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Designing and Simulation Analysis of Power management (Power Monitoring and Power Distribution) and Automatic System through Wireless communication

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***Abstract*—** This Paper presents the basic concept and methodology of smart grid, intelligent load management, intelligent load shedding, theft control, and automatic monitoring through wireless communication using Zigbee module. We have three main units in our project main server, intelligent terminal, local controller. The main server is used to monitor the load and distribute the load according to the requirement of the local controller. The intelligent terminal unit (I.T.U) is a customized unit that is used to distribute the load to the local controller. The local controller is used to monitor and store the consumption of load of the user.

Simulations are carried out using PROTEUS Software to verify the performance of the proposed controller. The output shows the controller has fast dynamic response high accuracy of monitoring controlling.

Keywords— Zigbee module, Microcontroller (Arduino), Current sensor, XBee wireless communication, IR sensors, ITU**.**

I. INTRODUCTION

The world is facing the most critical Problem of not getting the regular power. In many underdevelp and developing countries peoples are not getting at least the primary needs for their lights, fans, TV etc. In nearly every country, researchers are expecting that existing energy production capabilities will fail to meet future demand without developing new sources of energy, including new power plant construction. However, these supply side solutions ignore another attractive alternative which is to slow down or decrease energy consumption through the use of technology to dramatically increase energy efficiency. To manage the available power for one needy side usuatuly the power is cut for other particular area, and that area goes in dark i.e. not even a single bulb can work. Instead, we can use available power in such a way that only low power devices like Tubes, Fans, and Desktops TV, Which are primary needs of every home should be allowed and high power devices like heater, pump-set, A.C. etc should not be allowed for that particular period.

To achieve this, system can be created which will differentiate between high power and low power devices at every node and allow only low power devices to be ON. To achieve this system we create a wireless sensor network having number of nodes which communicate with each other in full duplex mode. The communication will consist of data transfer, controlling node operation. We are using Zigbee protocol for the wireless communication. The main advantage of using Zigbee protocol is that the nodes require very less amount of power so it can be operated from battery. And in this way we will manage the available power by using wireless sensor network working on Zigbee protocol. Each node is measuring the power, which is being consumed by the appliances. The appliance is controlled by the end device i.e. node.

An overall operation of the system controlled by the control device. Main purpose of the research is that the wireless sensor network will differentiate and control the devices in the network on the basis of power consumed by appliances to make the efficient use of power.

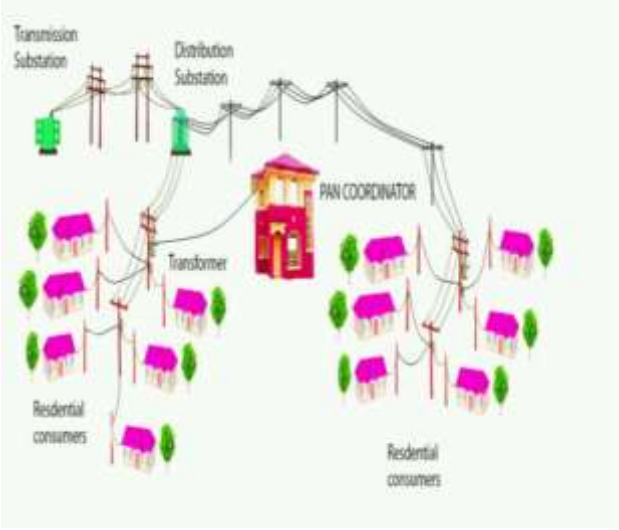

Figure 1. General Digrame of the system

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II. IMPLEMENTATION

The block diagram of the system is shown below Figure 2.1. The monitoring cell at the grid station in which whole power will be measured and will properly be distributed to the transformers. After that the power will be measured at every transformer and send the data through ZIGBEE back to the monitoring cell. We also have the ITU (intelligent terminal unit box) units which will be connected to every transformer that will monitor and distribute the electricity to every house according to their requirement. ITU unit is also workable for theft control. Another set of ITU is connected to the houses. These ITU's monitor and distribute the electricity. All the appliances in the house are control through the microcontroller based system.

This system will help in accurate billing, equal power distribution, theft detection and load management, reduction in power loss and intelligent load shedding.

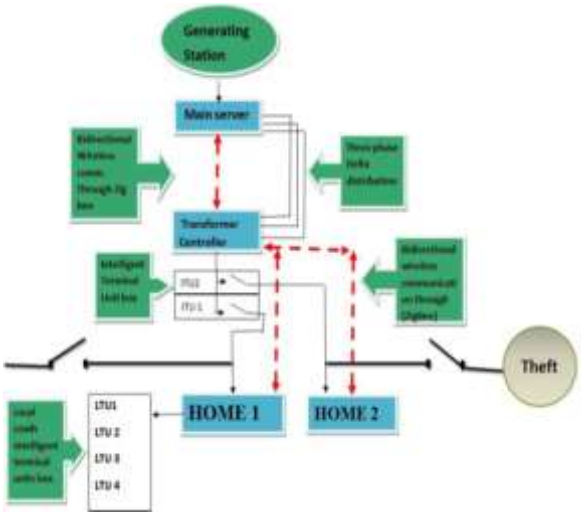

Figure 2. Block digrame of the system

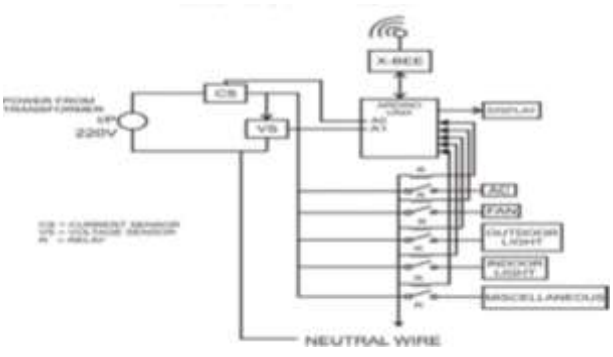

Figure 3. Local controller

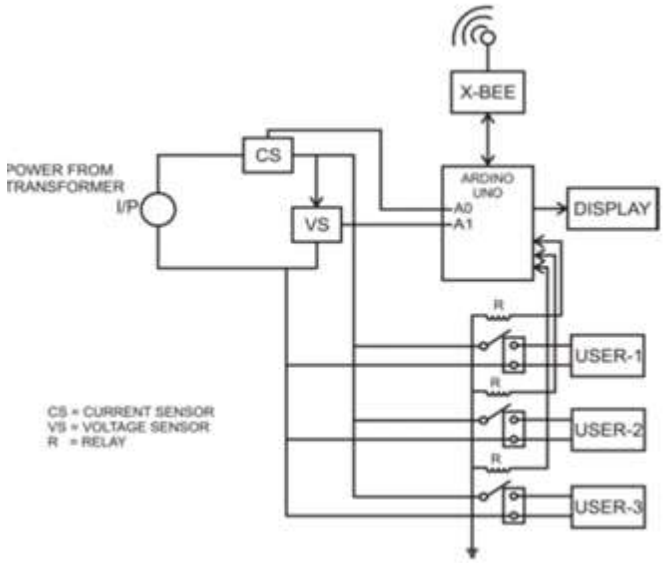

Figure 4. Intelligent Terminal Unit Diagram

2.1 Intelligent Load Manament

The increased levels of distributed generator (DG) penetration and the customer demand for high levels of reliability have attributed to the formation of the Micro grid concept. The Micro grid concept contains a variety of technical challenges, including load management and discrimination strategies. This research paper provides an innovative scheme in which loads and DG are able to detect the conditions where the load of the user cannot be sufficiently supplied. In these instances, a load shedding algorithm systematically removes loads from the system until an island can be maintained within satisfactory operating limits utilizing the local DG. The concept of an Intelligent Load Shedder (ILS) module is proposed in this paper. This module is connected in series with non-critical loads in order to detect the conditions where that non-essential load should be isolated from an island. This module must be capable of communicating with the static transfer switch (STS), which is the intelligent isolator associated with the island. The STS will also be capable of sending and receiving data with each DG's islanding protection device. The combined algorithmic control of the STS, ILS module and DG islanding protection device forms the Intelligent Load Management algorithm. This algorithm is capable of islanding protection and load shedding irrespective of the use of communications. The algorithms within this paper are simulated using PROTEOS SOFTWARE. The results show that, on a theoretical level, the intelligent load management scheme described in this paper can be used to detect the conditions where an insufficient load is available using local parameters. Load shedding coordination is also shown to be possible with and without the use of communications between the STS, ILS module and DG islanding protection module.

2.2 Intelligent Load Shedding

Conventional methods of system load shedding are too slow and do not effectively calculate the correct amount of load to

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be shed. This results in either excessive or insufficient load reduction. In recent years, load shedding systems have been repackaged using conventional under-frequency relay and/or breaker interlocks schemes integrated with programmable logic controllers to give a new look to an old load protection methodology. A truly modern and intelligent load shedding system with a computerized power management system should provide fast and optimal load management by utilizing system topology and actual operating environments tempered with knowledge of past system disturbances. This research demonstrates the need for a modern load shedding scheme and introduces the new technology of intelligent load

Shedding. Comparisons of intelligent load shedding with conventional load shedding methods are made from perspectives of system design, through this research.

2.3 Theft Control

Aiming at the disadvantage of current anti-theft technology, a smart grid based wireless power theft monitoring system in this paper. The system consists of multiple smart wireless transformer sensor node, smart controlling station, smart transmission line sensor node, and smart wireless consumer sensor node. The proposed software module also incorporates different data aggregation algorithms needed for the different pathways of the electricity distribution system. This design incorporates effective solutions for problems faced by Pakistan electricity distribution system such as power theft, and transmission line fault. The proposed architecture is designed for single phase electricity distribution system, and this design can be implemented for three phase system of electricity distribution with minor modifications.

III. WHY ZIGBEE

Zigbee was developed by the Zigbee Alliance, a world-wide industry working group that developed standardized application software on top of the IEEE 802.15.4 wireless standard. So it is an open standard. The power measurement application encompasses many services and appliances within the home and workplace, all of which need to be able to communicate with one another. Therefore, open standards architecture is essential. Open standards provide true interoperability between systems. Open standards also help to future-proof investment made by both utilities and consumers. Using an open protocol typically reduces costs in implementing: there are no interoperability problems to solve, and manufacture costs tend to be lower. Zigbee also

Provides strong security capabilities to prevent- Mischief, and is extremely tolerant of interference from other radio devices, including Wi-Fi and Bluetooth. Zigbee- enabled meters form a complete mesh network so they can communicate with each other and route data reliably. And the Zigbee network can be easily expanded as new homes are built or new services need to be added.

TABLE. I

BLUTOOTH	Targets medium data rate continuous duty
	One Mbps over the air, ~700 kbps best case data transfer
	Battery life in days only
	File transfer, streaming telecom audio
	Point to multipoint networking
	Network latency (typical)
	New slave enumeration-20s
	Sleeping slave changing to active-3s
	Uses frequency hopping technique
	8 devices per network
	Complexity is higher

TABLE II.

ZIGBEE	Targets low data rate, low duty cycle
	250 kbps over the air, 60-115 kbps typical data transfer
	Long battery life (in years)
	More sophisticated networking best for mesh
	Point to multipoint networking
	Network latency (typical)
	New slave enumeration
	Sleeping slave changing to active
	Mesh networking allows very reliable data transfer
	2 to 65535 devices per network
	Simple protocol

V. CONCLUSION

This research gives us the small ideas about Smart Grid where the load can manage through intelligent computerize system. We did the intelligent load management, through ITU(intelligent terminal unit) which moderate our old conventional system of PESCO. And will decrease the problems which faced by PESCO nowadays. We also did intelligent load shedding which can manage our load as a priority base. And will decrease the daily 10 to 14 hour load shedding in Pakistan. We also did work on the theft detection which will help our PESCO to save their power from the theft. At last I show the different simulation picture which improves efficiency of our old conventional system of PESCO. In this way we get the control of energy waste, safety and reliability of the system.

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VI. SCOPE

Even though monitoring and control solutions seems to be more expensive to implement up-front than traditional meters, the long-term benefits greatly outweigh any short-term pain. Utilities are able to track peak usage times (and days), which provides them with the ability to offer consumers greater range of rates and programs, such as time-based pricing. Demand response can enable utilities to keep prices low by reducing demand when wholesale prices are high. In recent trials, this has been shown to provide significant saving to all consumers. Not just those who adjust their usage habits. Utilities can post meter readings daily for consumers to view, which enables consumers to track and modify their energy usage this provides more timely and immediate feedback than traditional monthly or quarterly statement and theft Control.
Utilities can not only notify consumers of Peak demand times. But also monitor the extent to which those notifications cause consumers to change their habits and reduce their load during these periods. Utilities and consumers both benefit from more accurate billing that is available. It also helps to reduce the number of billing enquiries, and helps to make those enquiries easier to resolve

VII. FUTURE WORK

Since this research work for single phase supply system in future I will work on three phase system and also for Infrared base home automation system.

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