IOT MICRO-CONTROLLER BASED ENERGY METERING AND BILLING SYSTEM

Introduction

Energy meter is a device that measures the amount of electrical energy consumed. The most common unit of measurement on the electricity measurement is the kilowatt hour [kWh], which is equal to the amount of energy used by a load over a period of one hour. Energy meter system designed to meet your specific requirements. These meters measure the instantaneous voltage and currents, calculate its product, and gives instantaneous power. Each customer has different energy monitoring needs and depending on those we can supply electrical energy metering equipment, gas, water, or electrical consumption meters.

In this project, we are designing and constructing an energy metering and billing system that will carry out the following features:

- Measures the Active Power on the connected load.
- Measures the Reactive Power on the connected load.
- Measures the Apparent Power on the connected load.
- Measures the voltage supplied to the system.
- Measures the current flowing through the system and the load.
- Electricity energy billing system measures the amount of energy used over time with recharge capabilities.
- Internet-of-Things (IoT)-based.

Key components used & technical specifications

(1) **4 x 4 matrix keypad module:** The 4*4 matrix keypad usually is used as input in a project. It has 16 keys in total. In this project, we are using this keypad to give inputs to and communicate with our metering system. It serves as a channel for Administrative PIN input as well as inputting recharge token, checking the amount of energy left, and some other administrative functions.

(2) **ACS712 current sensor module:** This current sensor board is based on the Allegro ACS712ELCTR- bi-directional hall-effect current sensor chip that detects positive and negative flowing currents flowing in a circuit. The board operates at 5V DC and the current flow through the sensor is converted to an output voltage starting at 1/2Vcc (or 2.5V) for no current flow and moves up 100mV per amp for positive current or down -100mV per amp for negative current. In this project, we are using this module to measure the total current consumed by all connected loads to the metering system.

(3) SIM800L GSM/GPRS Module: This is a miniature GSM 2G modem which we can use to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting and logging data to internet through GPRS, TCP/IP, and more! In this project, we are using this module to ensure our metering and billing system maintains communication to a web server via a wireless GPRS network to securely upload our data into cloud, and remote connection to the system.

(4) Liquid Crystal Display (20 x 4): The display is composed of a 20-character x 4-line LCD display with a green backlight and black characters. Each of the characters are composed of a 5 x 8 dot matrix for good character representation. Custom characters can be defined and used with the display. In this project, we are using this LCD module to display all measured parameters and a means of visual output.

(5) Atmel ATmega328P microcontroller: This is the preferred microcontroller to execute our project. It is a low-cost, and powerful chip from the Atmel family of microcontrollers. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching one MIPS per MHz, balancing power consumption and processing speed, which all runs on a 5V.

(6) Power bank module: The charger and discharge module are integrated micro-USB interface, and the power bank circuit board can be used to charge other electronic products. In this project, we are using this module to stably provide 5v power for USB power usage.

(7) Resistive type voltage sensor circuit: This sensor mainly includes two circuits like a voltage divider & bridge circuit. The resistor in the circuit works as a sensing element. The voltage can be separated into two resistors like a reference voltage & variable resistor to make a circuit of the voltage divider. A voltage supply is applied to this circuit. The output voltage can be decided by the resistance used in the circuit.

(8) AC relays: Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

In this project, we are using relays to receive AC load switch signals from the microcontrollers.