Grid Tied Solar Hybrid System Using PIC And SCADA

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Abstract: Energy consumption increases day by day as there are more electronic and electrical equipments used in today's home. But there is the imbalance in between demand of electricity and generation. As there is the limitation for non renewable energy resources in the world due to shortage of non renewable energy resources, so this is the time to switch towards the renewable energy resources like solar, wind etc. This project is based on a hybrid uninterrupted power supply system using the solar and AC mains & PIC controller. This proposed model uses the PV cell, inverter, smart energy meters and PIC controller & SCADA. SCADA (Supervisory Control And Data Acquisition System) is used to visualize the whole system from start to end. The main advantage of system is the uninterrupted supply for domestic purpose and also saves the money.

Keyword: PV cell, PIC controller, Net meter, SCADA
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I. Introduction

It is necessary to generate and use energy in eco-friendly manner in order to be able to guarantee the life quality of future generations by decreasing the effects of global warming together with economic developments. From the different studies it is found that world's resources of fossil fuels are beginning to come to the end. Estimates of energy resource are vary but oil and gas reserves are thought to come to the end in roughly in 40 to 50 years respectively and coal reserves could only able to last another 200 years. Due to this reason it is necessary to search alternative energy resources which match to the present day's demands and also not contribute to increase the global warming unlike the nonrenewable energy resources. Renewable energy resources like solar, wind, water etc are the best alternative to the non renewable resources. Especially, as a result of the concern on energy sources like sun, wind, biogas, geothermal and hydrogen, researches on these areas have become more important. Utilization of the energy sources like sun, wind, biogas, etc that are known as renewable energy sources alone is not much useful in practice in terms of efficiency and effectiveness. For this reason, structures at which such systems are used together come into prominence today. So, studies concluded also demonstrate us this result. The hybrid power generation system is an electric energy generation method constituted by different energy systems that come together and is mostly used with renewable energy systems. The hybrid energy systems can be designed in a manner being operated in parallel with the electric distribution network or being operated fully independently from the network.

To use the renewable energy resources for domestic purpose there is one problem that is its reliability. Means of to generate the consistence amount of energy required for daily usage for domestic equipments like AC, refrigerates, tubes, fans, irons etc. it is not possible to use only one kind of resources for the daily requirements of home. To overcome from this problem this paper presents the combination of PV cell and the AC mains from the MSEB which will help to maintain the uninterrupted power supply for the daily requirement of home. As well as SCADA (Supervisory control and data acquisition system) represents the current situation of resources. Net metering concept is the calculation of energy to the grid and from the grid. To calculate this we are using the two different meters in this project.

Need of the Study:

This study provides the simple way to use the combination of renewable energy resource like Solar and the AC mains from grid which will maintains the reliability of hybrid system and provides the uninterrupted power for the domestic purpose.

II. LITERATURE REVIEW

By using the solar panel energy is generated to satisfy the load of home. ZigBee based energy measurement modules are used to monitor the energy consumption of home appliances and lights. A PLC based renewable energy gateway is used to monitor the energy generation of renewable energies. The home server gathers the energy consumption and generation data, analyzes them for energy estimation, and controls the home energy use schedule to minimize the energy cost. The remote energy management server aggregates the energy data from numerous home servers, compares them, and creates useful statistical analysis information. By considering both energy consumption and generation, the HEMS(Home Energy Management System) architecture is expected to optimize home energy use and result in home energy cost saving. In the energy generation, PLC modems are installed in each solar panel to monitor its status.[1] – [11].

For smart homes in which energy consumption and generation are simultaneously important for efficient energy minimization of cost and environment friendly generation of energy. Microcontroller based energy management module with ZigBee is used to control and monitor the energy consumption of smart home. For this solar and wind resources are used but as these are not

always available, also introduce water resources to generate the electricity. The charge controller, battery bank and battery level monitoring are used to provide stable energy module for smart home.[12]-[22].

Solar panels are used in capture the solar irradiance. But solar tracker is better than the panel as it senses the gyration of the earth and rotates by its axes following the sun to get the complete radiation and to maximize the efficiency. The proposed tracking system increases the output of the PV cell significantly in comparison with fixed solar panel.[23]

For The efficient operation of the photovoltaic based systems tracking the solar energy is done. An automatic single axis position control of the solar panel to track the sun from morning to evening which is connected to an AC load through a relay mechanism has been presented in this work. The position of the solar panel is changed using a stepper motor controlled by ATmega328p microcontroller. This position controlled solar panel has been used to charge a battery which is connected through a relay to a backup inverter supplying an AC load. [24]

Gaps Identified:

In the existing hybrid system Zigbee module is used to monitor the energy consumption of home appliances and lights which makes the system bulky and complex with internet connection. Complexity increases the installation and maintenance cost also. The use of SCADA avoids the above mentioned problems and makes the system user friendly. Here is the application of a "Net Meter". It calculates the net amount of energy that we receive from grid (MSEB). It has two meters, one measures feed from MSEB to customer. And another measures feed from PV system to the MSEB. Thus we get exact amount that we received from MSEB. Thus it's a grid tied system.

III PROPOSED MODEL:

3.1 IMPLEMENTATI ON STRATEGY

1. We are going to install Photo-Voltaic (PV) solar array system on the roof of home, which will generate electricity according to the availability of the solar radiations & size of PV array.
2. Furthermost this supply is given to load (Home). If load requirement is fulfilled, the remaining is fed to the grid through net metering (explained later in next article).If Solar PV array output is insufficient to tackle the load, the circuit is switched to AC mains through PIC controller.
3. All this process is visualized with the help of SCADA so that if any problem arises it can be detected on screen & can be resolved immediately.

Here, we used a combined system in which we have two energy sources.
1. First is a grid source (i.e. from MSEB).
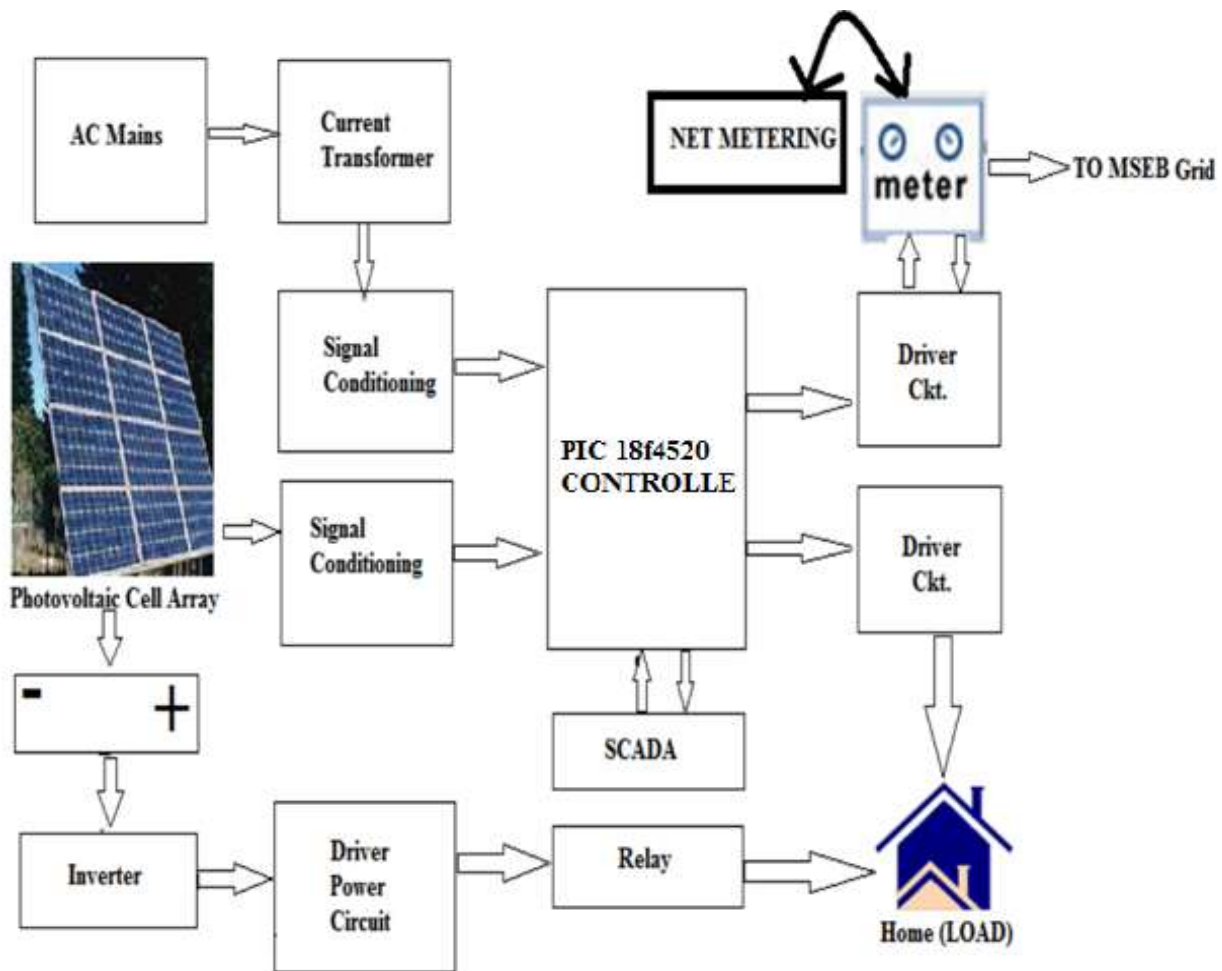2. Another source is Solar PV cells.
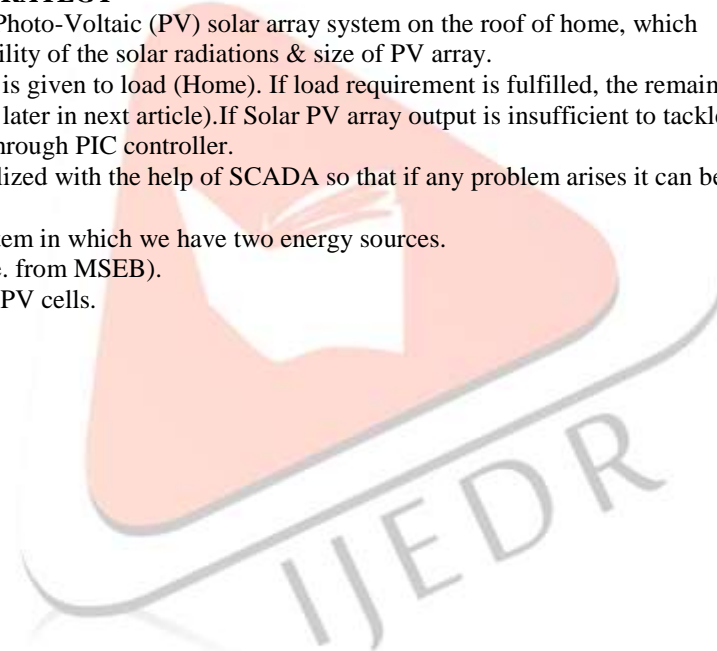
Fig 1 B.D of Grid tied solar hybrid system using PIC and SCADA

When the sun light strikes the surface of solar panels, the process of photoemission occurs in photovoltaic cell and solar energy is directly converted into electrical energy. Theoretically no heat dissipation is involved in this method. As shown in above fig. light energy is converted into DC electrical energy. But in home application supply should be AC, invertors is used to convert DC into AC and provided to load. If the light intensity is insufficient to produce the output voltage to run the load then the controller will send a command to disconnect the PV module from the load and switch to the AC mains of MSEB. This situation arises due to the limitation of PV cell that is at night time light source is totally disconnected. Due to this fact only solar system is not sufficient to run the load. So we move towards the hybrid system that is solar plus AC mains. Controller is basically used to switch between the solar and AC mains depending on the output of Solar panel. Output of PV cell is totally depends on the light intensity of SUN. Light intensity is totally different in different seasons like winter, Rainy and summer season. Second Condition of Switching by the controller arises when the output of PV cell is greater than the load requirement in summer. Controller used in the system is PIC 18F4520. That is when Light intensity is higher at that time output of the PV cell increases which fulfills the load requirement and excess amount of electricity is remaining. Then that excess amount of electricity is connected to the grid of MSEB. Netmeter used to calculate the power consumed by MSEB and generated power by PV cell. All this process is represented by the SCADA using the VB. Our whole system start from PV cells to grid can be covered by using the SCADA. That is the Signal flow from first to last can be visualized by using the SCADA. Hear VB is used to design the SCADA screen. The advantage of the SCADA is to detect the any fault created in system just by observing the display. As well as to control the system flow any time depends on situation.

Now a day's Indian government provides the subsidies on the grid tied solar system   installed on residential areas to promote the use of PV cell. We can also generate the energy using the PV cell for commercial purpose to earn the money. As well as by installing the above proposed system for domestic purpose we can save the money by crediting the extra energy generated from PV cell to the grid (MSEB)

IV RESULT AND DISCUSSION
4.1 SOLAR PV SYSTEM:
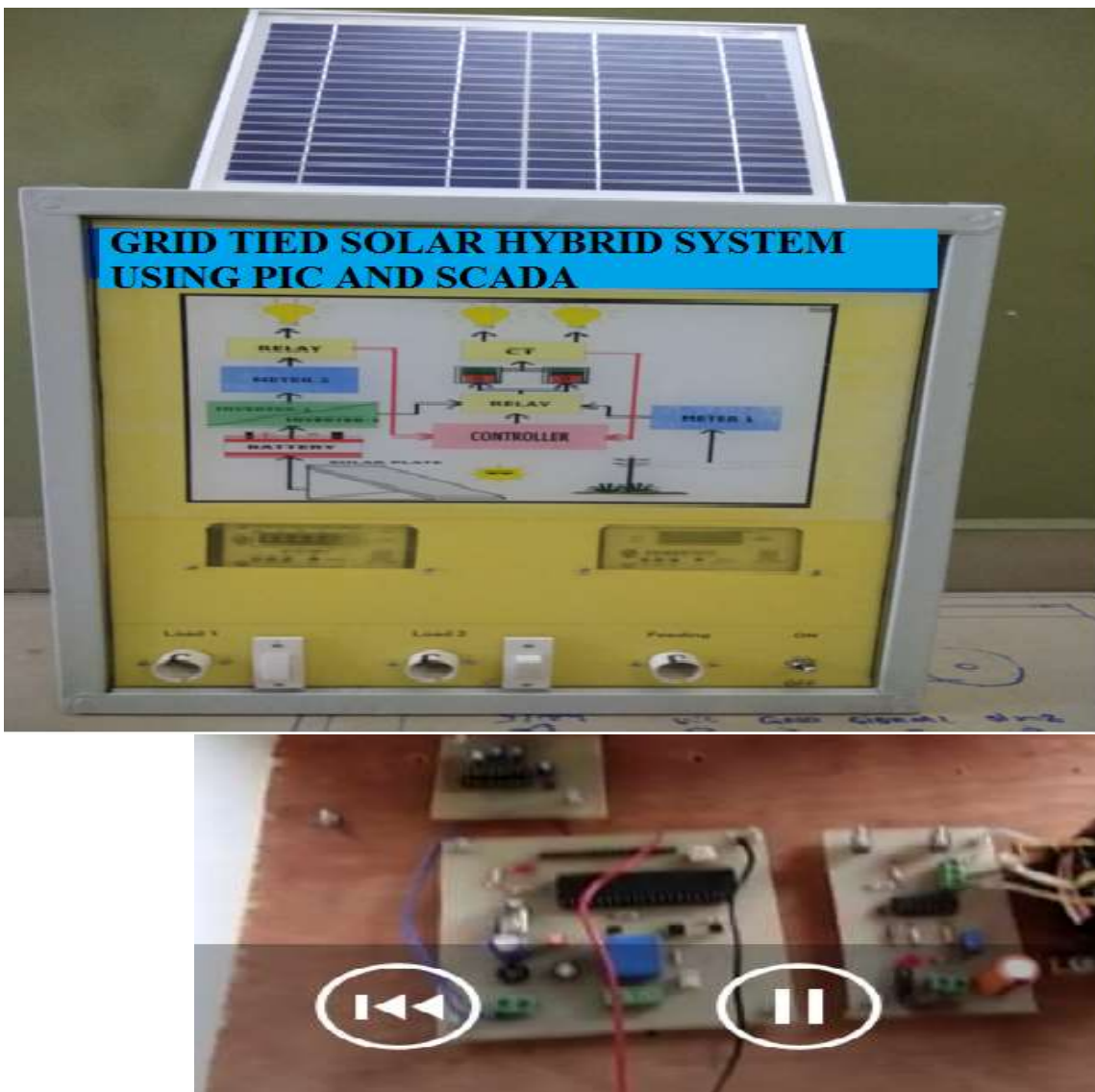In this prototype model we are using the 100W solar panel system with battery and inverter.

Fig: Front Panel Control Of System

Fig.3 Whole hardware of system

100W prototype model will nearly generate the 12V supply in full sunny days. If the load is less than 100W then solar output is connected to the load through controller. If load is greater than the 100W then controller switches load to the AC mains. At that time output of solar panel is stored in the battery.

4.2 SCADA DISPLY:

The special feature added in this project is the supervisory control and data acquisition system. As this is the hybrid system there are two different resources that is solar and AC mains. Depending on the output of PV cell and load requirement resource is selected. So there should be some provision to know which resource is to be selected to run the load. SCADA is this application which will display the status of current
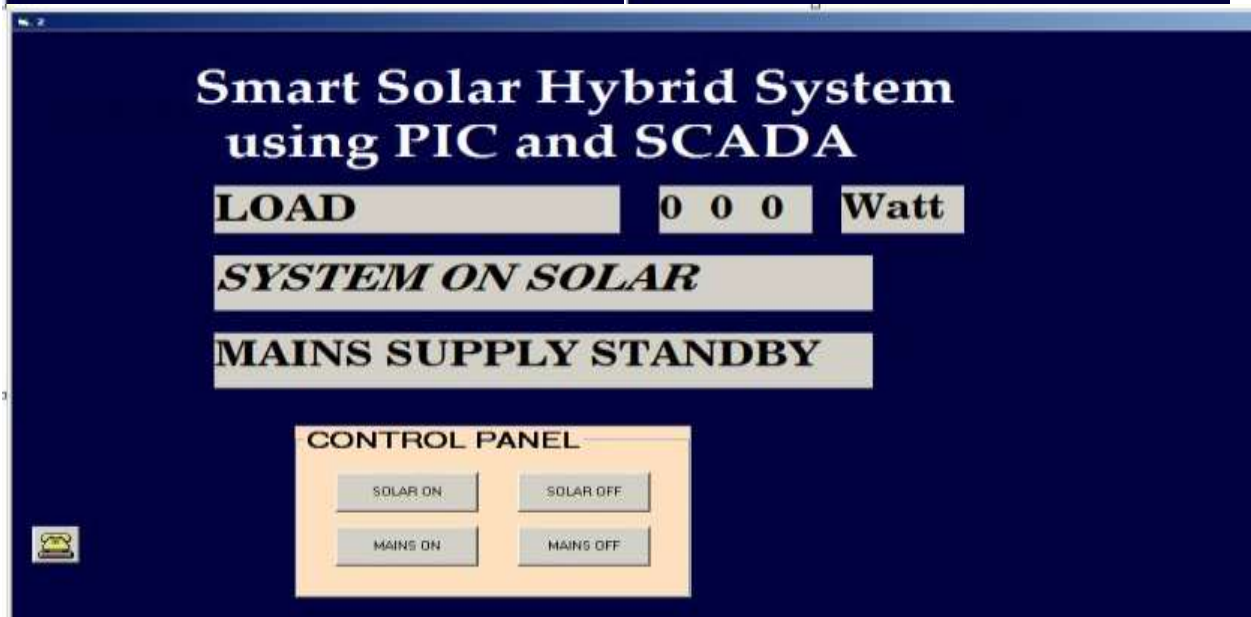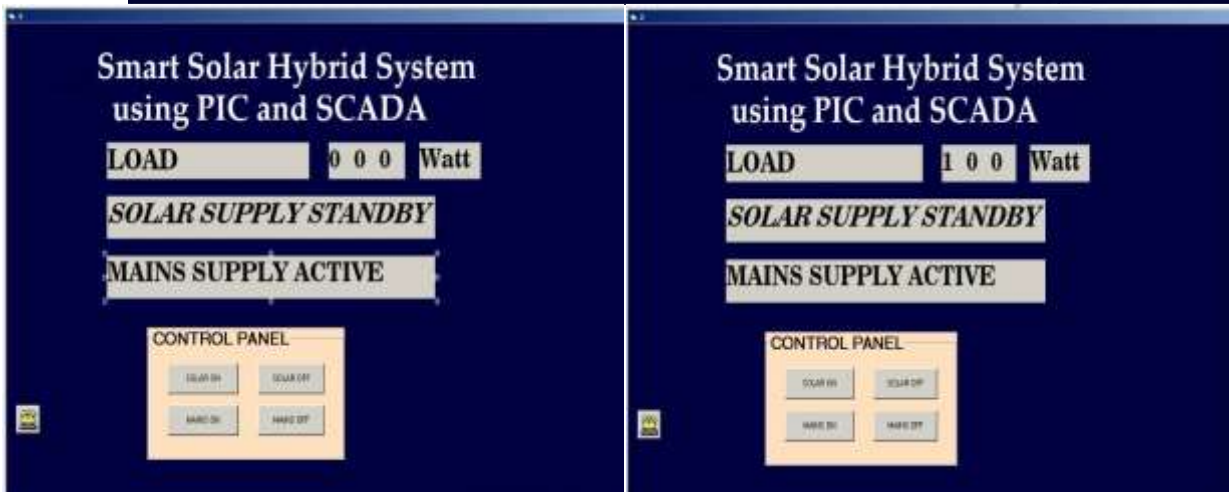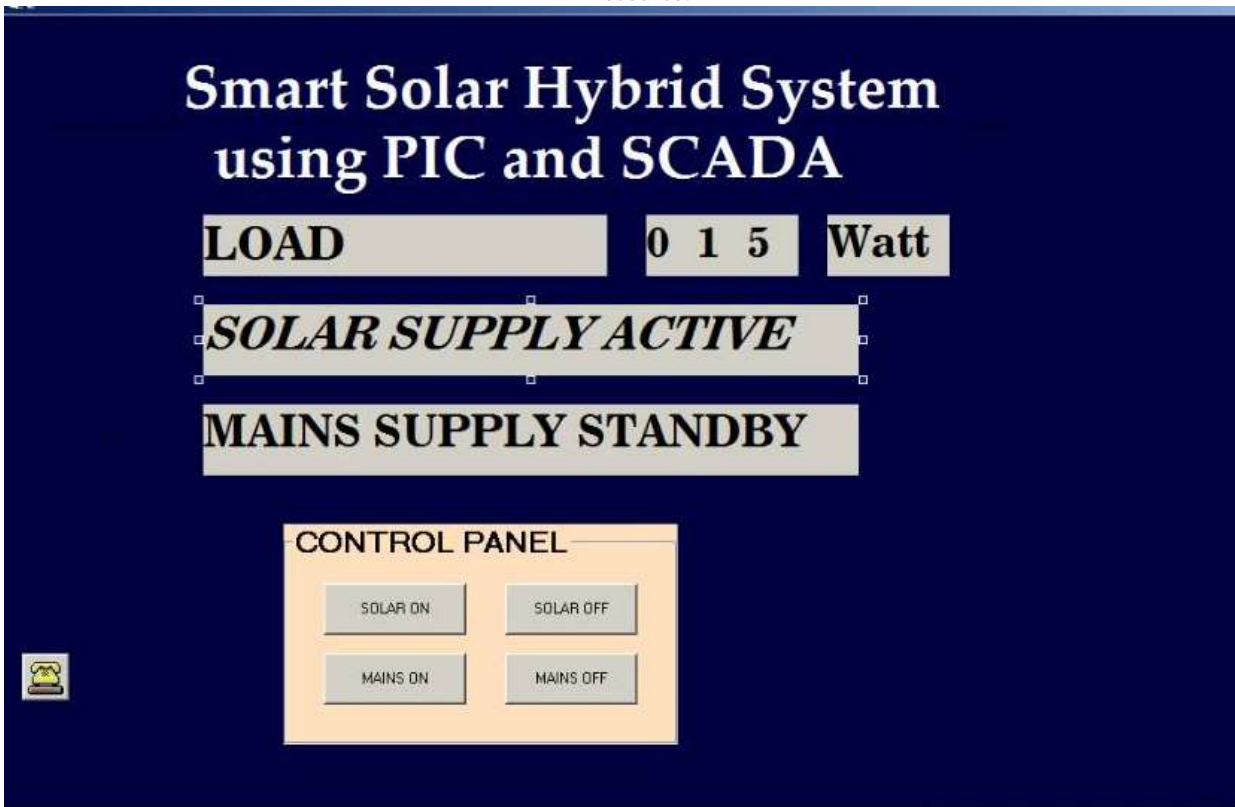
resource.

Fig.4 SCADA representation

As shown in above screenshots SCADA representation displays the current status of resource of load. As well as we can also switch in between solar and AC mains from control panel of SCADA depending upon the situation.

V CONCLUSION AND FUTURE SCOPE
5.1 CONCLUSION

This paper presented an innovative application of photovoltaic as part of an integrated uninterrupted hybrid power system. As residential homes have installed renewable energy sources to save the energy cost, it is important that both energy consumption and generation are simultaneously considered. Hybrid power generation system is considered to be important to go green with clean energy. The proposed hybrid system is a unique system in design, construction, troubleshooting with many advantages such as high degree of accuracy and maintenance free with help of controller and SCADA.

5.2 FUTURE SCOPE

As mentioned in introduction section we are using the combination of solar resource and the supply from grid (MSEB) to fulfill the load requirement of home. If we use the four panels of PV cell which generates 250V each that is 1KV total energy (near about 4 to 5 units per day in sunny days). This generation is sufficient for normal domestic (household) load module. By installing this system on the rooftop of home we can able to credit the excess amount of electricity to the MSEB with the help of grid tied inverter. This will help us to save the money. If the geographic areas of societies are somewhat hilly then we can use the combination of Solar, wind and AC mains which will increase the reliability of system as well as output energy. In future we can try for the different combinations of renewable energy sources to develop the hybrid system in terms of maximum generation of energy. The use of such type of system by the domestic level will balance the demand of electricity and the generation which will reduce the shortage of electricity.

5.3 Limitations of study:
1. The initial installation cost of the system is very high
2. Generation of electricity from solar is totally dependent upon the availability of solar radiations.

5.4 Sources of funding of the study:
Study was self financed by author.

5.5 Implications of the Finding:
Prepared model will helpful to domestic generation of electricity as well as it can be a perfect commercial model.

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