4th Information Systems International Conference 2017, ISICO 2017, 6-8 November 2017, Bali, Indonesia

Mobile Web Energy Monitoring System Using DFRduino Uno

Kristine Mae E. Galera, Orven E. Llantos*

School of Computer Studies, Mindanao State University – Iligan Institute of Science and Technology, Iligan City 9200, Philippines

Abstract

Energy consumption in residential households is very important to consumers. The rise in electricity prices have deemed to consumers the need to conserve energy, with less to no information on their energy consumption patterns. A step to towards energy conservation is a real time energy monitoring system which provides feedback to the consumers, thus the consumer will be able to identify the opportunities to adjust and identify how to conserve energy.

This paper presents a real time energy monitoring system that is cost-effective and reliable, it can be used to analyze and evaluate the output voltage or generated energy from a household appliance. A hardware device is used to gather energy data passed and stored to a database through cloud-based RESTful API resources. These resources are then used by the mobile web application for displaying real-time and historical energy readings.

The developed monitoring system have an accuracy rate of 94% in getting the correct energy consumption through testing. The results of user's feedback during testing provides insights to supplementary features which shows the usefulness of the energy monitoring system.

Keywords: Energy Management; Home Energy Monitoring; Mobile Computing; Embedded System

1. Introduction

Residential electric consumption is one factor that consumers are challenged about. One of the major challenges is how to conserve and lower electricity charges. Consumers do not have the information and real-time feedback on how much electricity energy their household is consuming in a given period of time. Monitoring energy consumption is

* Corresponding author. Tel.:+63-063-223-8641.
E-mail address: orven.llantos@g.msuiit.edu.ph

important so they will be able to change habits in order to reduce the amount of electricity they are consuming and at the same time lower their energy bill.

System user-friendliness is taken into consideration in this research in contrast to some existing products that do not often meet consumer's requirements especially with mobility and data access. The system uses DFRduino microcontroller and sensors connected to RESTful API web services. It consist of a mobile web user interface with a Restful API and its database running in Heroku cloud platform. The user interface visualize sensor data, providing real-time energy consumption feedback.

2. Review of Related Literature

This section presents how energy monitoring began and eventually how embedded system was integrated in the use of energy monitoring. It also includes some the existing studies of energy monitoring system implementations which inspired this study.

2.1. Embedded System and DFRduino

The embedded systems design considers the systems characteristics and restrictions that are fundamental for an efficient system function. As a result, low power design of communication intensive real-time embedded systems must consider the environment and application constraints to optimize the systems design [8] such as real-time responsiveness and intensive execution of communication tasks.

In this project the DFRduino Uno V3.0 from DFRobot was considered. It is a simple microcontroller board fully compatible with Arduino UNO R3 and Arduino IDE open-source development environment [2]. This environment implements the Processing / Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer [5].

2.2. Display Modules

A mobile web graphical user interface is implemented, where users are can access real-time data and monitor it using different browser on different mobile devices. An LCD display is connected to the micro-controller where users can see the real-time energy consumption on the LCD screen.

2.3. Energy Monitoring Implementations

2.3.1. Non-commercial

Studies on energy management systems have been undertaken as well with the use of microcontrollers. Smart Home Energy Management System by Barnicha [3] is a home energy management system that provides households with detailed information about energy consumptions and permit sensing, control, and smart algorithms with the use of renewable energy as a source of electricity at the residential level using an Arduino-based network. A study by Hertzog, et. al., [6] presents a customizable energy monitoring system which may be used to analyze and evaluate the operation of a number of different photovoltaic modules. A log of output voltage and energy from the data logged on a circuit interface which they used Arduino Mega 2560 data logger to a personal computer with a front panel display and result was viewed and developed in LabView.

There are several interesting approaches that allows providing energy consumption feedback for example Barsocchi, et. al., [4] presented a NIALM system able to provide real-time data gathered from a smart meter based on Arduino system embed a FSM that detects the usage of a domestic appliance. Monitoring is getting into the market as smart home system are taken into consideration just like the study of Adriansyah, et. al, [1] it offers a Small Smart Home System designed and created by utilizing WLAN network based on Arduino microcontroller. The system is able to monitor and control lights, room temperature, alarms and other household appliances from a device connected to a network that supports HTML5. The study of Putra, et. al., [7] offers the same smart home system that controls home electrical appliances while monitoring the electricity consumption using web based application. There are also