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A Novel Approach for Automatic Monitoring of Power Consumption using Smart Meter

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Abstract - *In Smart Grid, the smart meters are versatile role with intelligent capabilities in order to meet the consumer's demands and their each objective. Smart meter can measure and communicate detailed real time electricity usage, facilitate remote real time monitoring and control power consumptions and consumers are provided with real time pricing and analyzed usage information, which is a technical data to be transmitted to the grid, who are utility providers. More detailed feedback on each appliance to the user. This paper gives an overview of the security issues regarding power grids. It is targeted to use case scenarios, namely smart metering, and home gateway for applications like electric cars and home multimedia contents distribution over the power grid.*

Keywords: Smart Grid, AMI, AMR and Smart Meter

1. INTRODUCTION

The electric industry is poised to make the transformation from a centralized, producer-controlled network to one that is less centralized and more consumer-interactive. The move to a smarter grid promises to change the industry's entire business model and its relationship with all stakeholders, involving and affecting utilities, regulators, energy service providers, technology and automation vendors and all consumers of electric power.

A smarter grid makes this transformation possible by bringing the philosophies, concepts and technologies that enabled the internet to the utility and the electric grid. More importantly, it enables the industry's best ideas for grid modernization to achieve their full potential.

A smart meter is usually an electronic device that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing.[7] Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting. Such an advanced metering infrastructure (AMI) differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter.

Advanced Metering Infrastructure (AMI) are systems that measure, collect, and analyze energy usage, and communicate with metering devices such as electricity meters, gas meters, heat meters, and water meters, either on request or on a schedule. These systems include hardware, software, communications, consumer energy displays and controllers, customer associated systems, Meter Data Management (MDM) software, and supplier business systems.

Government agencies and utilities are turning toward advanced metering infrastructure (AMI) systems as part of larger "Smart Grid" initiatives. AMI extends current advanced meter reading (AMR) technology by providing two way meter communications, allowing commands to be sent toward the home for multiple purposes, including "time-of-use" pricing information, demand-response actions, or remote service disconnects. Wireless technologies are critical elements of the "Neighborhood Area Network" (NAN), aggregating a mesh configuration of up to thousands of meters for back haul to the utility's IT headquarters.

The network between the measurement devices and business systems allows collection and distribution of information to customers, suppliers, utility companies, and service providers. This enables these businesses to participate in demand response services. Consumers can use information provided by the system to change their normal consumption patterns to take advantage of lower prices. Pricing can be used to curb growth of peak consumption. AMI differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter. Systems only capable of meter readings do not qualify as AMI systems.

2. ADVANTAGES OF SMARTMETER

The concept of a smart power grid is to use innovative ICT to control appliances at consumers' homes to save energy, reduce cost and increase reliability and transparency. To be able to achieve these goals, usual electricity distribution must be complemented by an intelligent monitoring and information system that keeps track of all electricity flowing in the system. Therefore the smart grid will use automated meters, offering two-way communication and advanced sensors to improve electricity efficiency and reliability. This paper presents the scenarios and architecture being defined in the ENIAC JU project TOISE (Trusted Computing for European Embedded Systems) to experiment a set of secure and tamper-resistant solutions for embedded applications related to power grids.

3. EXISTING SYSTEM

When operating in the islanded mode, low-voltage smart micro grids can also exhibit considerable variation of amplitude and frequency of the voltage supplied to the loads, thus affecting power quality and network stability. In such context, a reconsideration of power theories is required, since they form the basis for supply and load characterization, and accountability. A revision of control techniques for harmonic and reactive compensators is also required, because they operate in a strongly interconnected environment and must perform cooperatively to face system dynamics, ensure power quality, and limit distribution losses.

The widespread application of power-electronic loads has led to increasing harmonic pollution in the supply system. In order to prevent harmonics from deteriorating the power quality, detecting harmonic components for harmonic mitigations becomes a critical issue. In this paper, an effective procedure based on the radial-basis-function neural network is proposed to detect the harmonic amplitudes of the measured signal. By comparing with several commonly used methods, it is shown that the proposed solution procedure yields more accurate results and requires less sampled data for harmonic assessment.

Recently, energy management has become one of the emerging services in the area of residential network service. A smart meter is the most essential component of advanced metering infrastructure (AMI) that connects the home energy management system of individual residences and a smart grid that optimizes the production, distribution, and consumption of electric power. Power strip type smart meters can be used to not only monitor but also control the electric power consumption at individual power outlet ports in the power outlet directly. They can be used to control and effectively reduce standby power consumption by the application of the direct power supply control. A smart multi-power tap (SMPT) is an advanced multi-outlet power strip type smart meter that provides important contextual information such as the identity and location of electric home appliances on the basis of the temporal power consumption data and the control of power supply to the appliances. However, the SMPT cannot be used to determine the location of appliances when the connections among SMPTs form a tree

structure. In this study, we develop a mathematical model of cascade connections among SMPTs and propose a solution for obtaining the location information of the tree structure. The proposed method helps realize real applications of the SMPT for providing activity-based context-aware home network services and energy management services.

Smart micro grids offer a new challenging domain for power theories and compensation techniques, because they include a variety of intermittent power sources, which can have dynamic impact on power flow, voltage regulation, and distribution losses. When operating in the islanded mode, low-voltage smart micro grids can also exhibit considerable variation of amplitude and frequency of the voltage supplied to the loads, thus affecting power quality and network stability. Due to limited power capability in smart micro grids, the voltage distortion can also get worse, affecting measurement accuracy, and possibly causing tripping of protections. In such context, a reconsideration of power theories is required, since they form the basis for supply and load characterization, and accountability.

DISADVANTAGES

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4. PROPOSED SYSTEM - SMART METER

Smart Meters are electronic measurement devices used by utilities to communicate information for billing customers and operating their electric systems. For over fifteen years electronic meters, have been used effectively by utilities in delivering accurate billing data for at least a portion of their customer base. Initially, the use of this technology was applied to commercial and industrial customers due to the need for more sophisticated rates and more granular billing data requirements. The use of electronic meters came into service to the largest customers of the utility and over time gradually expanded to all customer classes. This migration was made possible by decreasing cost of the technology and advanced billing requirements for all customer classes.

The combination of the electronic meters with two-way communications technology for information, monitor, and control is commonly referred to as Advanced Metering infrastructure (AMI).

The main task of the smart meter is to measure the power consumption by the Final Consumer (FC) and report related data to the Distribution Service Operator (DSO), also called Energy Service Provider (ESP) for billing.

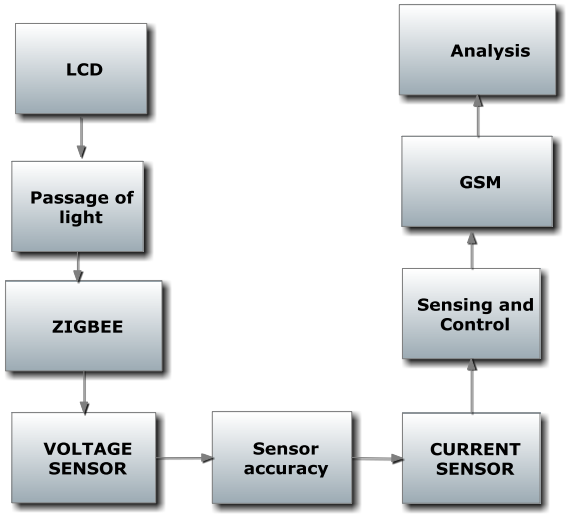

Fig -1: System Architecture

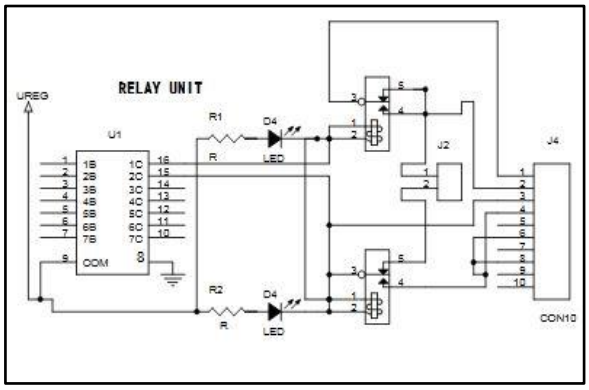

Fig -2: Connection Circuit

5. MODULE DESCRIPTION

Step 1: Gathering the requirements.
Step 2: Analyzing our components
Step 3: Testing process
Step 4: Connection phase

5.1. COMPONENTS USED

- LCD
- ZIGBEE
- CURRENT SENSOR
- VOLTAGE SENSOR
- POWER IC

5.2. COMPONENTS DESCRIPTION

ZIGBEE

- Zig Bee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications.
- Flow or process control equipment can be place anywhere and still communicate with the rest of the system.
- It can also be moved, since the network doesn't care about the physical location of a sensor, pump or valve.

Fig -3: Zigbee

ARDUINO

- Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world.
- It will do the mathematical calculation and get the reading from voltage sensor and currect sensor. Finally gets interfaced with zig bee.

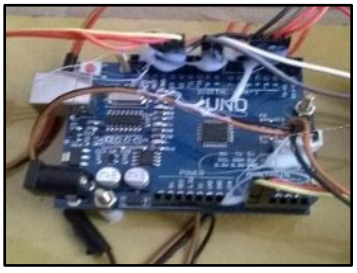

Fig -4: Arduino

VOLTAGE SENSOR

- The Smart Q Voltage Sensors are used to measure the potential difference between the ends of an electrical component. This range of Voltage Sensors can be used to measure both DC and low-voltage AC circuits.
- The Smart Q Voltage Sensors are equipped with a micro controller that greatly improves

the sensor accuracy, precision and consistency of the readings.

- They are supplied calibrated and the stored calibration (in Volts) is automatically loaded when the Voltage Sensor is connected.

Fig -5: Voltage Sensor

CURRENT SENSOR

- Sensing and Control (S&C) offers a wide variety of current sensors to monitor alternating (ac) or direct (dc) current.
- From digital output detectors sensing a few hundred milliamps to linear sensors monitoring over one thousand amps, our comprehensive line provides superior, often accurate performance at a reduced cost.
- As well as the advantages you'd expect from an experienced provider offering decades of engineering expertise: thru-hole design, fast response times, output voltage isolation from input.

Fig -6: Current Sensor

RELAY UNIT

- Relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

- In our project we used relay for automatic switch on or off process.

Fig -7: Relay unit

LCD

- LCDs use these liquid crystals because they react predictably to electric current in such a way as to control the passage of light.
- The approach is that if the distance traveled by the robot (indicated by encoders) reaches the reference distance sent by MATLAB, the robot stops and waits for the next command.
- The same approach is valid for rotation where the angle of rotation indicated by the wheel encoders can be compared with the reference rotation angle commanded.

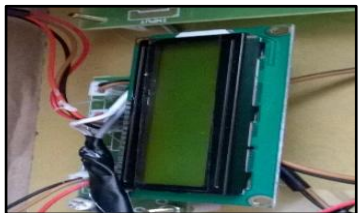

Fig -8: LCD

TRANSFORMER:

- Electrical power transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual

induction between two windings. It transforms power from one circuit to another without changing its frequency but may be in different voltage level.

- The working principle of transformer is very simple. It depends upon Faraday's law of electromagnetic induction. Actually, mutual induction between two or more winding is responsible for transformation action in an electrical transformer.

6. RESULTS AND DISCUSSION

We have presented the applications scenarios and the basic hardware architectures being developed the context. We have presented the principles of the approach in previous work and are currently implementing security services within the demonstrator. Hence also application data have to be considered. Multimedia streaming has all the services of smart metering, it consists of locally storing and distributing copyrighted multimedia data by means of the power grid,

We have presented a new method for computing weather related electricity consumption, illumination-related electricity consumption and electricity consumption due to appliances or groups of appliances. More precisely, given the hourly total consumption, we obtain the hourly weather-related and illumination- elated electricity consumption. After that, we apply an agent-based analytical model to extract the electricity consumption due to various appliances or groups of appliances. This work has focused on the residential sector, but it can be generalized to the commercial and the industrial sectors as well. The two-stage data processing model and algorithms presented in this work can be used to construct a tool for predicting short term residential electricity consumption, or they could be used in a smart grid context to predict how much smart grid demand response will be needed.

As the need for energy increases constantly, the smart management of power grids has become a prime topic of interest for researchers and industry alike. This paper has illustrated the scopes of the TOISE project in the field of power grids security, has described some scenarios and has presented architectural issues able to ensure privacy and integrity in power grid usage. The overall aim of TOISE is to maintain Europe as a worldwide player in the field of efficient implementation of secure integrated devices, to address the future applications.

6.1 RESULTS OBTAINED

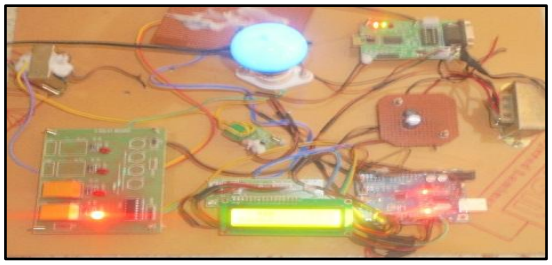

Fig -9: Smart Meter Implementation

7. CONCLUSION

The AMI is considered to be one of the most important components of the smart grid. However, its benefits are yet to be fully understood even in countries with existing infrastructure. In this work we presented an AMI emulator which emulates the salient features of the AMI.

Thus we obtained the generated power in our home and it will directly send the reading the eb center through Zig bee. So it will reduce the man power and provide accuracy in our generated reading per month.

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BIOGRAPHIES

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