Iot Based Energy Auditing in Girls Hostel

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Abstract: **The aim of this paper is to develop a power consumption monitor for domestic use. It uses an arduino, current sensor acs712 ,esp8266 and cloud platform as a service to store and analyze data. Our solution aims at saving power by constantly notifying the power consumed by the appliances & providing better insights to user and will help the user to cut down unmerited power and thus save a lot of resources and money.**

Keywords: Arduino uno, Energy audit , IOT, Power monitoring.

I.INTRODUCTION:

An energy audit is an inspection, survey and analysis of energy flows, for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s). In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprints.When the object of study is an occupied building then reducing energy consumption while maintaining or improving human comfort, health and safety are of primary concern. Beyond simply identifying the sources of energy use, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings.This paper focuses on developing a monitoring system using the concept of Internet of Things.IoT (Internet of Things) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system. IoT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations, and much more through smart devices and powerful enabling technology.

2. OBJECTIVE:

The objective of this solution is to provide the vital information base for overall energy conservation programme covering essentially energy utilization analysis and evaluation of energy conservation measures.

3. PROJECT DESCRIPTION :

The following are the components used in this solution.
Arduino Uno

Fig.1.Arduino Uno

The Arduino UNO is a widely used open- source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE(Integrated Development Environment) via a type B USB cable.It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows to upload new code to it without the use of an external hardware programmer.

SCT-013-000(CT):

Fig.2.SCT-013-000(CT)

Non-invasive current transformer, use this sensor clip to build your own Personal Energy Monitor. Suitable for current measuring, monitoring and protection of AC motors,lighting equipment, air compressor etc. Current transformers (CTs) are sensors that are used for measuring alternating current. They are particularly useful for measuring whole building electricity consumption.

HI-LINK:

Fig.3.Hi-Link(power supply module) 12V / 3W

SMPS Module from Hi-Link is a PCB mounted plastic enclosed isolated switching step down power supply module. It can supply 12V DC from 120V AC- 230V AC and has a power rating of 3 watt. Its ultra compact size makes it perfect to use in places where size isaconstraint. Thismodule replaces lots of parts from the traditional power supply like diodes, voltage regulator, transformer. There are many advantages for this module, such as low temperature rise, low power, high efficiency, high reliability, high security isolation etc. It is widely used in smart home, automation and control, communication equipment, instrumentation and other industries.

ESP-8266(Wi-Fi Module):

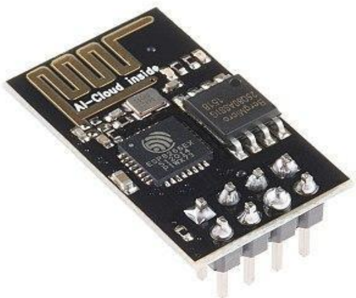


Fig.4.ESP-8266(Wi-fi module)

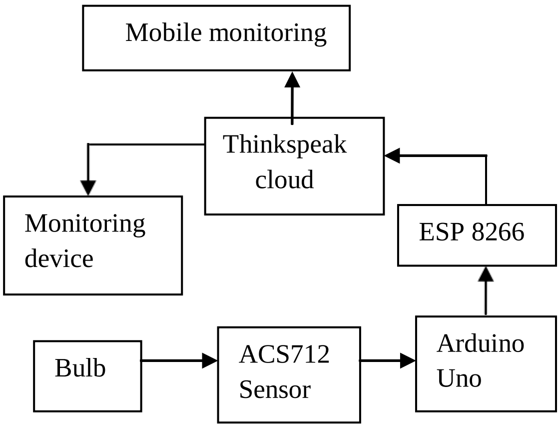
The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi- Fi networking functions from another application processor. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.
Its high degree of on-chip integration allows for minimal external circuitry, including the0front-end module, is designed to occupy minimal PCB area. The applications of ESP8266 are Smart power plugs,Home automation ,Wi-Fi location-aware devices,Industrial wireless control,Security ID tags.

DS-3231 RTC:

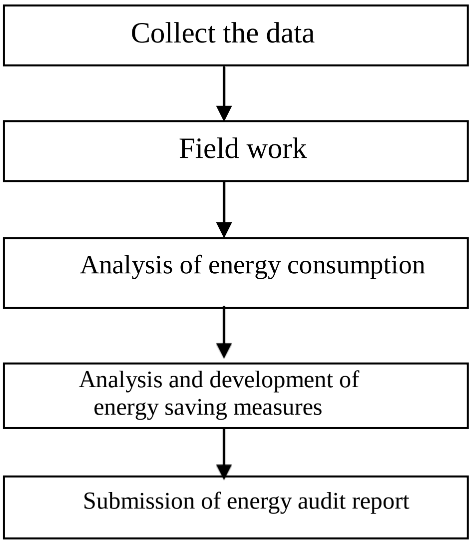
Fig.5.DS-3231 RTC

The DS3231 is a low-cost, extremely accurate I2C real time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted. The DS3231 is available in commercial and industrial temperature ranges, and is offered in a 16- pin, 300-mil SO package. The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of day alarms and a programmable square-wave output are provided. Address and data are transferred serially through an I2C bidirectional bus.

4. BLOCK DIAGRAM:



PROCEDUREOFTHEPROJECT WORK:



- Data collection: the auditor starts collecting some preliminary information on the energy consumption of the facilities and some technical details such as process diagrams, drawings and equipment inventory - usually provided by the organization.
- Field work: atleast one on-site visit is required, with the aim of gathering all the information needed for the study depending on the defined scope. This information includes collecting details of the energy consuming equipment such as brand, model, power and hours of operation. Some interviews with staff will also be required. Depending on the type of energy audit, some metering devices will be used.

- Analysis of energy consumption and performance of energy accounting: all the operations of the organization must be analyzed, as well as the equipment consuming higher energy. The processes which have higher energy consumption must be identified in order to determine the potential for reducing it and to define the energy saving measures to improve global energy performance. All information collected is used to evaluate the different uses of energy within the process and to establish a breakdown of the energy consumed. This energy accounting is also called Energy Balance.

- Analysis and development of energy saving measures: once all the data collected has been analyzed, energy saving measures can be identified. The information collected and analyzed enables the auditor to detect energy saving measures to reduce energy consumption. Energy and cost savings of these measures will be assessed, together with investment needed and payback.

- Energy audit report: following the energy audit, an energy audit report must be issued, which should include at least the following information:
  - Technical scope: this point includes facilities, services and included areas and level of depth in the analysis and detail required.
  - Methodology: this point includes the analysis of the state of art of the facilities (energy inputs, technologies and services), measurement results and energy balance.
  - Suggested energy saving measures: this point includes a description of each energy saving measure, including potential energy savings, economic savings, investment needed and payback.
  - Conclusions: this point includes the recommended measures, total energy savings, total economic savings, total investment and payback.

5. CASE STUDY:

The energy audit survey of each and every floor should be done to reduce the energy consumption and electricity bills. The audit can be done by monitoring the energy consumption of each and every equipment with the help of power monitoring device as shown in fig.6. For a sample, the energy audit survey of various floors is showed below for a particular building of a college.

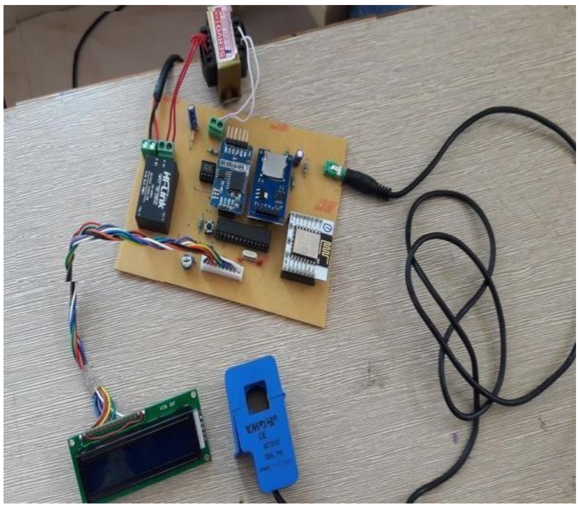


Fig.6.Power monitoring device

Energy audit survey of ground floor:

Table 1.Energy consumed by the equipments in ground floor for one day Total number of rooms-23

Equipments	Power(in Watts)	Time(in hours)	Total Whr
Fan-23	70W	15	24150
CFL-23	11W	4	1012
Laptops-6	60W	2	720
Camera-1	7W	24	168
Mobile charges-90	20W	2	3600
FL-46	40W	8	14720
Speaker-1	100W	2	200
Modem-2	16W	24	768
System-1	60W	8	480
Fingerprint box-5	15W	24	1800
AC-1	1480W	6	8800

Energy audit survey of first floor:

Table.2.Energy consumed by the equipments in first floor for one day

Total number of rooms-29

Equipments	Power(in Watts)	Time (in hours)	Total Whr
Fan-29	70W	15	30450
FL-58	40W	8	18560
CFL-29	11W	4	1276
Laptops-7	60W	2	840
Mobile phones-115	20W	2	4600
Iron box-2	750W	1	1500
Modem-2	16W	24	768

Energy audit survey of second floor:

Table.3.Energy consumed by the equipments in second floor for one day

Total number of rooms-30

Equipments	Power(in Watts)	Time(in hrs)	Total Whr
Fan-30	70W	15	31500
FL-60	40W	8	19200
CFL-30	11W	4	1320
Laptops-13	60W	2	1560
Mobile phones-120	20W	2	4800
Heater-4	1000W	1	4000
Iron box-3	750W	1	2250
Modem-2	16W	24	768

Energy audit survey of third floor:

Table.4.Energy consumed by the equipments in third floor for one day

Total number of rooms-23

Equipments	Power(in Watts)	Time(in hrs)	Total Whr
Fan-23	70W	15	24150
FL-46	40W	8	14720
CFL-23	11W	4	1012
Laptops-11	60W	2	1320
Mobile phones-88	20W	2	3520
Heater-1	1000W	1	1000
Iron box-2	750W	1	1500
Modem-2	16W	24	768

Energy audit survey of fourth floor:

Table.5.Energy consumed by the equipments in fourth floor for one day

Total number of rooms-26

Equipments	Power(in Watts)	Time(in hrs)	Total Whr
Fan-26	70W	15	27300
FL-52	40W	8	16640
CFL-26	11W	4	1144
Laptops-24	60W	2	2880
Mobile phones-86	20W	2	3440
Heater-2	1000W	1	2000
Iron box-2	750W	1	1500
Modem-2	16W	24	768

Energy audit survey of fifth floor:

Table.6.Energy consumed by the equipments in fifth floor for one day

Total number of rooms-11

Equipments	Power(in Watts)	Time(in hrs)	Total Whr
Fan-11	70W	15	11550
FL-22	40W	8	7040
CFL-11	15W	4	660
Laptops-12	60W	2	1440
Mobile phones-44	20W	2	1760
Heater-4	1000W	1	4000
Iron box-2	750W	1	750
Modem-2	16W	24	768

Energy audit survey of sixth floor:

Table.7.Energy consumed by the equipments in sixth floor for one day

Total number of rooms-9

Equipments	Power(in Watts)	Time(in hrs)	Total Whr
Fan-9	70W	15	9450
FL-18	40W	8	5760
CFL-9	15W	4	540
Laptops-16	60W	2	1920
Mobile phones-35	20W	2	1400
Heater-4	1000W	1	4000
Iron box-3	750W	1	2250
Modem-2	16W	24	384

Energy audit survey of the fluorescent lights in the floors:

Table.8.Energy consumed by the fluorescent lights in the floors for one day
Total number of floors-7

Equipment	Power(in Watts)	Time(in hrs)	Total Whr
Fluorescent lights-70	36W	8	20160

Energy audit survey of the elevator in the hostel:

Table.9.Energy consumed by the elevator for one day
Total number of elevator-1

Equipment	Power(in watts)	Time(in hrs)	Total Whr
Elevator-1	5500W	8	44000

SAMPLE CALCULATIONS:
Let we take the fans in the ground floor for sample calculation

Number of fans in ground floor =23
Power consumed per fan in Watts =70W
Working time of a fan in a day =15hrs
Total Watt-hour =70*23*15
=24150Whr
Cost of one unit =Rs.6.35
Total units =24150/1000
=24.15units
Cost of 24.15 units for 1 day =24.15*6.35
=Rs.153.3525

Similarly, for all the equipments in the hostel can be calculated.
Finally, the total Watthour, total units and total cost can be calculated for 1 month

Total Watt-Hour of the girls hostel=401384Whr Units per day for girls hostel =401.384 Units
per month for girls hostel =401.384*30
=12041.52
Cost of 12041.52 units =Rs.76463.652

6. ELECTRICITY BILL DATA COLLECTIONS:

For energy auditing of college, it is necessary to analysis of consumption of electrical energy of previous month. The electricity bill data of college is collected for the month of february 2018.The collected data is visualized through graph then only wastage of energy consumption can be easily identify for making recommendation to high authority. The collected bill data of college is taken from record of department.

7. RECOMMONDATIONS:

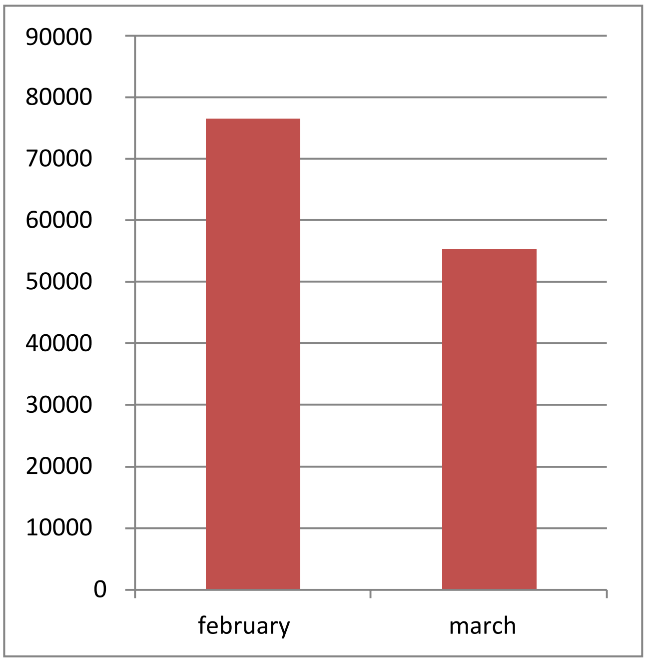
1) Energy saving can be done by replacing 40Watts fan instead of using 70Watts fan.Cost of 40Watts fan must be less compared to the 70Watts fan.40Watts fan is higher in efficiency and warranty of years will be better than 70Watts fan.

2) LED Bulbs are small, very efficient solid Bulbs LED technology is advancing rapidly, with many new bulb style.LED bulbs up to 10 times as long as CFL .LED bulbs use only 2-17 watts of electricity (1/3 to 1/30th of CFL). Although LED are initially expensive ,the cost is recouped over time.

3) LCD monitors typically require about 30% of the power required for a CRT monitor with the same screen area. In addition, the amount of heat generated by an LCD monitor is considerably less than a CRT monitor, resulting in a lower load on air-conditioning. Building cooling needs may be decreased by up to 20%.

8. RESULT OUTCOME:

This system helps to monitor power the power consumed by device at regular intervals. The graph plotted is against electricity bill(Y-axis) Vs month(X-axis). These results indicate the accomplishment of optimization in saving power. Some major facilities is concerned here, the details of savings after implemented the recommondations (follow-up) are the Tube light 30%, Air conditioning system 25%,Computer28%,fan14%,CFL 62%.There fore the 25 % of overall energy would be saved in the entire college campus.



Graph.1.electricity bill(Y-axis) Vs Month(X- axis)

9. CONCLUSION:

The aim of this paper has been to create and implement a simple system in which we can remotely monitor the power consumption of appliances on daily basis. This will help in using power more efficiently and thus saving electricity.

This paper focuses on using wireless technology along with fundamentals of Internet of things to build a system which will analyze daily power consumption for commercial and domestic use.

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