FFICIENT POWER MANAGEMENT USING WSN

[1]Jerome Christhudass . A., [2]T. Karthik,

[1]Karpagam Academy of Higher Education, Coimbatore Email: jeromedass1985@gmail.com
[2]Department of ECE, Karpagam Academy of Higher Education, Coimbatore, tm.karthik@gmail.com

ABSTRACT
The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home. Modern technologies include cutting-edge advancements in Information technology, sensors, metering, transmission, distribution, and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity. The prototype has been extensively developed and tested in real time scenarios also the results are appreciable.

Index Terms: Energy management, home automation, intelligent control system, wireless sensor network, ZigBee.

INTRODUCTION

1.1 Motivation of the Project: In this technological world the electric power is the main source for the development and advancement. The technology develops the power requirement and increases the power demand. These power demands occur in both domestic and industrial sectors. As we have seen that more and more home appliances and consumer elect-ronics are installed, residential energy consumption tends to grow rapidly. These large no. of home devices increase power consumption. With the advancements and rapid expansion of internet technologies and WSN in recent years the home environment has seen a rapid introduction of network enabled digital technology which offers new and exciting opportunities to increase the connectivity of devices within the home for purpose of home automation. Different information and comm-unication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for Optimal power utilization but individual controlling of the devices are limited to specific houses.

1.2 Objective of the Project: There has been designing and developments of smart meters Predicting the usage of power consumption. However, a low-cost, fle-xible, and robust system to Continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have designed and implemented a ZigBee-based intelligent home ene-rgy management and control service.

1) Use of Traic with Opto-isolated driver for controlling electrical appliances: Household appliances are controlled either remotely or automatically with the help of fabricated smart sensing units consisting of triac –BT138 [12].

2) No microprocessor / microcontroller: The design of smart sensing unit does not require a processing unit at the sensing end.

3) Flexibility in controlling the appliances: Depending on the user requirements, appliances can be monit-ored and controlled in different ways. Section III-B discusses about the various options of controlling the devices.

II. WORKING FUNCTION OF BLOCKS

2.1 Introduction: In this proposed system the building automation is done using sensors and manual wireless control. It can be operated manually or automatically. The temperature sensor is used to control the DC fan in the room. We use a Zigbee to communicate the device state with the controlling section. In manual wireless mode the whole system is controlled using Zigbee in the control section. This system mainly deals with the power consumption in a building.
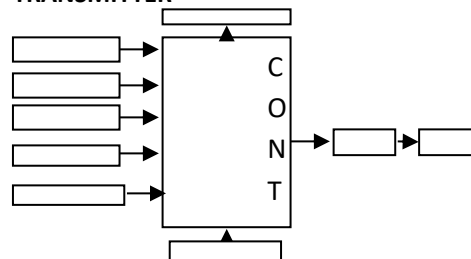
Block Diagram
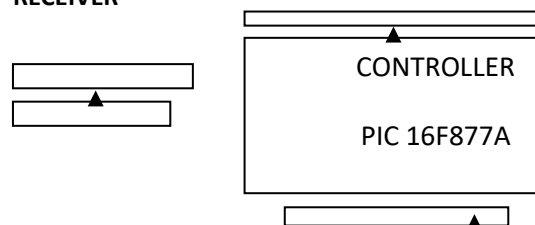**TRANSMITTER**

Fig.3.1 (a)

RECEIVER

Fig.3.1 (b)

2.2 LCD (Liquid Crystal Display) A liquid crystal display (commonly abbreviated LCD) is a thin, flat display dev-ice made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices bec-a- use it uses very small amounts of electric power [7].

2.2. Working principle of LCD: Resolution: The horizo-ntal and vertical size expressed in pixels (e.g., 1024x 768). Unlike CRT monitors, LCD monitors have a native-supported resolution for best display effect. Dot pitch:

The distance between the centers of two adjacent pixels. The smaller the dot pitch size, the less granularity is present, resulting in a sharper image. Dot pitch may be the same both vertically and horizontally, or different (less common) [9].

❖ Viewable size: The size of an LCD panel measured on the diagonal (more specifically known as an active display area).
❖ Response time: The minimum time necessary to change a pixel's color or brightness.
❖ Matrix type: Active or Passive.
❖ Viewing angle: (Coll., more specifically known as viewing direction).
❖ Color support: How many types of colors are supported (Coll., more specifically known as color gamut).
❖ Brightness: The amount of light emitted from the display (Coll., more specifically known as luminance).
❖ Contrast ratio: The ratio of the intensity of the brightest bright to the darkest dark.
❖ Aspect ratio: The ratio of the width to the height (for example, 4:3, 16:9 or 16:10).
❖ Input ports (e.g., DVI, VGA, LVDS, or even S-Video and HDMI).

3.3. LDR (Light Dependent Resistor): A Light Dependent Resistor (aka LDR, photoconductor, or photocell) is a device which has a resistance which varies according to the amount of light falling on its surface.
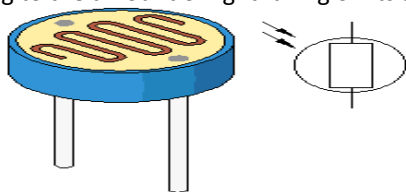

Fig.3.3 (LDR)

Light dependent resistors are a vital component in any electric circuit which is to be turned on and off automatically according to the level of ambient light - for example, solar powered garden lights, and night security lighting. LDRs or Light Dependent Resistors are very useful, especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically [4].

Fig. 3.4 Passive Infrared Sensor (PIR Sensor)

• Power supply: 3.3V - 5V input voltage,

• Sensitivity range: up to 20 feet (6 meters) 110 degrees x 70 degrees detection range
• Size: Rectangula

3.3.1. APPLICATIONS: Applications of passive infrared sensors are quite wide.

❖ Thermopiles based passive infrared sensors are used for non-contact temperature measurements such as automobile climate control, occupancy sensing, process temperature monitoring, household appliances, gas analysis, hazard control including flame and explosion detection, etc. [5].
❖ Pyroelectric based PIR Sensors are quite common as motion sensing, automatic light control, house security, etc. at various places like entrance, basements, toilets, corridors.
❖ Quantum types of infrared detectors are used for high performance imaging applications. Bolometers are also employed in some of the applications.

3.4 Temperature Sensor (LM35): You can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidetion, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

The Temperature sensor is a device which senses variations in temperature across it. LM35 is a basic temperature sensor that can be used for experimental purpose. It gives the readings in centigrade (degree Celsius) since its output voltage is linearly proportional to temperature. It uses the fact that as temperature increases, the voltage across diode increases at a known rate (actually the drop across the base-emitter junction of the transistor).
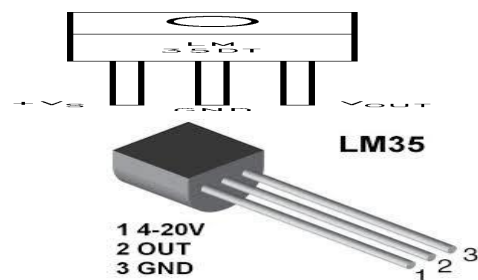

Fig.3.5 (Temperature Sensor)

3.4.2. Applications: The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature [1]. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35die would beat an intermediate temperature between the surface temperature and the air temperature. This is especially true for the TO-92 plastic package, where the copper leads are the principal thermal path to carry the heat into the device, so its

247

temperature might be closer to the air temperature than to the surface temperature.

3.5 CURRENT SENSORS: The Allegro ACS75x family of current sensors provides economical and precise solutions for current sensing in industrial, automotive, commercial, and communications systems. The device package allows for easy implementation by the customer [11]. Typical applications include motor control, load detection and management, power supplies, and over current fault protection.

The thickness of the copper conductor allows survival of the device at up to 5× over current conditions. The terminals of the conductive path are electrically isolated from the sensor leads (pins 1 through 3). This allows the ACS75x family of sensors to be used in applications requiring electrical isolation without the use of Opto-Isolators or other costly isolation techniques. The device is fully calibrated prior to shipment from the factory. The ACS75x family is lead-free. All leads are coated with 100% matte tin, and there is no lead inside the package. The heavy gauge lead frame is made of oxygen-free copper.
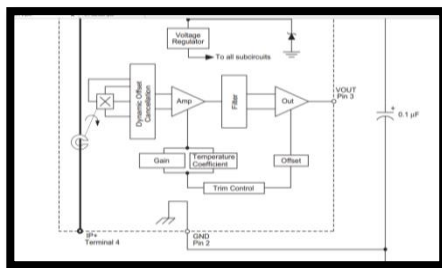

Fig -3.6: Block diagram of Current sensor

3.5.1. Features and Benefits
❖ Monolithic Hall IC for high reliability
❖ Single +5 V supply
❖ 3 KV RMS isolation voltage between terminals 4/5 and pins 1/2/3
❖ 35Hz bandwidth
❖ Automotive temperature range
❖ End-of-line factory-trimmed for gain and offset
❖ Ultra-low power loss: 100 µΩ internal conductor resistance
❖ Ratio metric output from supply voltage
❖ Extremely stable output offset voltage
❖ Small package size, with easy mounting capability
❖ Output proportional to AC and DC current

Tab 3.3 Electrical Characteristics

ELECTRICAL CHARACTERISTICS, over operating ambient temperature range unless otherwise stated

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Primary Sensed Current	I_P		–50	–	50	A
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Supply Current	I_{CC}	V_{CC} = 5.0 V, output open	6.5	8	10	mA
Output Resistance	R_{OUT}	I_{OUT} = 1.2 mA	-	1	2	Ω
Output Capacitance Load	C_{LOAD}	VOUT to GND	-	-	10	nF
Output Resistive Load	R_{LOAD}	VOUT to GND	4.7	-	-	kΩ
Primary Conductor Resistance	$R_{PRIMARY}$	I_P = ±100A; T_A = 25°C	-	100	-	µΩ
		Pins 1-3 and 4-5; 60 Hz, 1 minute	3.0	-	-	kV

Tab 3.4 Performance caracteristics

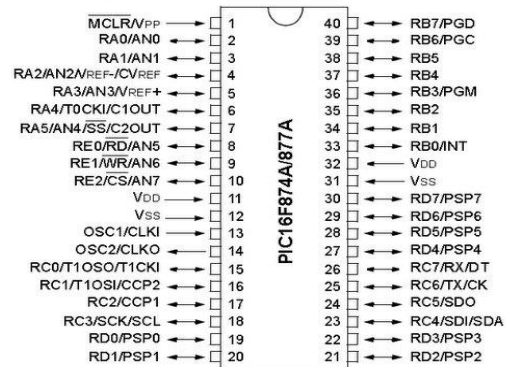### 3.6. PIC CONTROLLER:

40-Pin PDIP

Fig.3.7 (PIC 16F874A)

3.8. Transformer: A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled wires. A changing current in the first circuit (the primary) creates a changing magnetic field; in turn, this magnetic field induces a changing voltage in the second circuit (the secondary). By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other. The secondary induced voltage V_S is scaled from the primary V_P by a factor ideally equal to the ratio of the number of turns of wire in their respective windings:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up — by making N_S more than N_P or stepped down, by making it less.

3.8.1. Classification: The many uses to which transformers are put lead them to be classified in a number of different ways:

• By power level: from a fraction of a volt-ampere (VA) to over a thousand MVA;
• By frequency range: power-, audio-, or radio frequency;
• By voltage class: from a few volts to hundreds of kilovolts;
• By cooling type: air cooled, oil filled, fan cooled, or water cooled;
• By application function: such as power supply, impedance matching, output voltage and current stabilizer, or circuit isolation;
• By end purpose: distribution, rectifier, arc furnace, amplifier output;

- By winding turns ratio: step-up, step-down, isolating (near equal ratio), variable.

3.10. Proteus

I. **Creating a Proteus Session**: In this tutorial we'll create, edit, save and download a session into Proteus. If you haven't already installed at least Version 1.7 of the Proteus Editor and Operating System, please do so before starting, as we will be discussing some features only found in that release.

The process of creating and editing a new session includes the following basic steps:

1) Create and name a New File
2) Insert segment(s) into that file
3) Edit each segment
4) Test segments in real time using PC mode (optional)
5) Save the finished session
6) Transfer it to Proteus, alone or as part of an Album.

1. Create and name a new file. Follow these steps:
a. Open Proteus Session Editor, and click on the New File button. A single segment will appear at the bottom of the screen.
b. Save your session by clicking the Save File button, typing in a filename, and selecting (if necessary) the directory folder that the session will be stored in.

2. Insert segment(s) into the session. Click the Insert Segment button. All Proteus sessions require at least two segments in order to allow both "soft on" and "soft off" to be used. The settings you see are arbitrary [10].

3. Edit each segment. This is where things get more complicated, because there are so many options available to you. The following is a brief guide to what they are and how to use them. But first, a brief review of what a segment is 2 A segment is the basic organizational unit of the session. It can be run for one second or many minutes, and is bounded by the light/sound pulse rates and brightness levels at the beginning and at the end of the segment. For example, suppose you have constructed a twenty second segment with the following parameters:

The Red light pulse rate starts at 7.83 Hz and ends at 40.0 Hz;

Red light brightness starts at 2 (low brightness) and ends at 15 (maximum brightness);

The Green light pulse rate starts at 40.0 Hz and ends at 7.83 Hz;

Green light brightness starts at 7 (middle brightness) and ends at 7.

The Proteus software automatically calculates all of the values in between the starting and ending values as a linear ramp.

Sync. This checkbox is only available if you have not checked the Dual LFOs box. That is, it only works when the two channels are frequency-locked together. If you select this feature, then the lights will alternate between the two colors (red green- red-green…) every

pulse. Use this to create especially vivid visuals, or if you are using monochrome light frames it will alternate left/right.

4. Test segments in real time. One of the most powerful features of the Proteus Editor program is its real-time preview capability.

1. Connect Proteus to your PC and select the serial port you're using if you haven't already done so (using the Serial Port popdown menu)
2. Turn Proteus on and press the Mode (middle) button until the display reads PC
3. Select a segment to preview by clicking on it once (or select several segments by clicking on the first and while holding the button down, dragging the mouse pointer over all of the segments you wish to select).
4. Click on the "View Realtime" button; this will cause several new buttons to appear on the upper right side of the Session Editor window (Run Segment, Run Segments, Run Session, and Cancel). Select an appropriate one. A bar appears at the top left, showing you which segment in the selected segment group (if this is what you've chosen to do) is being run. You can cancel the preview at any time.

Tip: Once you've run a segment you can click on the Start or Finish portion of any segment and Proteus will immediately "play" those parameters.

5. Save the finished session. Once you're through experimenting, simply select File/Save As and type in a filename. Now you're ready to transfer it into Proteus [9].
6. Transfer it to Proteus. The example I'm going to give here is how to transfer a single session into the User memory bank; we'll get into albums and how they work in a later tutorial. Here are the steps:
a. Be sure Proteus is in DL mode.
b. Open the Session Manager (by clicking the Session Mangr. Button)
c. Click on Open New Album, then select the session you've just created
d. Click Add To List; the session name should now appear in the right window (the large one underneath Album Name)
e. Select Send To User Area. The session data will now transfer to the User Area as U01.

IV. RESULTS AND DISCUSSIONS

4.1. Experimental Results: The prototype is in operation in a trial home with various electrical appliances regularly used by an inhabitant. The following appliances were tested: room heaters, microwave, oven, toasters, water kettle, fridge, television, audio device, battery chargers, and water pump. In total, ten different electrical appliances were used in the experimental setup; however, any electrical appliance whose power consumption is less than 2000 W can be used in the developed system. The sampling rate for the fabricated sensing modules was set-up with 50 Hz, so that electrical appliance usages within

249

(less than 10 s) interval of time will be recorded correctly. By monitoring consumption of power of the appliances, data are collected by a smart coordinator, which saves all data in the system for processing as well as for future use.

The parameters will be entered in the data coordinator in software from appliances include voltage, current, and power. These parameters will be stored in a database and analyzed. Collected data will be displayed on the computer through the graphic user interface (GUI) window so that appropriate action can be taken from the GUI. The smart power monitoring and control system at a house where the system is on trial.
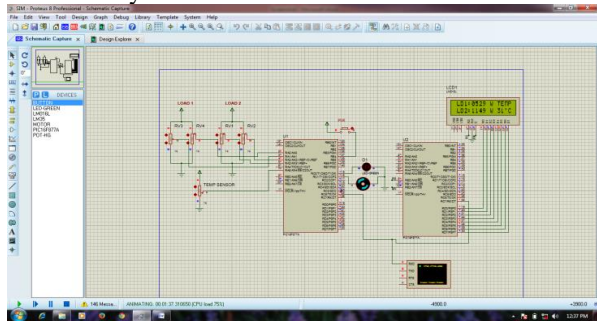

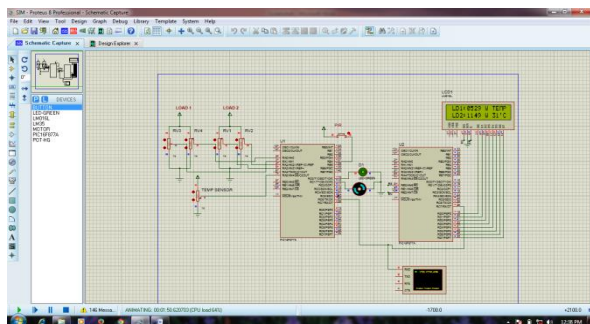**Fig 4.1** Simulation Result of Temperature Sensor Working and Power Calculation

Fig 4.2 Simulation Result of PIR Sensor Working

Fig. 4.3. System with Load's Connected.

V. CONCLUSION

A smart power monitoring and control system has been designed and developed toward the implementation of an intelligent building. The developed system effectively monitors and controls the electrical appliance usages at an elderly home. Thus, the real-time monitoring of the electrical appliances can be viewed through a website. The system can be extended for monitoring the whole intelligent building. We aim to determine the areas of daily peak hours of electricity usage levels and come with a solution by which we can lower the

consumption and enhance better utilization of already limited resources during peak hours. The sensor networks are programmed with various user interfaces suitable for users of varying ability and for expert users such that the system can be maintained easily and interacted with very simple.

This overview of smart home system focuses on implementation, usability and challenges. Smart power monitoring and controlling systems allow every point of the smart home to be connected and controlled from a crucial point, enabling power efficiency and energy optimization. Leveraging the deployment of communications-enabled smart electricity meters, many applications can be offered to home owners for optimizing overall energy management, and to utility companies as a means of managing the load of their grid and preventing power demand peaks. Smart power monitoring and controlling systems are the interface between the utility-controlled smart grid and energy consuming in-house objects

REFERENCES

1. Nagendar Kumar Suryadevara, Subhas Chandra Mukhopadhyay, Sean Dieter Tebje Kelly and Satinder Pal Singh Gill, WSN Based Smart Sensors and Actuator for Power Management in Intelligent Buildings, *IEEE Transactions on Mechatronics (2014).*

2. X.P. Liu, W. Gueaieb, S.C. Mukhopadhyay, W. Warwick and Z. Yin, Guest editorial introduction to the focused section on wireless mechatronics. *IEEE /ASME Trans. Mechatronics* 17(3): 397–403 (2012).

3. D.S. Ghataoura, J.E. Mitchell and G.E. Matich, Networking and application interface technology for wireless sensor network surveillance and monitoring. *IEEE Commun. Mag.* 49(10): 90–97 (2011).

4. P. Cheong, K.-F. Chang, Y.-H. Lai, S.-K. Ho, I.-K. Sou, and K.-W. Tam, A zigbee-based wireless sensor network node for ultraviolet detection of flame. *IEEE Trans. Ind. Electron.* 58(11): 5271–5277 (2011).

5. J. Misic and V.B. Misic, Bridge performance in a multitier wireless network for healthcare monitoring. *IEEE Wireless Commun.* 17(1): 90–95 (2010).

6. M. Erol-Kantarci and H.T. Mouftah, Wireless sensor networks for cost-efficient residential energy manage-ment in the smart grid. *IEEE Trans. Smart Grid* 2(2): 314 –325 (2011).

7. ZigBee alliance examining Japan's new smart home recommendations. Online Available: http://www. smatmeters.com/the-ews/3449-zigbee-alliance. Acessed on 8 Aug. (2012)

8. D. Man Han and J. Hyun Lim, Smart home energy management system using IEEE 802.15.4 and zigbee. *IEEE Trans. Consumer Electron.* 56(3): 1403–1410 (2010).

9. J. Han, C.S. Choi, and I. Lee, More efficient home energy management system based on zigbee communication and infrared remote controls. *IEEE Trans. Consumer Electron.* 57(1): 85–89 (2011).

10. K. Gill, S. H. Yang, F. Yao and X. Lu, A zigbee-based home automation system. *IEEE Trans. Consumer Electron.* 55(2): 422–430 (2009).

11. M. S. Pan, L. W. Yeh, Y. A. Chen, Y. H. Lin and Y. C. Tseng, A WSN based intelligent light control system considering user activities and profiles. *IEEE Sensors J.* 8(10): 1710–1721 (2008).

12. N. K. Suryadevara and S.C. Mukhopadhyay, Wireless sensor network based home monitoring system for wellness determination of elderly. *IEEE Sensors J.* 12(6): 1965–1972 (2012).

13. F. Benzi, N. Anglani, E. Bassi and L. Frosini, Electricity smart meters interfacing the households. IEEE Trans. Ind. Electron. 58(10): 4487–4494 (2011).