www.ijiarec.com

ISSN:2348-2079

Volume-7 Issue-1

International Journal of Intellectual Advancements and Research in Engineering Computations

Smart Grid Power Management and Load Sharing System using IOT

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ABSTRACT

The main aim of our paper is the power management and load sharing of power system using IOT technologies, also known as demand side management (DSM).It is the process of balancing the generated power on the grid side with the electrical load by adjusting or controlling the load rather than the power station output. This can be achieved by direct intervention of the utility in real time, by the use of frequency sensitive relays triggering the circuit breakers (ripple control), by time clocks, or by using special tariffs to influence consumer behavior. Load management allows utilities to reduce demand for electricity during peak usage times (peak shaving), which can, in turn, reduce costs by eliminating the need for peaking power plants. In addition, some peaking power plants can take more than an hour to bring on-line which makes load management even more critical should a plant go off-line unexpectedly for example. Load management can also help reduce harmful emissions, since peaking plants or backup generators are often dirtier and less efficient than base load power plants. New load-management technologies are constantly under development both by hospital, private industry and public entities.

Whenever there is an demand occurred on generating side the load is shared and providing the priority to the particular sector (Hospitality), at the same time providing the un-interrupted power supply to the other sector (Industrial and domestic) and we can monitor this process using IOT technology.

Index terms:-Ardino Uno Microcontroller, Current Transformer, Relay, IOT module, Damand switch, Buzzer.

INTRODUCTION

Condition 1: Hospital

We are most important to human life care, so 24 hours no limits of power, in demand time period.

Condition 2: Industrial

Generally EB board providing a power of KVA, based on equipment, if the power demand occurring 50 percentages, suddenly the total power will be stopped automatically, when the generating power increasing or reach 75 percentages, automatically total power enter into the industries.Every time total power will be calculating and monitoring purpose of overload, any one industries involved overload the CT are monitoring and intimating the over load periods of few time, suddenly minimizing the load. Because the loads are not minimized automatically total powers are shutdown.

Condition 3: Domestic

Generally EB board providing a power of single phase or three phase supply, based on appliance, if the power demand occurring 75 percentage, suddenly the total power will be stopped automatically, and same time solar power encaging the demand period, when the generating power increasing or reach 95 percentages, automatically total power enter into the domestic. Every time total power will be calculating and monitoring purpose of overload, any one domestic involved overload the CT are monitoring and intimating the over load periods of few time, suddenly minimizing

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the load. Because the loads are not minimized automatically total powers are shutdown.

Demand Switches

There are two demand switches are used in this system. Here we are using the toggle type demand switches. These toggle type demand switches are interfaced with the arduinouno microcontroller. So that when demand occurred the toggle switch automatically operates.

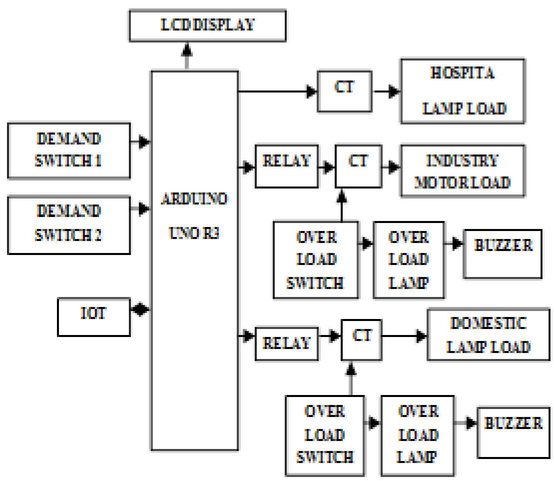
Buzzer

Here we are using buzzer for the purpose of overload indication. When the power consumption exceeds the prescribed limit the overload buzzer provides an indication to trips the circuit.

Node MCU unit

An node MCU unit provides the connection between the IOT and the working model.

Block Diagram



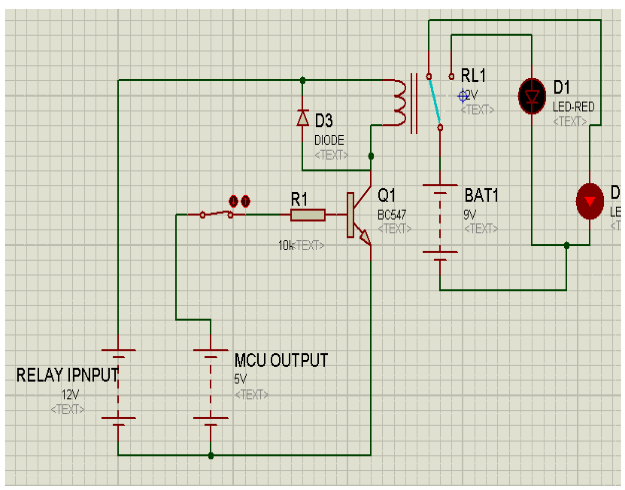
Microcontroller Functional Block Diagram

Description

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general-purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The device is manufactured using Atmel's high-density non-volatile memory technology. The Flash Program memory can be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash Section will continue to run while the Application Flash Section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self- Programmable Flash on a monolithic chip, the Atmel ATmega16 is a powerful microcontroller that provides a highly flexible and cost-effective solution to many embedded control applications. The ATmega16 AVR is supported with a full suite of program and system development tools, including C compilers, macro assemblers, program debugger/simulators, In-Circuit Emulators, and evaluation kits.

Relay



Working of relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further information about switch contacts and the terms used to describe them please see the page on switches.

IOTWIFI ESP8266

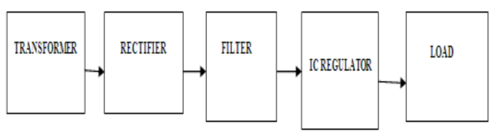
WIFI module Wifi ESP8266 is a low cost chip with TCP/IP stack and microcontroller. In our paper main importance of wifi is it performs IOT operation. The simple device is connected from microcontroller to send the information.

Web server In our paper we are displaying the information about the energy consumed in terms of units, about the bill and if any theft occurs that will be displayed in the website. Hence every user can check the information any where globally. Thingspeak web page is used for displaying the information of the paper .

Block Diagram of Power Supply

The AC voltage, typically 220V RMS, is connected to a transformer, which steps that AC voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variation.

A regulator circuit removes the ripples and also remains the same DC value even if the input DC voltage varies, or the load connected to the output DC voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.



Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using a precision rectifier are it will give a peak voltage output as DC, the rest of the circuits will give only RMS output.

Bridge Rectifier Circuit

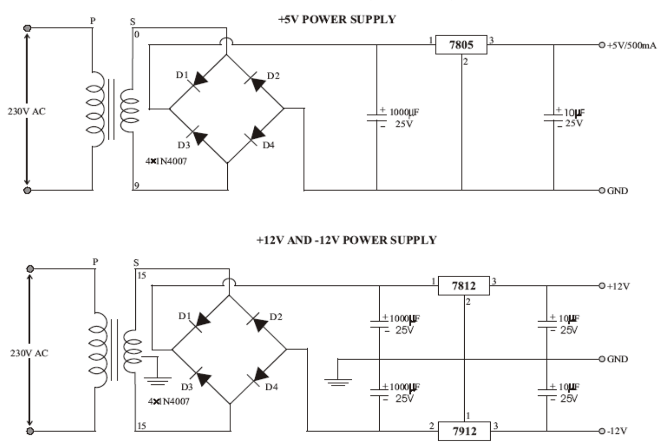
When four diodes are connected as shown in the figure, the circuit is called as a bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. The positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time the D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. This path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. The current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. Assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts. The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as a result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

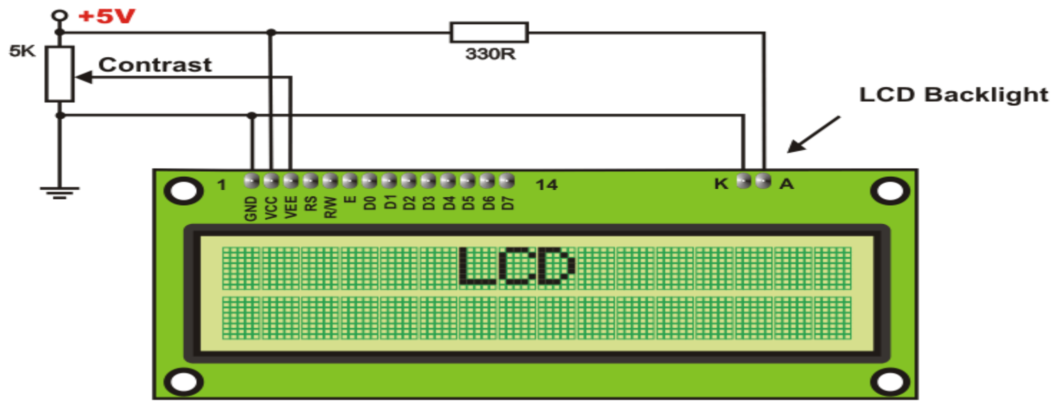
POWER SUPPLY (+5V, ±12V)



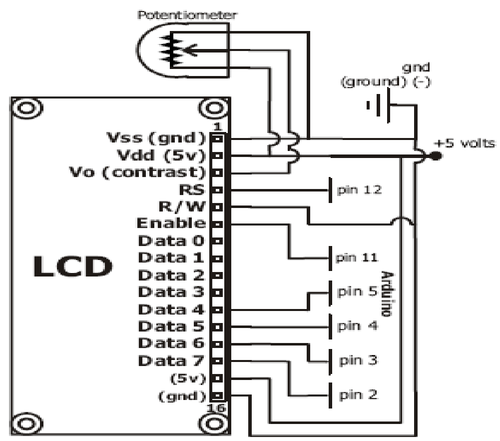
LCD Display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (*Hitachi*) and can display messages in two lines with 16 characters each . It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

All data transferred to LCD through outputs D0-D7 will be interpreted as commands or as data, which depends on logic state on pin RS: RS = 1 - Bits D0 - D7 are addresses of characters that should be displayed. Built in processor addresses built in "map of characters" and displays corresponding symbols. Displaying position is determined by DDRAM address. This address is either previously defined or the address of previously transferred character is automatically incremented.RS = 0 - Bits D0 - D7 are commands which determine display mode.



Schematic Diagram of LCD Display



Features of LCD Display

- 5 x 8 dots with cursor
- built-in controller (ks 0066 or equivalent)
- + 5v power supply (also available for + 3v)
- 1/16 duty cycle

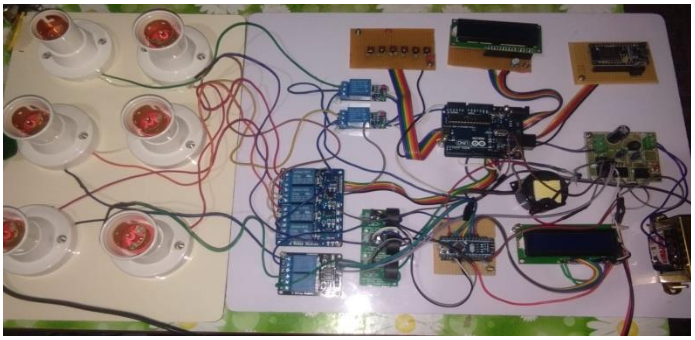
Operation

When demand occurs on the grid side the demand switch 1(toggle switch) will operates. we are providing the priority to hospital and industrial concern. So that the load from the domestic side is shared to the industrial and hospital facilities. At the same time we are providing the minimum amount of supply to the domestic side, at that situation if they consume too much of supply then the overload buzzer will give an intimation then trips the circuit. If the demand on the grid side is further increased then the demand switch 2 will operates, so that the load from the industrial side is shared to hospital facilities. At that situation if the industry consumes overload then the overload buzzer will provide a intimation then trips the circuit

Here we are using toggle type demand switch. The demand switch operation is depends upon the rating we fixed. The current transformer continuously sense the current rating. If there is an excess current then the current transformer will sense the signal and give the signal to the relay circuit, which trips the circuit accordingly. The IOT module continuously monitors the overall operation of the system

RESULT AND IMPLEMENTATION

Apart from the regular monitoring of the power line. We can also use this project to monitor the weather and its effect on the power system. With this we can get an idea about the weather patterns[7] near the power transmission line and we can predict which event is going to occur based on the data we have collected. Also in India the problem of power theft is common, so in order to avoid this problem we can take the help of IoTan prevent the power theft.



Advantages

- The load is shared by transformer automatically.
- No manual errors are taking place.
- It prevents the transformer from damage due to problems like overload and overheating.

CONCLUSION

This paper provides the efficient way for load sharing and control at real time. The arduino microcontroller based load sharing and control system is designed specifically to monitor the overload and manage the power on the grid side. Smart Grid (SG) is the future grid which solves the problems of uni-directional information flow, energy wastage, growing energy demand, reliability and security in the traditional power grid. The Internet of Things (IoT) technology provides connectivity anywhere and anytime. It helps SG by providing smart devices or IoT devices (such as sensors, actuators, and smart meters) for the monitoring, analysis and controlling the grid, as well as connectivity, automation and tracking of such devices. This realizes the IoT-aided SG system which supports and improves various network functions at the power generation, transmission, distribution, and utilization. In this paper, we have presented a comprehensive survey on IoT-aided SG systems. We have surveyed architectures and applications of IoT-aided SG systems. We discussed existing and potential applications of IoT-aided SG systems. We also presented various IoT and non-IoT communication technologies for SG systems by presenting their advantages, disadvantages, and applicability.We concluded the survey by presenting open issues, challenges, and future research directions for IoT-aided SG systems.

Acknowledgment

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