REAL TIME ENERGY DATA ACQUISITION AND ALARMING SYSTEM FOR MONITORING POWER CONSUMPTION IN INDUSTRY

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Abstract

Manufacturing and the processes involved consume substantial amounts of energy. There can be requirement of energy management technique in the power tool manufacturing industry. The maintenance department in power tool manufacturing industry may have different load centers like machine shop, winding shop, utility and assembly shop etc. Readings on these meters are taken manually. This process is time consuming and has inefficient accuracy. So, there can be need of computerized energy data acquisition system. By providing an alarming system the energy losses will be monitored. Through this system design, there will be automatic elimination of man-made errors, reading energy consumption report through Microsoft excel as well as firing through email.

Keywords: Energy losses, Microcontroller, RS 232 and PC

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1. INTRODUCTION

Manufacturing and the processes involved consume substantial amounts of energy. Manufacturing is one of the most energy-intensive industrial activities. Because of the current global energy crisis, reducing energy consumption in manufacturing has become one of the top research priorities [2]. There can be requirement of energy management technique in the power tool manufacturing industry. The energy management technique will use energy information as a basis to eliminate waste, reduce and control current level of energy use and improve the existing operating procedures in the industry. The sample of energy meter in industry is shown in figure 1 below. Figure 2 shows panel of energy meters in the different load centers.

Fig -1: Energy Meter

Fig -2: Panel of Energy Meter

1.1 Need

The maintenance department in industry may have different load centers like machine shop, winding shop, utility and assembly shop etc. From main incomer meter, energy is distributed to different meters having feeders to different load centers. Readings on these meters are taken manually. So for that purpose separate man-power is required. And this process is time consuming and has inefficient accuracy. Also there is energy wastage by workers in tea break and lunch break. These energy losses need to be monitored.

2. LITERATURE REVIEW

R.Rajmohan, R.Ramesh Kumar and R.Bhuvaneswari presented the design of an automatic electricity meter reading based on ZigBee, which is used for data acquisition system in view of energy reading can be observed without visiting the customer's site in "Microcontroller based remote and intelligent Energy Meter Reading with cost as SMS alert" International Journal of Engineering Technology and Computer Applications, Apr 2012 [1].

In "Energy Saving and Monitoring Technologies in Manufacturing Systems with Industrial Case Studies" Cao Vinh Le and Chee Khiang Pang, Oon Peen Gan reviewed the existing technologies that directly improve the energy efficiency in manufacturing plant as well as identify future research opportunities. Two industrial energy monitoring case studies are presented where idle energy is observed to contribute up to 63% of the total energy consumption [2].

In "Design and Construction of a Computer Based Power Billing System" paper Abubakar Sadiq Mohammed described the design and construction of a personal computer (PC) based electronic billing system. It is made up of integrated circuits, active and passive hardware devices. And a Visual Basic software program used for programming the PC parallel port [3].

Frank J. Dorhofer and Warren M. Heffington discussed with the installation of the data acquisition system and subsequent analysis of 15-minute data in "Electrical energy monitoring in an industrial plant" National Industrial Energy Technology, April 13-14, 1994. The data acquisition system has been used to justify energy conservation retrofits, increase productivity, and monitor plant activities [4].

Y. Lan, X. Lin, M.F. Kocher, and W.C. Hoffmann developed a simple PC-based data acquisition and control system in "Development of a PC-based Data Acquisition and Control System". Agricultural Engineering International: the CIGR E-journal. Vol. IX. August, 2007. This paper discusses the system hardware, software, and applications [5].

O.Homa Kesav , B. Abdul Rahim presented a new methodology for avoiding the high construction and maintenance costs in the existing meter reading technology in "Automated Wireless Meter Reading System for Monitoring and Controlling Power Consumption" International Journal of Recent Technology and Engineering (IJRTE) June 2012. Apart the use of wireless meter reading with network technologies has become need of the day. The designed system avoids the human intervention in Power Management [6].

3. OVERVIEW

There will be display of consumed units in different load centers on the centralized PC, which will be placed in the cabin of maintenance manager. So accuracy in recording readings will be achieved. Also there will be saving in time. There is energy wastage by workers in tea break and lunch break. By providing an alarming system the energy losses will be monitored. There is need of reading energy consumption report through Microsoft excel as well as firing through email. That need will be also provided through the software.

4. SYSTEM ARCHITECTRE

4.1 Scope

The process of recording consumed units is manual. So there is possibility of man-made errors like decimal point error. Also this process is time consuming as there is number of different load centers. And accuracy will not be achieved. With the help of the system architecture mentioned here, accuracy in recording readings will be achieved. Due to automation there will be automatic elimination of man-made errors. Maintenance manager will be able to read energy consumption report through Microsoft excel. Also the report will be sent via email.

4.2 Methodology

There will be separate unit for each meter. That unit will act as slave unit. As there are number of meters, there will be number of slave units.
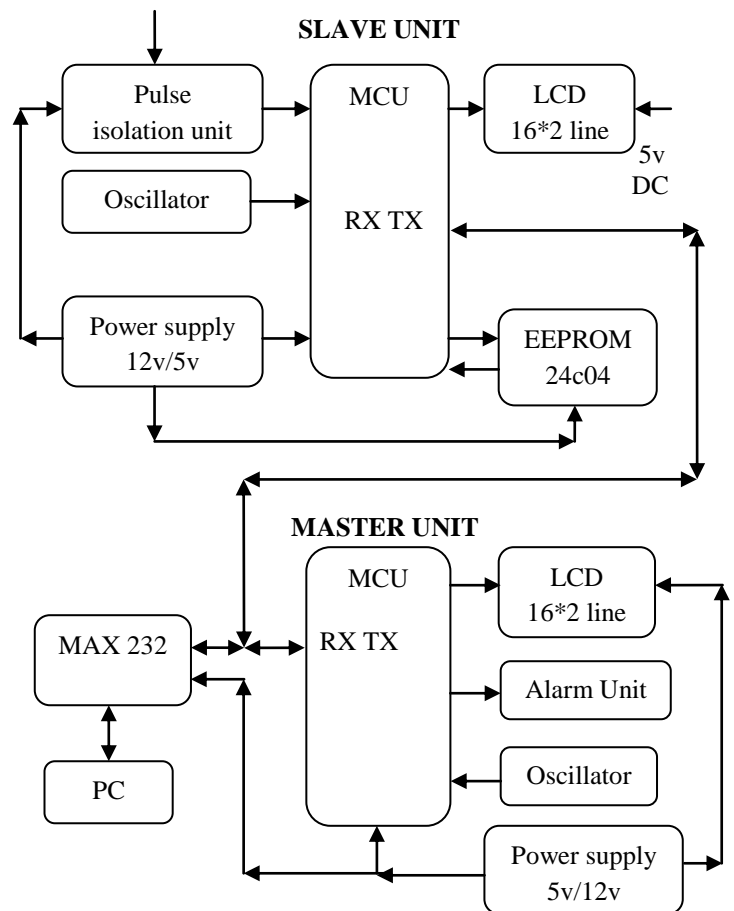
Pulses from energy measurement unit

Fig -3: Proposed System Architecture

There will be one master unit containing microcontroller. Master unit consist of microcontroller unit which is used to drive the LCD, alarm unit on the command given by PC. To communicate between microcontroller from the master unit and PC, RS232 will be used [5]. There will be wired serial communication between master unit and PC.

Visual Basic software will be used. There can be energy wastage by workers in tea break and lunch break. By providing an alarming system the energy losses will be monitored. This need will be fulfilled by using RTC through software. With the help of software, there will be provision of reading energy consumption report through Microsoft excel as well as firing through email.

4.2.1 Pulse Isolation Unit

The pulses may be in AC signal but microcontroller operates on digital level. So to isolate AC from DC opto-coupler is used.

4.2.2 Slave Unit

The function of slave unit is to count the pulses from energy measurement unit & save it to EEPROM. It will send the unit to PC on PC command.
  i.   Microcontroller (MCU):
       Function of microcontroller is to count the pulses, display the units on LCD, save the units in EEPROM & receive the command from pc & send the units to PC.
  ii. LCD:
       16*2 line LCD display is used to display current operation carried.
  iv. Oscillator:
       To provide clock to the microcontroller.
  v.   EEPROM:
       IC 24c04 EEPROM is used to save the readings. The EEPROM will store records of consumed units when electricity is not available.
  vi. Power supply:
       Unit will consist of step down transformer, bridge rectifier, capacitor filter, 7805, 7812 regulator IC to provide 12vdc, 5vdc supply to circuits.

4.2.3 Master Unit

Master unit consist of microcontroller unit which is used to drive the LCD, alarm unit on the command given by PC. PC unit consist of software which will read & check the units from slave by selecting the slaves simultaneously, if the energy units consumption is more than rated one then PC will give command to microcontroller to raise alarm.
  i.   Microcontroller (MCU):
       a) Function of microcontroller is to drive the display & show the current operation carried on it.

  b) To read the commands given by PC & control the alarm unit.
  ii. LCD:
       16*2 line LCD display will be used to display current operation carried.
  iii. Oscillator:
       To provide clock to the microcontroller.
  iv. Alarm unit:
       Alarm unit will contain buzzer & it will be activated on the command given by PC through microcontroller.
  v.   Power supply:
       Unit will consist of step down transformer, bridge rectifier, capacitor filter, 7805, 7812 regulator IC to provide 12vdc, 5vdc supply to circuits.
  vi. Max 232:
       It will convert data from TTL-CMOS or CMOS-TTL level.

4.2.4 PC

All the operations are carried out through software in it. Software will read the pulses from slave unit time to time by selecting the slave unit by unique code. All the records will be saved in data base. If power consumption of any of machine goes beyond the rated unit then PC will trigger an alarm.

5. SOFTWARE DESIGN

VISUAL BASIC is a high level programming language which evolved from the earlier DOS version called BASIC. Visual Basic 6 version will be used in this system design.

The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen. If you've ever used a drawing program such as Paint, you already have most of the skills necessary to create an effective user interface. The "Basic" part refers to the BASIC (Beginners All-Purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the history of computing. Visual Basic now contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI.

PC has the vital role in this system design. There will be real time display of consumed units of energy of different load centers on the centralized PC. Due to this, there will be easy monitoring of energy consumption. Maintenance manager will be able to read energy consumption report through Microsoft excel. Also the report will be sent via email. For this Visual Basic software will be used.

6. CONCLUSIONS

The display of consumed energy units in real-time will allow manager to see how much energy is consuming for manufacturing of a particular power tool. If energy consumed exceeds set limit then there will be alarm indication to maintenance manager. Maintenance manager will be able to read energy consumption report through Microsoft excel.

Manufacturing is one of the most energy-intensive industrial activities. The energy management technique described in this paper will eliminate waste, measure and monitor current level of energy use and improve the existing operating procedures in the industry. The system proposed in this paper is going to be implemented. The work is in progress.

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