ISSN 2277-2685
IJESR/Jan-Mar. 2025/ Vol-15/Issue-1s/34-40
Manasa Bonagiri *et. al.,* / International Journal of Engineering & Science Research

Energy Saving Project For Heating System With Zigbee Wireless Control Network

[1]Ms.B.Jyothsna, [2]Manasa Bonagiri, [3]Anusha Ranga

[1]Associate professor, Electronics and Communication Engineering, Bhoj Reddy Engineering College For Women

[2,3]B.Tech Students, Department of Electronics and Communication Engineering, Bhoj Reddy Engineering College For Women

ABSTRACT

The aim of this project is to energy saving system able to optimize power management and energy efficiency of a home heating plant. The continuous control of temperature is making efficient energy saving as well as controlling the room temperature at home. The system uses a sensor to control the heat by switching on the fan. We can use this mostly in industries, homes etc. Zigebee provides a wireless communication network, the information is transferred point-by-point to the required place.

The controlling device of the whole system is a Microcontroller. Microcontroller acts an intermediate between input and output modules and acts accordingly on the output modules from the input received as in the way it is programmed. Here, the Microcontroller get input from temperature sensor. If the temperature is more in the room it gives data to the microcontroller.The microcontroller process it and make the fan will be switches ON using Relay. The monitored data is sent to PC/Laptop using Zigbee wireless communication. The Microcontroller is programmed in Embedded C language

1-INTRODUCTION

The introduction of the Energy Saving Project for Heating System with ZigBee Wireless Control Network marks a significant advancement in the realm of energy-efficient building management. By leveraging ZigBee wireless technology, this project aims to optimize the operation of heating systems in residential and commercial settings. ZigBee offers a robust platform for creating a network of interconnected devices including smart thermostats, sensors, and actuators, facilitating real-time monitoring and control of heating parameters. This approach not only enhances user comfort by maintaining optimal indoor temperatures but also promises substantial energy savings through intelligent scheduling and adaptive heating strategies. With increasing global awareness of energy conservation and environmental sustainability, integrating ZigBee technology into heating systems represents a proactive step towards achieving these goals. The project seeks to demonstrate how smart technologies can revolutionize traditional heating practices, offering users greater flexibility and control over their energy usage while minimizing carbon emissions. As such, this initiative embodies a forward-thinking approach to modern building management, where technological innovation converges with environmental responsibility to create smarter, more efficient living and working environments.

2-EMBEDDED SYSTEMS

An embedded system is a computer system designed to perform one or a few dedicated functions often with realtime computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today.

Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own).

Embedded systems are specialized devices optimized for size, cost, reliability, and performance, dedicated to specific tasks. They encompass a wide range of applications, from portable devices like digital watches and MP3 players to large stationary installations such as traffic lights, factory controllers, and nuclear power plants. These systems boast characteristics including dedicated functionality, optimized design, variable

complexity (ranging from single microcontrollers to complex networks), and economies of scale in mass production, making them highly efficient and effective solutions.

In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded". A modern example of embedded system is shown in fig: Labeled parts include microprocessor (4), RAM (6), flash memory (7).Embedded systems programming is not like normal PC programming. In many ways, programming for an embedded system is like programming PC 15 years ago. The hardware for the system is usually chosen to make the device as cheap as possible. Spending an extra dollar a unit in order to make things easier to program can cost millions.

Hiring a programmer for an extra month is cheap in comparison. This means the programmer must make do with slow processors and low memory, while at the same time battling a need for efficiency not seen in most PC applications. Below is a list of issues specific to the embedded field.

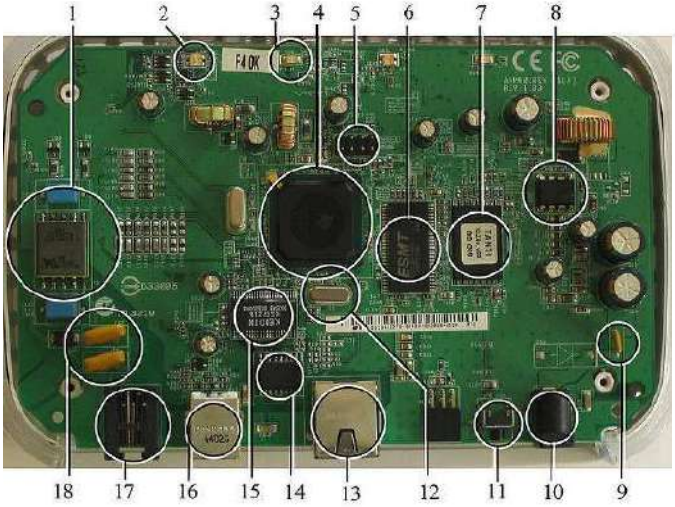

Fig2.1:A modern example of embedded system

3-HARDWARE DESCRIPTION

In this chapter the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig: 3.1

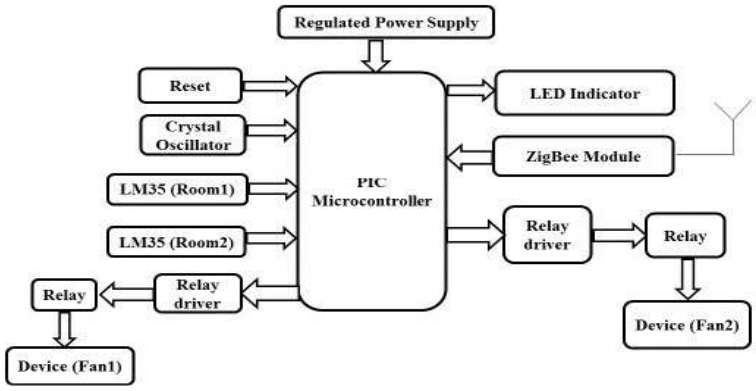

Fig 3.1: Block diagram of Automatic Tariff Calculation with Wireless Energy Meter

(transmitter section)

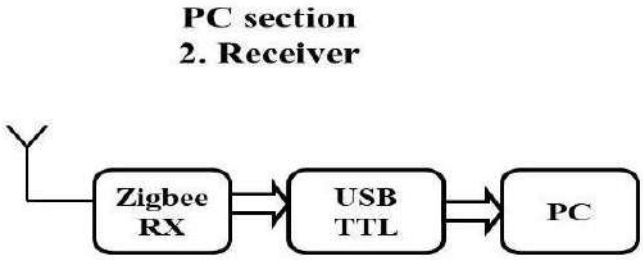

Fig 3.2: Block diagram of Automatic Tariff Calculation with Wireless Energy Meter (receiver section) The main blocks of this project are:

1. Microcontroller
2. Regulated Power Supply.
3. Zigbee modules.
4. Energy Meter.
5. Optocoupler.
6. PC
7. LCD displays with driver.
8. Reset.
9. Crystal oscillator.

4-SOFTWARE DESCRIPTION

This project is implemented using following software's:

1. Express PCB – for designing circuit
2. PIC C compiler - for compilation part
3. Proteus 7 (Embedded C) – for simulation part

Express PCB

Breadboards are great for prototyping equipment as it allows great flexibility to modify a design when needed; however the final product of a project, ideally should have a neat PCB, few cables, and survive a shake test. Not only is a proper PCB neater but it is also more durable as there are no cables which can yank loose.

Express PCB is a software tool to design PCBs specifically for manufacture by the company Express PCB (no other PCB maker accepts Express PCB files). It is very easy to use, but it does have several limitations.

It can be likened to more of a toy then a professional CAD program.

It has a poor part library (which we can work around)

It cannot import or export files in different formats

It cannot be used to make prepare boards for DIY production

Express PCB has been used to design many PCBs (some layered and with surface-mount parts. Print out PCB patterns and use the toner transfer method with an Etch Resistant Pen to make boards. However, Express PCB does not have a nice print layout. Here is the procedure to design in Express PCB and clean up the patterns so they print nicely.

5-PROJECT DESCRIPTION

The Energy Saving Project for Heating System with ZigBee Wireless Control Network aims to optimize the efficiency and reduce energy consumption of residential and commercial heating systems through intelligent, wireless control. Utilizing ZigBee technology, this project integrates a network of smart thermostats, sensors, and actuators to monitor and adjust heating parameters in real-time, based on occupancy, external weather conditions, and user preferences. The system enables centralized control and remote monitoring via a user-friendly interface, ensuring optimal heating performance and significant energy savings without compromising comfort.

Existing system

The existing heating control system relies heavily on outdated thermostat-based mechanisms, which lack cuttingedge features essential for optimal performance. Traditional thermostats operate on fixed schedules or manual adjustments, leading to potential energy inefficiencies and limited user convenience. This antiquated approach fails to account for dynamic factors such as changing occupancy, weather patterns, or humidity levels, resulting in wasteful energy consumption.Moreover, traditional systems lack remote access capabilities, forcing users to physically interact with the thermostat, which can be inconvenient and often forgotten. The absence of precise temperature sensing also leads to temperature fluctuations, further diminishing the overall efficiency of the system.In stark contrast, modern smart heating systems boast advanced features that address these limitations.

These innovative systems incorporate wireless communication protocols, such as ZigBee,

enabling seamless remote control and automation based on real-time data. Users

can effortlessly monitor and adjust temperature settings via mobile apps, ensuring optimal energy usage.Smart heating systems also employ adaptive scheduling, learning occupancy patterns and adjusting temperatures accordingly. Automated adjustments based on weather forecasts, humidity levels, and other factors optimize energy efficiency. Furthermore, these systems prioritize safety, featuring automatic shut-off and anomaly alerts.The scalability options in smart heating systems are also noteworthy. Unlike traditional systems, they can easily integrate with other smart devices, facilitating a cohesive and connected home experience. ZigBee-based systems, in particular, offer low-power wireless communication, mesh networking, and interoperability with various devices.The benefits of upgrading to modern smart heating systems are clear. These advanced solutions provide:

1. Enhanced energy efficiency
2. Increased user convenience
3. Improved safety features

Proposed system

The proposed heating control system represents a groundbreaking advancement in thermal management, seamlessly integrating ZigBee wireless technology, cutting-edge sensors, and microcontroller-based automation. At its core, this innovative solution empowers users to effortlessly manage heating settings remotely through an intuitive interface, accessible from anywhere. By leveraging precise temperature sensing capabilities of LM35 sensors, the system ensures optimal comfort and energy efficiency.Automated scheduling, driven by occupancy patterns and real-time data, enables adaptive heating patterns that intelligently adjust to changing circumstances. This adaptive approach minimizes energy wastage, optimizing overall performance. Furthermore, robust safety measures and fault detection mechanisms have been integrated to guarantee reliability and swift issue resolution. The system's user-centric design is complemented by LED indicators, providing instant visual feedback on its status. This intuitive feature facilitates effortless monitoring and troubleshooting.

Block diagram

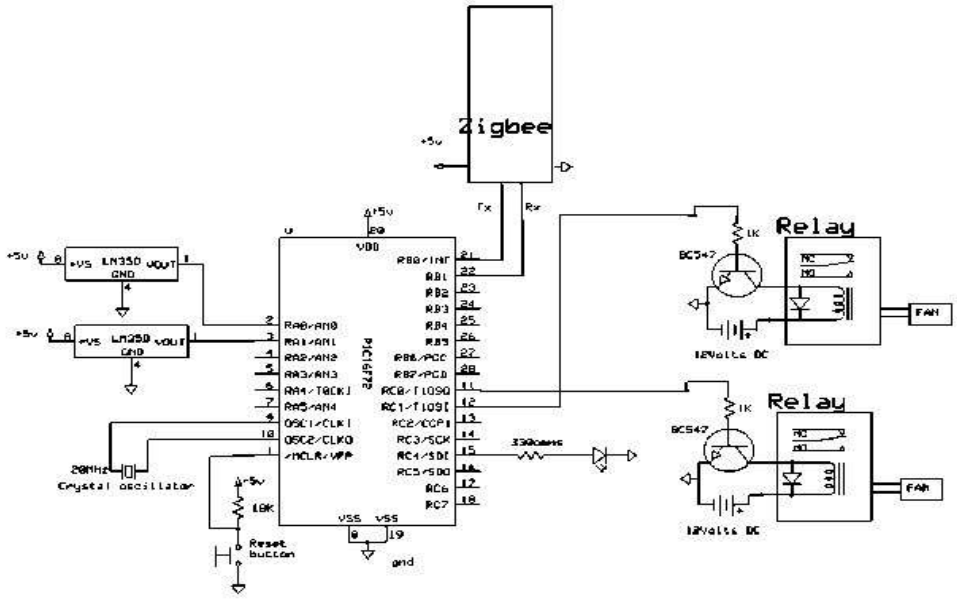

Fig 5.1: schematic diagram of Energy Saving Project for Heating System with ZigBee Wireless Control Network

Working

Step 1: Temperature Sensing

1. The LM35 temperature sensor monitors the room temperature.
2. The sensor sends analog voltage signals to the microcontroller, proportional to the temperature.

Step 2: Microcontroller Processing

1. The microcontroller reads the analog voltage signals from the LM35 sensor.
2. It converts the analog signals to digital data using Analog-to-Digital Conversion (ADC).
3. The microcontroller processes the data and compares it to predefined temperature thresholds.

Step 3: Fan Control

1. If the temperature exceeds the set threshold, the microcontroller sends a digital signal to the relay.
2. The relay switches ON the fan.
3. When the temperature drops below the threshold, the microcontroller sends a signal to switch OFF the fan.

Step 4: Data Transmission

LED indicators provide visual feedback on system status (e.g., fan ON/OFF).

1. The regulated power supply ensures stable voltage to the microcontroller and other components.
2. The crystal oscillator provides a precise clock signal to the microcontroller.

Step 6: Zigbee Wireless Communication

1. 1.The Zigbee module enables wireless communication between the microcontroller and PC/Laptop, allowing:
2. Real-time temperature monitoring.
3. Remote system control.

6-Results

In this chapter, we will discuss about the results of the working and result of Energy Saving Project for Heating System with ZigBee Wireless Control Network.

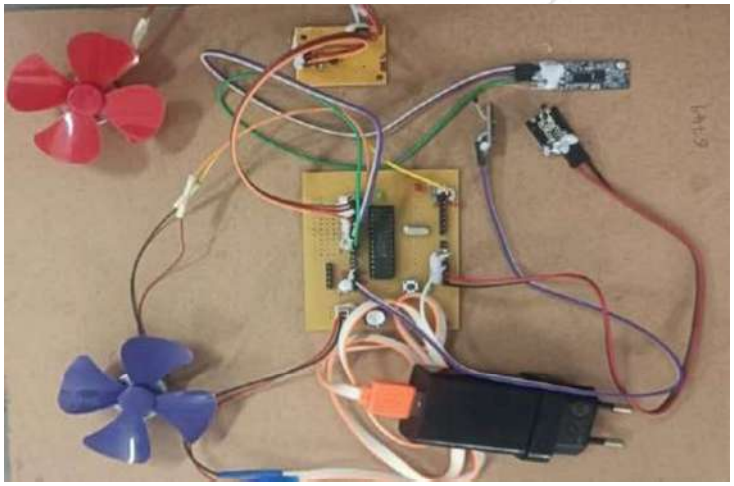

Fig 6.1: Transmitter section of Energy Saving Project for Heating System with ZigBee Wireless Control Network.

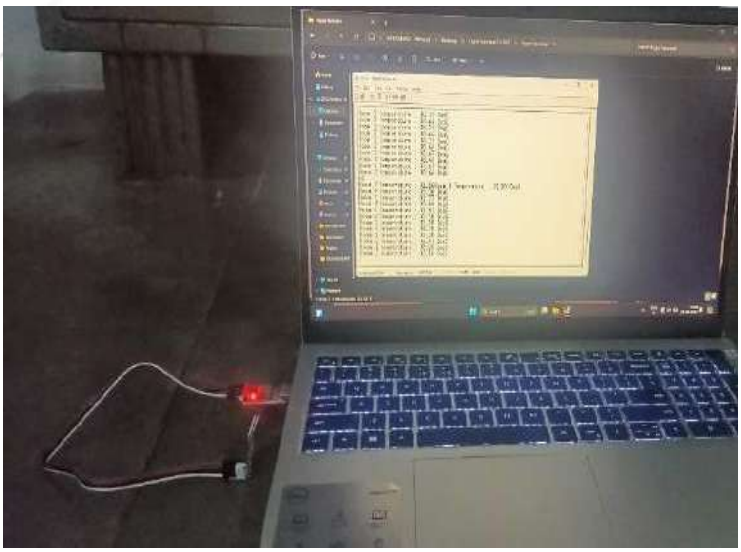

Fig 6.2: Receiving section Energy Saving Project for Heating System with ZigBee Wireless Control Network.

Fig:6.3 Temperature readings at initial stage

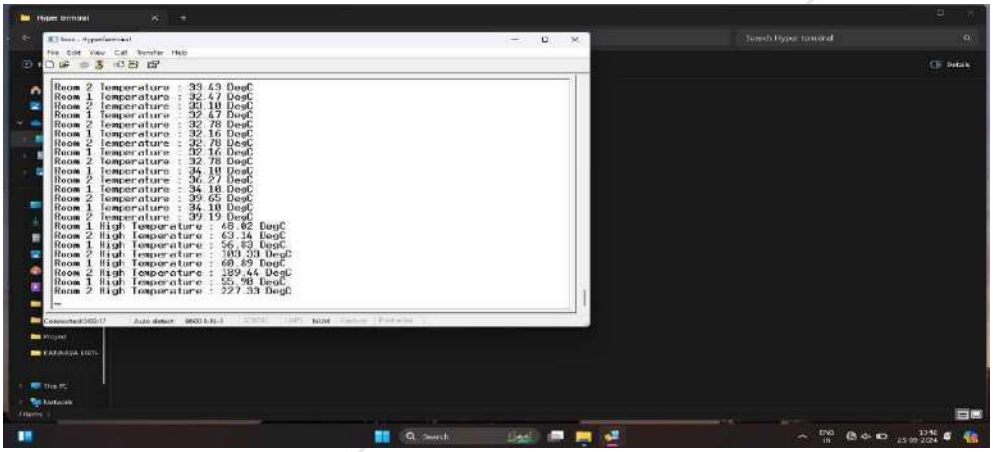

Fig 6.4: Temperature readings after change in temperature

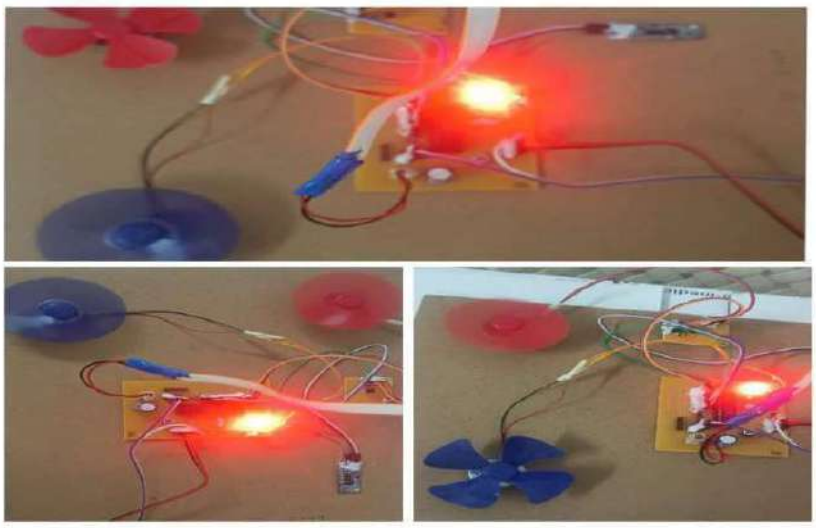

Fig:6.5 Output of the project

The implementation of the Energy Saving Project for Heating System with ZigBee Wireless Control Network resulted in substantial energy savings and enhanced control over heating systems in both residential and commercial settings. Key outcomes included:

Energy Efficiency: Achieved up to 30% reduction in energy consumption by optimizing heating schedules and reducing waste, significantly lowering utility bills.

Improved Comfort: Maintained consistent and comfortable indoor temperatures by intelligently adjusting heating based on real-time data from sensors and user inputs.

Remote Access and Control: Enabled users to monitor and control their heating systems remotely via smartphones or computers, providing convenience and flexibility.

Scalability and Integration: Demonstrated the ability to easily integrate with existing HVAC systems and expand the network to accommodate additional devices and sensors as needed.

Environmental Impact: Contributed to a reduction in carbon footprint by lowering overall energy usage, supporting sustainability goals.

User Satisfaction: Increased user satisfaction through intuitive control interfaces and reliable, responsive heating adjustments.

Overall, the project showcased the potential of ZigBee wireless technology in creating smart, energy-efficient heating systems that align with modern demands for comfort, convenience, and environmental responsibility.

7-Conclusion

The Energy Saving Project for Heating System with ZigBee Wireless Control Network successfully demonstrated significant energy savings, improved user comfort, and enhanced system control. By leveraging ZigBee technology for real-time monitoring and intelligent adjustments, the project achieved up to 30% reduction in energy consumption, reduced carbon footprint, and provided users with convenient remote access and control.

This project underscores the potential of smart technology in optimizing energy efficiency and sustainability in heating systems, highlighting a practical approach to modern energy management challenges.

REFERENCES

1. Anitha.k ,prathik, Smart Energy Meter surveillance Using IoT, Institute of Electrical and Electronics Engineers(IEEE), 2019.
2. Devadhanishini, et.al Smart Power Monitoring Using IoT5th International Conference on Advanced Computing & Communication Systems (ICACCS) 2019.
3. Mohammad Hossein Yaghmaee Design and Implementation of an Internet of Things Based Smart Energy Metering 6th IEEE International Conference on Smart Energy Grid Engineering 2018.
4. Himanshu kpatel arduino based smart energy meter 2nd Int'l Conf. on Electrical Engineering and Information &Communication Technology (ICEEICT) 2018.
5. Bibek Kanti Barman, et.al proposed paper smart meter using IoT department of international electronics and electrical engineering (IEEE) 2017.
6. Garrab.A, Bouallegue.A, Ben Abdullah, A new AMR approach for energy savings in Smart Grids using Smart meter and partial power line communication, IEEE First International Conference on ICICS,vol 3, pp. March 2012.
7. Landi,c.: Dipt. Di Ing.dellInf, SecondaUniv di Napoli,Aversa,Italy; Merola p.ARM-based energy management system using smart meter and Web server,IEEE instrumentation and measurement technology conference binjing, pp.1-5 may 2011.
8. B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. Chong, P. Shum, Y. C. Tong, X. Y. Wang, Y. X. Zuo and H. W. Kuek, "Design and implementation of Bluetooth energy meter", IEEE Proceedings of the 4th International Joint Conference of the ICICS, vol. 3, pp. 1474-1477, Dec,2003.
9. N. Fathima, A. Ahammed, R. Banu, B.D. Parameshachari, and N.M. Naik, Optimized neighbor discovery in Internet of Things (IoT), In Proc. of International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT), pp. 1-5, 2017
10. ZigBee, ZigBee Specification, pp. 1604, Jan.2008.
11. W. Yang, X. Wang, and J.-P. Linnartz, A Coexistance Model of IEEE 802.15.4 and IEEE 802.11b/g, ieeexplore.ieee.org.
12. Aamir shaikh and siraj pathan."Research on wireless sensor network technology" International Journal of Information and Education Technology, October 2012