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EMA: Energy Monitoring Application for Android

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Abstract

Real time metering of energy usage sustains energy efficacy, improved energy saving, reduced tariff. In recent times, implications. This paper explains the Internet of things (IOT) based energy monitoring of electric energy with real time examples. The proposed system extracts energy consumption data from the energy meter, transmitted wirelessly to a cloud platform. The android application, interprets the data retrieved from the cloud. This work provides the user with data like Units consumption, Floating electricity bill, Daily limit setting and also overload alert on an easily readable Android application and also alert the consumer through GSM. The proposed work will also help the service provider to directly access to the energy data and generate the bill automatically at the end of month.

Index Terms; *Android application, Energy meter, Global system for Mobile (GSM), IOT, Arduino mega Thingspeak(Cloud platform).*

I. INTRODUCTION

Now a days, the use electrical utilizations are increased all over the world. Few of the basic essential Electric Appliances for living such as computer, ventilator, washing machine, refrigerator or Mixer grinder, etc. Due to the increased energy demand, the cost of electricity has been increased. Hence, it is necessary to find feasible alternate to save energy. Moreover, most people are not aware of the energy consumed by each electric appliances at different times of the day.

On account of these reasons, our project intended to develop an application to monitor the energy consumption of each appliance. This EMA helps the user to monitor the energy consumed by each appliance through a smart phone to enhance the energy saving thereby reduction in electricity bill. The energy consumption can be observed as a graph in real-time and overloading alert, electricity bill can be viewed through an Android mobile. The Existing system consists of the energy meter installed at the metering terminal. The units consumed are displayed on the pinion gear wheel inside the energy meter in numerical format. Since the TNEB tariff is not a one point tariff, it becomes tedious for the consumer to calculate the consumption cost from the units consumed. Moreover it requires a TNEB person to come and note the units consumed during the end of the month.

A number of methods are proposed for energy monitoring using android application. Few are as follows: This paper is an addition of work formerly presented in the International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE2017). The concept of electronic meter with a digital display, microcontrollers is described in [1, 6]. The system safeguards precise energy measurement in the event of an electrical outage. If the supply is restored immediately, the meter revives with the new stored value. A smart metering system with GSM technology is implemented in [2-5] which resulted in indicating the over usage of power, better energy supervision, energy conservation and reduced electricity billing. [7] explained the increase in

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revenue for the utility via online energy monitoring which eliminates the problems of unsettled bills and human error during measurement.

II. PROPOSED SYSTEM

The proposed system records the energy consumption by home appliances and are processed by ARDUINO and the control signals are sent through GSM and Wi-Fi module. The cloud stores the data and the energy consumption is saved in the android application. The block diagram of EMA is shown in Fig.1.

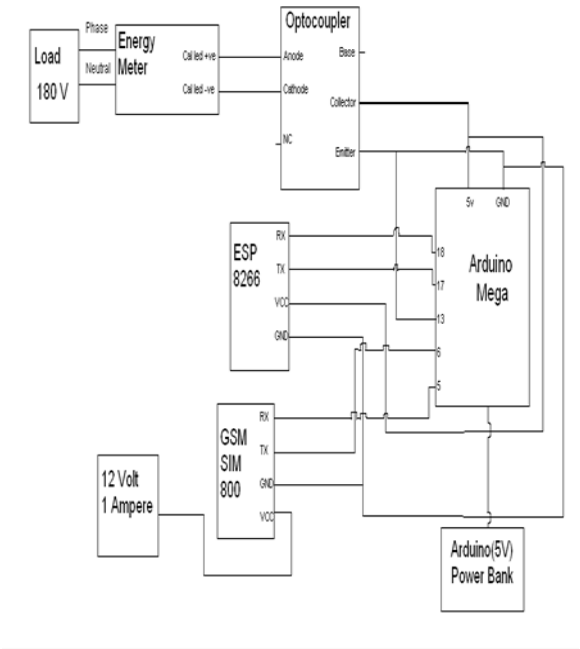

Fig 1. Functional diagram

The functional diagram employs components such as energy meter, opto-coupler, Arduino mega, GSM, ESP8266 and the associated components as shown in the Fig.1.

The components are integrated with the controller ATMEGA 2560, from where all the commands and actuations are performed.

The optocoupler helps avoiding the floating values that appear over the Arduino input pins dire to electromagnetic noise and also facilitates the isolation between impulse signals and Arduinosignals.

The GSM and ESP8266 communicate with the Arduino via serial communication to receive the processing data and perform their respective tasks as specified by the controller.

III. METHODOLOGY

energy consumption details are read from the existing energy meter at our home and transmitted wirelessly to a cloud platform. The data could be analysed in a graphical or chart format in the cloud platform. The data from the cloud could be retrieved back into the Android application, which is highly readable allowing any person irrespective of knowledge to know the consumption details. This system has the TNEB electricity tariff programmed inside, so it eliminates the strain taken to calculate the consumption cost from the units consumed data. Since, the data is on cloud. The Service provider could have direct access to our energy data and generate the bill automatically at the end of month. The algorithm is shown in Fig. 3.2 which list the step by step process to be followed.

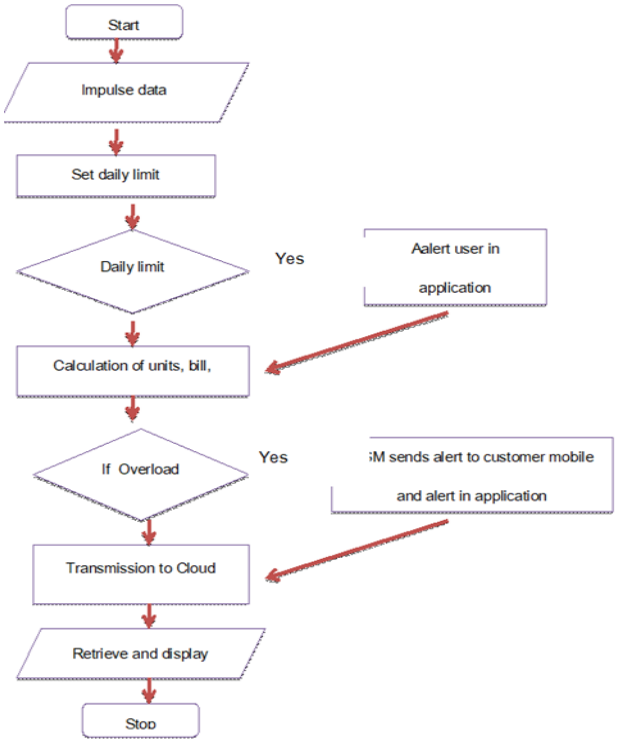

Fig 2. Algorithm

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- The computed data is sent from the controller to Wi-Fi module (ESP8266) by means of serial communication.
- ESP8266 is connected to the house Wi-Fi network through a modem or hotspot.
- ESP8266 sends the computed data as packets to the internet cloud platform (Thingspeak)
- Thingspeak stores the data in cloud and displays the data in graphical or chart formats and also allows us to establish control over it in MATLAB.
- The daily limit setting is programmed in MATLAB and the units consumed are constantly monitored to check if there is a breach of limit set.
- Android application developed from MIT app inventor, allows us to retrieve data from cloud and displays it in two modes:
- Compact
- Analytical
- The Compact view displays numerical data of units consumed, floating electricity bill, units remaining and overload indication.
- There is also a provision in Compact view to set the daily limit and analyze it as the day proceeds.
- The Analytical view displays the data dynamically over time and helps the user to analyze it.
- When an overloading occurs, an SMS is sent to the consumer mobile number to alert him through a GSM module.

IV. MATLAB ANALYSIS

Thingspeak also provides an option to analyse the field data and perform computations in it using MATLAB, which could then be displayed onto another thingspeak data field.

Here, MATLAB is used for analysing the daily limit setting.

In the application window, there are three fields in channel 1 and one field in channel 2. They are:

1. Field 1: Units consumed
2. Field 2: Floating electricity bill
3. Field 3: Setting daily limit
4. Field 4: Units remaining for the day

The EMA helps the customer to monitor the energy consumed by the electric appliance via android application. The method of estimation of tariff is simple and firm. It displays the daily limit and monthly limits on usage beyond the limit setting. The utility persons can access the energy consumed by a service main using this EMA by sitting at his place rather than measuring at customer premises.

V. IMPLEMENTATION

The hardware model of the proposed system shown in Fig. 3. The following sequence of events are executed in the model:

- The Arduino receives the impulse data from the domestic energy meter via opto-coupler.
- Impulse data is analyzed, and various functionalities like units consumed, floating electricity bill are calculated in the Arduino IDE(Integrated Development Environment)
- The computed data is sent from the controller to ESP8266 Wi-Fi module (ESP8266) by means of serial communication.
- ESP8266 is connected to the house Wi-Fi network through a modem or hotspot.
- ESP8266 sends the computed data as packets to the internet cloud platform (Thingspeak)
- Android application developed from MIT app inventor, allows us to retrieves data from cloud and displays it in two different modes.

When an overloading occurs, Arduino sends signals to GSM and an SMS is sent to the consumer mobile number.

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Fig 3.Hardware setup.

VI. RESULTS AND DISCUSSIONS

The proposed system was run successfully and the various results such as energy consumption data and graph, overload indication are displayed over a period of time in the MIT app.

Application window:

The results are viewable in two different formats

- Compact
- Analytical

Compact view displays tariff and units consumed. There is also a provision for setting the daily limit and a text box to overlook the units remaining. This is in an easily readable format

Analytical view displays the daily and monthly energy consumed over time as a graph for analysis purpose.

On the application window, the following information is displayed

- Units consumed.
- Floating bill calculation.
- Analysis of energy consumption.
- Heavy load denotation.
- Limit notifier.
- Variable daily limit setting.

During normal load:

Under normal conditions i.e when the predefined overload limit is not exceeded, loading column is displayed with a greenish Normal text indicating that appliances are running safe as shown in the Fig. 4.1.

During over load:

When the predefined overload limit set in the program is exceeded, user receives an alert in the customers mobile as shown in the Fig. 4.2 in addition to the red coloured overload text displayed in the application window in Fig. 4.3.

Analytical sections:

In order to prove the feasibility and endurance of the system, it is run for over a day and the units consumed are displayed over time. In the app, it is possible to view the units consumed for the previous day and compare it with the current one. Fig. 4.4 shows the plot of unit consumption. Fig 4.5 displays the bill over time scale.

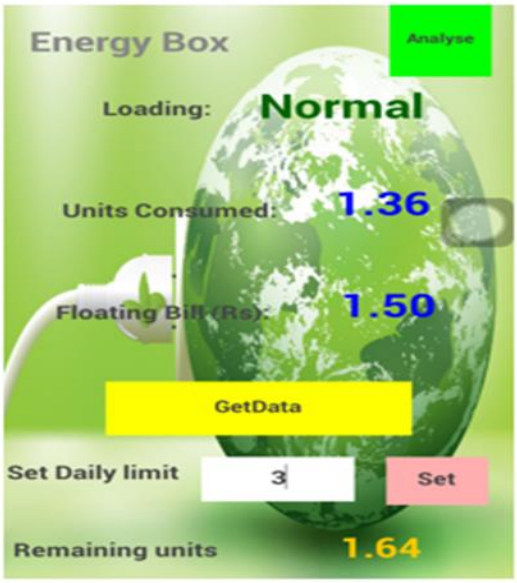

Fig. 4.1. Normal loading view

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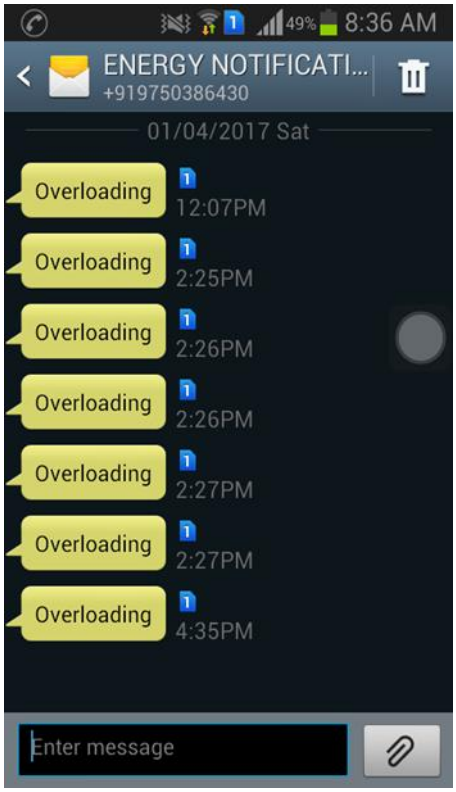

Fig 4.2 Mobile SMS

Fig. 4.3. Over loading view

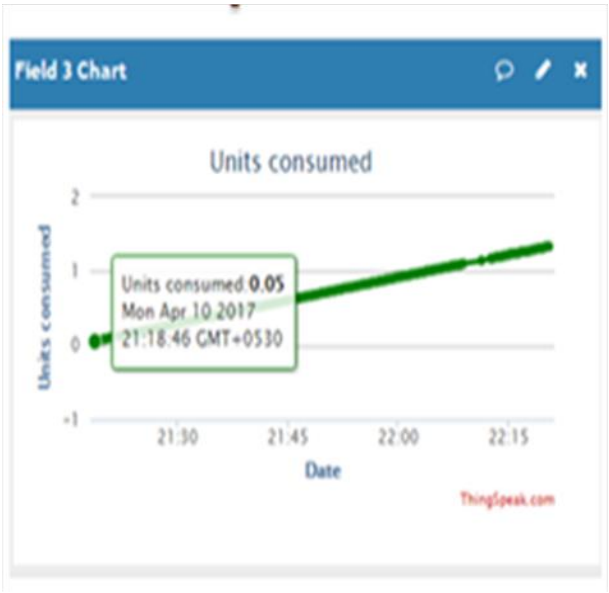

Fig. 4.4. Units Consumption

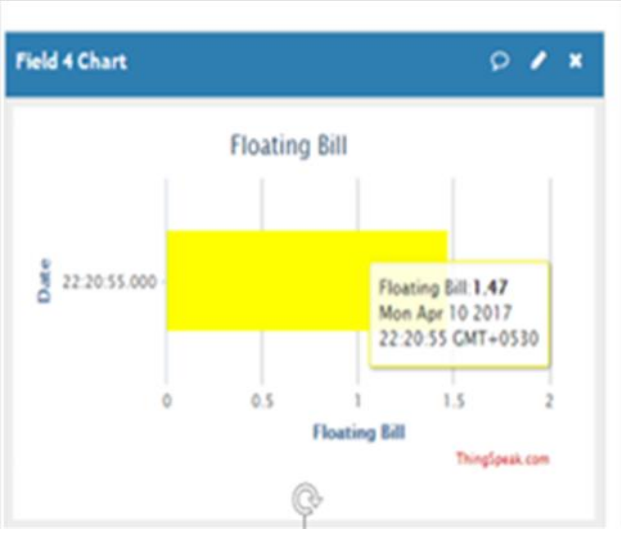

Fig. 4.5. Bill

Fig. 4.6. Daily limit

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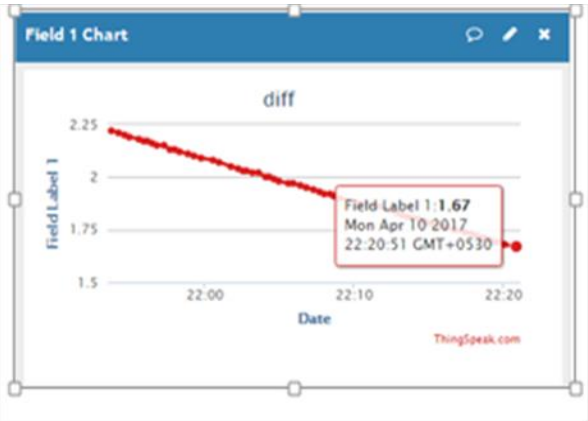

Fig. 4.6.Units remaining for use.

The set limit is compared and subtracted from the units data and the decreasing trend or the units remaining is displayed as shown in fig 5.5.

VII. CONCLUSION

The proposed system is implemented and tested with the Android application and the following results are proven.

- The units consumed and floating power bill are displayed.
- The daily limit is set and analyzed if that limit has reached.
- The energy values are plotted against time and the datas during any part of the day can be viewed and analyzed.
- SMS is received over the customer's mobile number if overloading occurs.

VIII. FUTURE SCOPE

The proposed system can be extended by adding additional features as follows:

- Each purchaser would be given an unique ID (channel ID) so that the Energy provider can generate the monthly bill from the data's available on each consumer channel.
- Monitoring of individual appliances and evading their operation during peak load times.
- Automatic turn-off of prioritized heavy load appliances during overloads.
- Embedding the bill payment platform in this Android application.
- Universal Android application to suit any sorts of consumers (industrial, household, etc).

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