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Costing and Estimation of Energy Using Raspberry pi

Sowmya G K[1], Murugesh Kolhar[2], Parvati Kasaval[3], Syed Faisal Pasha[4], Shanthveeresh N S[5]

[1],[2],[3],[4]Students, Department of Electrical and Electronics Engineering, PES Institute of Technology and Management, Shimoga, Karnataka, India
[5]Assistant Professor, Department of Electrical and Electronics Engineering, PES Institute of Technology and Management, Shimoga, Karnataka, India

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Abstract - *Since the population is growing exponentially, the living standard of human beings is also increasing. That indeed leads to a power crisis. In order to avoid that, saving energy at the consumer end is eminent. The proposed work helps consumers to monitor energy consumption and allows them to adjust the load according to the needs. This project is configured using Raspberry pi 3 and Wi-Fi modules. The instantaneous consumption data obtained by the microprocessor is sent to consumers via the IoT platform. The real time energy consumption details help consumers to control the monthly expenditure on electricity bills and as the two way communication enables the controlling of load in an effective manner that leads to responsible consumption and production.*

Key Words: **Power crisis, Raspberry pi 3, Wi-Fi (Wireless-Fidelity), IoT (Internet of Things), Two Way communication**

1. INTRODUCTION

Energy meter refers to a device which measures the energy consumption of the device powered by electricity. Normally electricity consumption is measured in terms of kilowatt hour (kWh). One kilowatt hour equals one unit.

In existing meters consumers do not have any idea about the electricity consumption until their monthly bill is made available. Moreover, the monthly bill does not clearly state the amount of energy consumed by each of the common household appliances. If consumers could know or have a rough idea which appliance is consuming how much electricity then they can plan better power management [1]. This Raspberry pi 3 based system measures the rms voltage, current and calculates the power factor based on phase difference and also provides the estimated energy consumption and pricing details for future periods.

Some other researchers are also using light sensing methods for taking data from traditionally LED blinking meters. Though getting a signal from the LED blinking by using a light sensor is not a dependable method. The lightning condition of every place is not equal and the threshold value will vary for different situations and mounting light sensors properly on an energy meter is a very crucial task [2].

1.1 Traditional System

Static energy meter is installed at the consumer end which will record the amount of power consumed by the consumer. During the month end, the reader from the electricity board has to visit every consumer and issue the bill. This traditional meter reading by human operators is inefficient to meet the future residential development needs. So, there is increased demand for Automatic Meter Reading (AMR) systems which collect meter readings electronically and its application is expanding over industrial, Commercial and utility environments [3]. The major disadvantage of the traditional system is that there is no control of usage from the consumer's side. There is a lot of wastage of power. Since the supply of power is limited, as a responsible citizen, there is a need to use electricity in an improved and efficient way [4].

2. PROPOSED SYSTEM

The proposed system involves the measurement of rms voltage, current and calculates the power factor based on phase difference between the voltage and current. The obtained real time data is sent to the consumer through IoT (mobile application) along with the estimated data for future periods such as daily and weekly basis by mentioning the price details for consumption. From the instantaneous data, the consumer can get a better idea about his electricity usage pattern so he can control the electricity usage as per his electrical and financial needs. Thus, we can avoid the energy wastage and we can resolve the complaints and confusion from consumers about their energy usage.

2.1 Basic Blocks

A. Current sensor

Fig. 1 shows the ACS712 current sensor which is used for the measurement of the current without any contact based on the Hall effect where a magnetic field will be generated around a current carrying conductor.

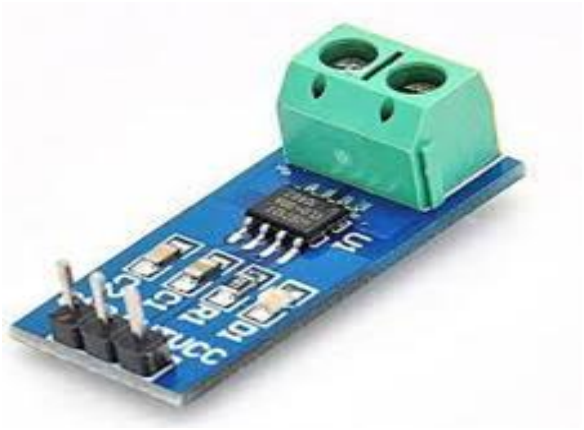

Fig. 1-ACS712, 20A current sensor module

B. Voltage divider circuit

Every electrical or electronic device will require a power supply and that has to be converted into required values. Similarly, Raspberry pi reads the voltage ranges from 0-5 volts. So, there is a necessity of a voltage divider circuit in order to step down the service line voltage.

C. Raspberry pi 3

Fig. 2 shows the Raspberry pi 3 module which serves as a controller circuit in the proposed work. It receives the signal from the current sensor, voltage divider circuit and transfers the estimated data to cloud storage using the wi-fi module.

Fig.2-Raspberry pi 3 module

D. Relay unit

Relay circuit plays an important role in power circuit as it is used to reconfigure the load based on consumer needs. Fig. 3 shows the four-channel unit used in the proposed system.

Fig. 3- Four channel relay unit

E. Wi-Fi module

Calculated and Estimated energy consumption data from the microprocessor is updated to the consumer via ESP 8266 Wi-Fi module which is shown in Fig. 4.

Fig. 4- ESP 8266 Wi-Fi module

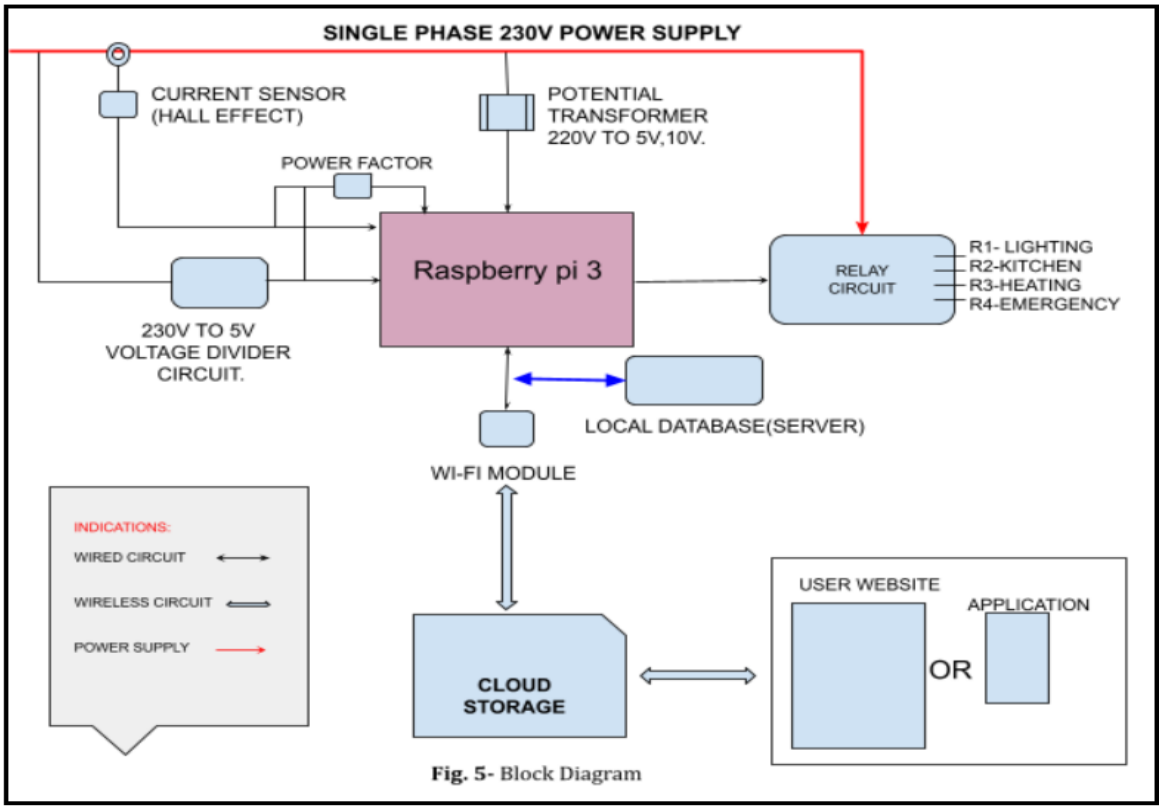

Fig. 5- Block Diagram

3. IMPLEMENTATION

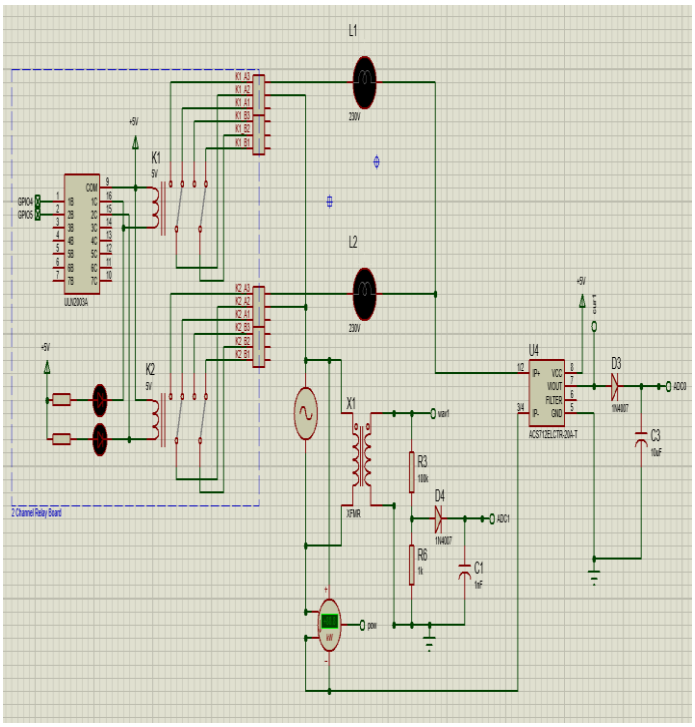

Fig. 6- Circuit implementation on Proteus 8.11

Implementation of proposed work (according to Fig. 5) is carried out on Proteus 8.11 platform where input from current sensor and voltage sensor are fed to Raspberry pi as inputs. From those inputs' calculation of present energy consumption and future energy consumption can be estimated. Obtained data will be considered as output and that will be shared with consumers through digital mode. Fig. 6. shows the detailed circuit implementation on Proteus 8.11 platform.

4. RESULTS AND DISCUSSIONS

Results for the implemented circuit are shown in Fig. 7 and Fig. 8. Fig. 7 is the graphical representation of voltage and current for the corresponding load and Fig. 8 represents the values of voltage, current and power along with power consumption and price estimation on a daily and weekly basis. By getting this information consumers can go with better power management.

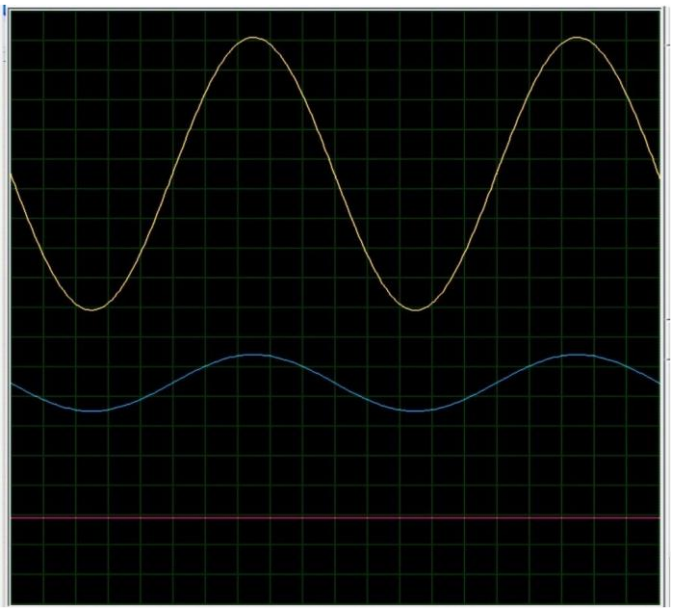

Fig. 7- Simulated Result (1)

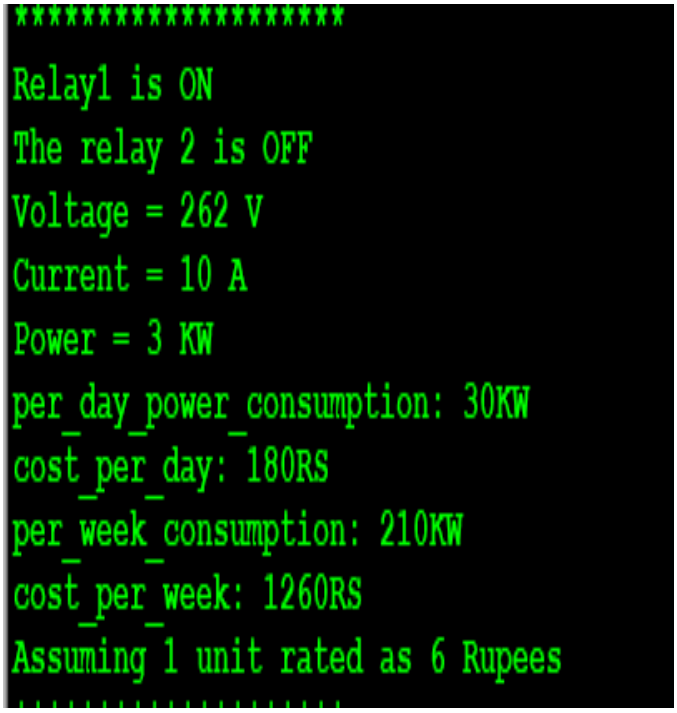

Fig. 8- Simulated Result (2)

Note: For per day power consumption, the number of hours is taken as 10 and during cost calculation for one unit, Rs. 6 has been considered.

5. CONCLUSION

This project enables Bilateral communication between the consumer and the appliances using Raspberry pi 3 and Wi-Fi module as a controlling and transferring unit respectively. As the proposed system involves the IoT platform, energy consumption data can be received by the consumer at greater speed. Moreover, the consumer will have the choice to opt for reconfiguration of loads based on his priority and the consumer also gets proper control over their monthly expenditure on electricity bills. That resolves the major complaints by consumers regarding their monthly electricity invoice. Proposed work plays an important role in conservation of energy at the user end hence contributes to sustainable development.

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