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Detection of False-Reading in Smart Grid Net-Metering System

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Abstract: *Malicious consumers may hack their smart meters (SMs) in the smart grid to report fake readings in order to make unlawful financial profits. Since the reported readings are used for energy management, the utility suffers significant financial losses as a result, and grid performance may suffer as a result. The net metering system, in which one SM is used to report the difference between the power consumed and the power generated, is the subject of this research, which is the first study to look into the issue. First, we process real power consumption and generation information to create a benign dataset for the net-metering system. The data was then examined, and time correlations between the net meter readings and correlations between the measurements and pertinent information from reliable sources, such as temperature, were discovered. Based on the data analysis, we suggest a single-pole double-throw detector to detect erroneous readings. In addition to data from reliable sources, our detector is trained on net meter readings from every customer in order to improve its performance by discovering correlations between them. We also create a relationship between the customer and the grid. Since the only billing system available nowadays is online, this project includes an app that may be used to solve a variety of problems, including electrical outages. Overall, with this, we improve customer and grid communication and simplify their lives.*

Keywords: Security, net metering, and smart grid

I. INTRODUCTION

1.1 Introduction:

The Internet of Things (IOT) is a scenario which has the ability to automatically transfer data over a network without requiring human-to-human or human-to-computer interaction. IOT has evolved from the convergence of wireless technologies, micro-electromechanical systems and the Internet. The internet of things also called an Internet of objects. Online monitoring system for continuous casting equipment is established based on IOT sensing technology and communication technology. As the system contains a variety of sensor types like IR speed sensor, pressure sensor, Fuel level sensor, etc. And data transmission protocols, it will lead to a large amount of heterogeneous data of different sensors current and voltage values and the data is difficult to integrate with applications in upper layer. A data processing framework is introduced into the system to deal with such problems. A data processing framework is introduced into the online monitoring system, which is a bridge between physical layer and application layer. Finally, application in online monitoring system proved the validity of the framework. From this framework we came to know that the requirements of the equipment are used in the technology and we can also monitor system wide changes. In order to study new methods of multipurpose transport services, researchers need to prototype integrated transport systems. We demonstrate its feasibility by presenting the integrated real-time transporting management solution, by studying signal delay and transmission robustness regarding changing communication channel characteristics, and by evaluating issues reported by the bus during the trial phase. Embracing this approach for the bus data like pressure, fuel level, and speed levels are in data acquisition unit. GPRS are used to find the location. Data are received from the LAN network and it is passed through the router to data stored data base server like .net, c sharp, MySQL. User take the information from data base server by using Ethernet IP address connected between LAN server and SQL data base.

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This paper helps to reduce traffic congestion, real-time traveler information, road weather information systems, traffic signal optimization and commercial vehicle operations.

II. LITERATURE SURVEY

[1].M. Baghaie, S. Moeller, and B. Krishnamachari, "Smart Power Monitoring Using IoT," in Proc.IEEEPOWERCON, pp. 1–8, 2010.

They discussed how energy consumption is a crucial and difficult problem in this essay. In large electric energy distribution systems, automatic electrical energy meters are employed. The system functions as a smart power monitoring system thanks to the integration of Arduino WiFi and SMS. Data from smart energy meters can be used to optimize processes and use less energy. This system also has a motion sensor, so it will shut off the power supply if there isn't a person in the building or house. This makes it feasible to control how much energy the power system uses, which ultimately lowers prices and consumption overall. A new AMR strategy for energy savings in smart grids employing smart meters and partial power line communication was published in 2012 by "Garrab, A.; Bouallegue, A.; Ben Abdallah"

[2].In this paper, the authors discuss how factors like the rising demand for energy, the capacity constraints of energy management, the need for one-way communication between various standards, the security of the communication, and greenhouse gas emissions have all contributed to the emergence of a new infrastructure grid called the Smart Grid. One of the suggested solutions for the smart grid is smart In particular, a fresh set of assaults made specifically for the net-metering system have been suggested to imitate the actions of hostile consumers, and then they have been utilized to An AMR solution that offersimproved end-to-end application is used in this project. It is based on the Power Line Communication standards and an energy meter with a low-power microprocessor, the MSP430FE423A. The microcontroller has an ESP430CEl energy metering module. This project's objective is to implement real- time pricing by using the suggested communication infrastructure. This concept is really.

[3] "Malicious Data Attacks on the Smart Grid," IEEE Trans. Smart Grid, vol. 2, pp. 645–658, 2018. O. Kosut, J. Liyan, R. J. Thomas, and T. Lang This research examines for the first time the detection of false- reading attacks in the net- metering system With a collection of actual power generation and consumption readings, generate malicious samples. After that, data analysis was done to find time correlations between the net meter readings and correlations between the readings and pertinent information gleaned from reliable sources like solar irradiance and temperature. A universal multi-data-source deep learning-based detector has been presented to identify false-reading attacks based on the data analysis. Our detector has been trained on online meter readings in addition to pertinent information from reliable sources to discoverthe

III. SYSTEM DESIGN

3.1 Proposed Work And Block Diagram

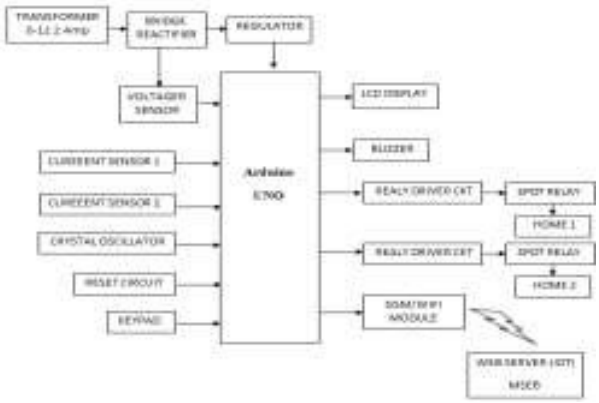

Fig: 3.1 Block diagram

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Because of this, we have created an IOT-based energy management system where sensors like current, voltage, and frequency sensors are used and readings sensed are communicated to an Arduino microcontroller. IOT stands for Internet of Things. based upon The Arduino microcontroller is configured to regulate grid usage based on the measured value. This system shows data on how much energy is usedin units, and if there is ever a theft, it will be reported on the website.

Therefore, every user can access the information from anywhere in the world. The system's information is displayed on a Thing Speak web page. In this IOT-based meter reading system, the service provider and meter reading are both continuously monitored. Voltage sensors are used in the system to keep track of the incoming voltage. Additionally, the voltage sensor and the current sensor are used to monitor the voltage and current that the loads are consuming. The sensor values are tracked, and if there is a significant difference between the voltage and current sensor readings in the incoming and outgoing directions, a theft warning is sent to the person in question. Demand for and requirements for loads may fluctuate, which could lead to dangerous conditions in the distribution system. By turning on the grid fora brief period of time, load shading is provided to solve this issue. For each grid, times may be equal or multiple of one another. based on the need and the task that was schedule

Arduino Board:-

An open-source electronics platform called Arduino is built on simple hardware and software. A motor can be started, an LED can be turned on, and something may be published online by using an Arduino board to receive inputs like light on a sensor, a finger on a button, or a tweet.A microcontroller board called the Arduino Uno is based on the ATmega328 (datasheet). It contains a 16 MHz ceramic resonator, 6 analog inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just use a USB cable to connect to a computer or an AC-to-DC adapter or battery to power it.

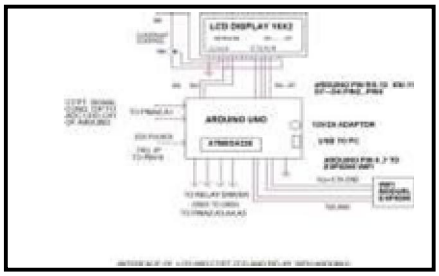

Fig: 3.2.1 block diagram Arduino

Fig: 3.2.2 Arduin
Fig Arduino

Technical specifications:-

- Microcontroller ATmega328POperating Voltage 5V
- Input Voltage (recommended) 7-12VInput Voltage (limit) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)PWM Digital I/O Pins 6
- Analog Input Pins 6

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- DC Current per I/O Pin 20 mA DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB (ATmega328P) of which 0.5 KB is used by boot loaderSRAM 2 KB (ATmega328P)
- EEPROM 1 KB (ATmega328P)
- Clock Speed 16 MHzLength 68.6 mm
- Width 53.4 mm
- Weight 25 g.

Pin diagram of the board:

A current transformer (CT) is a tool used in electrical engineering to measure

Current Transformer (CT) & Potential Transformer (PT electric currents. Instrument transformers are defined as current transformers, voltage transformers (VT), and potential transformers (PT). When a circuit's current is too large to be applied directly to measuring devices, a current transformer generates a reduced current that is precisely proportionate to the circuit's current and can be easily linked to measuring and recording devices. A current transformer also protects measurement equipment from potentially extremely high voltages in the circuit being watched. In the electrical power business, current transformers are frequently employed in metering and protective relays. The MDC system's input stage is where the load's power consumption is really detected. Because it takes a lot of voltage and current to process these high-level signals. Consequently, these signals are converted into comparable tiny- level signals. A potential transformer reduces the 0-2.

Grid control relay section:

In order to operate the grid safely, we must have enough load. One grid is turned on or off at a time by arelay. An electrically controlled switch is a relay. Other operating principles are also utilised; however, electromagnets are frequently used in relays to mechanically activate a switching mechanism. Relays areemployed when several circuits need to be controlled by a single signal or when a low-power signal is required to control a circuit with perfect electrical isolation between the control and controlled circuits.

Fig: 3.2.5 Relay

The SIM800 is an integrated quad-band GSM/GPRS solution in an LGA type that may be used in client applications. SIM800H supports the quad-band frequencies of 850/900/1800/1900 MHz and can transmit voice, SMS, and data with less power use. It can fit into the narrow and compact requirements of client design due to its small size of 15.8*17.8*2.4 mm. It enables overall cost reductions and quick time-to-market for customer applications because it has embedded AT.

LCD Display

The state of the system is displayed via an alphanumeric liquid crystal. The Arduino controller is connected to a 16x2 LCD display. This is the Parallel Port's first interface illustration. We'll get started with something easy. This example should work with most if not all, parallel ports because it does not use the bi- directional functionality available on later ports. However, it doesn't demonstrate how to connect a 16-character, 2-line LCD module to the parallel port using the status port as an input. These LCD modules are widely used today and fairly easy to use because all the necessary functionality to run them is built right into the device.

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LCD Background:-

Fortunately, there is a widely adopted standard that enables us to interact with the vast majority of LCDs, irrespective of the manufacturer. The controller chip that accepts data from an external source (in this case, the 8051) and directly communicates with the LCD is known as the HD44780U standard.

44780 LCD background

According to the 44780 standards, the data bus must have 4 or 8 I/O lines in addition to 3 control lines. The user can choose between an 8-bit data bus and a 4-bit data bus for the LCD to use. The LCD will need a total of 7 data lines (3 control lines plus the 4 lines for the data bus) if a 4-bit data bus is employed. The LCD will need a total of 11 data lines, including 3 control lines and 8 lines for the data bus if an 8- bit data bus is employed EN, RS, and RW are the three control lines' names. "Enable" is the name of the EN line. You can inform the LCD that you are sending it data using this control line. Your program should check that this line is low (zero) before setting the other two control lines and/or sending data to the databus on the LCD. Bring EN high (1) when all other lines are ready, wait the minimum amount of time specified by the LCD datasheet (this varies from LCD to LCD), and then bring EN low (0) once more to finish. The "Register Select" line is marked with an RS. The data should be considered a command or special instruction (such as clean screen, position cursor, etc.) when RS is low (zero). RS is high (1) when sending data. The Data in text format is displayed on the screen.

Wi-Fi Module :GSM:-

With its SIM800A chip and RS232 interface, this GSM modem makes it simple to connect to a PC or laptop via the USB to Serial adapter or to a microcontroller via the RS232 to TTL converter. Once the SIM800 modem is connected to the USB to RS232 cable, Enter the Device Manager of the USB to SerialAdapter to identify the proper COM port. Then, using Putty or any other terminal program, establish a connection to that COM port at 9600 baud, the modem's default baud rate. You can start transmitting AT commands once a serial connection has been established between your microcontroller and computer

The SIM800 is an integrated quad-band GSM/GPRS solution in an LGA type that may be used in clientapplications. SIM800H supports the quad-band frequencies of 850/900/1800/1900 MHz and can transmitvoice, SMS, and data with less power use. It can fit into the narrow and compact requirements of client design due to its small size of 15.8*17.8*2.4 mm. It enables overall cost reductions and quick time-to- market for customer applications because it has embedded AT.

Many communication devices that employ GSM (Global System for Mobile Communications) technology require GSM modules. It is used to connect a computer to the GSM network. Only AT commands are understood by the GSM module, and it can react accordingly. The simplest instruction is "AT"; if GSM responds with "OK" then everything is well; if not, GSM will react with "ERROR". ATD to dial a call, ATA to answer a call, and more AT commands are available. To read the message, press AT+CMGR; to send an SMS, press AT+CMGS; etc. Carriage return, or r (0D in hex), should come after AT commands, for example, "AT+CMGSr." These commands allow us to use the GSM module.

V. ADVANTAGES & APPLICATION

Advantages:

- Emergency services get the information about accident in time, and then many lives could have been saved.
- Real time location tracking is possible
- We can find the location of the vehicle.

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- Alert message to mobile phone for remote information.
- This project is user-friendly and reliable

Disadvantages

- Costlier.
- Sending data not secure.
- This system is not applicable for poor network connection places.

Application:

- Automotive and transport vehicles.
- Security,remote monitoring and transportation and logistics.
- This system also can be interfaced with vehicle alerting system.

VI. CONCLUSION & FUTURE SCOPE

Conclusion

As part of this project, we are creating a system that can identify false readings and foster communication between the smart grid and each individual client while also safeguarding the smart grid. The project's goal is to develop a solution for the smart grid's net metering that can detect false- reading assaults. The project's primary goals are cost reduction and the development of an accurate, eco-friendly technology with little room for error. Energy transmission and distribution through a smart grid must be dependable, secure, and efficient. State estimation is a crucial part of running a power grid system. used at the control canter by Energy Management Systems (EMS) to make sure the electrical system is operating as it should.

Future Scope:

This project marks the first time that false-reading attacks on the net metering system have been looked into. A new set of attacks designed specifically for the net-metering system has been put forth to imitate the actions of malicious consumers, and then they have been utilized to produce malicious samples from a dataset of actual measurements on power generation and consumption. After that, data analysis was done to find time correlations between the net meter readings and correlations between the readings and pertinent information gleaned from reliablesources like solar irradiance and temperature. Our detector has been trained on online meter readings in addition to pertinent information from reliable sources to discover the relationship between them. Fine-grained measurements from consumers' net meters are being reported. enables the utility to find erroneous readings. However, providing the utility with these readings puts consumers' privacy at risk because they divulge personal information about them, such as the appliances they are using, when they do. sleep, whether or not they are at home, etc. Therefore, we will look into this issue in our upcoming work. They will encrypt their net meter readings before sending them to the utility in order to protect the consumers' privacy. As a result, in order to protect the privacy of the users, we will build a method for evaluating the machine learning model described in this research using encrypted readings

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