INTERNET OF THINGS (IOT) BASED SMART GRID

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ABSTRACT:—The research work is dedicated on internet of things (IOT) which performs the function and maintenance by using different type of sensors. The sensors are mainly used for both maintenance and theft prevention. IOT enhances the reliability of power transmission and minimize economic loss. Government is showing interest in development of smart cities but the IOT smart Grid is the feature of smart city model. In simple words I am presenting a very effective model for power systems using IOT Technology to make real sense of smart concept in electrical engineering. All consumers get electricity through power transmission hubs known as Power Grids and sometimes problems rise due to failure of the power grids and results in black out of an entire location getting electricity supply from that particular power grid. The model proposed in this research solve this problem using IOT as the means of communication and also tackling various other issues which a smart system can deal with to avoid unnecessary losses to the Energy producers. With the help of proteussoftware we can easily detect power theft, faults, various types of loads etc.

KEY WORDS: IOT, SMART GRID, SMART CITIES¸PROTEUS,THEFT,FAULT.

1. INTRODUCTION

The IOT is used to improve sensitivity and subsequent system reliability enhancement, the use of sensors or IOT concepts for power system maintenance has many other advantages like deployment of human workers for dangerous operations, such as live maintenance of high voltage transmission lines, has been a long-standing effort in the power community. Other importance of IOT in power systems include operation in dangerous environments, such as radioactive areas in atomic plants, access to tight spaces, for example, link by means of conduits and cooling pipes, and precise positioning of measurement equipment. Therefore, we can say that the deployment of IOT technology will play a very important role in the monitoring of electric power systems. This research focus on deployment of IOT technology in electric grids to make them more and more efficient and make the smooth and very smart Grid monitoring process.

1.1 SMART GRID

The Smart Grid will enable the customers to actively decide their energy choices and to accommodate their generation and storage options. The same grid will provide higher reliability and consistent power quality, which are required by our digital economy, by optimizing the use of assets and the grid operation. The future power grids will come into reality by enabling intelligent communication across sensing, measurement, and control layers that are embedded into the existing power systems. Smart distribution systems will increasingly be dependent on monitoring of the system conditions for both real time management and improved maintenance strategies. Integrated distribution monitoring systems will require various types of sensors and transducers to help understand system conditions and respond to disturbances affecting it. Voltage and current monitoring will be critical for a large number of applications. Specific sensor requirements will include support for:

- Advanced voltage control functions for voltage optimization, voltage reduction, Volt/VAR control, • Load current monitoring for reconfiguration strategies, asset management and fault location applications,

- Protection and reconfiguration applications (fault current monitoring, coordination of protection characteristics, etc.),
- Waveform acquisition for fault location and other diagnostic applications including incipient fault detection and location,
- Harmonic monitoring for power quality assessments and other diagnostic applications. Nowadays, several manufacturers offer performing sensors to improve network performance.

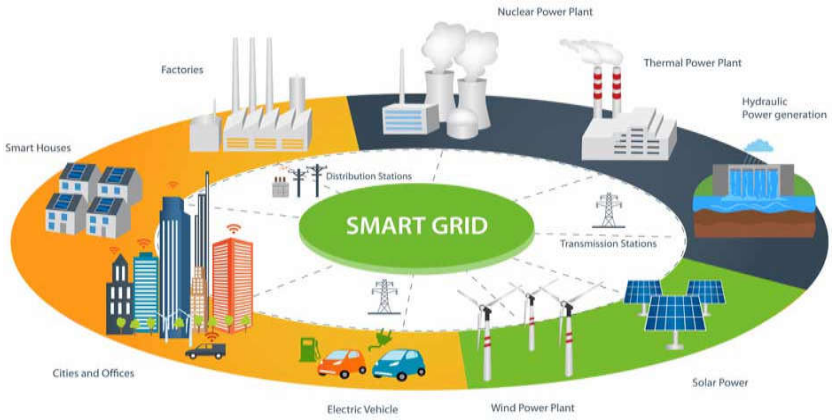


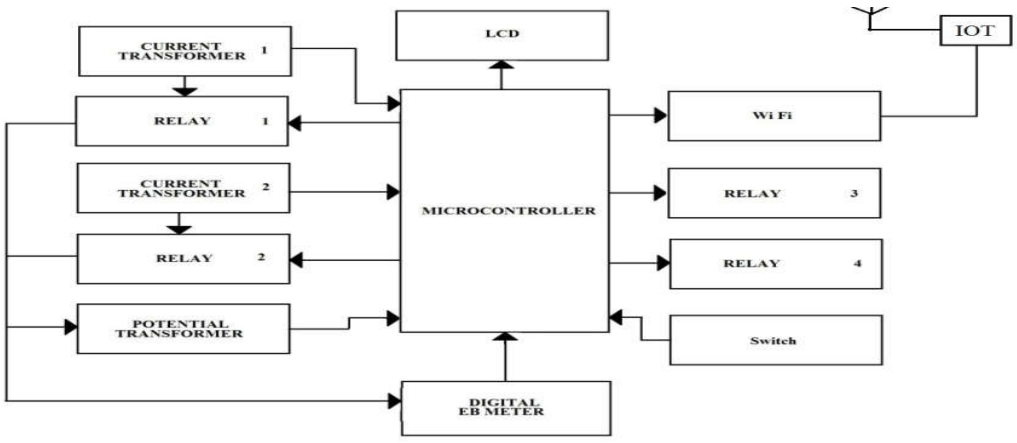
Figure 1.1 Smart grid

A smart grid uses sensing. Embedded processing and digital communications to empower the power grid to be detectable (ready to be estimated and envisioned), controllable (ready to controlled and enhanced).Automated (able to adapt and self-heal), fully integrated with existing systems and with the capacity to incorporate a diverse set of energy sources).

The following attributes of the smart grid are:-

- It enables demand response and demand side management through the integration of smart meters, smart appliances and consumer loads, micro-generation, and electrical storage (electric vehicles) and by providing customers with information related to energy use and prices. It is foreseen that clients will be provided with information and incentives to adjust their consumption pattern to defeat some of the constraints in the power system.
- It assures and improves reliability and the security of supply by being resilient to disturbances, attacks and natural disasters, anticipating and responding to framework unsettling influences (predictive maintenance and self-healing), and reinforcing the security of supply through improved exchange capacities. It maintains the power quality of the electricity to cater for sensitive equipment that increases with the digital economy.
- It opens access to the markets through increased transmission paths, aggregated supply and demand response initiatives and ancillary provisions.

1.2 BLOCK DIAGRAM:



1. METHODOLOGY

Smart grid is coordination of electrical and communication infrastructures. As in the traditional grid there are no such facilities of real time monitoring but in case of smart grid full duplex stream of electricity and data is given. Smart grid is designed to provide demand side management through implementation of smart meters, distribution automation, micro power generation, storage of electricity. Smart grid comprises of various hierarchical networks such as Home Area Network, Neighbour Area Network and Wide Area Network. Real time monitoring of the various network components is the key characteristic of smart grid network. some of the important features about the smart grid technology are dynamic pricing, real time management , reliability, consistency of power, rapid disaster recovery, consumer friendly smart devices for active involvement of consumers, assets management, minimization of process, waste hit management, greater transparency in billing and elimination in errors. So smart grid can be defined in terms of technical as well as functional aspects as a past grid which is having a integration of electric and communication infrastructure.

In facilitate advanced metering control and real time monitoring, distribution and generation renewable power generation and distribution automation, fault diagnosis migration and healing, disaster recovery, device to device communication and IOT fault grid management and reduce carbon emission etc. In order to enhance reliability, security, safety, distribution and consumption of power supply. The electricity grid is a network that carries, takes energy, converts it to electricity and delivers it you, the consumer. Currently, for the most part, energy is produced in central generation stations. These are power plants that produce electricity by turning a generator. There are many ways to turn a generator, from using wind, to burning natural gas or coal to spin a turbine. From power plant, the electricity then enters what is known as the power grid.

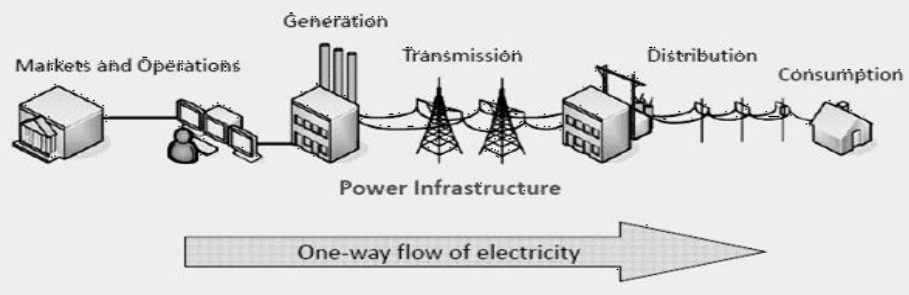


FIGURE 2(a): TRADITIONAL GRID

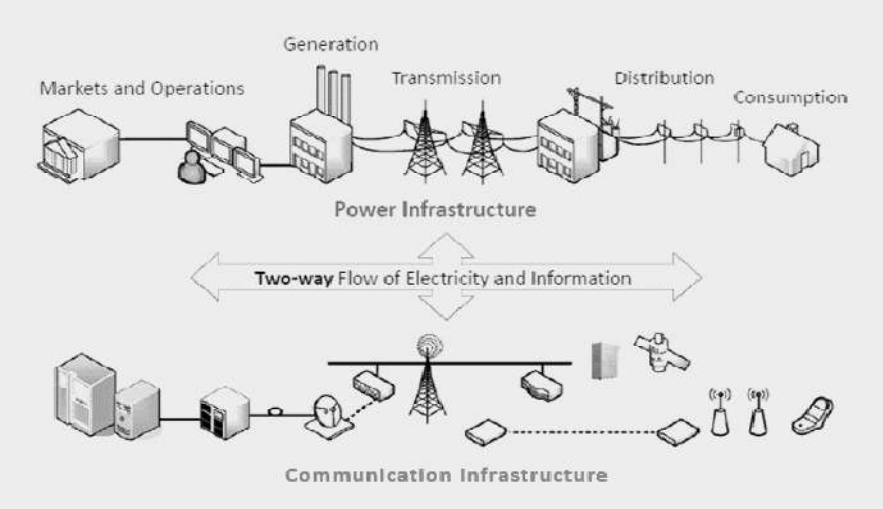


FIGURE 2(b): SMART GRID REPRESNTATION

2.1PROPOSED WORK

The model is based on the concept that whenever one grid station which transfers the power to households is interrupted due to some fault ,with the help of IOT based technologies we can connect all the loads connected to grid station with some other station so that power supplied does not get interrupted. The existing methodology does the same work but manually The current thesis provide us the way to connect the IOT technology to the power station so that this can be done with the help of a particular software with the help of the single click.We know sometimes there is possibility of number of problems that rises due to different technical issues in electric power grids. The model proposed really solves these problems using the popular IOT

Technology. The present grid system needs remote or robotic monitoring for better power supply and the implementation of IOT and other related technologies make it possible.

The IOT based Smart Energy Grid is based on microcontroller concept of AT mega family to control and manage various events of the system. This system communicates over the internet by utilizing Wi-Fi technology. To demonstrate valid and invalid power consumer's bulbs will be used. The leading thing that the model simplifies is re-connection of transmission line to the active grids.

The system is very useful because if there is any fault or technical problem present in power grid the system will automatically shifts the Transmission Lines towards the active or alternative grid thus enabling continuous electricity supply to that particular area whose power grid is faulty. And the important thing is that the information of active grid is updated through IOT Gecko based GUI webpage where the experts can login and view the updates. Not only monitoring the power grids this model has other advanced abilities of monitoring energy consumption with the option electricity theft. This information is regarding the quantity of electricity consumed and the estimated cost of the usage gets updated on the IOT Gecko webpage with the complete energy grid information. Two switches will be deployed to simulate the conditions in the system. Switching one each time will simulate a theft condition and also will alert the experts over the IOT GUI interface. In this way , the Smart Energy Grid venture ensures that the power supply is nonstop and aides in keeping up a refreshed record of utilization and burglary data which is a significant profitable data for the vitality delivering organizations. The main objectives of this work are

1. Advanced energy management
2. Energy conservation
3. It provides information and power
4. It might help in increasing the world's economy

2.2 WORKING

The technology is highly accessible and has a complete command to operate the devices. The scope of this is widely varying to all the sectors like medical, industrial, education etc. The main aim of this project is to control the devices using IOT and monitoring the energy consumed. In application of this project it can be used in domestic as well as industrial purposes. The hardware included in this project AURDINO UNO, two loads, relay mode, current transformer, power transformer, signal conditioning and WI-FI module ESP8266. The software used is Things speak. The methodology of this project is the loads are connected to the relay and the relay is connected to the AURDINO by GIPO pins. The current and the power transformers are connected to the signal conditioning board and signal conditioning board changes AC to DC and the AURDINO has operating voltage as 5V so the signal conditioning board gives 5V to AURDINO. The energy is calculated from voltage and current consumed and uploaded in things speak. We can control the devices anywhere in the world so users can easily follow the energy consumption.

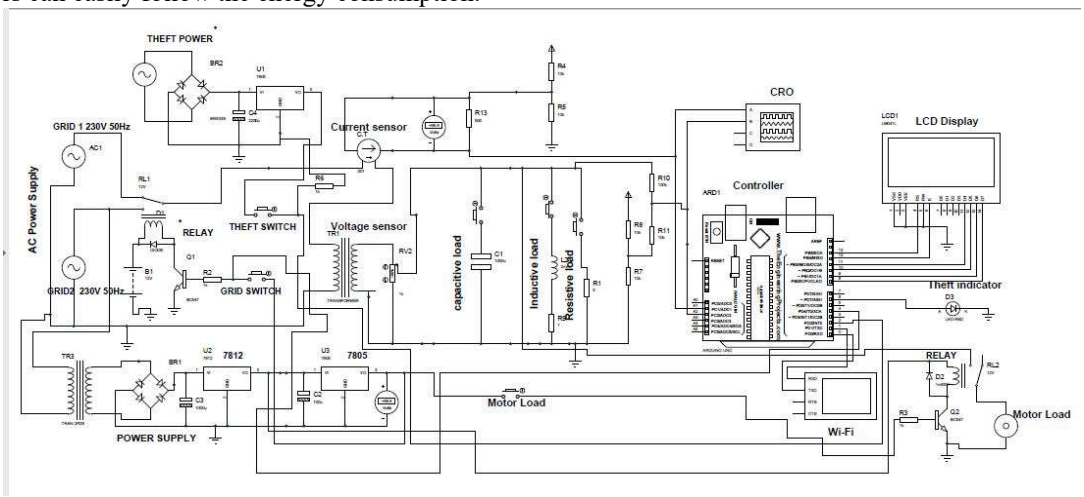


FIGURE 2.2(a): CIRCUIT OF IOT BASED SMART GRID

Internet of Things plays a vital part of Smart Grid as it facilitates an uploading of various parameters like temperature, current, humidity, pressure etc and downloading of commands from utilities. Because the utilities or the main controller will control this devices for that it requires statics. Moreover, Internet Of Things also plays pivotal role in smart grids automation. Each and every devices has its own IP and MAC addresses for realization of integrated operation with other network devices and central controller various communication protocols such as ZIGBEE, WILAN, Cellular technologies, Wireless HART, Bluetooth, WIMAX etc can be easily used for communication between network devices. The choice of this communication Protocols depends

upon the coverage area, data rate required, type of application etc..The main features of this project are as shown :

1. Consumer and owner get clarity of electricity consumption readings.
2. Owner can cut electricity supply remotely through internet if dues/bills are not paid.
3. The data collected form smart meters cannot be access by unauthorized entities. In case energy theft is happened the owner and consumer get message to take necessary action.

Figure2.2(b). BASIC FEATURES OF SG

features. Sensors can recognize capricious conditions or breakdowns and reaction quickly. Smart grid may change from grid to islanded mode and work in it until the point that system is steady or breakdown is settled.

3. RESULTS AND DISCUSSION

Proteus is a simulation and plan programming device created by Lab centre Electronics for Electrical and Electronic circuit outline It likewise have 2D CAD drawing highlight. It deserves to bear the tagline from concept to completion. It is a product suite containing schematic, simulation and additionally PCB outlining. The product ISIS is mainly used for schematics and recreates the circuits in genuine time. The simulation permits human access amid run time, thus giving constant simulation. ARES is utilized for PCB designs. It has the element of review yield in 3D perspective of the composed PCB layout segments. The planner can likewise create 2D illustrations for the products.

ISIS has extensive variety of components in its library. It has sources, signal generators, measurement and examination apparatuses like oscilloscope, voltmeter, ammeter and so on., tests for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lights, discrete segments like resistors, capacitors, inductors, transformers, computerized and Integrated circuits, switches, transfers, microcontrollers, processors, sensors and so on.

3.1 SIMULATION RESULTS

The simulation of the IOT based smart grid is shown below . The main of this simulation is to detect the results by using the protest software in order to implement the IOT in Smart Grid. The purpose for the protest toolbox is to simulate the making of a schematic circuits and how to lead an intelligent simulation utilizing protest VSM. users will focus on the utilization of active parts and the troubleshooting offices of the ISIS editor, the basic a of layout is a schematics well as general circuit administration is covered in the software. Proteus toolbox joins with the blended mode spice circuit simulation, animated components and other models in order to encourage co-simulation of microcontroller based plans.

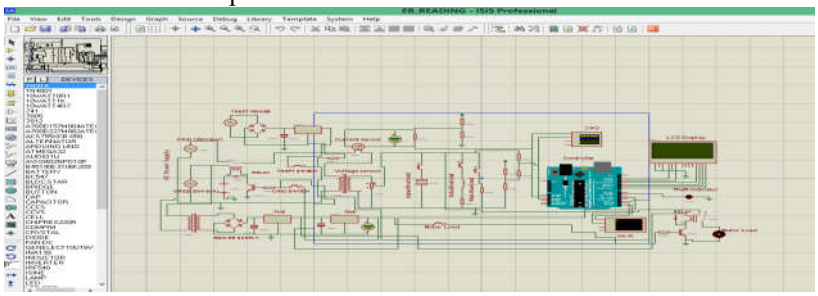
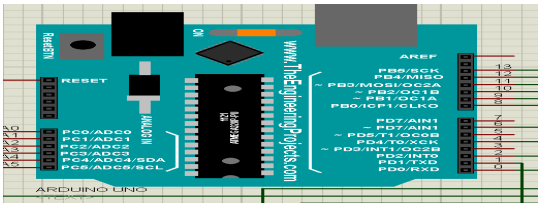
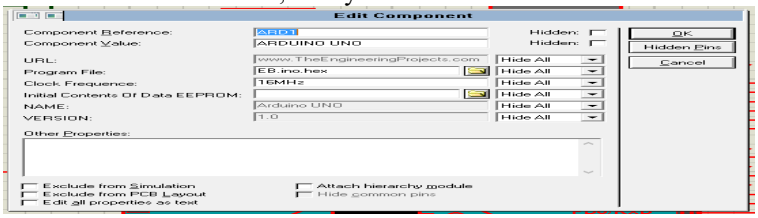


FIGURE 3.1.1 SIMULATION CIRCUIT DIAGRAM OF IOT BASED SMART GRID IN ISIS PROFESSIONAL

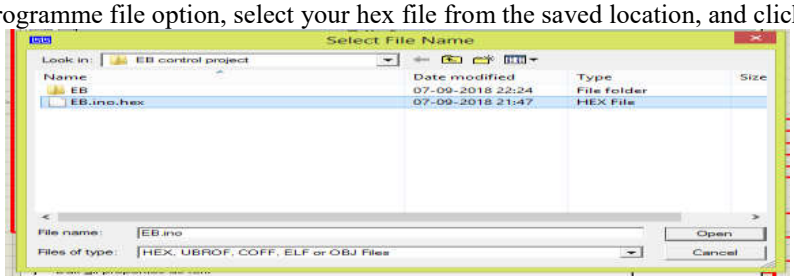
Working: The simulation will work by following the steps mentioned below :



1. Double click on the microcontroller selected, then you will see a menu box.



2. Now go to the programme file option, select your hex file from the saved location, and click on OK.

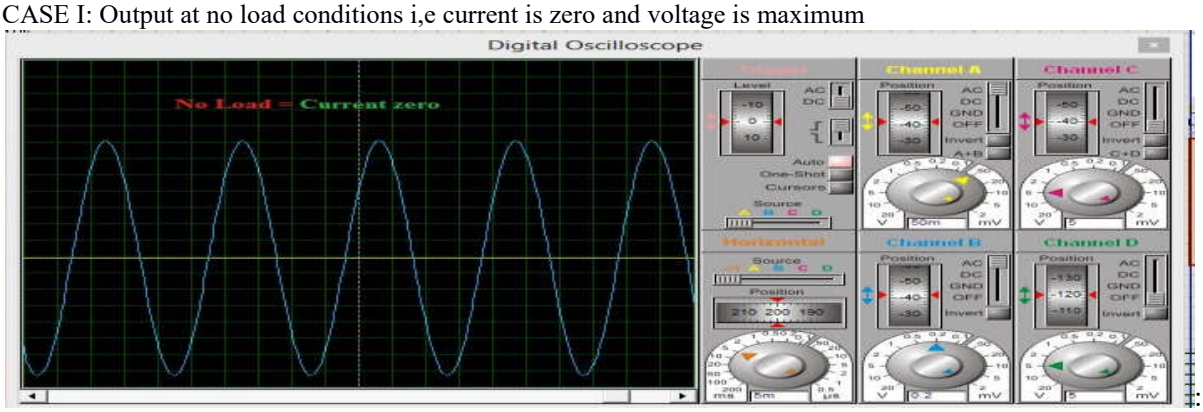


3. Your hex file will be loaded, now you can run the circuit.
4. When the circuit is run, first select any load using turn on switch.
   - Capacitive load
   - Inductive load
   - Resistive load
   - Motor Load

5. If u select capacitive load, corresponding voltage , current , power factor and Units are display in LCD display and Wi-Fi and CRO also.
6. Same for all loads.
7. If u turn on theft switch, theft indicator Led will glow. It means power theft.
8. If u turn on Grid switch, supply will change grid 1 to grid 2 by using relay.

RESULTS: The results of the simulation are as:

CASE I: Output at no load conditions i,e current is zero and voltage is maximum



GRAPH 3.1.1 oscilloscope value at no load

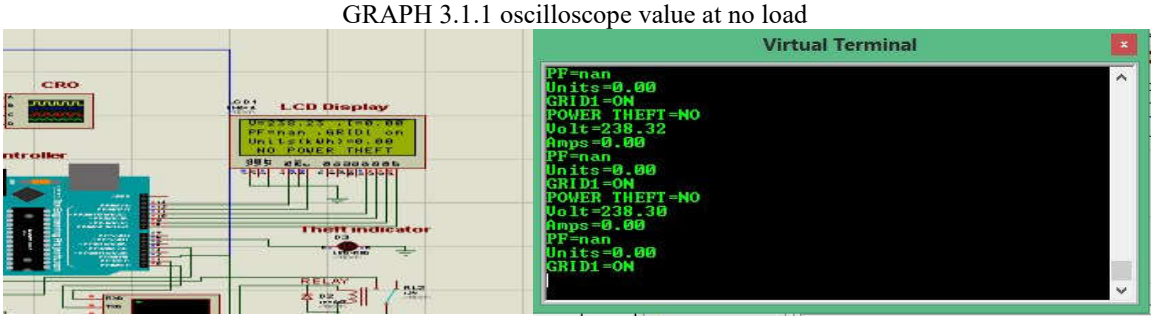
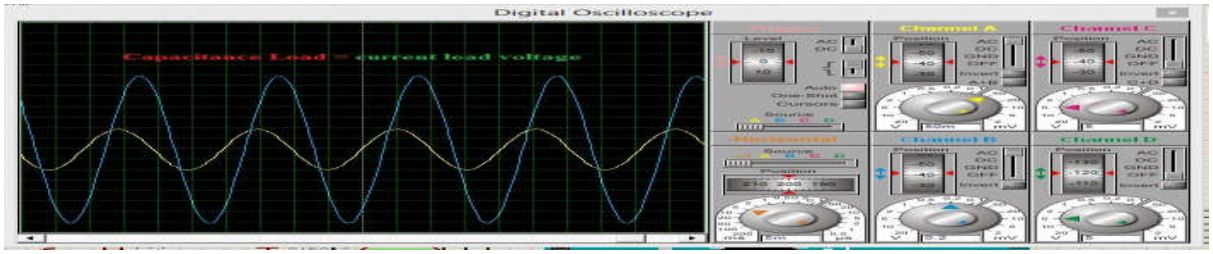


Figure 3.1.2 a) DISPLAY READING AT N LOAD b) VIRTUAL TERMINAL AT NO LOAD

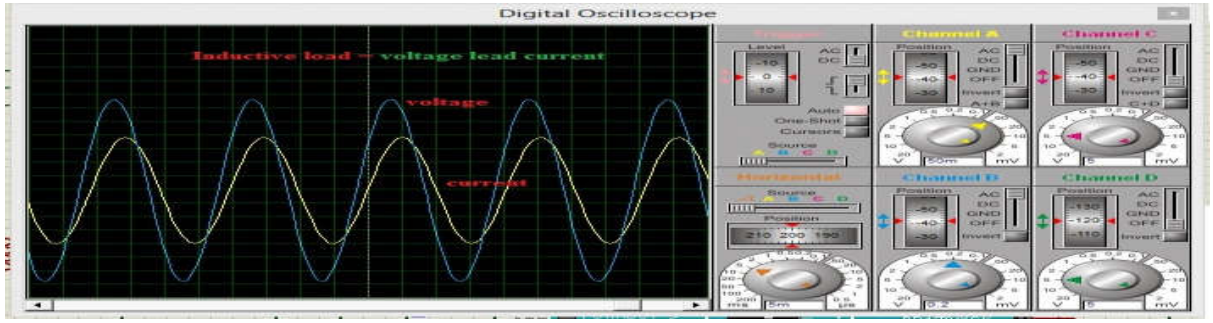
CASE II: Output when capacitive load is ON, current lead voltage is equal to capacitance load



GRAPH 3.1.2 OSCILLOSCOPE WHEN CAPACITIVE LOAD IS ON

Figure 3.1.3. a) DISPLAY READING AT CAPICTIVE LOAD IS ON b) VIRTUAL TERMINAL AT CAPACTIVE LOAD

CASE III: Output when Inductive Load is ON and Voltage is leading to the current



GRAPH 3.1.3 OSCILLOSCOPE WHEN INDUCTIVE LOAD IS ON

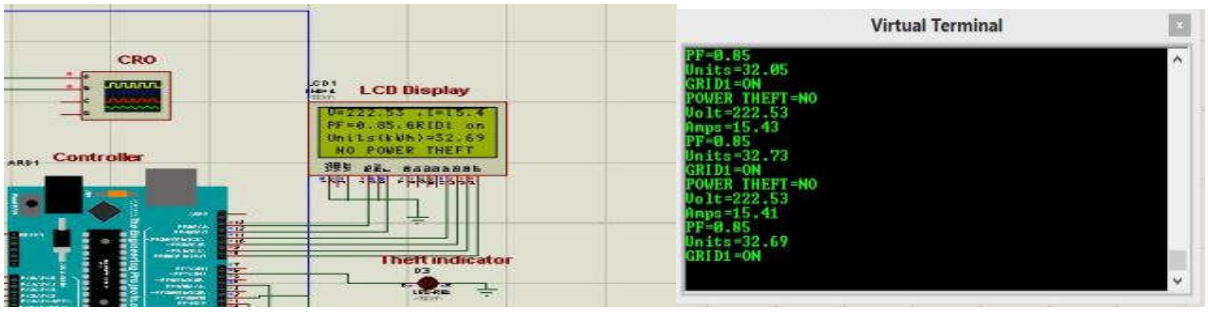
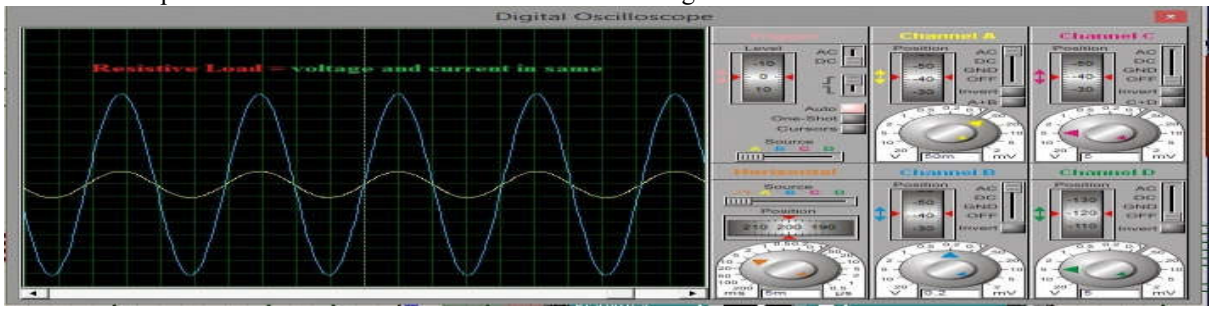


Figure 3.1.4 a) DISPLAY READING AT INDUCTIVE LOAD IS ON b) VIRTUAL TERMINAL AT INDUCTIVE LOAD

CASE IV: Output when Resistive Load is ON at that time voltage and current is same



GRAPH3.1.4 OSCILLOSCOPE WHEN RESISTIVE LOAD IS ON

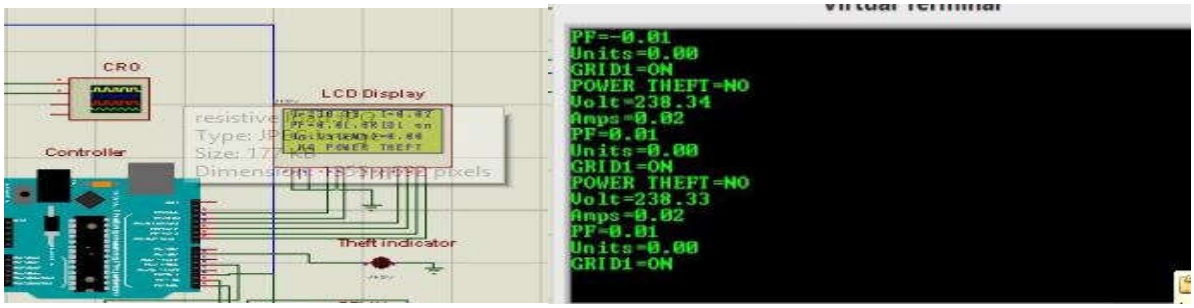


Figure 3.1..5 a) DISPLAY READING AT RESISTIVE LOAD IS ON b) VIRTUAL TERMINAL AT RESISTIVE LOAD

CASE V: (a) NO POWER THEFT READINGS

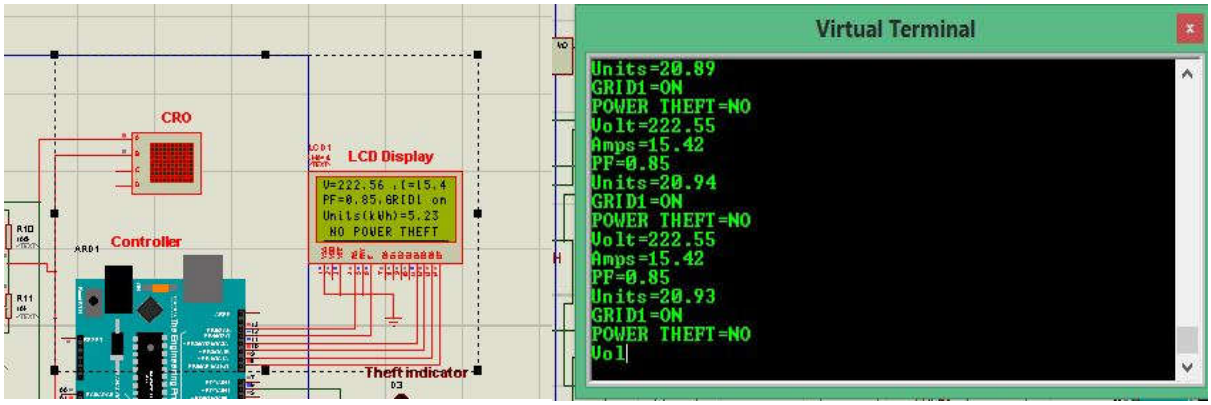


Figure 3.1.6 a) LCD DISPLAY AT NO POWER THEFTb) VIRTUAL TERMINAL READINGS AT NO POWER THEFT

(B) POWER THEFT READINGS

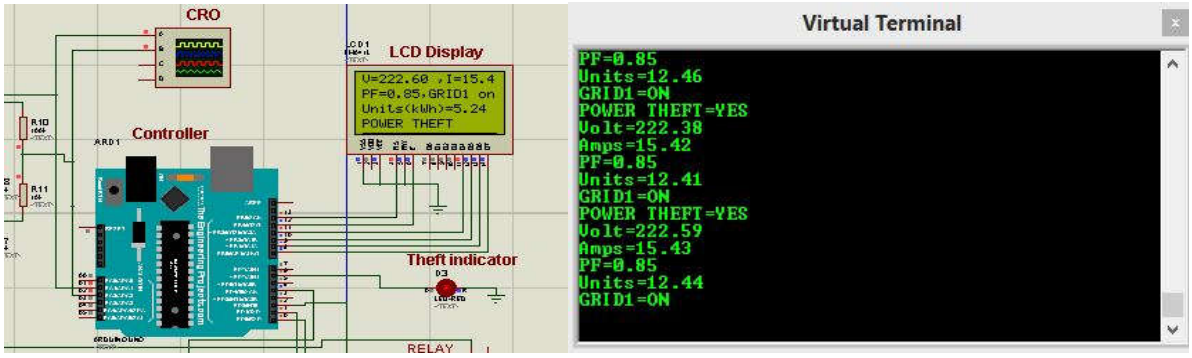


Figure 3.1.7a) LCD DISPLAY AT POWER THEFTb) VIRTUAL TERMINAL READINGS AT POWER THEFT

CASE VI: When we turn on Grid switch, supply will change grid 1 to grid 2 by using relay

(a) When grid 1 is on

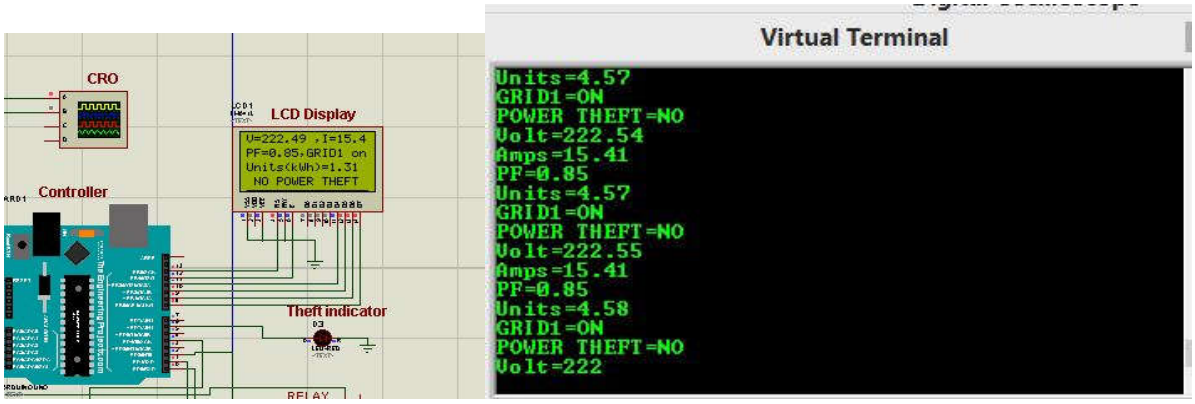


Figure 3.1.8 a) LCD DISPLAY when Grid 1 is ONb) VIRTUAL TERMINAL READINGS when Grid 1 is ON

(B) When Grid 2 is ON

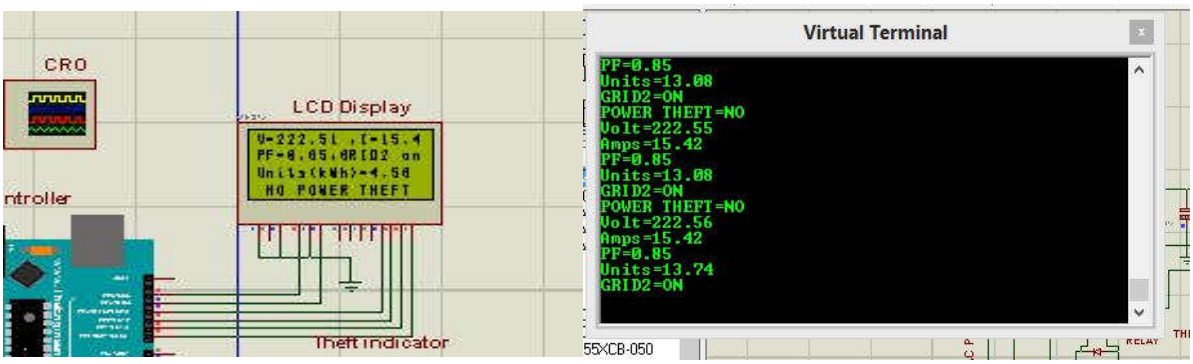


Figure 3.1..9 a) LCD DISPLAY when Grid 2 is ON b) VIRTUAL TERMINAL READINGS when Grid 2 is ON

4. CONCLUSION

Based on the above results, we discussed about the main issuesthat occurs in the Smart Grid, More efficient transmission of electricity. The smart Grid can exceedingly profits by the IOT vision. By the help of IOT ,things allows object to be sensed and controlled remote across the existing network infra-structure creating opportunities and more direct integrated between the physical as well as computer based system and regulating in improved efficiency. Apart from this by the use of IOT the country economic can grow up easily. Now days power theft is major issue and is increasing day by day. It mainly affects the economy of the country. In order to overcome all these problems we can use IOT to stop these type of issues

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