View (V), and we are to introduce these selections in order



1. Create new files

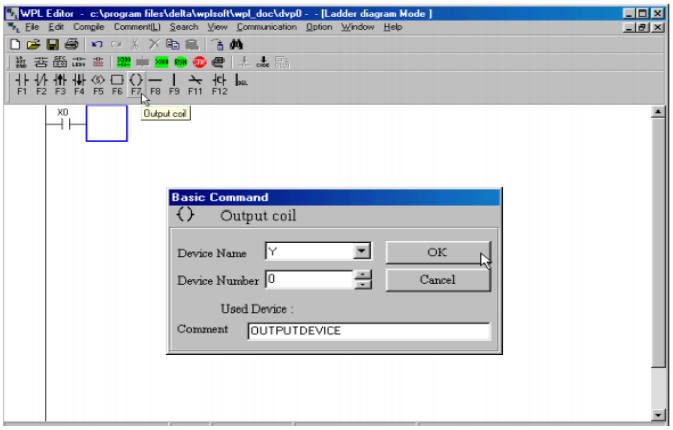


Click on the "Normally Open" icon, or press the F1 function key



What appears consequently are the device name and the comment dialog box, simply select a proper device name, device number and the comment, then press "OK" to complete the process.

Click on the output coil icon, or press the F7 function key and repeat the above-mentioned procedure.



Click on the application command icon, , or press the F6 function key; click on "All application" or "Other commands" under the Function Type, then click on "END" command under Application or key in "END" directly, and finally, press "Enter", then "OK" to complete the process.

Click on the icon, and convert the edited ladder diagram into the command program through compiling, and after the compiling is completed, the number of Steps will show up on the left side of the Origin.

If the graph of the ladder diagram appeared to be incorrect, the message dialog box would show up and point out the exact erroneous rows.

Then Run the Program.

6. ADVANTAGES & DISADVANTAGES:

There are growing expectations for comforts and service in commercial places/Residencies, so Building Management System helps for fulfilling these expectations.

7. Advantages

Many applications can manage at a time.

1. Energy conservation.
2. Less operating cost.
3. Use of PLC is more flexible as compared to other controllers.
4. Real time monitoring and controlling.
5. On the SCADA screen we can see the exact location of fault in the building monitored by PLC.

8. CONCLUSION

In this present automated world, building management system can also be used for completing expectations of middle-class people regarding the building services and comforts, as it is having less operating cost and more beneficial from their point of view.

9. FUTURE SCOPE

Use of PAC (Programmable automation controller) instead of PLC as it geared more towards complex automation system. These are better able to handle analog I/O and related control function, also it tends to provide larger memory capacity and more feature. IOT based building management system Remote controlling and monitoring Auto dialer system for security purpose.

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