Intrusion Detection System With Embedded Backup Solar Panel for Advanced Metering Infrastructure

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ABSTRACT

With the proliferation of smart grid research, the advanced metering infrastructure has become the first ubiquitous and fixed computing platform. However, due to the unique characteristics of AMI, it is a challenging issue to make AMI secure. Energy theft is one of the most important concerns related to the smart grid implementation. To address this challenge, in this paper, we discuss the background of AMI and identify the major security requirements that AMI should meet. To attain our concept we use an embedded system which is dedicated to specific task and is based on microcontrollers.

KEYWORDS : Advanced metering Infrastructure, PIC Controller, Embedded system, solar panel.

INTRODUCTION

Smart Grid is a set of technologies that integrate modern information technologies with present power grid system. Along with other benefits, two way communication, updating users about consumption are unique features of Smart Grid. To facilitate such kind of features, SG incorporates GSM for communication, current sensors for monitoring and solar panel for backup supply.

In this paper, we focus on the security of Advanced Metering Infrastructure (AMI), which is one of the most crucial components of SG. For providing bidirectional flow of information AMI serves as a bridge.

In order to protect AMI from malicious attacks, the Intrusion Detection System(IDS) aspect of security solution is used.

WORKING PRINCIPLE:

In any end user places we can detect the power theft by using current sensors. There are two current sensors. If a difference in current sensor is detected, controller will give intimation to the authorized person through GSM and LCD will give notification to the surrounding. RFID tag is used to verify whether the person is authorized. If the power failure is detected, load is powered up by battery. Battery is charged by the solar panel.
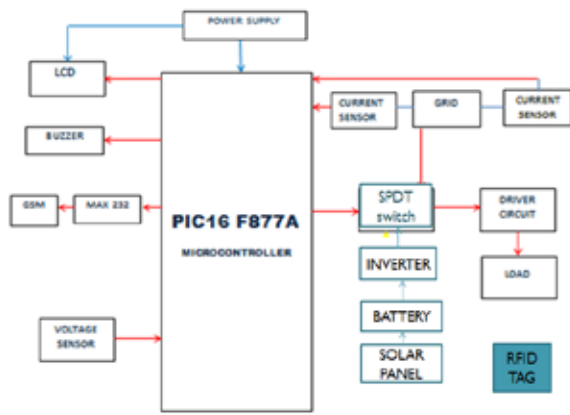
BLOCK DIAGRAM:

Fig 1. Block diagram

UNITS:

Power Supply Unit, Microcontroller Unit,

Power generating unit, Sensor unit, Display Unit,

Software Unit, Communication unit, Battery Power Supply Unit

The supply of 5V DC is given to the system which is converted from 230V AC supply. Firstly, the step down transformer will be used here for converting the 230V AC into 12V AC. Then it is converted into DC. The output of the rectifier will have ripples so a capacitor is used for filtering those ripples. The output from the filter is given to the 7805 voltage regulator which will convert the 12V DC into 5V DC.

MICRO CONTROLLER UNIT
PIC16F877A

In the micro controller unit we are going to use PIC 16F877A microcontroller which is used to read the sensor values based on the sensor value controller control SMS and driver unit. In the communication part data conversion is done internally in the controller. The controller also converts the data to serial communication for wireless data communication.

LCD

The display unit is mainly achieved by the 16X2 LCD. A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. The monitored data from the environment is viewed in the display.

POWER GENERATING UNIT
Solar panel

A polycrystalline solar panel is used for power generation. A solar panel (PV module) is a device that will produce a flow of electricity under sunlight. This electricity can be used to charge batteries with the aid of an inverter.

Most PV modules are framed in aluminum, topped with tempered glass, and sealed by a waterproof backing.

Sandwiched between the glass and backing layers are the photo-reactive cells, often made of silicon.

SENSOR UNIT
Current sensor:

Current sensor is used to measure the current flow in the transmission line. A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs.

Also, a magnetic field is generated surrounding the current carrying conductor. Both of these phenomena are made use of in the design of current sensors. Thus, there are two types of current sensing: direct and indirect. Direct sensing is based on Ohm's law, while indirect sensing is based on Faraday's and Ampere's law.

Voltage sensor:

A Bridge Rectifier is used to convert the AC in to DC. Capacitors are avail-

able to filter the converted voltage. Converted voltage is sampled by variable resistor. Multiply output with some factor to get the exact output.

Software Unit

Software is used to compile the coding of the desired application for the corresponding embedded system.

MPLAB

The PIC16F877A microcontroller is founded by Microchip and they had designed a compiler to develop user-defined programs for different kind of applications which is namely called as MPLAB Compiler. Both Assembly and C programming languages can be used with MPLAB IDE v8. It is also a cross compiler which can also be used other kind of architectures. For PIC series of controllers only MPLAB compiler is used.

In this project we are using PIC16F877A Microcontroller and for thatcontroller Microchip developed a compatible and user-friendly compiler for programming which is named MPLAB or hi-tech compiler. Hence we choose that controller.

COMMUNICATION UNIT:

GSM:

GSM – Global System For Mobile Communication.

It is used to send and receive radio waves between mobile phone and microcontroller.

It is interfaced with microcontroller using MAX232.

Fig 2. GSM using microcontroller

BATTERY:

An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy.

Each cell contains a positive terminal, or cathode, and a negative terminal, or anode.

The capacity of a battery depends on the capacity of solar panel.

12V battery is used.

SIMULATION OUTPUT

Fig 3. Simulation Result

RESULT:

When an intrusion is detected, the LCD displays "INTRUSION DETECTED" a message is sent to authorized person through GSM. This process is demonstrated through PROTEUS simulation

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[8]   A. Zangeneh, S. Jadid, and A. Rahimi-Kian, "Promotion strategy of clean technologies in distributed generation expansion planning," Renew. Energy, vol. 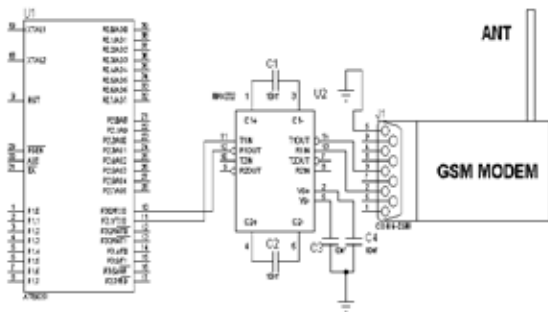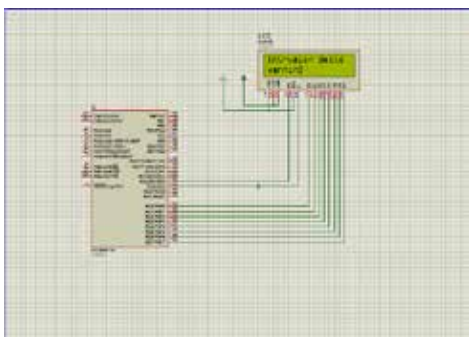34, no. 12, pp. 2765–2773, Dec. 2009.