IoT based Energy Monitoring System for Industrial Applications

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Abstract: In all industries there are three focusing points, which is left behind. There are consumption of power, calculation of production and pollution monitoring. The power consumption & cost, production and pollution are not monitored and compared in a daily basis. For the betterment of industries we have planned to make application which gives all the details about consumption of power and cost per day will be shown. Daily and monthly graph shows the consumption of power through current sensor and production. For production we use infrared sensor to monitor every second. For pollution we use pollution sensor to monitor every second, if the pollution will exceed the fixed value, the pollution status bar will change the colour from green to red. The output of current sensor, pollution sensor, and infrared sensor will be sent to raspberry pi microcontroller, through this microcontroller the output will be displayed in the IOT application. So the purpose of the project is to help for most of industries to increase the level of production and decrease the cost and consumption of power. This project focuses of the monitoring the production process and abstraction of calibration data from output chart.

Keywords: Component, formatting, style, styling, insert

I. INTRODUCTION

Nowadays Industries in India are growing in a rapid way and foreign investment also a major cause for the rapid increase in industries. The major source of industries is a power source. All the equipment and the machinery are mainly based upon the power source. The industrial worker cannot calculate and compare the power consumption and production in manual, because which is more difficult. In industry the energy consumption and production has become a big subject for discussion, because of the huge difference in energy consumption and production. The all industries are run under the time basis, the number of the product should be manufactured in particular. In regard, industries are facing so many problems due to the frequent power failure, unstable load, leakage current and short circuit, etc.,

Another important reason for power cuts is due to the unlimited energy consumption by a short circuit and fault circuit. During over load condition the power factor rating become lag. Due to the power factor lagging, the electric bill amount is greater than the production cost. There are many factors are affecting production and these factors are cannot monitor manually. The role of the project is to calculate, calibrate, and compare the value of power consumption and production through the Internet of Thing.

In most of the industries there are three major problems they are facing day by day, first they doesn't know and calculate about the consumption of power and cost per day. The second one is most of the industries are not comparing and calibrating the daily production and consumption of power. Then the third one is most of the industries are not calculate the air pollution ratings, which cause harmful to nature and human. These problems can be rectified by the monitoring the power consumption and production data through the sensors. The raspberry pi microcontroller gets an input date through the sensor and sent the respected output data to online protocol. For the betterment of industries we have planned to make an application which gives all the details about consumption, current and cost per day will be shown and daily and monthly graph shows. If the pollution will exceed the fixed value, the pollution status bar on the online protocol will change the color from green to red. So this will be helpful for most industries to increase the level of production and decrease the cost and consumption of power.

When this paper would be established in industries, it has a major scope because in India is becoming a more popular in manufacturing industries. Foreign industries are focusing India as a major one. This project has a major scope in all types of industries. Generally, the monitoring cost of goods is high because there is a lack of power monitoring. This project will overcome the above problem and has a better scope in future for energy monitoring & management

II PROPOSED SYSTEM

A. Block diagram

The time elapse button is used indentify the accurate power consumption and production which are respected to the time (hours, day). In every click the appropriate value are monitor through the graph in IOT portal. The calculation of the power also easily identifies through the time elapsing button. The output of the IOT portal is showed by the dynamic graph

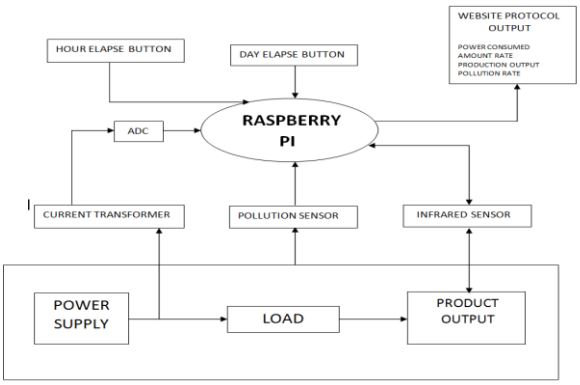


Fig 1.Block diagram of IOT based energy, production and pollution monitoring system

A power supply is an electronic device that supplies electric energy to an electrical load. A DC power supply is one that supplies a constant DC voltage to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains. Switched-mode power supplies are usually regulated, and to keep the output voltage constant, the power supply employs a feedback controller that monitors current drawn by the load. The switching duty cycle increases as power output requirements increase.

A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs. Also, a magnetic field is generated surrounding the current carrying conductor. Both of these phenomena are made use of in the design of current sensors. Thus, there are two types of current sensing: direct and indirect. Direct sensing is based on Ohm's law, while indirect sensing is based on Faraday's and Ampere's law. Current measurement is of vital importance in many power and instrumentation systems. Traditionally, current sensing was primarily for circuit protection and control. However, with the advancement in technology, current sensing has emerged as a method to monitor and enhance performance

Pollution sensor is used in automobile or Factory to warn of fatal carbon monoxide build-ups. The unit will work with a simple drive circuit and offers excellent stability with long life. The carbon monoxide is sensed by the CO sensor. The smoke sensor is the one type of transducer which produces the voltage signal depends on the carbon monoxide level. Then the voltage signal is given to inverting input terminal of the comparator. The comparator is constructed by the operational amplifier LM 741. The reference voltage is given to non inverting input terminal.

The infrared sensor is an electronic sensor that measure infrared light radiating from objects in its field of view. The infrared sensor is typically mounted on the printed circuit board containing the necessary electronics required to interpret the signals from the sensor itself. The complete assembly is usually contained within housing, mounted in a location where the sensor can cover area to be monitored. The sensor works entirely by detecting the energy off by other objects

The Raspberry Pi is a series of credit card–sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries. The original Raspberry Pi and Raspberry Pi 2 are manufactured in several board configurations through licensed manufacturing agreements with Newark element14 (Premier Farnell), RS Components and Ego man. The hardware is the same across all manufacturers.

The entire output of the project is mainly based on the Internet of things. The output is seen by the website portal. The output of the project consists of production according to the time, Power consumption according to the time, pollution rating , cost according to the respective units, number of product leave out. Through the website portal each and every presses can be easily monitored. Through the mobile network these presses can be monitored.

B.SOFTWARE MODULES

The paper consists of hardware such as software such as Mysql, HTML, Apache server, web server, python coding. Instead of implementing a single architecture, Apache provides a variety of Multiprocessing Modules (MPMs), which allow Apache to run in a process-based, hybrid (process and thread) or event-hybrid mode, to better match the demands of each particular infrastructure. This implies that the choice of correct MPM and the correct configuration is important. Where compromises in performance need to be made, the design of Apache is to reduce latency and increase through put, relative to simply handling more requests, thus ensuring consistent and reliable processing of requests within reasonable time-frames. The 2.2 series was considered significantly slower than nginx. To address this issue, the Apache version considered by the Apache Foundation as providing high-performance is the Event MPM, which mixes the use of several processes and several threads per process in an asynchronous event-based loop.

Web server respond to the client request in either of the following two ways:

- Sending the file to the client associated with the requested URL.
- Generating response by invoking a script and communicating with database

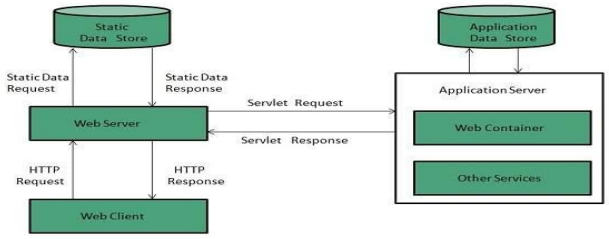


Fig2.Flowchart of HTT Pweb process

When client sends request for a web page, the web server search for the requested page if requested page is found then it will send it to client with an HTTP response.

If the requested web page is not found, web server will the send an HTTP response: Error 404 Not found.

If client has requested for some other resources then the web server will contact to the application server and data store to construct the HTTP response.

Web Server Architecture follows the following two approaches:

1. Concurrent Approach

2. Single-Process-Event-Driven Approach.

1) Concurrent Approach

Concurrent approach allows the web server to handle multiple client requests at the same time. It can be achieved by following methods:
Multi-process, Multi-threaded and Hybrid method.

a) Multi-processing

In this a single process (parent process) initiates several single-threaded child processes and distribute incoming requests to these child processes. Each of the child processes are responsible for handling single request. It is the responsibility of parent process to monitor the load and decide if processes should be killed or forked.

b) Multi-threaded

Unlike Multi-process, it creates multiple single-threaded processes.

c) Hybrid

It is combination of above two approaches. In this approach multiple process are created and each process initiates multiple threads. Each of the threads handles one connection. Using multiple threads in single process results in fewer loads on system resources.

III HARDWARE MODULES

The model consists of hardware such as keypad, IR sensor, pollution sensor, power supply, current sensor, conveyer

A CURRENT SENSOR

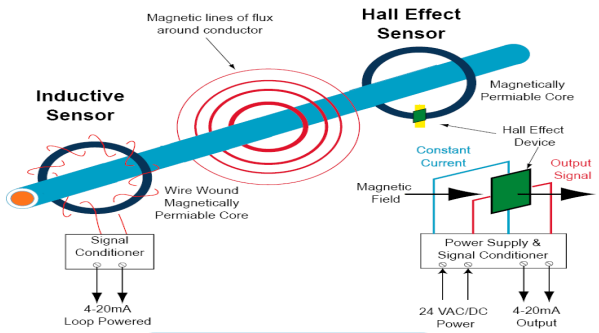


Fig 3. Schematic diagram of magnetic field with inductive sensor

Electric current sensing technologies. The technology used by the current sensor is important because different sensors can have different characteristics for a variety of applications. Most sensors work because a current-carrying wire produces a magnetic field. Current sensing resistors are used when current is directly measured in the circuit.

B. Hall Effect –

Hall Effect sensors consist of a core, Hall effect device and signal conditioning circuitry. The sensor works when the current conductor passes through a magnetically permeable core that concentrates the conductor's magnetic field. The Hall Effect device, which is mounted within the core, is at a right angle to the concentrated magnetic field and a constant current (in one plane) excites the Hall device. The energized Hall device is then exposed to a magnetic field from the core and it produces a potential difference that can be measured and amplified into process level signals such as 4-20mA or a contact closure.

C. Inductive-

Inductive sensors use a coil through which a current-carrying wire passes. This causes power to flow in the coil that is proportional to the current. This happens because of the magnetic field produced by flowing current. Inductive sensors are used for AC currents. The sensor has a wire-wound core and a signal conditioner. As the current conductor passes through the core, it becomes magnified by the conductor's magnetic field.

Since AC current is constantly changing potential from negative to positive (general rate of 50 to 60 Hz) and therefore creating an expanding and collapsing magnetic field, a current is induced in the windings. The secondary current is converted to a voltage and conditioned to output process; signals such as 4-20mA or contact closures.

D Magneto resistive-

The magneto resistive effect is the property of certain materials to change the value of its resistance as a function of a magnetic field applied to it. If magnetic flux is not applied, the current flows straight through the plate. If magnetic flux is applied, a Lorentz force proportional to the magnetic flux density will deflect the current path. As the current path is deflected, the current flows through the plate for a longer distance, causing the resistance to be increased.

Current Sensor Features

Isolated tip means that the active, measuring tip of the sensor is electrically isolated.

High voltage current sensors are designed for high voltage applications.

Intrinsically safe equipment is defined as "equipment and wiring which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration."

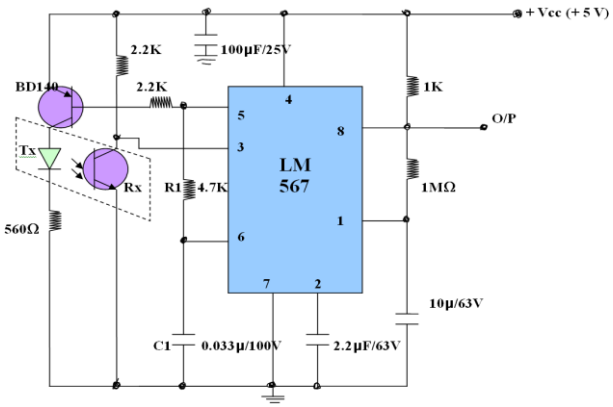


FIG NO.4 CIRCUIT DIAGRAM OF IR SENSOR

e.Hardware

The Raspberry Pi hardware has evolved through several versions that feature variations in memory capacity, and peripheral device support. This block diagram depicts models A, B, A+, and B+. Model A and A+ and Zero lack the Ethernet and USB hub components. The Ethernet adapter is connected to an additional USB port. In model A and A+ the USB port is connected directly to the SoC. On model B+ the chip contains a five-point USB hub, of which four ports are available, while model B only provides two. On the model Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

f.Processor

The SoC used in the first generation Raspberry Pi is some what equivalent to the chip used in older smart phones (such as iPhone / 3G / 3GS). The Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SoC), which includes an 700 MHz ARM1176JZF-S processor, Video Core IV GPU, and RAM. It has a Level 1 cache of 16 KB and a Level 2 cache of 128 KB. The Level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible.

IV.EXPERIMENTAL SETUP

The model consists of the 3 major power supplies, these supplies for raspberry pi, load and electronic component of the circuit. The every power source consists of different voltage and current rating. When the supply is given to the circuit, the raspberry pi will sent the message to the online protocol. The circuit consist of the current sensor, IR sensor is to identify the product output and pollution sensor is helps to identify the pollution rating. The time elapse button is used to identify the power consumption according to the day and month. According to a power, the output of the product can be easily identify. The complete operation of the project is energy management and monitoring by the internet of things.

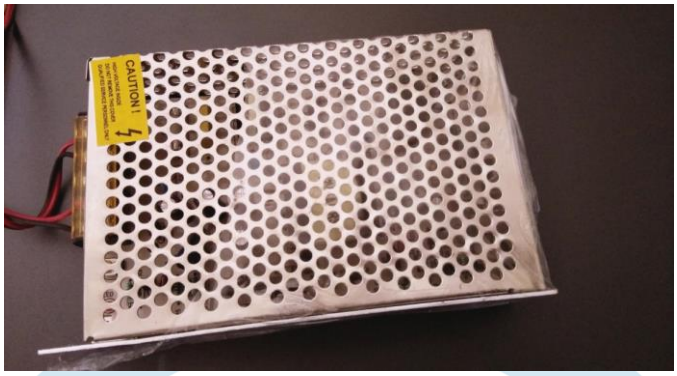
A,Raspberry Pi 3

The Raspberry Pi is a series of credit card–sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries. Raspberry pi gives the power sources to the current, Infrared and pollution sensors. And through raspberry pi wifi the output would be displayed through the computer. A Raspberry Pi Foundation sanctioned device, designed for educational purposes, that expands the Raspberry Pi's GPIO pins to allow interface with and control of LEDs, switches, analog signals, sensors and other devices. It also includes an optional Arduino compatible controller to interface with the Pi.

Fig No.5.Raspberry pi 3

B.SMPS Power supply

A power supply is an electronic device that supplies electric energy to an electrical load. A DC power supply is one that supplies a constant DC voltage to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains.



SWITCHED-MODE POWER SUPPLIES ARE USUALLY REGULATED, AND TO KEEP THE OUTPUT VOLTAGE CONSTANT, THE POWER SUPPLY EMPLOYS A FEEDBACK CONTROLLER THAT MONITORS CURRENT DRAWN BY THE LOAD

C.Time Elapse Button

The time elapse button is used indentify the accurate power consumption and production which are respected to the time (hours, day). In every click the appropriate value are monitor through the graph in IOT portal. The calculation of the power also easily identifies through the time elapsing button. The output of the IOT portal is showed by the dynamic graph

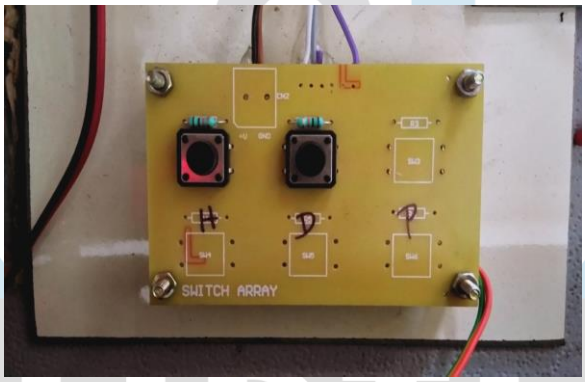


Fig No7 Time elapse button

D.Pollution sensor

Pollution sensor is used in automobile or Factory to warn of fatal carbon Monoxide build-ups. The unit will work with a simple drive circuit and offers excellent stability with long life. The carbon monoxide is sensed by the CO sensor. The smoke sensor is the one type of transducer which produces the voltage signal depends on the carbon monoxide level. Then the voltage signal is given to inverting input terminal of the comparator. The comparator is constructed by the operational amplifier LM 741. The reference voltage is given to non-inverting input terminal

Fig No.6 Pollution sensor MQ2

E.Infrared Sensor

The infrared sensor is an electronic sensor that measure infrared light radiating from objects in its field of view. The infrared sensor is typically mounted on the printed circuit board containing the necessary electronics is required to interpret the signals from the sensor itself The complete assembly is usually contained within housing, mounted in a location where the sensor can cover area to be monitored. The sensor works entirely by detecting the energy off by other objects.

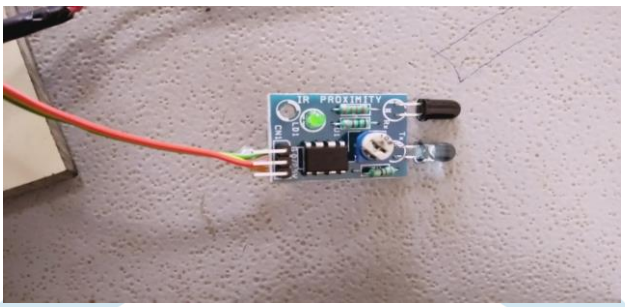


Fig.8 IR sensor

F.Load Setup

We use conveyor setup to show demo for our project, we use conveyor setup for production purpose and we had inserted the infrared sensor on the conveyor to detect the product which passes the conveyor.

Fig No.9 Load conveyer setup

G.Experimental setup for proposed system

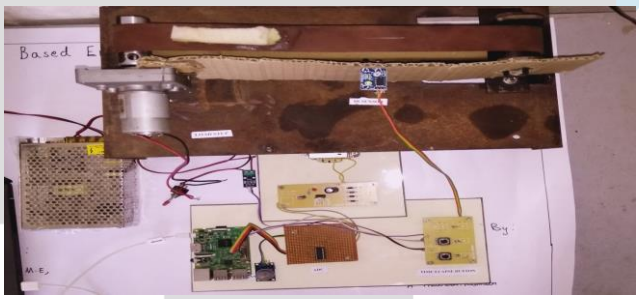


Fig No.10 Experimental setup

IV. RESULT MANIPULATION

The entire output of the paper is mainly based on the Internet of things. The output is seen by the website portal. The output of the project consists of production according to the time, Power consumption according to the time, pollution rating , cost according to the respective units, number of products manufactured. Through the web portal each and every process can be easily monitored.

Fig No.10.Output chart showing the power consumption, Production, cost & pollution

A.SCALEING FORMULA (REAL TIME CALCULATION)
Infrared sensor range 1 Product = 100 Product
Current sensor range
At, no load condition, power consumption is (0 to 8)
At, load condition, Power consumption is more than 50
Unit Power calculation
Graph output Unit value = x
Genuine Power consumption per hour y= x / (2* No of hours) watt hr
Genuine unit x = y/1000 (y/1000 = Real time value)

Cost calculation
X1=Less than 100 unit = x * 10
X2=Less than 200 unit = x * 20
X3=Greater than 200 unit = x * 30
Total value = X1+X2+X3
Pollution sensor range
Output reading (180 to 315) is low air pollution
Output reading (320 above) is high air pollution

V.CONCLUSION

This hardware setup for power consumption, production and pollution monitoring system was tested as a scaled down model. The raspberry pi microcontroller was used to manipulate the date which are obtained from IR sensor , air pollution sensor and current sensor for monitoring the production, pollution and power consumption respectively through the web browser using IOT. The Internet of thinks plays a major role in monitoring the day to day power consumption, production and pollution in industry.

VI FUTURE ENHANCEMENT

Only monitoring of power consumption, pollution and production is employed in this project. In future the Energy management, pollution control etc, can be included with the current work to make this system more efficient. The monitoring process is only gives a result and indication, but in future by use this monitoring process to control the error and fault through the automation and improve the lossless efficient production.

References

[1].L. J. Kozlowski and W. F. Kosonocky, "Infrared detector arrays," in Hand-Book of Optics, M. Bass, Ed., chapter 23, Williams,W. L.Wolfe, and McGraw-Hill, 1995.

[2].Rogalski, "IR detectors: the next millennium," in International Conference on Solid State Crystals 2000 Epilayers and Heterostructures in Optoelectronics and Semiconductor Technology, vol. 4413 of Proceedings of SPIE, pp. 307–322,October 2000.

[3.]"Experimenting at Home With Air Quality Monitors". The New York Times. April 15, 2015. Retrieved May 29, 2015. Macy's advertisement". New York Times. November 17, 1985. p. A29.

[4].Luo, Fang Lin; Ye, Hong (2004), Advanced DC/DC Converters, CRC Press, ISBN 0-8493-1956-0

[5].Luo, Fang Lin; Ye, Hong; Rashid, Muhammad H. (2005), Power Digital Power Electronics and Applications, Elsevier, ISBN 0-12-088757-6

[6].Maniktala, Sanjaya (2004), Switching Power Supply Design and Optimization, McGraw-Hill, ISBN 0-07-143483-6

[7] Communication and Information Office, "World energy outlook 2008," International Energy Agency, 2008.

[8] R. Targosz and D. Chapman, "Cost of poor power quality," Application Note, European Copper Institute, May 2012.

[9] J. L. Afonso, J. G. Pinto, and H. Gonçalves, "Active power conditioners to mitigate power quality problems in industrial facilities," in Power Quality Issues, Ahmed Zobaa, Ed., InTech, 2013, pp. 105-137.

[11] ADEME, "Energy efficiency trends and policies in the EU 27: results of the ODYSSEE-MURE project," ADEME Editions, 2009.

[12] R. Alves et al., "Electric power quality monitoring results in different facilities," IEEE IECON '09, pp.3666-3671, Nov. 2009.

[13] J. K. Pal and F. C. Huff, "Advantages of an electrical control and energy management system," ISA Transactions, vol. 39, no. 1, Feb. 2000, pp. 103-114.

[14] Y.-C. Jung, H.-S. Jung, and J.-U. Kim, "Implement of power line communication module for an electric power energy monitoring system," ICPE '07, pp.320-323, Oct. 2007.

[15] G. Zheng and Z. Zhang, "Intelligent wireless electric power management and control system based on ZigBee technology," TMEE 2011, pp.1120-1124, Dec. 2011.

[16] A. Rashdi et al., "Remote energy monitoring, profiling and control through GSM network," IIT 2012 - International Conference on Innovations in Information Technology, pp.184,188, Mar. 2012.

[17] M. Erol-Kantarci and H.T. Mouftah, "The impact of smart grid residential energy management schemes on the carbon footprint of the household electricity consumption," EPEC 2010 - IEEE Electric Power and Energy Conference, Aug. 2010.