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OPTIMAL ENERGY SCHEDULING FOR SMART HOME WITH CENTRALIZED RENEWABLE ENERGY SOURCE

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ABSTRACT- Future smart grids will be featured by flexible supply-demand management and great incursion of renewable energy to enable efficient and inexpensive grid operation. While the renewable energy offer a cheaper and cleaner energy deliver, it introduces supply improbability due to the volatility of renewable source. In this project power consumption of the loads are determined according to that the loads are used which is proportional to the power. And the capacitor banks are used to improve the power factor when motor load is used. It is therefore of sensible importance to investigate the optimal exploitation of renewable energy based on the supply demand framework of future smart grids, wherever the energy providers (or the energy-users) adaptively adjust their energy provisioning (or energy-demands) according to some system state information that takes into account the volatility of renewable energy. The average power measurements are measured to share the power for each unit. Residents have the opportunity to schedule their power usage in the home by themselves for the purpose of reducing electricity expense and alleviating the power peak-to-average relation. To diminish losses in the distribution system, and to moderate the electricity bill, power factor correction, frequently in the form of capacitors, is added to make safe as much of the magnetizing current as possible. According to the power, the load has turned on and off. The techniques to improve the efficiency of motor drive by power factor correction play an important role in the energy saving during energy conversion. While using the motor load, capacitor banks are used to improve the power factor. Power factor correction is achieved through the addition of capacitors in parallel with the connected motor circuits and can be realistic at the starter, otherwise applied at the switchboard or distribution section. Specifically, it considers cost-efficient energy scheduling for residential smart grids prepared with a centralized renewable energy source.

Key Words- Renewable Energy Source; Load Sharing; AC/DC Converter; Resistive load; Inductive load; Power Factor; Capacitor Bank .

1. INTRODUCTION

The main objective of this project is to design an energy saving scheme for the Residential distribution network. The homes are assumed to use energy management controllers (EMCs) to control the operation of some of their appliances. A systematic method is presented in this project to show that, based only on the dimensions of the input voltage and current, the load impedance can be instantaneously monitored and load power controlled without using any direct measurement from the load. Non-linear loads create harmonic currents in addition to the inventive AC current. The industrialization is principally increasing the inductive loading, the Inductive loads have an effect on the power factor, so the power system sufferers its effectiveness. A poor power factor is usually the result of a significant phase difference between the voltage and current at the load mortals, or it can be due to a high choral content or a distorted current waveform.

An electrical load that operates on alternating current requires apparent power, which consists of real power in addition reactive power. Real power is the power in point of fact addicted by the load. Reactive power is repeatedly demanded by the load and returned to the power source, and it is the frequent result that occurs when alternating current passes through a load that contains a reactive component. The occurrence of reactive power causes the real power to be less than the apparent power, also the electric load has a power factor of less than unity. Automatic Power factor correction apparatus reads the power factor from line voltage and line current, calculating the reparation requirement switch on different capacitor banks.

Thus Power factor correction (PFC) is usually achieved by adding capacitive load to offset the inductive load present in the power system. The automotive power factor correction using capacitive load banks is very efficient as it reduces the cost by decreasing the power drawn from the supply. The embedded system is now a day's very much popular and most of the products are developed with Microcontroller based embedded technology. The compensation of using the microcontroller is the reduction of the cost and also the use of further hardware such as the use of timer RAM and ROM can be avoided.

II. BLOCK DIAGRAM

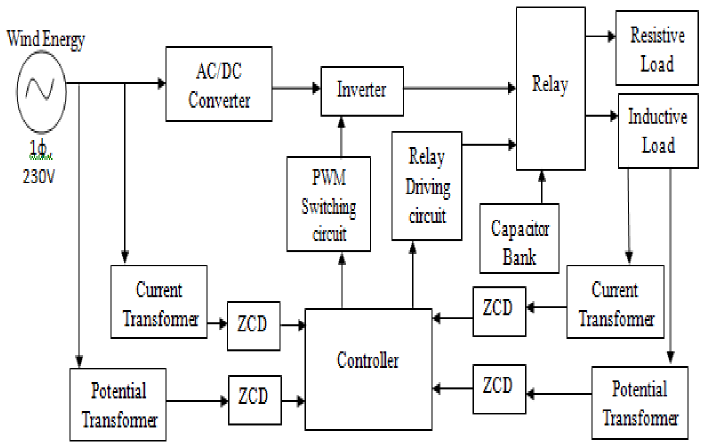

Fig.1 Block diagram of proposed system

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The AC input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating DC voltage. So in order to get a pure DC voltage, the output voltage from the rectifier is fed to a filter to remove any AC components present even after rectification. The supplied voltage and current signals, taken through a potential transformer and a current transformer. The two sinusoidal waveforms are being changed to square waves through two zero-crossing detectors. The zero crossing detector output fed to microcontroller to calculate phase difference and thus power factor. Power factor correction is achieved by means of the accumulation of capacitors in parallel with the connected motor circuits and can be applied by the side of the starter, or applied through the side of the switchboard or distribution panel. The Energy used by the loads (Resistive and Inductive) are calculated so according to the loads, the switching will be turned on and off thus, load sharing will be achieved.

III. AC/DC CONVERTER

AC/DC conversion of voltage allows the consequential power to be used for electronic circuits, computers, and most other devices. It completes this task using four fundamentals they are transformer, rectifier, filter, and voltage regulator. Generally, the task of the transformer in a power supply is to “step down” or shrink the inputted 120 AC voltage to a tolerable range. Most converters have amendable ranges in which the voltage is dropped down to. This aspect gives the user versatility in choosing an acceptable voltage.

The rectifier’s function is to guzzle the dropped down voltage received by the transformer and essentially renovate the AC to a unstable DC voltage. Now that the current is curving in one direction, it is sent to the filter to smooth unstable voltage. The filter’s purpose is to take the unstable DC voltage and create a much smaller “ripple” unstable wave. As a concluding point, this rippled signal is sent to the voltage regulator to sustain a constant voltage to be outputted to the device which is connected.

IV. POWER FACTOR DETECTION UNIT

In this fragment the foremost components are: potential transformer, current transformer, PIC microcontroller and LCD display. The potential transformer connected parallel to the supply and the current transformer associated series to the supply line. Both components step down the supply voltage and current to advantageous standards, which are given as participation to the ZCD. ZCD convert both sine waves into the subsequent square waves. If the phase dissimilarity is 90 degree power factor would be nil. For 90 degree the time holdup is 5 milliseconds. From that customer generated a count value, beyond that value the power factor is a leading one in between that by using the count assessment the angle and power factor is designed. The programming of PIC is accomplished on the micro controller. The count value, angle and power factor are exposed on the LCD display. For the PIC timer 1 is worn for this use because it’s the only 16 bit timer. The PIC has the facility in the capture mode in order to find out the phase difference by continuously capturing the square wave-forms from the ZCD. Consumer will get two outputs from the PIC and provide the outputs to the Relay driving circuit entity whether the power factor is lagging or leading. LCD is interfaced in the company of the PIC microcontroller.

V. POWER FACTOR CORRECTION UNIT USING CAPACITOR BANK

Power factor correction attempts to fine-tune the power factor of an AC load or an AC power transmission system to unity throughout a diversity of methods. When power factor augmentation capacitor banks are planned and arranged properly, the Power Factor Correction system becomes proficient. The capacitor bank is comprised of creature capacitor elements. Prominent features of PF correction capacitor banks are tremendously high consistency with self-healing capabilities; proficient of controlling the requirement of kVARs to achieve PF as close as union; compacted, proficient and long examination life; protected against over-voltage, over-current, over warmth, switching surges.

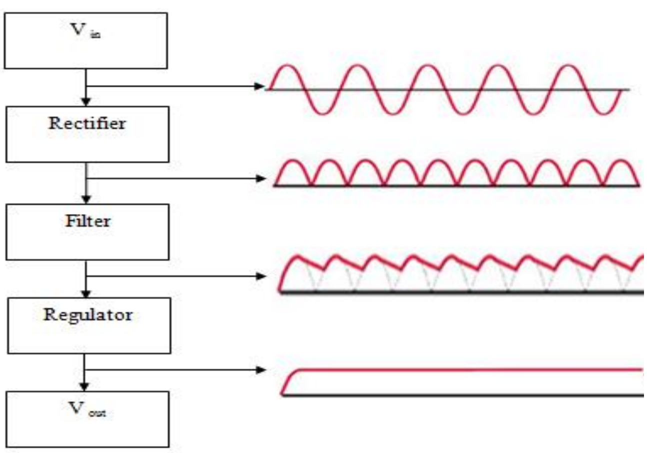

Fig.2. Working of AC/DC Converter

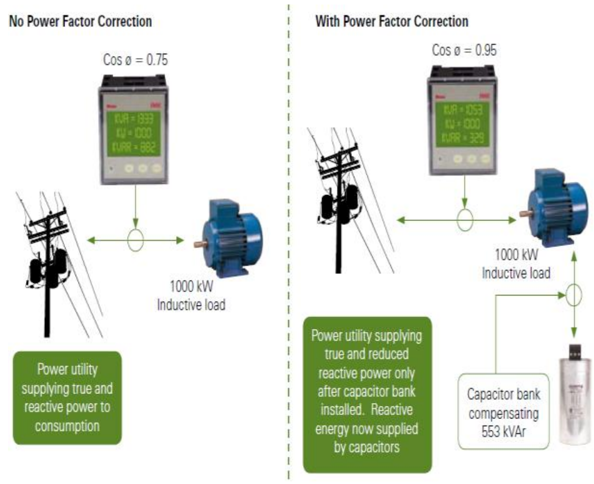

Fig.3. Capacitor Bank in Power Factor Correction

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VI. INVERTER

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power managing depend on the design of the unambiguous device or circuitry. The inverter does not fabricate any power; the power is provided by the DC source.

A power inverter can be utterly electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not employ moving parts in the conversion process. This simple low power dc to ac inverter (dc to ac converter) circuit converts 12V DC to 230V AC. By doing simple amendment you can also convert 6V DC to 230V AC. It can be used as inverters for residence requirements to facilitate light loads (electric bulb, CFL, etc) at the minute of electricity breakdown.

VII. POWER CONSUMPTION OF APPLIANCES

Appliance	Minimum	Maximum
100W light bulb	100W	100W
25" color TV	150W	150W
60W light bulb	60W	60W
Ceiling Fan	10W	50W
Clock radio	1W	2W
Desktop Computer	50W	150W
Laptop Computer	20W	50W
Submersible Water Pump	400W	400W
Table Fan	10W	25W
Vacuum Cleaner	200W	700W
Washing Machine	500W	500W

Table.1. Home Appliances Power Usage

The energy used with household appliances is calculated on the basis of their capacity (expressed in watts) and the length or frequency of use. Much of the electrical energy devoted in a classic production operation flows throughout large-horsepower electric motors. Because of this, it makes logic to congregate round data on large motors and stature out how much it costs to run each one. The data gathered is valuable for supplementary purposes too. It allows identifying motors that are under loaded (and thus costly to operate) or overloaded (and at risk of burn out).

VIII. SINGLE-PHASE AC MOTORS

Single-phase ac electric motors run in the way in which they are started; and they are started in a predetermined direction according to the electrical connections or mechanical setting of the preliminary earnings. General-purpose ac motors may be operated in whichever direction, but the standard ac motor rotation is counterclockwise when facing the end opposite the drive shaft. AC motors can be reconnected to revoke the direction of rotation.

A single phase motor has only one stator winding. This winding generates a field which simply pulsates, as a replacement of rotating. When the rotor is stationary, the increasing and failing stator field induces currents in the rotor. These currents generate a rotor field contradictory in polarity to that of the stator. The divergence of the field exerts a turning force on the upper and lower parts of the rotor trying to turn it 180° from its location. Since these forces are exerted throughout the center of the rotor, the revolving force is equivalent in every direction. As a effect, the rotor does not revolve. If the rotor is started rotating, it will keep on to revolve in the direction in which it is started, since the turning potency in that track is aided by the momentum of the rotor.

IX. ZERO CROSSING DETECTOR

Zero crossing detector (ZCD) is a voltage comparator that switches the output between +Vsat and –Vsat (Vsat: Saturation voltage in the order of equal to 14V) when the input crosses zero reference voltage. In ZCD, have to place one of its input as zero i.e. zero reference voltage. The output is obsessed into –Vsat when the input signal passes through zero to optimistic direction. On the contrary, when input signal passes through zero to negative direction the output switches to +Vsat.

X. CURRENT TRANSFORMER

A current transformer (CT) is used for measurement of alternating electric currents. Current transformers, mutually with voltage (or potential) transformers (VT or PT), are known as instrument transformers.

When current in a circuit is too high to apply straightforwardly to measuring instruments, a current transformer produces a condensed current precisely proportional to the current in the circuit, which can be expediently connected to measuring and tracking instruments. A current transformer isolates the measuring instruments from what may be very high voltage in the monitored circuit. Current transformers are universally used in metering and protective relays in the electrical power industry

XI. POTENTIAL TRANSFORMER

Voltage transformers (VT) (potential transformers (PT)) are a parallel connected type of instrument transformer, used for metering and fortification in high-voltage circuits or phasor phase shift seclusion. They are designed to present negligible load to the supply being measured and to have a precise voltage ratio to enable perfect metering. A potential transformer may have numerous secondary windings on the same core as a primary winding, for use in dissimilar metering or fortification circuits

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XII. SIMULATION RESULT

Case-I : During High Power

The power is fed to AC/DC Converter which is used to filter the unwanted harmonics signal into constant one. After that the power is transferred to the inverter. PWM switching will be done by the microcontroller to the inverter. When the power is high both the loads (Resistive load & Inductive load) will be turned on by using the Relay switching circuit. When the power is low only one load (Resistive load) is turned on.

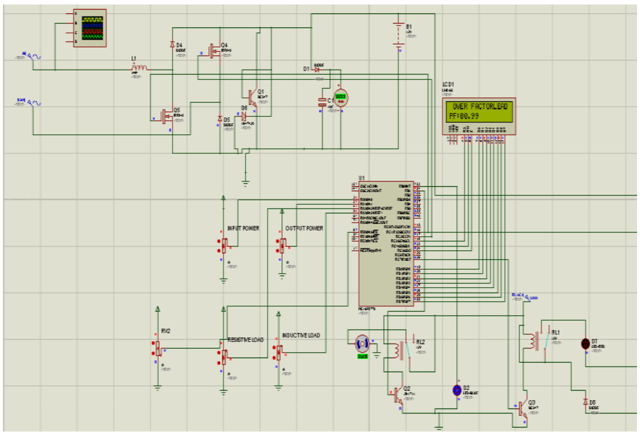

Fig.4. During High Power, Resistive and Inductive Loads are turned on.

Case-II : During Low Power

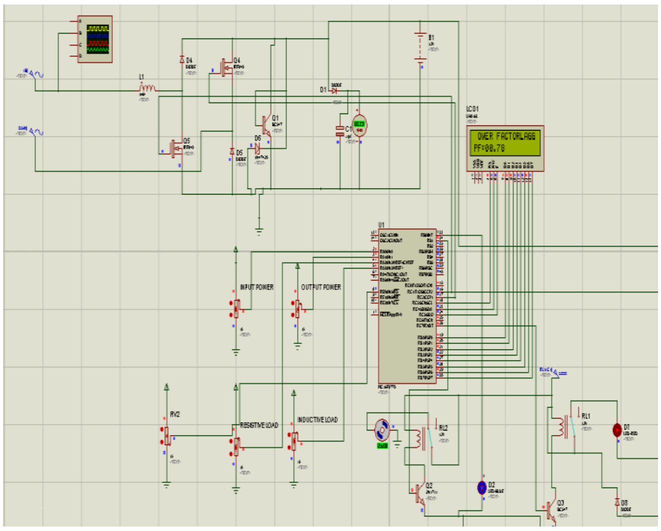

Fig.5. During Low Power, Single load is turned on

The voltage and current sample signals are feed to microcontroller and the difference between the arrivals of waveforms indicate the phase angle difference. The values are displayed in the LCD. PFC capacitors are placed in front of the starter or variable frequency drive. A sufficient capacitance is connected so that the power factor is adjusted to be as close to unity as possible.

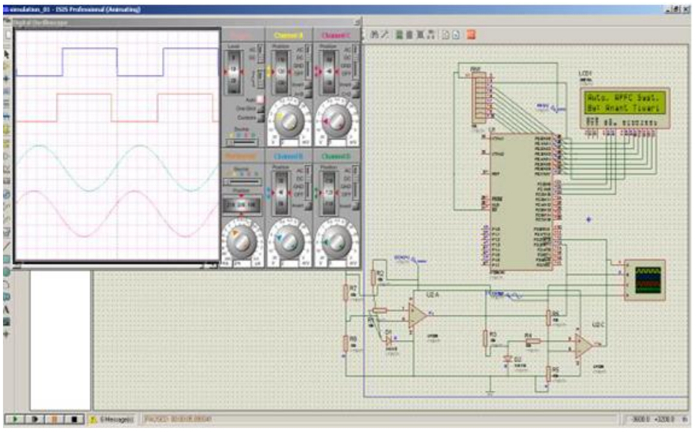

Fig.6.Power factor correction on proteus

It shows input waveform of voltage and current by way of phase distinction. Both of the waveforms are fed to zero crossing detectors, which provide square waves in digital configure. These digital waveforms are worn via microcontroller to compute power factor. Microcontroller takes assessment to switch suitable capacitor bank to balance for power factor.

XII.HARDWARE RESULT

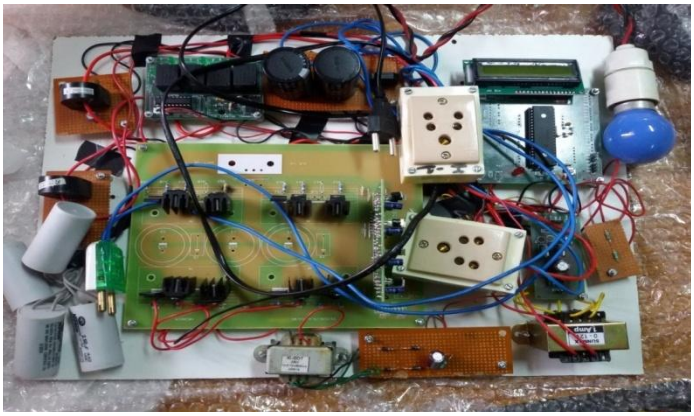

Fig.7. Hardware Module

XIV. DISCUSSION ON RESULT

The Proposed project is simulated in PROTEUS. PFC generates less conduction loss comparing with the conventional PFC. The simulation results the Power Factor in 0.99 which is closer to the Unity Power factor. According to the power the loads are turned on. During high power inductive load and resistive load will be in working mode.

While Inductive load is in working condition PFC also takes place. During low power single load will be turned on according to the incoming power. In the interest of reducing the losses in the sharing structure, power factor correction is added to neutralize a portion of the magnetizing current of the motor. Classically, the corrected power factor will be 0.85- 0.99.

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XV. CONCLUSION

In this project the energy management in decentralized generation systems based on renewable energy sources. The main contribution of the project is focused on energy management and power factor correction using the wind/load's fluctuating power The method is based only on the measurements of the input voltage and current, the load impedance can be instantaneously monitored and load power controlled without using any undeviating measurement from the load. A diminution in the overall cost of electricity can be achieved by humanizing the power factor to a more cost-effective level. By installing suitably sized power capacitors into the circuit the Power Factor is enhanced and the value becomes closer to 0.85 to 0.99 thus minimizing line losses and civilizing the efficiency of a plant.

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