# INTELLIGENT HOME AUTOMATION WITH SMART POWER OPTIMIZATION

*A Project Report*

*Submitted in partial fulfilment of Requirements for the Award of the*

*Degree of*

## BACHELOR OF TECHNOLOGY

## IN

## ELECTRONICS AND COMMUNICATION ENGINEERING

***By***


| | |
|---|---|
| **G. Uday kiran** | **(208A1A0487)** |
| **B. Kesava Naidu** | **(208A1A0480)** |
| **T. Vara prasad** | **(218A1A0413)** |
| **P. Jaya Manikanta** | **(208A1A04A6)** |

***Under the Esteemed Guidance of***

**Mr. K. Suresh Babu** M.Tech, (Ph.D)(NITP)
Associate Professor
Dept. of ECE




**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)

(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)

An ISO 9001:2015 certified Institute

NH-16, Valluru, -523272, Ongole, Prakasam District, A.P


**2020- 2024**

# RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)
(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)
An ISO 9001:2015 certified Institute
NH-16, Valluru, -523272, Ongole, Prakasam District, A.P

## Department of Electronics & Communication Engineering

## ***CERTIFICATE***

This is to certify that the project work entitled **"INTELLIGENT HOME AUTOMATION WITH SMART POWER OPTIMIZATION SYSTEM"** is a bonafide record of project work done jointly by **G. UDAY KIRAN (208A1A0487), B. KESAVANAIDU (208A1A0480), T. VARAPRASAD (218A1A0413), P.JAYA MANIKANTA (208A1A04A6),** under my guidance and supervision and is submitted in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology in Electronics & Communication Engineering by Jawaharlal Nehru Technological University , Kakinada during the academic year 2023-2024

PROJECT GUIDE
**Mr. K. Suresh Babu** M.Tech, (Ph.D)(NITP)
**Associate Professor**
**Dept. of ECE**

HEAD OF THE DEPARTMENT
**Dr. Ch. Venugopal Reddy** M.E, Ph.D.
**Professor & HOD**
**Dept. of ECE**

EXTERNAL EXAMINER

# ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our guide, to **Mr. K. Suresh Babu** Associate Professor, for providing his invaluable guidance, comments, suggestions and support throughout the course of the project.

We express our heart filled thanks to **Dr. Ch. Venugopal Reddy**, Head of the Department, Electronics and Communication Engineering, for his valuable support to bring out this project in time.

We pay our profound sense of gratitude to our Principal **Prof. Dr. A.V. Bhaskara Rao** for providing an excellent environment in our college and helping us at all points for achieving our task.

We express our sincere thanks to the **Management of RISE Krishna Sai Prakasam Group of Institutions, Valluru** for providing a good environment and infrastructure.

Finally, we thank all our faculty members, supporting staff of ECE Department and friends for their kind co-operation and valuable help for the completion of the project.

**Project Associates**

| | |
|---|---|
| **G. UDAY KIRAN** | **(208A1A0487)** |
| **B. KESAVANAIDU** | **(208A1A0480)** |
| **T. VARAPRASAD** | **(218A1A0413)** |
| **P. JAYA MANIKANTA** | **(208A1A04A6)** |

# RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)
(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)
An ISO 9001:2015 certified Institute
NH-16, Valluru, -523272, Ongole, Prakasam District, A.P

## Department of Electronics & Communication Engineering

| | |
|---|---|
| **Vision of the Institute** | To be a premier institution in technical education by creating professionals of global standards with ethics and social responsibility for the development of the nation and the mankind. |
| **Mission of the Institute** | Impart Outcome Based Education through well qualified and dedicated faculty. |
| | Provide state-of-the-art infrastructure and facilities for application-oriented research. |
| | Reinforce technical skills with life skills and entrepreneurship skills. |
| | Promote cutting-edge technologies to produce industry-ready Professionals. |
| | Facilitate interaction with all stakeholders of foster ideas and innovation. |
| | Inculcate moral values, professional ethics and social responsibility |
| **Vision of the Department** | To become a center of excellence in Electronics and Communication Engineering to meet the global, technological and industrial requirements. |
| **Mission of the Department** | Provide modern technical knowledge, professional skills and attitude to meet industry needs. |
| | Promote innovations through professional training and development. |
| | Develop a team with professional ethics and social responsibility. |

# RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)
(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)
An ISO 9001:2015 certified Institute
NH-16, Valluru, -523272, Ongole, Prakasam District, A.P

## Department of Electronics & Communication Engineering


**Program Educational Objectives (PEOs):**

Graduates of the program will be able to

| | |
|---|---|
| **PEO1:** Core Skills | Intensive and extensive engineering knowledge and skill to understand, analyze, design and create novel products and solutions in the field of Signal Processing, Communication Systems, Embedded Systems and VLSI. |
| **PEO2:** Problem Solving and Lifelong Learning | Capability to pursue career in industry or higher studies with continuous learning. |
| **PEO3:** Entrepreneurship Skills | Leadership qualities, team spirit, multi-disciplinary approach, character Moulding and lifelong learning for a successful professional career. |
| **PEO4:** Professionalism | Professional and ethical attitude, effective communication skills, and sense of responsibility toward society. |

**Program Outcomes (POs):**

| | |
|---|---|
| **PO1** | **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO4** | **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |

| | |
|---|---|
| **PO5** | **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Program Specific Outcomes (PSOs):**

A student of the Electronics and Communication Engineering Program will be able to

| | |
|---|---|
| **PSO1** | Design and implementation of complex systems by applying basic concepts in Electronics & Communication Engineering to Electronics, Communications, Signal Processing, VLSI, Embedded Systems (**Core Skills**). |
| **PSO2** | Solve complex Electronics and Communication Engineering problems, using hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions relevant to the society (**Problem-Solving Skills**). |
| **PSO3** | Quality in technical subjects for successful higher studies and employment (**Professional Career**). |

# RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)
(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)
An ISO 9001:2015 certified Institute
NH-16, Valluru, -523272, Ongole, Prakasam District, A.P

## Department of Electronics & Communication Engineering

**Project Outcomes**

**Name of the Course** : Project Work **Year & Semester** : IV Year II Sem
**Academic Year** : 2023-2024 **Regulation** : R20

| Co. No | Project outcome | BTL |
|---|---|---|
| | After completing this project the student will be able to | |
| C421.1 | Envisaging applications for societal needs | Evaluating |
| C421.2 | Develops skills for analysis and synthesis of practical systems | Creating |
| C421.3 | Acquire the use of new tools effectively and creatively | Creating |
| C421.4 | Work in team to carry out analysis and cost-effective, environmental friendly designs of engineering systems | Creating |
| C421.5 | Write Technical / Project reports and oral presentation of the work done to an audience | Evaluating |
| C421.6 | Demonstrate a product developed | Creating |

# RISE Krishna Sai Prakasam Group of Institutions::Ongole

(Approved by AICTE-New Delhi, Affiliated to JNTUK Kakinada)
(Accredited By NAAC with "A" Grade & NBA for B.Tech. in ECE, EEE, CE, ME and CSE)
An ISO 9001:2015 certified Institute
NH-16, Valluru, -523272, Ongole, Prakasam District, A.P

## Department of Electronics & Communication Engineering

**Name of the Course** : Project Work **Year & Semester** : IV Year II Sem
**Academic Year** : 2023-2024 **Regulation** : R20

**CO Vs PO Mapping**

| Course Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C421.1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| C421.2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| C432.3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| C421.4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C421.5 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| C421.6 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C421 | **2.00** | **2.00** | **2.83** | **2.67** | **3.00** | **3.00** | **2.33** | **2.50** | **3.00** | **2.67** | **2.67** | **2.67** |

**CO Vs PSO Mapping**

| Course Outcomes(COs) | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| C421.1 | 3 | 3 | 3 |
| C421.2 | 3 | 3 | 3 |
| C421.3 | 3 | 3 | 3 |
| C421.4 | 3 | 3 | 3 |
| C421.5 | 2 | 2 | 2 |
| C421.6 | 3 | 3 | 3 |
| C421 | **2.83** | **2.83** | **2.83** |

# CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# ABSTRACT

As the day passes towards the future the technologies which are developing day-to-day in intelligent home automation has revolutionized the way households manage energy consumption and optimize power usage. Comprising microcontrollers, by employing DH11, thermistors, humidity, and gas sensors, and also calculate the current, voltage, and power from the energy meter to send an alerts to the owner through the IOT these are the backbone of the proposed solution. These systems are strategically deployed throughout the household infrastructure to monitor and control various devices and appliances in real-time. The core functionality of the smart power optimization system lies in its ability to analyze energy consumption patterns, predict usage trends, and dynamically adjust power settings to minimize waste and enhance efficiency. The implementation of intelligent home automation with a smart power optimization system offers numerous benefits, including reduced utility bills, increased comfort and convenience, and lower environmental impact through decreased carbon emissions. This solution demonstrates the potential for transformative advancements in residential energy management and sustainability,

**Keywords** – DH11, Node MCU, Arduino, Energy meter, Current, Voltage, sensors.

# CHAPTER-1
# INTRODUCTION

## 1.1 Introduction:

The integration of Node MCU and Arduino microcontrollers, coupled with DHT11 temperature and humidity sensors, as well as current and voltage sensors, signifies a pivotal advancement in intelligent home automation with smart power optimization systems. This amalgamation of hardware components empowers homeowners with granular control over their household energy consumption, enabling them to achieve unprecedented levels of efficiency, comfort, and sustainability.

Node MCU, built on the ESP8266 Wi-Fi module, serves as a robust platform for Internet of Things (IoT) applications, offering seamless connectivity to home networks and cloud services. Its integration with Arduino, renowned for its versatility and ease of use in electronics prototyping, enhances the system's capabilities, enabling complex control and automation tasks. Moreover, the inclusion of DHT11 sensors enables real-time monitoring of temperature and humidity levels, providing valuable insights for optimizing environmental conditions within the home. It is an open-source firmware and development kit based on the ESP8266 Wi-Fi module, serves as a robust platform for building IoT (Internet of Things) applications. Its integrated Wi-Fi capabilities enable seamless connectivity to home networks, cloud services, and mobile devices, making it an ideal choice for remote monitoring and control of smart home devices. Arduino, on the other hand, provides a flexible and user-friendly platform for prototyping and developing custom electronic projects. With its extensive ecosystem of sensors, actuators, and shields, Arduino empowers users to create tailored solutions for a wide range of applications, including home automation and energy management.

In this model i implemented a system that can be operated through an amazon alexa, google assistant through web based controlling as a switch and it can be operated by manually also. In older technology we have only one operation is implemented in a real time I proposed a model combination of all models as well as calculating the power and temperature gas sensors and we getting an alerts through an iot device about temperature, humidity, current and voltages values of the owners mobile devices .so this is the advanced model in home automation to reduced the power bills and make the smart home for environment sustainability by using this smart home it gives us more comfort and convenience.

The proposed intelligent home automation system offers numerous benefits, including reduced energy bills, enhanced comfort, and reduced environmental impact. By harnessing the collective capabilities of NodeMCU, Arduino, DHT11 sensors, and current/voltage sensors, homeowners can create smart, energy-efficient homes that adapt to their needs and preferences while contributing to a more sustainable future.

Some domestic automation networks with many different technologies have been developed over the years. Through technological advances, the standard and capabilities of a home automation device have improved significantly. The DTMF receiver was one of the earliest systems used as a communication interface and the ring line authentication of the user [1]. Some devices of specific micro controllers, such as Arduino microcontroller and PIC microcontroller, have recently been introduced. The benefit of these programs is that they can be easily implemented and do not need an internet connection. The SIM card and text messages can be used to operate them. Systems were also developed using the microcontroller Raspberry Pi and e-Mail is used to carry the message in GSM-based systems as opposed to text. While these machines have some benefit, it is very cost-intensive to first send an e-mail each time you have to do something that is really boring. The Raspberry Pi itself is very expensive. Even attempts were made to create an intelligent power management system using sensors and mobile technology, which is a quite useful approach for intelligent home management and could also be developed into intelligent homes which can operate without human interference. In comparison Bluetooth is used to build sophisticated homes that are just like wireless Internet, but Bluetooth is not as long as possible as with wireless Internet . Engineering Bluetooth is disadvantageous and at a time that would be a major disadvantage, as it needs multiple devices to connect at home and also mesh technology is not yet supported, only one node could be connected. Some also attempted to incorporate Bluetooth technology, which actually improves the usability of the system, into speech recognition technology. The best advances in home automation have come with Wi-Fi technology because it provides a wide range of applications in a free manner so that no licenses are required and could be used from anywhere in the world to connect multiple devices at the same time.

## 1.2 INTRODUCTION TO EMBEDDED SYSTEMS

Each day, our lives become more dependent on 'embedded systems', digital information technology that is embedded in our environment. More than 98% of processors applied today are in embedded systems, and are no longer visible to the customer as 'computers' in the ordinary sense. An Embedded System is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale. The increasing use of PC hardware is one of the most important developments in high-end embedded systems in recent years. Hardware costs of high-end systems have dropped dramatically as a result of this trend, making feasible some projects which previously would not have been done because of the high cost of non-PC-based embedded hardware. But software choices for the embedded PC platform are not nearly as attractive as the hardware.

Typically, an embedded system is housed on a single microprocessor board with the programs stored in ROM. Virtually all appliances that have a digital interface -- watches, microwaves, VCRs, cars -- utilize embedded systems. Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program.

Physically, Embedded Systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants.

In terms of complexity embedded systems can range from very simple with a single microcontroller chip, to very complex with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

**1.3 Definition of an Embedded System**:

Embedded system is defined as, For a particular/specific application implementing the software code to interact directly with that particular hardware what we built. Software is used for providing features and flexibility, Hardware = {Processors, ASICs, Memory, is used for Performance (& sometimes security)There are many definitions of embedded system but all of these can be combined into a single concept. An embedded system is a special purpose computer system that is used for particular task.

**1.4 Features of Embedded Systems:**

The versatility of the embedded computer system lends itself to utility in all kinds of enterprises, from the simplification of deliverable products to a reduction in costs in their development and manufacture. Complex systems with rich functionality employ special operating systems that take into account major characteristics of embedded systems. Embedded operating systems have minimized footprint and may follow real-time operating system specifics.

The special computers system is usually less powerful than general-purpose systems, although some expectations do exist where embedded systems are very powerful and complicated. Usually a low power consumption CPU with a limited amount of memory is used in embedded systems. Many embedded systems use very small operating systems; most of these provide very limited operating system capabilities.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Some embedded systems have to operate in extreme environment conditions such as very high temperature & humidity.

For high volume systems such as portable music players or mobile phones, minimizing cost is usually the primary design consideration. Engineers typically select hardware that is just “good enough” to implement the necessary functions.

For low volume or prototype embedded systems, general purpose computers may be adapted by limiting the programs or by replacing the operating system with a real-time operating system.

### 1.5 Characteristics of Embedded Systems:

Embedded computing systems generally exhibit rich functionality—complex functionality is usually the reason for introducing CPUs into the design. However, they also exhibit many non-functional requirements that make the task especially challenging:

• Real-time deadlines that will cause system failure if not met;

• Multi-rate operation;

• In many cases, low power consumption;

• Low manufacturing cost, which often means limited code size.

Workstation programmers often concentrate on functionality. They may consider the performance characteristics of a few computational kernels of their software, but rarely analyze the total application. They almost never consider power consumption and manufacturing cost. The need to juggle all these requirements makes embedded system programming very challenging and is the reason why embedded system designers need to understand computer architecture.

### 1.6 Overview of an Embedded System Architecture:

Every Embedded system consists of a custom-built hardware built around a central processing unit. This hardware also contains memory chips onto which the software is loaded.

The operating system runs above the hardware and the application software runs above the operating system. The same architecture is applicable to any computer including desktop computer. However these are significant differences. It is not compulsory to have an operating system in every embedded system. For small applications such as remote control units, air conditioners, toys etc.

### 1.7 Applications of Embedded Systems:

Some of the most common embedded systems used in everyday life are:

Small embedded controllers: 8-bit CPUs dominate, simple or no operating system (e.g., thermostats)

Control systems: Often use DSP chip for control computations (e.g., automotive engine control)

Distributed embedded control: Mixture of large and small nodes on a real-time Embedded networks(e.g., cars, elevators, factory automation)

System on chip: ASIC design tailored to application area (e.g., consumer electronics, set-top boxes)

| | |
|---|---|
| Network equipment: | Emphasis on data movement/packet flow (e.g., network switches; telephone switches) |
| Critical systems: | Safety and mission critical computing (e.g., pacemakers, automatic trains) |
| Signal processing: | Often use DSP chips for vision, audio, or other signal Processing (e.g., face recognition) |
| Robotics: | Uses various types of embedded computing (especially Vision and control)(e.g., autonomous vehicles) |
| Computer peripherals: | Disk drives, keyboards, laser printers, etc. |
| Wireless systems: | Wireless network-connected "sensor networks" and "Motes" to gather and report information |
| Embedded PCs: | Palmtop and small form factor PCs embedded into Equipment |
| Command and control: | Often huge military systems and "systems of systems" (e.g., a fleet of warships with interconnected Computers) |

Home Appliances, intercom, telephones, security systems, garage door openers, answering machines, fax machines, home computers, TVs, cable TV tuner, VCR, camcorder, remote controls, video games, cellular phones, musical instruments, sewing machines, lighting control, paging, camera, pinball machines, toys, exercise equipment

Office Telephones, computers, security systems, fax machines, microwave, copier, laser printer, color printer, paging

Auto Trip computer, engine control, air bag, ABS, instrumentation, security system, transmission control, entertainment, climate control, cellular phone, keyless entry

**1.8 TYPES OF EMBEDDED SYSTEMS:**

Based on functionality and performance embedded systems categorized as 4 types

1. Stand alone embedded systems
2. Real time embedded systems
3. Networked information appliances
4. Mobile devices

### 1.8.1 Stand-alone embedded systems:

As the name implies, stand-alone systems work in stand-alone mode. They take i/p, process them and produce the desire o/p. The i/p can be an electrical signal from transducer or temperature signal or commands from human being. The o/p can be electrical signal to drive another system an led or LCD display

Ex: digital camera, microwave oven, CD player, Air conditioner etc.

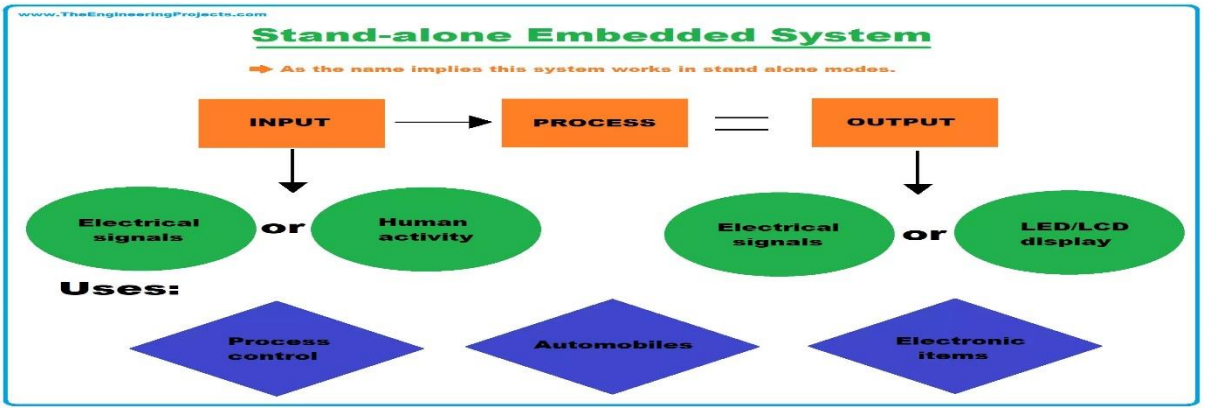



**Fig1.1: Standalone embedded system**

### 1.8.2. Real time embedded systems :

In this type of an embedded system a specific work has to be complete in a particular period of time.

Hard Real time systems: - embedded real time used in missiles

Soft Real time systems: - DVD players

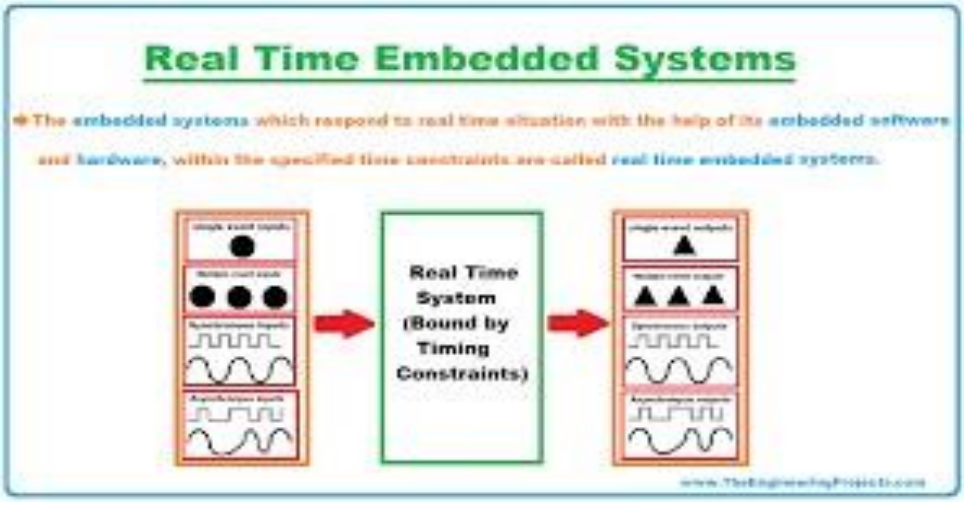



**Fig-1.2: Real time embedded systems**

### 1.8.3. Networked information appliances:

Embedded systems that are provided with n/w interfaces and accessed by n/w such as local area n/w or internet are called Network Information Appliances

Ex A web camera is connected to the internet. Camera can send pictures in real time to any computers connected to the internet

### 1.8.4. Mobile devices:

Actually, it is a combination of both VLSI and Embedded System Mobile devices such as Mobile phone, Personal digital assistants, smart phones etc are special category of embedded systems

**Fig-1.3: Mobile Devics**

## 1.9 MICROCONTROLLER VERSUS MICROPROCESSOR

A system designer using a general-purpose microprocessor such as the Pentium or the 68040 must add RAM, ROM, I/O ports, and timers externally to make them functional. Although the addition of external RAM, ROM, and I/O ports makes these systems bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand.

A Microcontroller has a CPU (a microprocessor) in addition to a fixed amount of RAM, ROM, I/O ports, and a timer all on a single chip. In other words, the processor, the RAM, ROM, I/O ports and the timer are

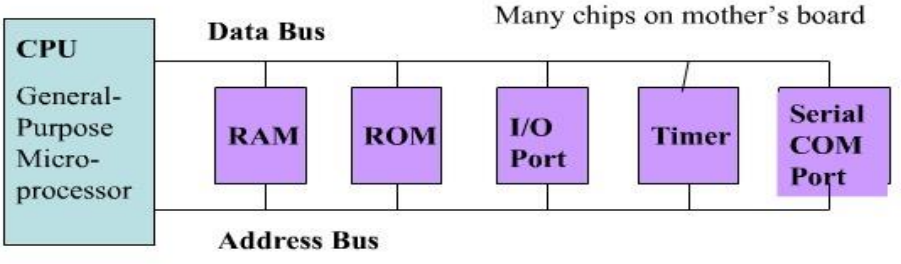
all embedded together on one chip; therefore, the designer cannot add any external memory, I/O ports, or timer to it. The fixed amount of on-chip ROM, RAM, and number of I/O ports in Microcontrollers makes

them ideal for many applications in which cost and space are critical.

**Microprocessors:**

General-purpose microprocessor

- CPU for Computers
- No RAM, ROM, I/O on CPU chip itself
- Example：Intel's x86, Motorola's 680x0




General-Purpose Microprocessor System

**Fig-1.4: Microprocessor**

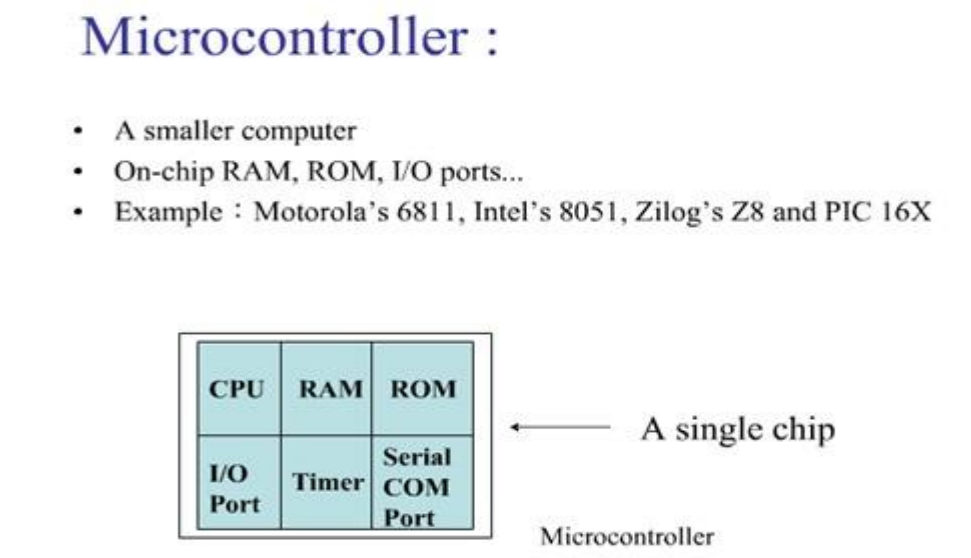



**Fig-1.5: Microcontroller**

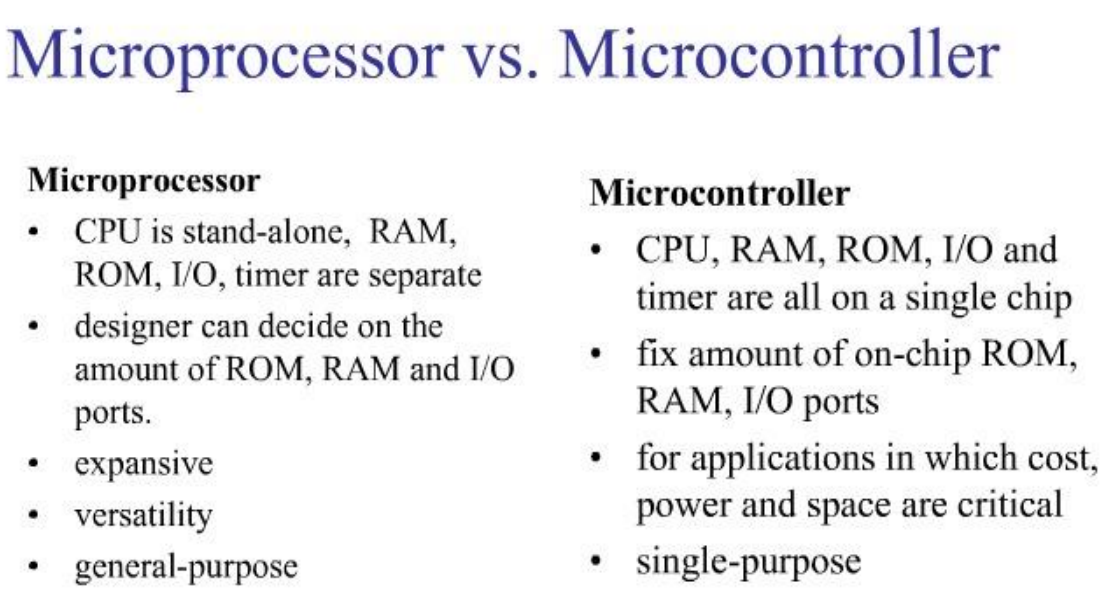



**Fig-1.6: Microprocessor vs Microcontroller**

# CHAPTER 2
# LITERATURE SURVEY

## 2.1. Smart Energy Efficient Home Automation System Using IoT

**Authors** - Satyendra K. Vishwakarma

Advancement in IoT based application has become the state-of-the art technology among the researcher due to the availability of Internet everywhere. To make the application more user friendly, web based and android based technologies have gained their importance in this cutting edge technology. In this paper, smart energy efficient home automation system is proposed that can access and control the home equipments from every corner of the world. For this system, Internet connectivity module is attached to the main supply unit of the home system which can be accessed through the Internet. For wireless connectivity, the static IP address is used. Home automation is based on multimodal application that can be operated using voice recognition command of the user using the Google Assistant or through a web-based application. Thus, main objective of this work is to make our home automation system more secure and intelligent.

**Keywords**- Home Automation, Relay, Node MCU (ESP8266), IFTTT, Adafruit, Internet of Things (IoT), Google Assistant, Voice Control, Smartphone.

**Technologies Used**

- IOT
- Adafruit
- Node MCU

**Drawbacks and Limitations**

- Complexity of Installation and Setup.
- It having the Limited Energy Savings.

### 2.2. Power Consumption Optimization and Home Automaton using Smart Sensor Networks

**Authors -** Veeramanenisharath Kumar, P. Anuradha

The process of obtaining power consumption optimization and home automation has been accounted. We are making use of various sensors for this purpose. All the sensors used are negative coefficient sensors. Unnecessary wastage of electricity is reduced with the help of sensors. Sensors are used to get information such as light intensity, temperature, humidity, harmful gases using LDRs, thermistors, humidity sensors and gas sensors respectively. The data is given to the GSM from controller with the help of Max232 IC. With the help of GSM, one can monitor the conditions in the environment from long distance also. The model has been broadly tried, in actuality, circumstances and exploratory outcomes are exceptionally reassuring. At first Zigbee wireless sensor network is used to monitor and control the system, but because of some limitations of the Zigbee network such as its inability for long range communications, GSM system is used in the extension part of the project.

**Key Words**: smart monitoring, controlling system, Zigbee wireless, GSM system

**Technologies Used**

- GSM
- Zigbee
- Lpc 2148 Micro Controller

**Implementation of Proposed System Is Divided into Two Major Modules.**

- Home Automation
- Sensors

**Drawbacks and Limitations**

- High power consumption

### 2.3. An Intelligent IoT-based Home Automation for Optimization of Electricity Use

**Authors -** Antony Francis, Sheema Madhusudhanan, Arun Cyril Jose.

The world is gearing towards renewable energy sources, due to the numerous negative repercussions of fossil fuels. There is a need to increase the efficiency of power generation, transmission, distribution, and use. The proposed work intends to decrease household electricity use and provide an intelligent home automation solution with ensembled machine learning algorithms. It also delivers organized information about the usage of each item while automating the use of electrical appliances in a home. Experimental results show that with XG Boost and Random Forest classifiers, electricity usage can be fully automated at an accuracy of 79%, thereby improving energy utilization efficiency and improving quality of life of the user.

**Key Words**: Microcontrollers, Home automation**,** Proximity sensors

**Technologies used**

- Machine Learning

**Drawbacks and Limitations**

- Initial Cost and Investment
- Compatibility and Interoperability Issues

### 2.4. Energy Management And Analysis For Smart Homes Using IoT

**Authors** - Shreya Oswal, Varun Modani, Shubham Gundawar.

The increasing load on conventional sources of energy and the alarming rate at which fossil fuels are depleting called for a shift towards renewable sources of energy. The past decade has kindled the era of solar panels for home use in a time of global climate change. However, solar panels cannot operate at maximum efficiency all the time. There will be certain days when a grid connection is necessary to fully cover the power usage. This paper proposes energy management and analyzing system that aims to optimize energy supply from solar energy and grid supply and minimize energy expenses by smartly switching between the two sources of energy, forming an essential component of a smart grid system. Switching between power supplies is done to draw power from the source which is more efficient in terms of cost and balancing energy supply at a given time. The system analyses the energy consumption routine of the model and ensures efficient energy supply.

**Keywords**-. User Behavior Analysis, Remote Control, Energy Cost Optimization, Environmental Sustainability.

**Technology Used**

- Energy Optimization Algorithms
- Renewable Energy Integration

**Drawbacks and Limitations**

- Maintenance and Upkeep
- Reliability and Stability

**2.5. Smart home automation system for energy efficient housing**

**Authors –** Niksa Skeledzija, Niksa Skeledzija, Edin Koco

This paper presents a concept and implementation of modern smart monitoring and control system for building automatization. The system is designed to enable significant reduction of energy consumption and carbon footprint by increasing the energy efficiency of the building under control. The system consists of a Linux-based remotely accessible main embedded control unit, a custom designed programmable logic controller named littlePLC, and a propriatery low-power Wireless Sensor Network (WSN). The energy flow is optimized by using a Model Predictive Control (MPC) algorithm that runs on the main control unit. The main control unit communicates with littlePLC, which serves as an interface that controls the parameters and state of HVAC systems in the building. The feedback information for MPC is gathered by means of the WSN, which consists of various sensor node types, such as temperature, air pressure, humidity, VOC and CO2. The WSN nodes are connected in a star type network topology, with a communication HUB connected to the main control unit. The information gathered by WSN are used in the MPC algorithm in order to calculate and estimate the requirements for heat corrections, with respect to ventilation and weather predictions.

**Key words:** Wireless sensor networks, Mathematical model, Buildings, Batteries, Wireless communication.

**Technology Used**

- Mathematical model
- Algorithms

**Drawbacks and Limitations**

- Reliability and Stability Concerns.
- Complexity and Technical Knowledge Requirement.

### 2.6. Energy Optimization for Smart Home Automation in Multi-Cloud Environment

**Authors:** V.Raghav Shanka, S. Suchitra, B. Pavithra.

With technological development, connecting with everyday applications engage the user over a remote environment via a mobile device like a Smartphone with Internet connectivity has become a common practice. The creation of the Internet of Things (IoT) has enabled the smart communication infrastructure. The proposed work encompasses a system in which household interactions are made much easier through automation, safety and the Internet of Things helps to develop a system that allows anyone to remotely monitor and control certain parts of a house from anywhere remotely and also makes them safe with multi-cloud design to ensure greater safety. The project's basic idea is the use of multi-cloud and low energy IC to incorporate home automation with high security. Using the widely available Google Cloud Platform, the proposed system is efficiently designed to control the various elements of the smart home. This system is significantly coupled with the low cost Integrated Circuits controlling the electrical components which eventually results in an efficient and power effective Smart Home Solution.

**Key words:** Integrated circuits, Home appliances, Automation, Smart homes, Software, Safety, Security

**Technologies Used**

- Internet of Things (IoT)
- Edge Computing

**Drawbacks and Limitations**

- Interoperability Issues
- Data Governance and Compliance

### 2.7. Low Power WSN Protocol for Smart Green Homes

**Authors:** Ema Teixeira, Paulo Pedreiras, Alexandre Mota

The concept of Smart Homes has been around for decades, but is gaining momentum nowadays thanks to the dissemination and exponential growth of Internet of Things technologies. However, the logic integration and holistic management of all devices within a home, despite appealing, brings significant technical challenges. Particularly, tasks such as problem diagnosis or energy consumption optimization are becoming increasingly complex. The supervision networking infrastructure plays here a crucial role and is particularly challenging because smart homes combine characteristics commonly found both at the industrial and domestic level. This paper introduces a wireless communication protocol that has been specifically designed for supporting optimization and fault diagnosis systems for smart homes. As distinctive features, the protocol combines determinism and reliability with an high level of adaptivity and flexibility, which are often regarded as conflicting requirements and are not jointly supported, in an effective way, by current state of the art protocols. The paper includes preliminary experimental results that validate some of the desired properties of the protocol.

**Keywords:** Protocols, Sensors, Schedules, Wireless sensor networks, Energy consumption, Real-time systems, Synchronization.

**Technologies Used**

- Bluetooth Low Energy (BLE)
- Zigbee

**Drawbacks and Limitations**

- Limited Bandwidth
- Interference and Signal Degradation

## 2.8. Internet of Things Based Energy Aware Smart Home Control System

**Authors:** Murad khan, Bhagya Nathali silva, Kijunhan

The concept of smart home is widely favored, as it enhances the lifestyle of the residents involving multiple disciplines, i.e., lighting, security, and much more. As the smart home networks continue to grow in size and complexity, it is essential to address a handful among the myriads of challenges related to data loss due to the interference and efficient energy management. In this paper, we propose a smart home control system using a coordinator-based ZigBee networking. The working of the proposed system is three fold

1) smart interference control system controls the interference caused due to the co-existence of

IEEE 802.11x-based wireless local area networks and wireless sensor networks.

2) smart energy control system is developed to integrate sunlight with light source and optimizes the energy consumption of the household appliances by controlling the unnecessary energy demands.

3) smart management control system to efficiently control the operating time of the electronic appliances. The performance of the proposed smart home is testified through computer simulation. Simulation results show that the proposed smart home system is less affected by the interference and efficient in reducing the energy consumption of the appliances used in a smart home.

**Keywords**- Bayesian decision, binary classifiers, biometrics, data fusion, face recognition, speaker recognition, support vector machine

**Technologies Used**

- Wireless Communication Protocols
- Energy Management Systems (EMS)

**Drawbacks and Limitation**

- Reliability and Stability

# CHAPTER 3

# EXISTING SYSTEM

Advancement in IoT based application has become the state-of-the art technology among the researcher due to the availability of Internet everywhere. To make the application more user friendly, web based and android based technologies have gained their importance in this cutting-edge technology. In this paper, smart energy efficient home automation system is proposed that can access and control the home equipments from every corner of the world. For this system, Internet connectivity module is attached to the main supply unit of the home system which can be accessed through the Internet. For wireless connectivity, the static IP address is used. Home automation is based on multimodal application that can be operated using voice recognition command of the user using the Google Assistant or through a web-based application. Thus, main objective of this work is to make our home automation system more secure and intelligent.

## 3.1 Problem Statement

The advancement of Internet of Things (IoT)-based applications has garnered significant attention from researchers due to the pervasive availability of internet connectivity. To enhance user accessibility and convenience, there has been a notable emphasis on integrating web-based and android-based technologies into IoT frameworks. This paper proposes a smart, energy-efficient home automation system designed to enable remote access and control of household appliances from any location worldwide.

The proposed system integrates an Internet connectivity module with the primary home supply unit, facilitating remote access via the internet. Wireless connectivity is established using a static IP address. The home automation functionality is facilitated through a multimodal application, which can be operated either through voice commands utilizing Google Assistant or through a web-based interface.

The primary objective of this research is to enhance the security and intelligence of home automation systems. By leveraging IoT technologies and incorporating features such as remote accessibility and voice control, the proposed system aims to provide users with greater convenience, efficiency, and control over their home environments.

### 3.2 Existing System Block diagram

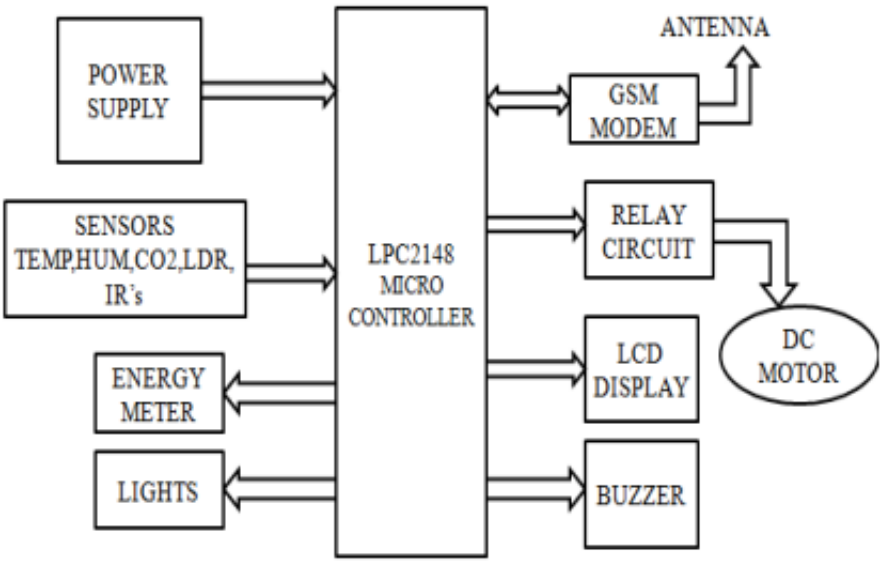



**Fig:3.1 Existing System Block diagram**

# CHAPTER 4
# PROPOSED SYSTEM

This section includes the structure of proposed technique for constructing a household automatic system. This system is the combination of software and hardware-based technologies. In our proposed model, we have focused on power consumption problems. Electricity Dispatcher for home automation is the proposed solution for most of the electric power consumption problems. This proposed system consists of three automated techniques web-based, app-based, voice based and locally. For voice based I used both google assistance and alexa. The implementation of this model has included the Arduino Uno along with sensor, switches, and relay modules. For research we have focused on four appliances Bulb, Fan, Ac & electric heater, which are being observed under defined conditions and by three ways i.e., locally, web, voice and app-based they are being controlled. In the local case, Arduino Uno is programmed in such a way that it will take the results from the sensor then after processing the response is being generated so relay module and switches will perform their "5 goals": cost effectiveness, comfortability, personalization, sustainability, and smartness actions accordingly to break or restore the circuit. In web, voice and app-based cases the circuit consists of Arduino, relay and NodeMCU connected to appliances.

**4.1 Block Diagram**

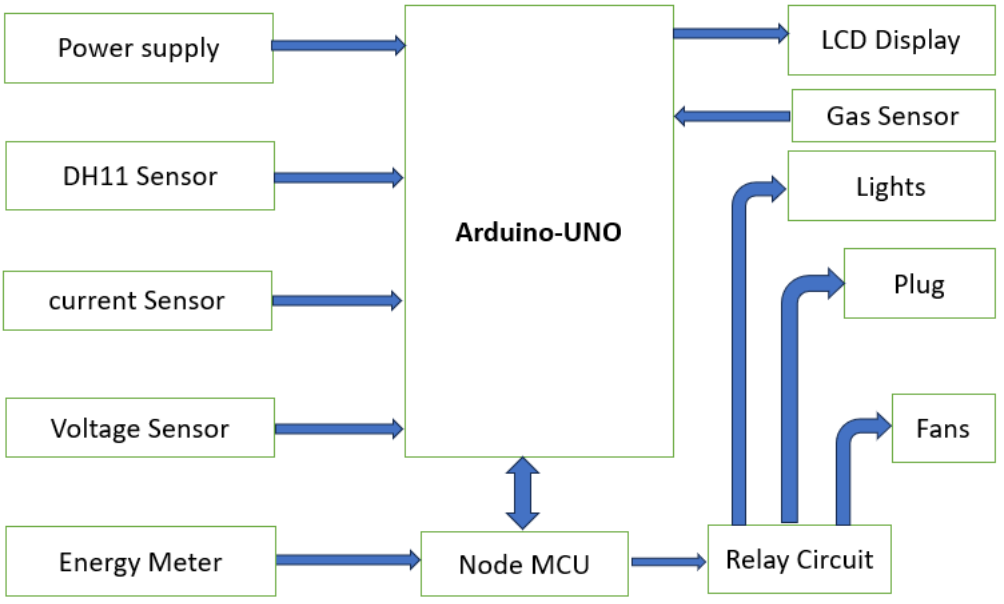



**Fig 4.1. Block Diagram of Intelligent Home Automation with Smart Power Optimization System**

## 4.2 Hardware Description

### 4.2.1 Arduino UNO ATMEGA 328P

**Introduction**

Arduino is a both an open-source software library and an open-source breakout board for the popular AVR micro-controllers. The Arduino IDE (Integrated Development Environment) is the program used to write code, and comes in the form of a downloadable file on the Arduino website. The Arduino board is the physical board that stores and performs the code uploaded to it. Both the software package and the board are referred to as "Arduino."

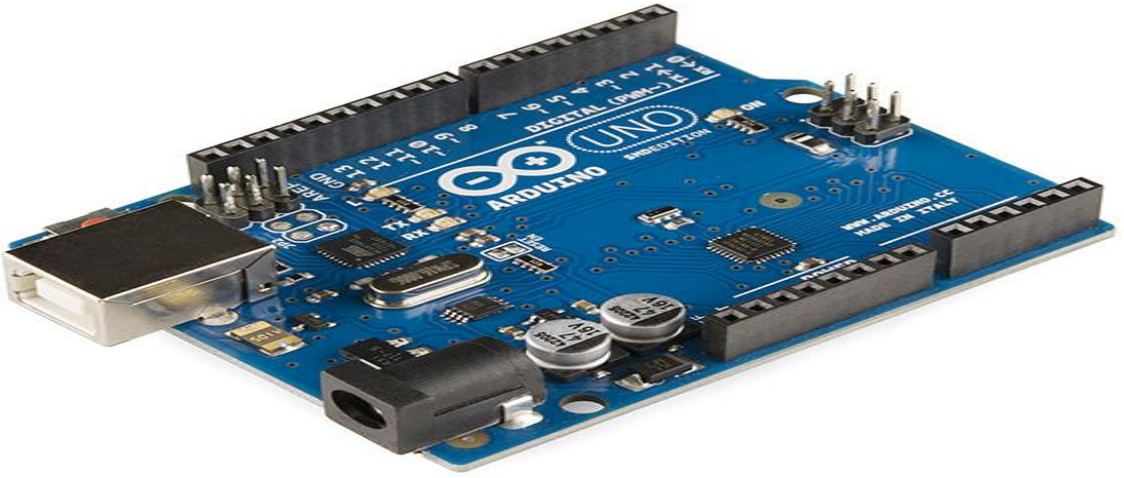



**Fig4.2: Arduino UNO ATmega328P**

To begin, download the Arduino IDE from the Arduino website. Make sure to select the right version for your Operating System (OS). For a full getting started guide for each OS, please refer to the Arduino guide. Once the arduino.zip file has been downloaded, extract the file to a folder somewhere on your computer. There is no install simply open the folder and double click the .exe.

**PIN configuration of Arduino**

The components of Arduino UNO board are shown below:

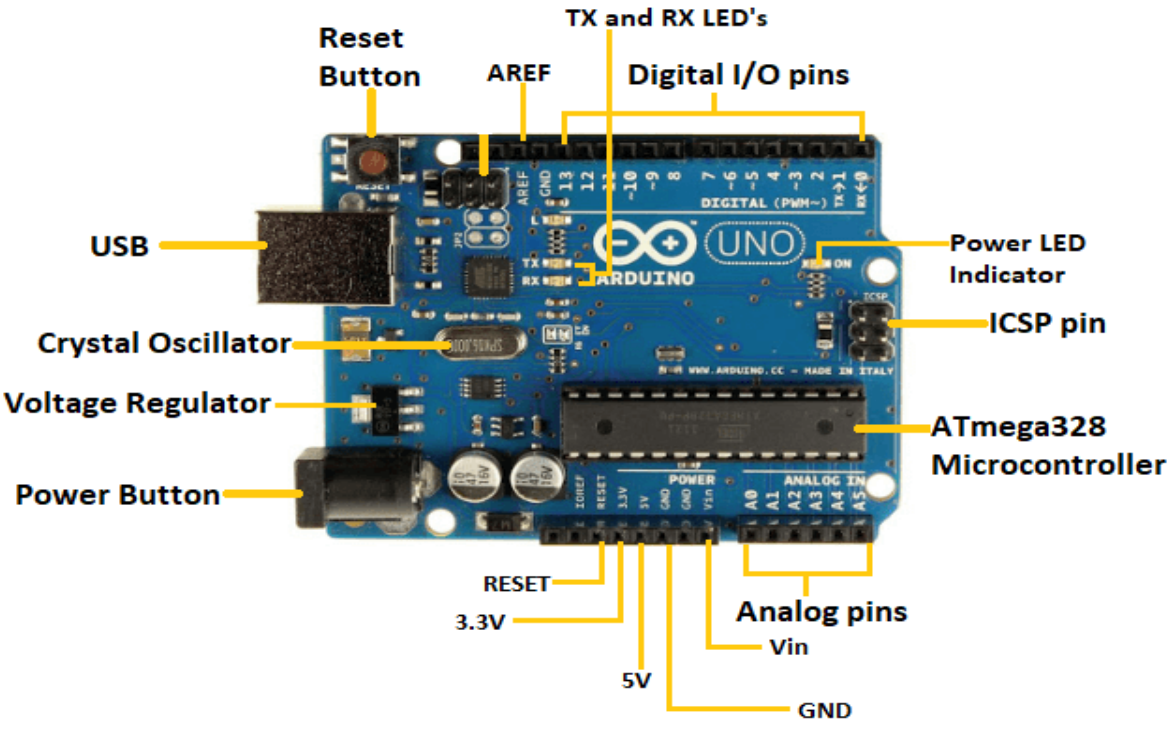



**Fig 4.3: Pin configuration of Arduino UNO ATMEGA328P**

Let's discuss each component in detail.

- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines **Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.**
- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.

- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's**- The successful flow of data is represented by the lighting of these LED's.
- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB**- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator**- The voltage regulator converts the input voltage to 5V.
- **GND**- Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin**- It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

**Features of Arduino**

- **ATMega328P Processor**
- **Memory**
  - AVR CPU at up to 16 MHz
  - 32KB Flash
  - 2KB SRAM
  - 1KB EEPROM
- **Security**
  - Power On Reset (POR)
  - Brown Out Detection (BOD)
- **Peripherals**
  - 2x 8-bit Timer/Counter with a dedicated period register and compare channels
  - 1x 16-bit Timer/Counter with a dedicated period register, input capture and compare channels
  - 1x USART with fractional baud rate generator and start-of-frame detection
  - 1x controller/peripheral Serial Peripheral Interface (SPI)
  - 1x Dual mode controller/peripheral I2C
  - 1x Analog Comparator (AC) with a scalable reference input
  - Watchdog Timer with separate on-chip oscillator
  - Six PWM channels
  - Interrupt and wake-up on pin change
- **ATMega16U2 Processor**
  - 8-bit AVR® RISC-based microcontroller
- **Memory**
  - 16 KB ISP Flash
  - 512B EEPROM
  - 512B SRAM
  - Debug WIRE interface for on-chip debugging and programming
- **Power**
  - 2.7-5.5 volts

**Applications**

Advantages of Arduino in real-time

- Easy to Use
- Inexpensive Hardware
- Cross Platform Support

### 4.2.2 MQ2 Gas Sensor

It can detect: LPG, i-butane, propane, methane, alcohol, Hydrogen, Smoke.

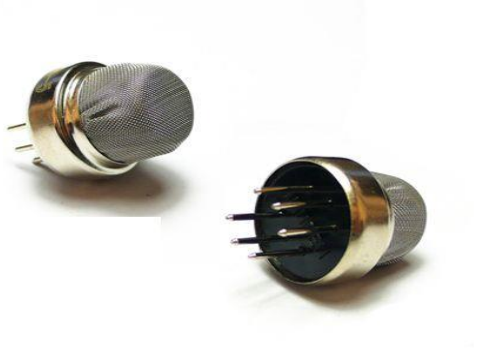


**Fig 4.4: MQ-2 Semiconductor Sensor for Combustible Gas**

**Description:**

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration.

MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different positions.

**Characters:**

- High sensitivity to combustible gas in wide Combustible gas in wide range.
- High sensitivity to LPG, Propane and Hydrogen.
- Fast response.
- Wide detection range.
- Stable performance long life low cost.
- simple drive circuit.

### 4.2.3 Liquid Crystal Display (LCD):

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

**Pin Description:**


**Fig4.5: LCD Pin Description**

| Pin No. | Name | Description |
|---|---|---|
| 1 | VSS | Power supply (GND) |
| 2 | VCC | Power supply (+5V) |
| 3 | VEE | Contrast adjust |
| 4 | RS | 0 = Instruction input<br>1 = Data input |
| 5 | R/W | 0 = Write to LCD module<br>1 = Read from LCD module |
| 6 | EN | Enable signal |
| 7 | D0 | Data bus line 0 (LSB) |
| 8 | D1 | Data bus line 1 |
| 9 | D2 | Data bus line 2 |
| 10 | D3 | Data bus line 3 |
| 11 | D4 | Data bus line 4 |

| | | |
|---|---|---|
| 12 | D5 | Data bus line 5 |
| 13 | D6 | Data bus line 6 |
| 14 | D7 | Data bus line 7 (MSB) |
| 15 | LED+ | Back Light VCC |
| 16 | LED- | Back Light GND |

**Table 4.1: Pin Description of LCD**

**LCD INTERFAC WITH MICROCONTROLLER**

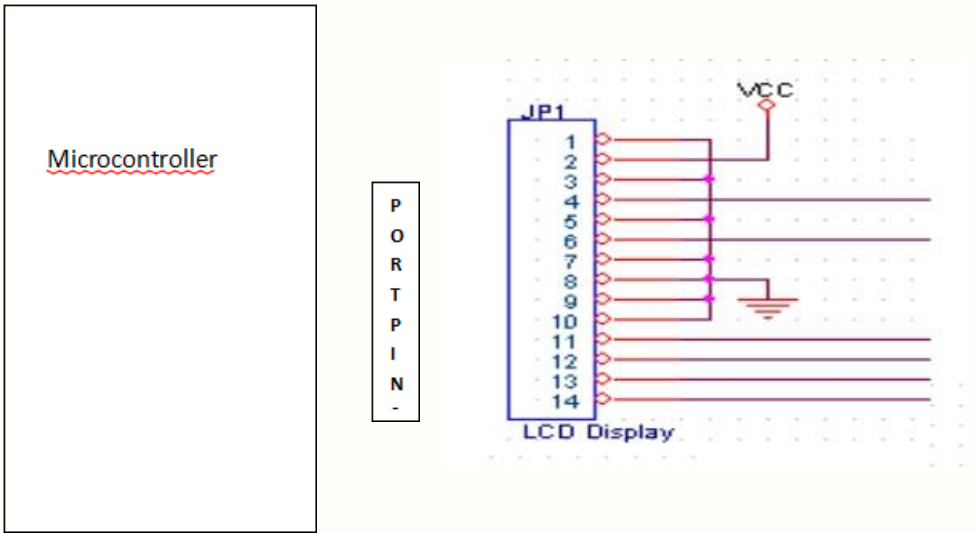



**Fig4.6: Lcd Interface With Microcontroller**

**INTERFACING LCD TO MICROCONTROLLER**

The LCD is generally interfaced in 8-bit mode or 4-bit mode. in this project LCD is connected in 4-bit mode the interface connections of LCD with microcontroller are as follows

RS of LCD is connected to p0.0 of microcontroller

EN of LCD is connected to p0.1 of microcontroller

D4 of LCD is connected to p0.4 of microcontroller

D5 of LCD is connected to p0.5 of microcontroller

D6 of LCD is connected to p0.6 of microcontroller

D7 of LCD is connected to p0.7 of microcontroller

In 8-bit mode, the complete ASCII code is sent at once along with the control signals. But in 4-bit mode, the data is divided into two parts, i.e. MSB & LSB, and are called upper nibble & lower nibble.

The control signals are RS, R/W & E. RS is used to select the internal registers i.e. data register & command register. R/W is used to set the mode of LCD to read mode or write mode. E is used as chip select and is used to push the data internally to the corresponding registers.

To transfer the data/command in 8-bit mode, the data is written to the 8-bit data bus after selecting the required register and setting the mode to write mode. The E signal pin is then given a high to low signal to transfer the data.

To transfer the data/command in 4-bit mode, the higher nibble is first written to the MSB of the data port and the E is given a high to low signal. After a little delay or when the LCD is not busy, the lower nibble is transferred in the same procedure.

### 4.2.4 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

**SOLID-STATE RELAY:**

A solid state relay (SSR) is a solid state electronic component that provides a similar function to an electromechanical relay but does not have any moving components, increasing long-term reliability. With early SSR's, the tradeoff came from the fact that every transistor has a small voltage drop across it. This voltage drop limited the amount of current a given SSR could handle. As transistors improved, higher current SSR's, able to handle 100 to 1,200 Amperes, have become commercially available. Compared to electromagnetic relays, they may be falsely triggered by transients.

**Fig4.7: Relay INTERFACING WITH 8051**

Relays are devices which allow low power circuits to switch a relatively high Current/Voltage ON/OFF. For a relay to operate a suitable pull-in & holding current should be passed through its coil. Generally relay coils are designed to operate from a particular voltage often its 5V or 12V. **The function of relay driver circuit is to provide the necessary current (typically 25 to 70ma) to energize the relay coil**.

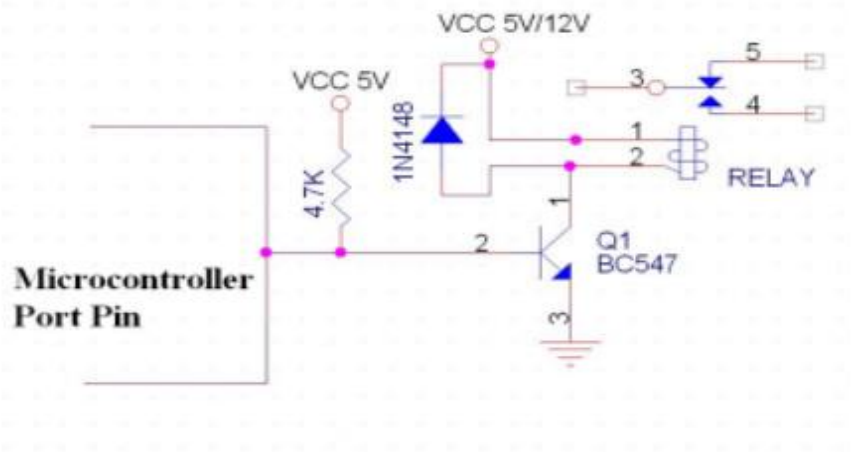
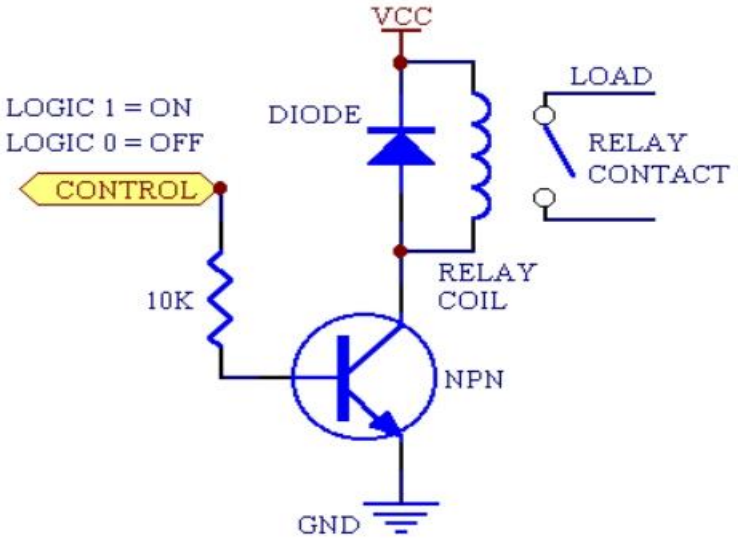



**Fig 4.8: Relay Driver Circuit**

*Above figure* shows the basic relay driver circuit. As you can see an **NPN transistor BC547** is being used to control the relay. The transistor is driven into saturation (turned ON) when a LOGIC 1 is written on the PORT PIN thus turning ON the relay. The relay is turned OFF by writing LOGIC 0 on the port pin.

A diode (1N4007/1N4148) is connected across the relay coil, this is done so as to protect the transistor from damage due to the **BACK EMF** generated in the relay's inductive coil when the transistor is turned OFF. When the transistor is switched OFF the energy stored in the inductor is dissipated through the diode & the internal resistance of the relay coil. As you can see we have used a pull up resistor at the base of the transistor. AT8951/52/55 has an internal pull up resistor of 10k so when the pin is pulled high the current flows through this resistor so the

maximum output current is 5v/10K = 0.5ma, the DC current gain of BC547 is 100 so the maximum collector current we can get is 0.5ma x 100 = 50ma, but most of the relays require more than 70ma-130ma current depending on the relay that we have used, 0.5ma of base current is not suitable enough for turning ON the relay, so we have used an external pull up resistor. When the controller pin is high current flows through the controller pin i.e. 5v/10k=0.5ma as well as through the pull up resistor. We have used 4.7k pull up resistor so 5v/4.7k=1.1ma so maximum base current can be 0.5ma + 1.1ma=1.6ma i.e. collector current =1.6ma x 100 = 160ma which is enough to turn ON most of the relays. The right relay depends on what you want to switch and how fast. What voltage, current, etc... You won't be able to drive it directly from the Arduino pin, as most general purpose relays require at least 150mW to switch which is >30mA @ 5V. You will need to use something like this:




The NPN can be just about any general purpose NPN (2N2222, BC337, etc) and the diode can be most general purpose diodes (1N4001 or similar) VCC is your +5V

If you go to somewhere like Farnell, and use the parametric search to narrow down you options, you will get hundreds of choices, here is an example search with 5VDC general purpose relays capable of >10A and >250VAC selected.

It seems this is to turn an ATX supply on by pulling the PC_ON (usually green) connection to ground. In this case the relay is a bit overkill, and a simple open collector NPN transistor circuit can be used.

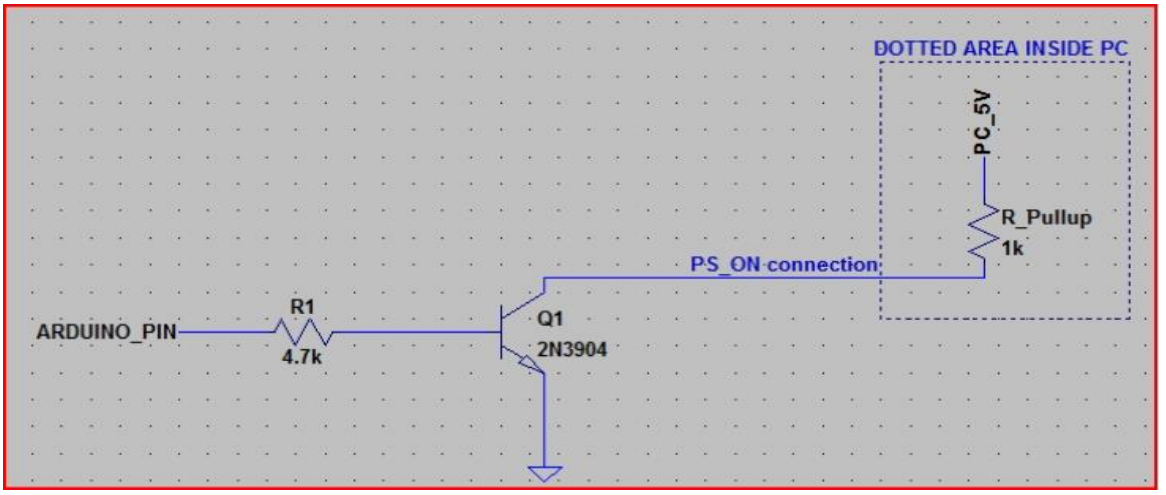



**Fig 4.9: Open collector NPN transistor circuit**

### 4.2.5 Current Sensor:

Measuring current within any system without affecting its performance is significant. So, current measurement is very essential in many instrumentation and power systems. Usually, current sensing was mainly for protection & control of the circuit. But, with the progress in technology, sensing current has appeared as a technique to examine and improve performance. So knowing the sum of current being transmitted to the load is very helpful for an extensive variety of applications. So this article discusses an overview of a **current sensor** – working with applications.

**What is a Current Sensor?**

A device that is used to detect & also change current to assessable output voltage is known as a current sensor. This output voltage is simply proportional to the current flow throughout the measured path. After that, this output voltage signal is used to display the current measured within an ammeter, for controlling purposes or simply stored for more analysis within a data acquisition system. So this is the function of a current sensor.

There are different types of sensors available in the market and each sensor is used for a particular range of current & ecological conditions. As compared to all these sensors, a current sensor is most frequently used by considering it as a current-to-voltage converter by placing a resistor into the flow of the current path, so the current is changed into voltage in a linear mode.

The technology utilized by this sensor is significant because different kinds of sensors can contain different characteristics for various applications.


**Fig 4.10: Current sensor**

Current Sensor Working Principle

The working principle of the current sensor is; once current is supplied throughout a circuit or a wire then a voltage drop takes place and also magnetic field will be generated nearby the current-carrying conductor. So, there are two kinds of current sensing direct current sensing & indirect current sensing.

Direct sensing mainly depends on Ohm's law whereas indirect sensing depends on Ampere's & Faraday's law. Direct Sensing is used to measure the voltage drop associated with the flow of current throughout passive electrical components. Similarly, indirect sensing is used to measure the magnetic field nearby a current-carrying conductor. After that, the magnetic field which is produced is used for inducing proportional current o voltage which is afterward changed to use measurement or control purposes.

## Current Sensor Specifications

The current sensor specifications mainly describe how the sensor operates and interacts in the preferred environment. So, the specifications of this sensor are discussed below.

**Measuring Range**

The measuring range is the highest flow of current that a current sensor can measure up to 120A.

**Input Voltage**

This is the required voltage to activate the device is +5V.

**Frequency Range**

The range of frequency this sensor can operate is 20Hz – 20kHz.

**Response Time**

The response time of this sensor is the time taken between the input excitation application & the appearance of the equivalent o/p signal. The response time of this sensor is < 20 ns.

**Isolation Voltage**

The isolation voltage is the voltage that a sensor can handle to defend the devices connected to it. If the voltage range is increased than the fixed range then it can damage the current sensor & gives inaccurate measurements.

**Accuracy**

The accuracy of the current sensor is above 90%.

### 4.2.6 Voltage sensor:

Devices that can sense or identify and react to certain types of electrical or optical signals. The implementation of a **voltage sensor** and current sensor techniques have become an excellent choice for the conventional current and voltage measurement methods.

**Types of Voltage Sensors**

In this article, we can discuss a voltage sensor in detail. A voltage sensor can determine, monitor, and measure the supply of voltage. It can measure the AC level and/or DC voltage level. The input to the voltage sensor is the voltage itself, and the output can be analog voltage signals, switches, audible signals, analog current levels, frequency, or even frequency-modulated outputs.

That is, some **voltage sensors** can provide sine or pulse trains as output, and others can produce amplitude modulation, pulse width modulation, or frequency modulation outputs.

In voltage sensors, the measurement is based on a voltage divider. Two main types of voltage sensors are available: **capacitive type voltage sensor** and **resistive type voltage sensor**.


**Fig 4.11: Voltage sensor**

### 4.2.7 DHT11

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc… Humidity sensors are of two

types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

**What is a DHT11 Sensor?**

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

**Working Principle of DHT11 Sensor**

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.

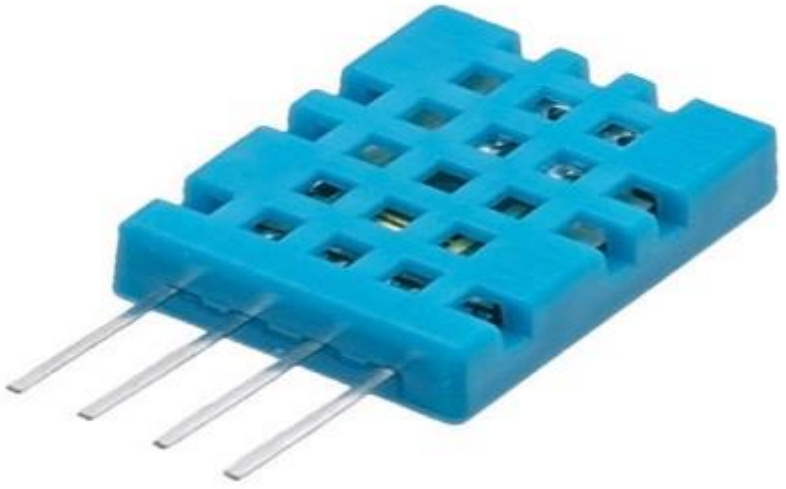


**Fig 4.12: DHT11 Sensor**

DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.

**Applications**

This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity. Offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure.

### 4.2.8 Energy Meter

The meter which is used for measuring the energy utilizes by the electric load is known as the energy meter. The energy is the total power consumed and utilized by the load at a particular interval of time. It is used in domestic and industrial AC circuit for measuring the power consumption. The meter is less expensive and accurate.

Construction of Energy Meter

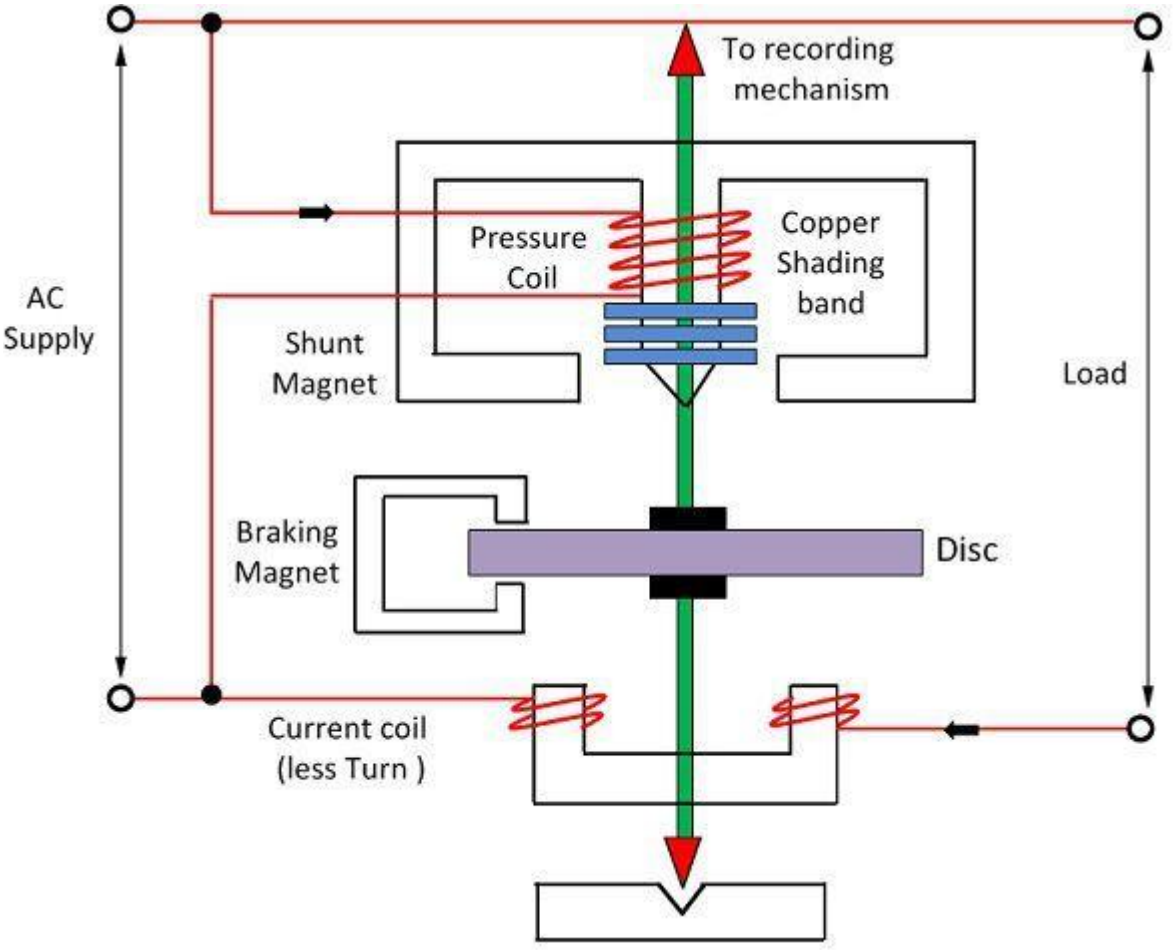



**Fig 4.13: construction of the single phase energy meter**

The energy meter has four main parts. They are the

Driving System

Moving System

Braking System

Registering System

The detail explanation of their parts is written below.

**1. Driving System** – The electromagnet is the main component of the driving system. It is the temporary magnet which is excited by the current flow through their coil. The core of the electromagnet is made up of silicon steel lamination. The driving system has two electromagnets. The upper one is called the shunt electromagnet, and the lower one is called series electromagnet.

The series electromagnet is excited by the load current flow through the current coil. The coil of the shunt electromagnet is directly connected with the supply and hence carry the current proportional to the shunt voltage. This coil is called the pressure coil.

The centre limb of the magnet has the copper band. These bands are adjustable. The main function of the copper band is to align the flux produced by the shunt magnet in such a way that it is exactly perpendicular to the supplied voltage.

**2. Moving System** – The moving system is the aluminium disc mounted on the shaft of the alloy. The disc is placed in the air gap of the two electromagnets. The eddy current is induced in the disc because of the change of the magnetic field. This eddy current is cut by the magnetic flux. The interaction of the flux and the disc induces the deflecting torque.

When the devices consume power, the aluminium disc starts rotating, and after some number of rotations, the disc displays the unit used by the load. The number of rotations of the disc is counted at particular interval of time. The disc measured the power consumption in kilowatt hours.

**3. Braking system** – The permanent magnet is used for reducing the rotation of the aluminium disc. The aluminium disc induces the eddy current because of their rotation. The eddy current cut the magnetic flux of the permanent magnet and hence produces the braking torque.

This braking torque opposes the movement of the disc, thus reduces their speed. The permanent magnet is adjustable due to which the braking torque is also adjusted by shifting the magnet to the other radial position.

**4. Registration (Counting Mechanism)** – The main function of the registration or counting mechanism is to record the number of rotations of the aluminium disc. Their rotation is directly proportional to the energy consumed by the loads in the kilowatt hour.

The rotation of the disc is transmitted to the pointers of the different dial for recording the different readings. The reading in kWh is obtained by multiply the number of rotations of the disc with the meter constant. The figure of the dial is shown below.

### 4.2.9 Internet Of Things IOT):

The Internet of Things (IoT) has taken over the conventional methods used in industries; it is simply a network of connected devices which interact with one another to exchange information, collect data, and use it to make optimum decisions. Gadgets with IoT devices are capable of performing more efficiently; they can also adapt to the environment to which they are exposed. IoT has also changed the face of today's industries. To list a few advancements: boosting production rate, product improvement, data-based analysis, risk reduction in business, and so on.

**Fig 4.14: Connecting of IOT devices**

**Node MCU**

Node MCU ESP8266 Pinout, Features, and specifications– in this basic getting started tutorial you will learn the very basic things about the Node MCU ESP8266 Wifi Module.

Node MCU is an open-source firmware for which open-source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. Node mcu ESP8266 and Node mcu ESP32 are becoming very popular and are almost used in more then 50% IoT based projects today.

The firmware uses the Lua scripting language. The firmware is based on the eLua project and built on the Espress if Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project

and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.

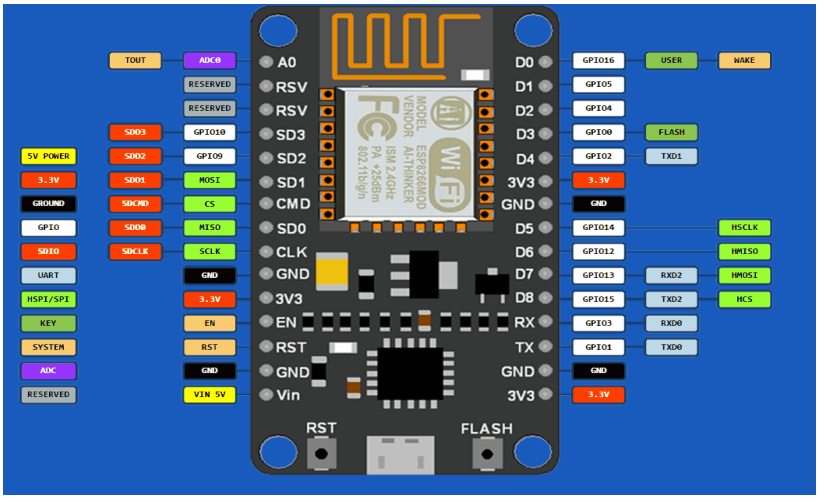



**Fig 4.15: Node MCU**

NodeMCU ESP8266 Wifi Module is an open-source Lua based firmware and development board specially targeted for IoT based applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

### 4.2.10 Interfacing with Telegram

Using Telegram with the Internet of Things (IoT) for intelligent home automation with smart power optimization system is a brilliant and practical idea. It allows us to remotely track the environment' s of our home and receive real-time updates right on our phone. Here's a breakdown of how it works:

Components:

1. Sensors: These capture data on various pollutants like LPG gas, Butane gas, Humidity and Temperature. Popular options include the MQ6 and DHT11.
2. Microcontroller board: This processes sensor data and transmits it to the cloud. Arduino Uno ESP8266 are common choices.
3. Telegram bot: Sends house information and alerts to your Telegram app. You can create one using Bot Father or third-party services.

Process:

1. Sensor data collection: The sensors gather power, current, voltage and gas readings at regular intervals.
2. Data processing: The microcontroller board cleans and formats the sensor data.
3. Data transmission: The data is sent to the cloud platform via Wi-Fi.
4. Data visualization: The cloud platform stores and visualizes the data over time. You can access it through a web dashboard.
5. Telegram notifications: The Telegram bot retrieves data from the cloud and sends you alerts if air quality levels exceed safe limits.

Benefits:

1. Remote monitoring: Track the from anywhere with an internet connection.
2. Real-time alerts: Get notified instantly when pollution levels rise.
3. Data visualization: Analyze air quality trends over time
4. Actionable insights: Take steps to improve indoor air quality, like opening windows or using air purifiers.

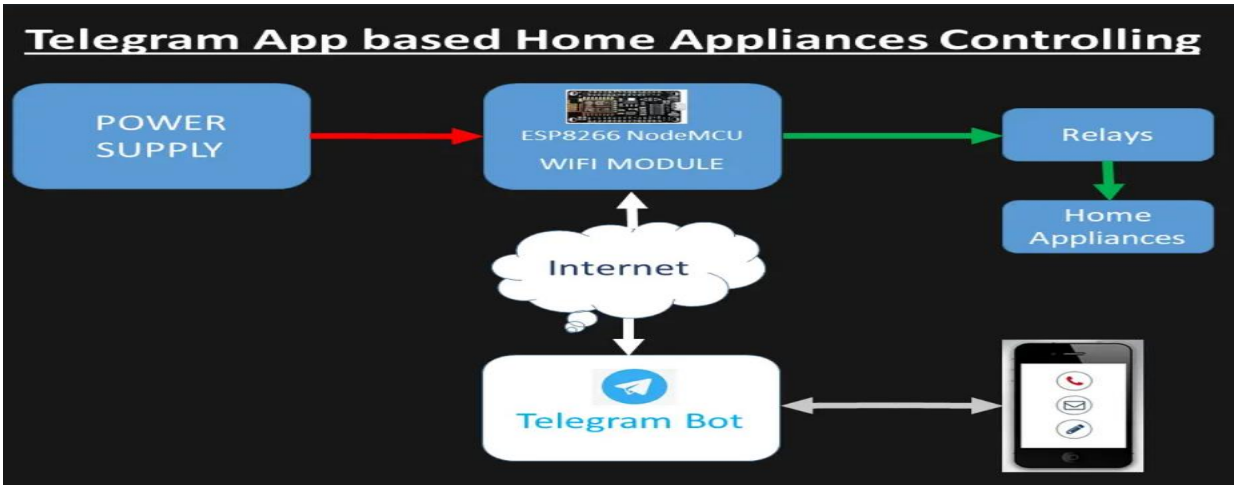



**Fig 4.16: Interfacing with Telegram**

## 4.3 SOFTWARE USED

### Arduino idle

Arduino is a both an open-source software library and an open-source breakout board for the popular AVR micro-controllers. The Arduino IDE (Integrated Development Environment) is the program used to write code, and comes in the form of a downloadable file on the Arduino website. The Arduino board is the physical board that stores and performs the code uploaded to it. Both the software package and the board are referred to as "Arduino."

To begin, download the Arduino IDE from the Arduino website. Make sure to select the right version for your Operating System (OS). For a full getting started guide for each OS, please refer to the Arduino guide. Once the arduino.zip file has been downloaded, extract the file to a folder somewhere on your computer. There is no install simply open the folder and double click the .exe.

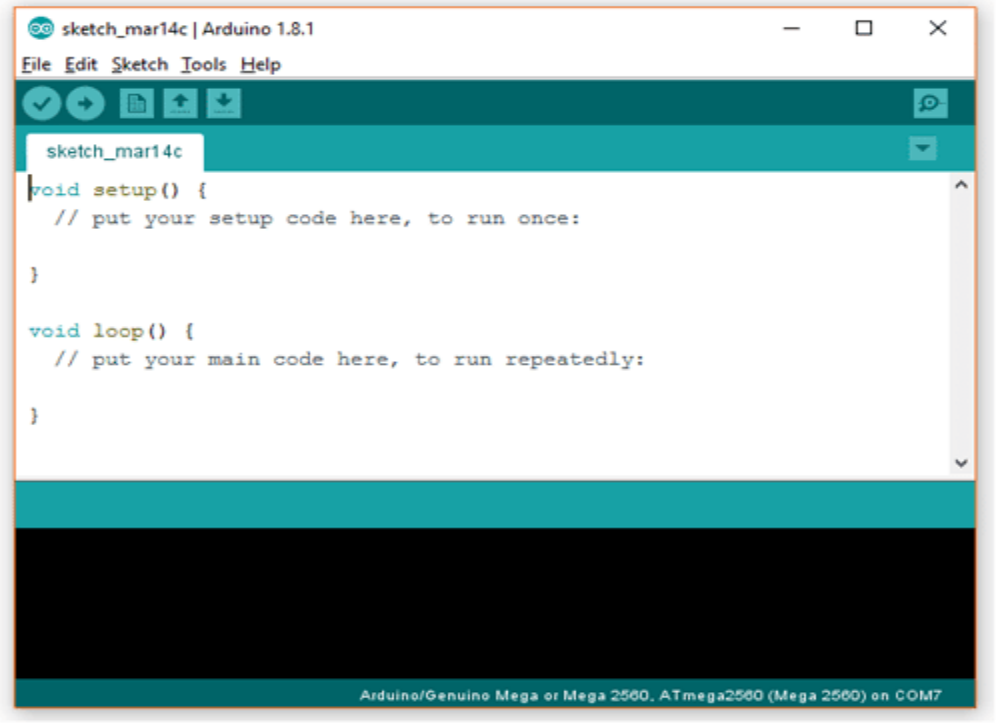



**Fig 4.17: Arduino sketch**

## 4.4 ADVANTAGES AND DISADVANTAGES

**ADVANTAGES:**

- It increased energy efficiency and enables more efficient energy management, leading to reduced energy wastage and lower utility bills over time.
- It gives more enhanced comfort and convenience to Homeowners can enjoy greater comfort and convenience with the ability to remotely monitor and control various devices and appliances in real-time, optimizing their home environment to suit their preference.
- By optimizing energy usage and reducing utility bills, homeowners can achieve significant cost savings over the long term, making this solution financially beneficial.
- The reduction in energy consumption and carbon emissions contributes to environmental sustainability, aligning with broader efforts to combat climate change and reduce ecological footprint.
- The ability of these systems to analyze energy consumption patterns and predict usage trends allows for proactive optimization of power settings, further enhancing efficiency and reducing waste.

**DISADVANTAGES:**

- The initial cost can be relatively high, including the purchase of hardware components and installation fees, which may deter some homeowners.
- The complexity of these systems, including the integration of various sensors, microcontrollers, and IoT technologies, may require technical expertise for setup and maintenance, posing a challenge for some users.
- The connectivity of these systems to the internet and cloud-based platforms raises concerns regarding data privacy and security, as sensitive information about household activities and energy usage may be vulnerable to hacking or unauthorized access.
- Homeowners may become overly reliant on the technology, leading to a loss of manual control and potential disruption in case of system failures or connectivity issues

# CHAPTER 5
# RESULTS

- The Below Kit shows the “Intelligent home automation with smart power optimization system " which Consists of Arduino board , LCD , IOT module ,voltage Sensor and curent Sensor, Fan and Light

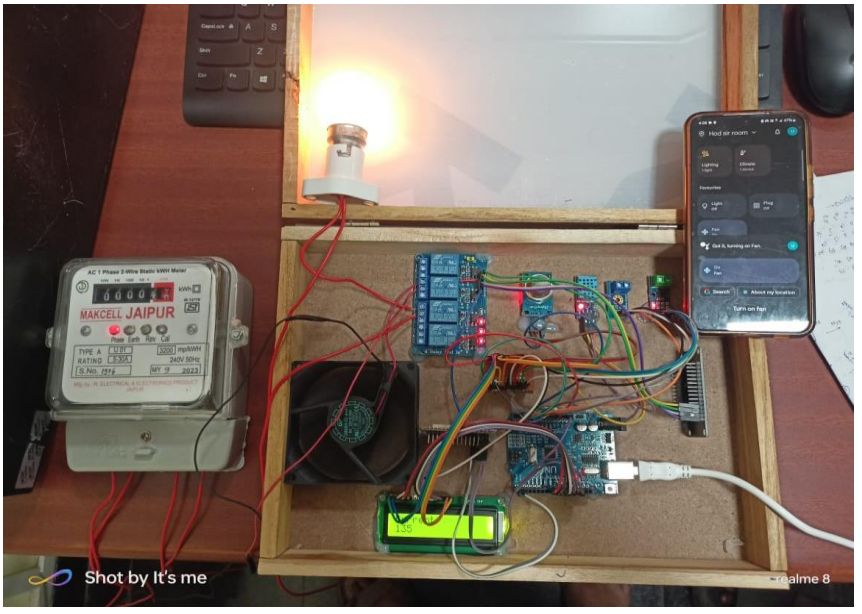



**Fig 5.1: Intelligent home automation with smart power optimization system.**

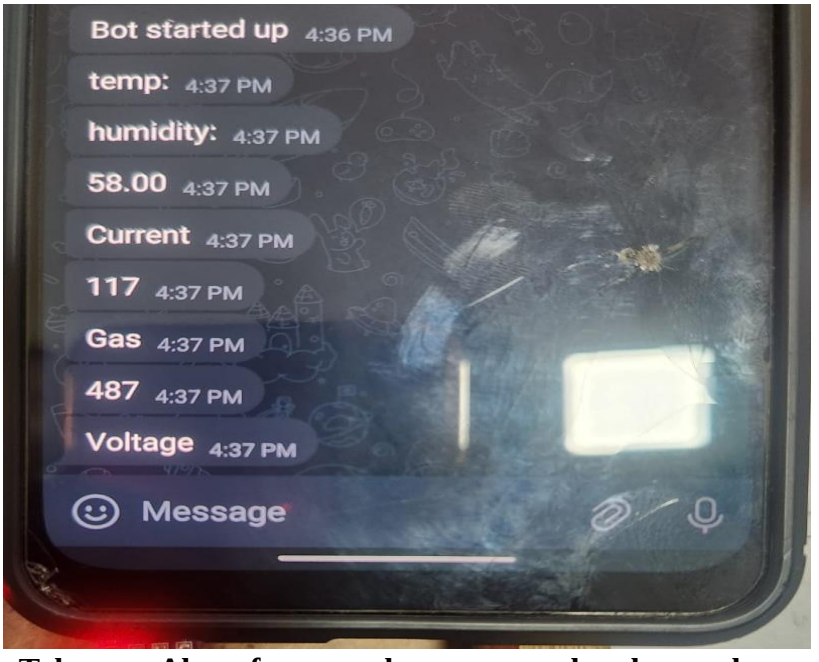



**Fig 5.2: Telegram Alerts for temp, hum, curr, vol and gas values.**


**Fig 5.3: LCD displaying the temperature value**


**Fig 5.4: LCD displaying the Humidity value**

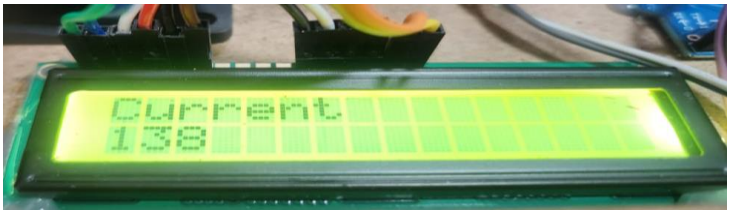



**Fig 5.5: LCD displaying the Current Value**

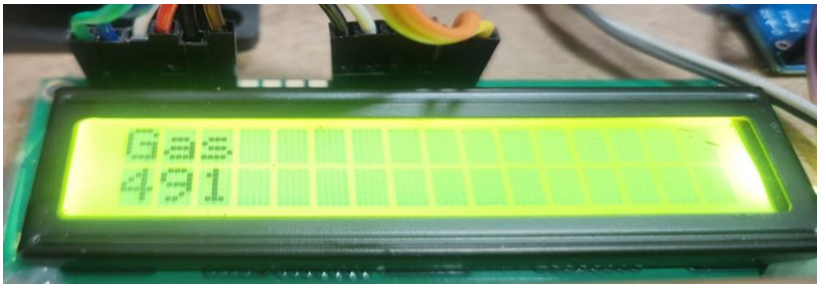



**Fig 5.6: LCD displaying the Gas value Present in the house**


**Fig 5.7: LCD displaying the voltage value**

# CHAPTER 7
# CONCLUSION

Thus, the proposed system comprises represents a significant step forward in residential energy management and sustainability. By leveraging advanced technologies such as microcontrollers, sensors, and IoT connectivity, these systems enable households to monitor, analyze, and optimize energy usage in real-time. The ability to predict usage patterns and dynamically adjust power settings allows for more efficient resource allocation, leading to reduced utility bills, increased comfort, and lower environmental impact.

Furthermore, the transformative potential of this solution extends beyond immediate benefits to individual homeowners. It contributes to broader efforts aimed at reducing carbon emissions and promoting environmental sustainability on a larger scale. As technology continues to evolve and improve, intelligent home automation with smart power optimization systems holds promise for revolutionizing the way we manage energy consumption in households, paving the way for a more efficient and sustainable future.

Hence, the proposed work helps to save considerable amount of energy, which can be seamlessly controlled from any part of the system. The overall system is safer than the existing ones, which completely utilizes and embeds the multiple techniques. Thus, this work proposes and effectively designs a combination of intelligent home automation and considerable energy conservation, which has proven to be far more efficient than the existing technologies.

# CHAPTER 8
# FUTURESCOPE

The future scope of intelligent home automation with smart power optimization is promising and expansive. Here are some potential avenues for further development and advancement:

1. Enhanced AI and Machine Learning Integration: Future systems could leverage more sophisticated artificial intelligence (AI) and machine learning algorithms to continuously improve energy optimization strategies. These systems could learn from user behaviors and preferences, dynamically adjusting settings to maximize efficiency and comfort.

2. Expanded Sensor Capabilities: As sensor technology continues to advance, future systems may incorporate a wider range of sensors to monitor additional environmental factors such as air quality, occupancy patterns, and appliance health. This comprehensive data could further refine energy optimization strategies and provide valuable insights for homeowners.

3. Integration with Renewable Energy Sources: With the growing adoption of renewable energy sources such as solar panels and wind turbines, intelligent home automation systems could integrate with these technologies to optimize energy usage based on real-time availability and production levels.

4. Enhanced User Interfaces and Control: Future systems could feature more intuitive user interfaces and control mechanisms, including voice commands, augmented reality interfaces, and predictive analytics dashboards. These advancements would empower homeowners to interact with their smart homes more seamlessly and make informed decisions about energy usage.

5. Cybersecurity and Privacy: As smart home technologies become more prevalent, ensuring robust cybersecurity measures and protecting user privacy will be critical considerations for future developments in intelligent home automation.

Overall, the future of intelligent home automation with smart power optimization holds immense potential for further innovation and improvement, offering homeowners increasingly sophisticated tools to manage energy consumption, enhance comfort, and contribute to sustainability efforts.

# CHAPTER-9
# REFERENCES

[1] X. Lei, G. Tu, A. X. Liu, C. Li, T. Xie, "The insecurity of home digital voice assistants - amazon alexa as a case study", CoRR, vol. abs/1712.03327, 2017.

[2] N Vikram, K S Harish, M S Nihaal, RakshaUmesh, ShettyAashik, Ashok Kumar, "A Low Cost Home Automation System Using Wi-Fi Based Wireless Sensor Network Incorporating Internet of Things(IoT)", 2017 IEEE 7th International Advance Computing Conference.Design and implementation of a power consumption management system for smart home over fog-cloud computing.

[3] Yan-Da Chen ; Muhammad Zulfan Azhari ,Jenq-Shiou,eu.

[4] Md. NasimuzzamanChowdhury, Md. ShibleeNooman, SrijonSarker, "Access Control of Door and Home Security by Raspberry Pi through Internet", International Journal of Scientific & Eng.

[5] A Surveys based on Cloud Internet of Things Frameworks for Smart Home Service. (2017). Multi-Disciplinary Manila (Philippines) Conferences Jan. 23-24, 2017, Manila (Philippines). doi: 10.17758/uruae.ae0117515

[6] A., M., & S., J. (2010). Integrated Wireless Technologies for Smart Homes Applications. Smart Home Systems. doi: 10.5772/8412.

[7] Balasubramanian, K., &Cellatoglu, A. (2010). Selected Home Automation and Home Security Realizations: An Improved Architecture. Smart Home Systems. doi: 10.5772/8408

[8] Energy Optimization for Smart Home Automation in Multi-Cloud Environment.

[9] Domb, M. (2019). Smart Home Systems Based on Internet of Things. IoT and Smart Home Automation [Working Title]. doi: 10.5772/intechopen.84894.

[10] Harper, R. (n.d.). Inside the Smart Home: Ideas, Possibilities and Methods. Inside the Smart Home, 1–13. doi: 10.1007/1-85233-854- 7_1.

# APPENDIX

## A. INTRODUCTION TO ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It consists of a programmable circuit board (often referred to as a microcontroller) and a development environment used to write and upload code to the board. Created in Italy in 2005, Arduino has gained widespread popularity among hobbyists, students, and professionals due to its simplicity, versatility, and affordability.The core component of an Arduino board is its microcontroller, typically based on the Atmel AVR or ARM architecture. These microcontrollers come with built-in input and output pins, which can be used to connect various sensors, actuators, and other electronic components.

Arduino boards are programmed using the Arduino Integrated Development Environment (IDE), a cross-platform application that simplifies the process of writing and uploading code. The IDE is based on the Processing programming language and uses a simplified version of C and C++.

One of the key features of Arduino is its extensive library of pre-written code, known as "sketches," which makes it easy to interface with a wide range of sensors, displays, motors, and other peripherals. Additionally, Arduino's open-source nature encourages collaboration and innovation, with a vast community of users contributing tutorials, projects, and improvements to the platform.

In summary, Arduino provides a user-friendly platform for prototyping and developing electronics projects, making it accessible to both beginners and experienced users alike. Its simplicity, affordability, and strong community support have made it a popular choice for learning, experimentation, and real-world applications in fields such as automation, robotics, IoT (Internet of Things), and interactive art.