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Home Automation Sytem Through Wireless Sensor Network.

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Abstract—
In recent timesthe home automation system deals with monitoring and control of building services, such as heating, lighting controlling and air conditioning.The proposed system presents Home Automation System through Wireless Sensor Networks is able to control lighting which includethe ability to track occupancy and energy use, to monitor and control lighting and the ability to minimize peak demand. This design controls the appliances using wireless technology and it acts as center to monitor and to control the devices in Home Area Network.This system isimplemented using ARM7 Cortex M3 processor that controls devices through a home network controller prototype according to the information received from the sensors.The proposed system controls the Home appliances and keep the sufficient lighting by changing the illuminance levels according to the day lighting ventilation. Major enhancement of this work is that the device can be operated in either of two modes: Manual or Automatic.The data can be received from various nodes (wireless sensor network) is transmitted using Zigbee for effectively deliver solutions for a variety of areas by the design of a multi-sensing and controlling.

Keywords—Home automation, Wireless sensor Network, Cortex-M3 (LPC 1768), Auto mode.

I INTRODUCTION

In the present existing system, building parameters and environment conditions will be monitored by a person and controlling of the devices are done by manual operation. As technology is being advanced now the people has gone through with remote automation systems for appliances. We can overcome the disadvantage of the existing method by remote control is not a new feature and used in home automation systems. This paper proposesHome automation system through wireless sensor network which is used for controlling various appliances at home using ZigBee wireless network exchange information over the wireless network.

In this project the main purpose is to provide a single control point which provides access to all home services with low cost reduction factors. A remote monitoring allows the quick detection of failing devices without needing long searches and wasting personal time.

The design, this continuous monitoring enables a preventive, or predictive as well, maintenance, which results in a reduction of operational and maintenance costs. Since it is estimated that the operational cost of a building is about seven times the initial investment, taking into consideration the global life-cycle an additional initial cost is worth the effort.

As an extension to existing work, an Auto mode operation has been implemented in this work. This system upgrades the functionality to embed the automation feature. Depending on the environmental light and temperature conditions, devices within the network are operated automatically. We have a facility to operate the device in either Manual mode or Auto mode based on the user's convenience. In this perspective, accessibility is defined as a condition for autonomous and safe use of home networks by people with physically challenged.

The communication protocol has been mostly used to connect personal computers so far, but shortly all kinds of appliances with embedded computers will exchange information over the wireless network.The advantage of using WSN is that thissystem can be easily installed in already existing buildings where as a wired system will be expensive and difficult to install in the same scenario.

This paper proposes a single feasible interface to control multiple devices in Home Area Networks. It designs a system that enables the users to remotely control and coordinate the home appliances.

II RELATED WORK

In this section, Cortex-M3 (LPC 1768) microprocessor,ZigBee module, sensorsrelay and used in the work are reviewed.

A. Cortex-M3 Microprocessor

In order to integrate the display interface with a home automation system, a development board with an embedded microprocessor (LPC1768) was used. Based on the data information it receives via Zigbee, it controls lighting, air conditioner, fan, and few other common appliances within the network.

Cortex -M3 processor is preferred in this paper because of its rich features like high performance through better efficiency, rich connectivity. It is also powerful and fully deterministic in interrupt handling, and results in low power consumption.

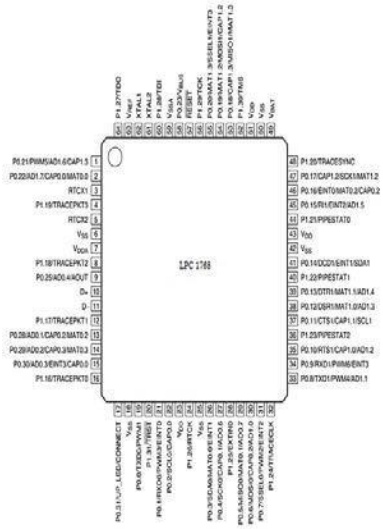

Fig1:MicroprocessorboardLPC1768connected with Zigbee at Receiver end.

B. ZigBeeModule Overview

Cortex M3 display interface works in a home automation environment using a ZigBee-based wireless sensors and actuators network.

A. ZigBee applications, markets and forecastsAlthough ZigBee standard development is stillunder progress, the ZigBee market is opened for manyvarious applications. The most promising are:

- Home Control: Security, Heating, Ventilation,and Air-Conditioning (HVAC), Lightingcontrol,Access control, Irrigation,
- Personal healthcare: Patient monitoring, Fitnessmonitoring,
- Industrial control: Asset management, Processcontrol, Energy management,Environmental,
- Buildingautomation: Automatic MeterReading (AMR), Security, HVAC, Lightingcontrol, Access control,
- Consumer electronics: Remote control,
- PC & peripherals: Mouse, keyboard, joystick,
- Environment: Environment monitoring.

ZigBee is one of the most promising technologies for Home Area Networks. It is a low cost, low power wireless mesh network standard.ZigBee is preferred in applications that require low data rate, long battery life and secure network. In this work, Zigbee acts as coordinator which transmits and receives the commands from the interface to the end devices wirelessly. Information reaches the main processor from ZigBee (receiver) networks and depending on the processor information, devices are controlled accordingly. To develop this accessible interface,Zigbee module is connected to the main processor i.e. LPC 1768 board.

ZigBee is best suited for periodic, intermittent data or single signal transmission from a sensor or an input device to transmit it over a long distance.ZigBee has also very low latency compared to Bluetooth which in turn helps in resulting less power consumption.

C. Networking Overview

Zigbee network uses three device types: NetworkCoordinatorFull Function Device and ReducedFunction device. Various network topologies used by Zigbee are shown in figure2.

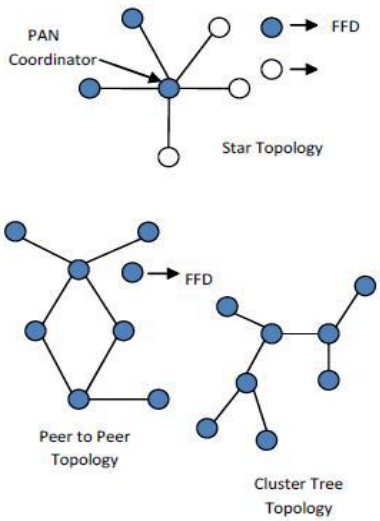

Figure2: Various networking topologies used by Zigbee

D. Relay:

In our display design, there are various items available along with the commands to monitor and control the devices.

This work makes use of SPDT relays to switch the appliances to ON or OFF state accordingly based on

the input signals received from the user end. Relays are like electromechanical devices whichare used in many applications because of their relative simplicity, long life and higher reliability. Below figure illustrates relay with Dc motor to switch it to either ON/OFF. Similarly relays are used in controlling other appliances like Fan, light, geyser etc

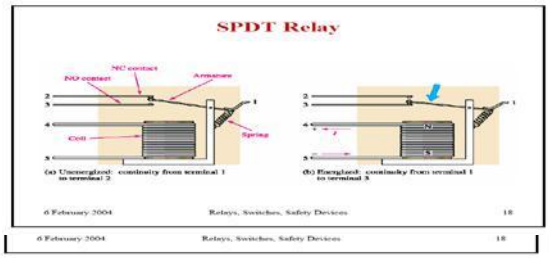

Figure4: Controlling of SPDT Relay with DC Motor.

E. Sensors

As an enhancement to the existingwork, Auto mode has been achieved in this paper. Depending on the current conditions of a room, devices within the network are operated automatically. This has been implemented by making use of different sensors like Light sensor(LDR) and temperature sensor (LM35)

When a human presence in the room is identified then current environmental conditions of a room like temperature, lighting intensity level are monitored with the help of sensors and then the appliances are operated automatically.

III INTERFACE DESIGN

Here the system with sensors are interfaced with theMicrocontroller which is used to monitor the light source, temperature and moisture content of a room are gathered and transmitted to the monitoring section using Zigbee wireless communication. As this work targets to provide the illumination of the home or building as per the recommended illumination levels, aeasy to use interface was designed with considering four different rooms with different lux levels.

The design of four different rooms.An example of this approach can be seen in below Figure

ROOM(1) General factory areas CANTEEN–AVERAGE ILLUMINANCE **150 LUX**	ROOM(2) OFFICES- COMPUTER ROOMS **500 LUX**
ROOM(3) ASSEMBLE SHOP-MEDIUM WORK FOR EXAMPLES MECHINE SHOPS,ENGINE ASSEMBLY **300 LUX**	ROOM(4) INSPECTION SHOPS-ROUGH WORK FOR EXAMPLE, COUNTING AND ROUGH CHECKING OF STOCK PARTS **150 LUX**

Figure5: four rooms with different lux levels.

A. System Overview Framework

The improved ZigBee wireless sensor network iscomposed of various sensors, ZigBee nodes, hostcomputer. In the network, the sensor collects theinformation and uploads it to the ZigBee node.The ZigBee node sends this information to thecontrol section .Then it will monitor the status of each device and also will control can be done by sending command signal to those devices.

B. Design

The design of the ZigBee wireless sensor networkincludes two parts: ZigBee Transmitter and Zigbee receiving section. The ZigBee sensor node consists of multiplesensors used to sense the status of the devices andtransmits the sensed data to the control section. Zigbee control device will receive the data and displayed in PC. The control command will be send through Zigbee to the node then it will be transferred to the intended destination.

C. Transmission Section

Using Zigbee technology the home automation like lighting, temperature checking and air conditioning is done by using wireless sensor network.Here the system with sensors are interfaced with theMicrocontroller which is used to monitor the light source, temperature content of a room are gathered and transmitted to the monitoring section using Zigbee wireless communication.

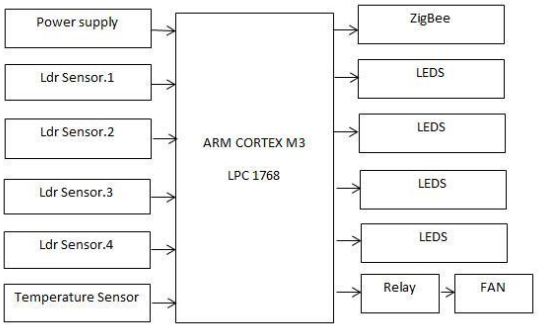

Fig 6: Block diagram of Transmission Section

D. Receiving Section

The data from the transmitter section will bereceived by the receiver end they can control the system. So the control data will reach the proper node and after receiving the data the controller will controls the devices. A PC personal computer is used in every section for displaying the status.

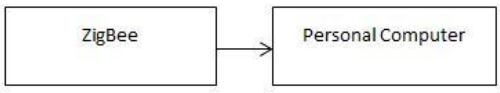

Fig 7: Block diagram of Receiving Section

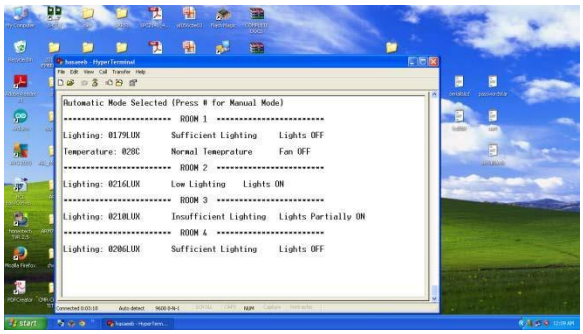

Fig 8: Result in monitoring Section

When the input is given to temperature sensor andLDR, the output of those devices are in analog form so ADC is used to convert the analog signal in to digital form. Then the digitized output is given to controller and will be transmitted to the monitoring section. The transmitted data will be displayed in PC. If the temperature is high then the speed of the fan will be increased and if the place is dark light will gets turned on automatically.
Fig 8Four rooms of a home automation interface, each one representinga different level of the interface. Room ”1” presents options for Canteen , Room ’2” for Office room, Room “3” for Assembly Shop and Room ”4” for Inspection area.

This paper includes control of home appliances using designed interface.Other home automation applications such as security lock of gates and doors and other systems safety (gas and smoke sensors) and home entertainment can be integrated into the interface.

IV SYSTEM IMPLEMENTATION AND RESULTS

Manual mode Implementation

This below picture shows is the manual mode is selected by # and in order to control the system the controllers are displayed to operate manully.(L/M) means L-light, M- motor. (1/2/3/4) these numbers initiating names of the rooms, and (o/l/h) o-off, l-low, h-high. By using these commands we can operate manually. Fan in the room that has been selected from menu by pressing Mand for lights-L and selecting room 1.
After a room is selected from the main menu, control the appliances availablein that room along with the commands. Here control and operating of the light intensity level and fan speed in the room that has been selected from the main menu is being done. When we touch on the command “Light-H” and h-high all the LED’s from a bunch will glow resulting high intensity of light. Similarly we have commands for “Light- l” (few out of bunch will glow) , ”Light-O” offs the lights and in case of controlling fan speed, we have commands available like” Fan Low”, ”Fan High “ and “Fan Off” as shown in figure 9.These various proposed optionsfor controlling light and Fan would result in power saving.

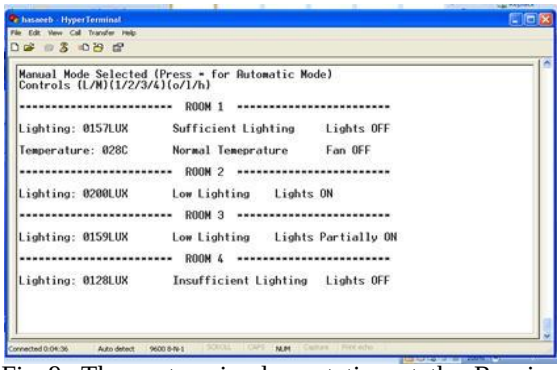

Fig 9: The system implementation at the Receiver side in Manual mode.

Current Status information:

As a part of enhancement, this work includes feedback system which provides the state of device. It provides the facility to the user to knowabout the current status of device if it is in OFF state or ON state before or while operating them using this display. To develop this, Microcontroller from which its output data is carried to ZigBee further and with the help of LED indications we can track the current state of the device. As eight devices are being controlled in four rooms, Below figure illustrates Microcontroller for Current status and complete system prototype.

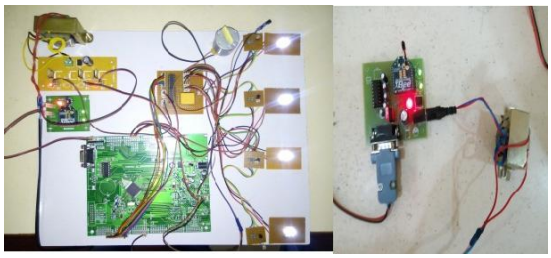

Fig 10: Shows System Prototype

Auto mode Implementation

The Mode is selected in Auto mode by pressing “ * ” , then it checks the level of light intensity in the corresponding room with the help of light sensor. Depending on the intensity value, drives the LED’s (either 7 out of 4 or 3 out of 7) in switching on the

lights automatically. Next it checks for the temperature level inside the room with the help of temperature sensor. Now depending on the current temperature inside the room, relay switches the Fan to either ON or OFF state. In this system Home conditions are detected and the light intensity will be adjusted to the required value.

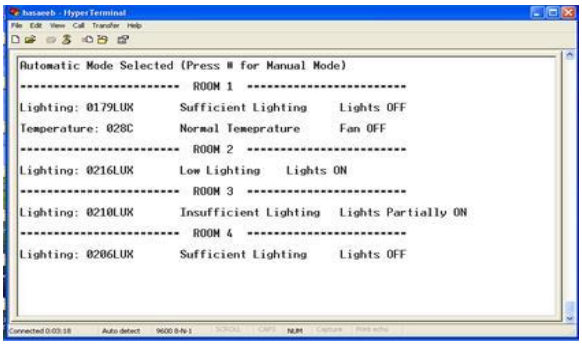

Fig 10: The system implementation at the Receiver side in Automatic mode.

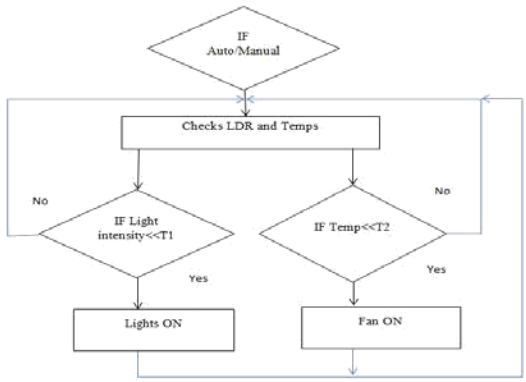

Fig11:Flow chart illustrates working of Interface in Auto mode.

The algorithm is as follows

Step1: Initialization of process

Step2: Select the type of mode-Manual or Auto

Step3: If selected mode is Manual, give the input commands to operate the devices accordingly.

Step4: If the selected mode is Auto

Step5: First Checks the ldr, and temp sensor.

Step6: Check the light intensity of the room.

Step7: If the light intensity value is less than predefined value, automatically lights will be ON.

Step8: if not, lights will remain OFF.

Step9: Similarly after step6, it will check for temperature condition in the room.

Step10: If temp greater than some value say T2, Fans will be ON.

Step11: If not Fan will remain OFF.

Stpe12: Stop the Process.

V CONCLUSION AND FUTURE SCOPE

This paper provides a single control point which provides access to all building services.Our main purpose is to provide the end consumer with an economical fully centralized system in which home appliances are managed by an IEEE 802.15.4 based wireless sensor network.It is used for managing energy usage is a crucial factor in addressing the home's growing energy concerns.

As a future scope we can Further implementations will be done in order to extend the proposed system to other standards or technologies of lamps, luminaries or lightning communication and control protocols.We can include applications based on proper security and safety of a person at home like preventing thefts, prevention and control of gas leakages at home.

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