VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama" Belagavi- 590018

Project Report on

TEMPERATURE MONITRING IN PHARMA/FOOD APPLICATION

Submitted by

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Submitted in partial fulfilment for the award of Degree of

BACHELOR OF ENGINEERING
in
MECHATRONICS and ELECTRONICS & COMMUNICATION

Under the Guidance of

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Accredited by NAAC & NBA*
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SRI VENKATESHWARA COLLEGE OF ENGINEERING
— Affiliated to VTU, Approved by AICTE, Recognised by UGC u/s 2(f) & 12(B)—

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CERTIFICATE

This is to certify that the Project Work entitled

"TEMPERATURE MONITRING IN PHARMA/FOOD APPLICATION"

Carried out by

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In partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechatronics and Electronics & Communication Engineering of Visvesvaraya Technological University, Belagavi, during the year 2022- 2023. It is certified that all corrections/suggestions indicated for Internal Assessment havebeen incorporated. The Project Report has been approved as it satisfies the academic requirements in respect of the Project Work prescribed for the said Degree.

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ABSTRACT

The proper temperature control of sensitive products, such as pharmaceuticals and food, is crucial to maintain their quality and safety throughout the supply chain. Cold-chain logistics, which involve the transportation and storage of temperature-sensitive goods, present unique challenges that require advanced monitoring and control systems. In this paper, we propose a temperature monitoring and control system that utilizes Internet of Things (IoT) technology and a web-based interface to enable real-time monitoring and control of temperature in the cold-chain logistics of the pharma/food industry. The system incorporates NodeMCU controllers, temperature sensors, and a web-based dashboard for remote monitoring and control. The proposed system provides real-time temperature monitoring, data logging, and alerts for out-of-range temperature conditions, allowing timely intervention to prevent spoilage, contamination, and other temperature-related issues. The system also allows for remote control of temperature settings, ensuring that the desired temperature conditions are maintained throughout the supply chain. The system is scalable, cost-effective, and can be easily integrated into existing cold-chain logistics processes. We discuss the design, implementation, and evaluation of the proposed system, and highlight its potential applications in the pharma/food industry, cold-chain logistics, transportation of sensitive goods, storage facilities, and supply chain management.

DECLARATION

We **Vikhyath S (1VE19MT020), Praveen HN (1VE20MT400), Tejas S (1VE19EC101)** and **Pruthvik K R (1VE19EC083)** students of final semester B.E in Mechatronics and Electronics & Communication Engineering, Sri Venkateshwara College of Engineering, Bengaluru, hereby declare that the dissertation work entitled **"TEMPERATURE MONITRING IN PHARMA/FOOD APPLICATION"** has been carried out under supervision **Mr. Murugesh Dodakundi** Assistant Professor, Department of Electrical & Electronics Engineering and **Dr. Latha M S**, Professor, Department of Civil Engineering, SVCE, Bengaluru, the partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechatronics and Electronics & Communication Engineering by Visvesvaraya Technological University, Belagavi during the academic year 2022-23. Further, the matter embodied in the dissertation has not been submitted previously by anybody for the award of any degree or diploma to any other university.

Date: 22/05/2023

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CHAPTER 1

INTRODUCTION

The project's goal is to track the temperature in the pharmaceutical and food industries. The model will upload its data to a server, where customers can then remotely access the data. The information we provide is continuously checked around-the-clock, and customers may track the progress of their orders up until they arrive at their destination. Food safety and hygiene must be upheld in order to keep food fresh, edible, and to decrease food waste. The pace of decomposition can be slowed down by keeping the atmosphere suitable for the food that is being kept. There are several factors that may affect how rapidly food decomposes, but the three that have the most impacts are temperature, humidity, and bacteria. The danger zone for storage is between 40 and 140 degrees Fahrenheit because at such temperature, bacteria grow rapidly and double in number in just 20 minutes. In order to preserve the good quality of the food for as long as is practical, the humidity in the food storage area ought to range between 50 and 55 %.

In the pharmaceutical & food industries, controlling the temp of products is essential for assuring their efficacy, quality, and safety. To avoid deterioration, loss of effectiveness, or contamination, all of which could cause large financial losses or even jeopardize public health, a variety of items, including vaccines, pharmaceuticals, and perishable foods, must be stored and delivered at precise temperature conditions. As a result,it is crucial to regularly check the temperature of these products throughout every stage of their life—from manufacturing to storing to shipping. A crucial component of quality control in the pharmaceutical and food sectors is temperature monitoring.

To maintain their safety, effectiveness, and high quality, products including vaccinations, pharmaceuticals, and perishable foods must be stored and delivered under specific temperature requirements. Lack of proper temperature control can cause products to decay, lose their efficacy, or even get contaminated, which can be expensive in terms of product waste and legal repercussions. Systems for monitoring temperature are created to continuously track and document the temperature of products during every stage of their existence, from manufacturing to storing and shipping.

These systems typically collect temperature measurements using temperature sensorsand data loggers, which are subsequently sent to a central monitoring system for evaluation and storage. Manufacturers and distributors can verify that their products are maintained within the proper temperature range and, if necessary, take corrective action to avoid qualityissues, by employing temperature monitoring systems. We want to create a temperature monitoring system exclusively for the pharmaceutical and food industries in this project. To gather and send temperature data to a cloud-based server, we will employ temperature sensors and microcontrollers.

We will also provide a user interface that enables users to keep track of temperature data in real-time, set alert thresholds, and get alerts when temperature readings deviate from the predetermined range.

Our objective is to develop a low-cost, simple-to-use temperature monitoring device that would aid in ensuring the security and caliber of pharmaceutical and food items.

By putting in place an effective temperature monitoring system, manufacturers and merchants can maintain the right temperature range for their products and, if necessary, take

corrective action to minimize quality concerns. Additionally, we will give consumers access to a user interface that lets them set temperature thresholds, view real-time temperature data,and receive alerts when temperatures stray from the expected range.

We will consider a variety of factors when creating the system, including the ideal temperature range for various product types, the accuracy and coverage of the sensors, the processing speed and memory of the microcontroller, and the usability and visual appeal of the user interface. Due to the system's inexpensive price, easy installation process, and user-friendly interface, small and medium-sized businesses in the food and pharmaceutical industries will be able to benefit from continuous temperature monitoring.

To guarantee product quality, safety, and regulatory compliance in pharmaceutical and food applications, temperature monitoring is essential. Accurate temperature monitoring and data recording are crucial for preserving the integrity of food and pharmaceutical items throughout their entire lifecycle, from production to distribution and storage, in light of the strict rules around temperature control.

We shall examine the importance of temperature monitoring in food and pharmaceutical applications in this project report. We will investigate different temperature

monitoring strategies, such as sensor-based systems, data recorders, and real-time monitoring options. We will also go over the value of temperature validation, calibration, and mapping in food and pharmaceutical environments.

The International Conference on Harmonization (ICH) guidelines, other regulatory standards that need temperature monitoring in the pharmaceutical and food industries will also be highlighted. We will also go over the repercussions of breaking temperature control laws, such as product spoiling, potency loss, and legal penalties.

Additionally, we will assess the advantages of temperature monitoring in pharmaceutical and food applications, including greater customer satisfaction, improved product quality, prolonged shelf life, and decreased product recalls. We'll also look at cutting-edge innovations, like block chain and the Internet of Things (IoT), that are transforming how the food and pharmaceutical industries monitor temperature.

Finally, this project report intends to present a thorough overview of temperature monitoring in pharmaceutical and food applications, emphasizing its significance, legal requirements, advantages, and cutting-edge technological advancements. The results of this study will aid those involved in the food and pharmaceutical industries in understanding the value of temperature monitoring and putting it into practice to guarantee product quality, safety, and compliance with legal requirements.

CHAPTER 2

LITERATURE SURVEY

[1] Yang Yang; Yan Jiang; Chao Du, (2022). Design of Temperature Monitoring System of Fresh Product Self-Collection Cabinet Based on LoRa, 2022 4th International Conference on Communications, Information System and Computer Engineering (CISCE), ISBN:978-1-6654-9848-7.

- The central monitoring platform can display the temperature levels and send out immediate notifications if the temperature rises above a predetermined threshold thanks to the LoRa module's use of wireless temperature data transmission.
- The choice of the temperature sensor, the LoRa module, and the microcontroller, among other technical aspects of the system design, are also covered by the writers.
- They also go into detail about the firmware and software architecture used to interface between hardware parts and provide data to a central monitoring platform.
- They come to the conclusion that the method can successfully stop food from spoiling and guarantee the quality of the fresh goods.

[2] Ganesan Subramanian; Anand Sreekantan Thampy; Nnamdi Valbosco Ugwuoke; Baghwan Ramnani, (2021). Crypto Pharmacy – Digital Medicine: A Mobile Application Integrated with Hybrid Blockchain to Tackle the Issues in Pharma Supply Chain, IEEE Open Journal of the Computer Society (Volume: 2), ISSN: 2644-1268

- Every year, this technique avoids a few million dollars' worth of defective medication that is absorbed into the global market.
- In addition to cryptomedicine, the IoT technology has been used to evaluate real-time monitoring of liquid medicine.
- For patients in intensive care units, it retrieves temp data in-to the block-chain & verifies the accuracy of the medication.
- Paper discusses about patient safety, monetary losses, and diminished faith in the pharmaceutical sector.

[3] Ahmad Musamih; Raja Jayaraman, Khaled Salah; Haya R. Hasan; Ibrar Yaqoob; Yousof Al-Hammadi, (2021). Blockchain-Based Solution for Distribution and Delivery of COVID-19 Vaccines, IEEE Access (Volume: 9), ISSN: 2169-3536.

- Important difficulties pertaining to the distribution and delivery of COVID-19 vaccinations have been addressed, as well as surveillance, recording, and monitoring procedures.
- In order to make the supply and distribution of COVID-19 vaccines decentralized, traceable, transparent, dependable, auditable, secure, and trustworthy, we suggested an Ethereum blockchain-based solution.
- This covers research that has suggested blockchain-based methods for boosting supply chain transparency, guaranteeing the legitimacy of vaccines, enhancing data privacy, and improving logistics for vaccine distribution.
- The authors emphasize the advantages of utilizing blockchain technology, such as improved transparency, traceability, and accountability, to resolve the issues with the supply of COVID-19 vaccinations.

[4] S. M. Mahidul Hasan; Md. Rezwanul Ahsan; Md. Dara Abdus Satter, (2021), IoT cloud-Based Low-cost Temperature, Humidity, and Dust Monitoring System to Prevent Food poisoning, 3rd International Conference on Electrical & Electronic Engineering (ICEEE), 22-24 December, 2021, EEE, RUET, Bangladesh, ISBN:978-1-6654-8281-3.

- Cloud based temp humidity and dust concentration alert tracking system have been implemented in food shops to prevent food poisoning.
- The paper gives a general review of the significance of food safety as well as the difficulties involved in preventing food poisoning.
- The quality and safety of food goods can be impacted by storage conditions, such as temperature, humidity, and dust levels, thus they emphasize the necessity for efficient monitoring systems to maintain optimum storage conditions.
- IoT technology and its possible uses in the context of food safety are thoroughly examined in the literature review.
- This covers the IoT's core ideas, such as sensor networks, data gathering, and communication protocols, as well as the possible advantages of using IoT to the monitoring of food safety, such as real-time monitoring, remote access, and data analytics.

[5] N. D'Uva(1), F. Camera(1), S. Amendola(1), S. Nappi(1), (2021), Battery less Wireless Temperature/Humidity Sensor for Item-level Smart Pharma Packaging, 978-1-6654-1980-2/21/$31.00 ©2021 IEEE, ISBN:978-1-6654-1980-2.

- In order to wirelessly and without an integrated power source detect the temperature and relative humidity inside a pharmaceutical pill package, this study presents an item-level smart packaging solution based on RFID technology.
- The authors give a brief overview of the significance of monitoring temperature and humidity in pharmaceutical packaging to assure the quality and safety of the final product.
- They draw attention to the drawbacks of conventional battery-powered sensors, including their short lifespan, upkeep requirements, and environmental effect, which has resulted in the demand for batteryless wireless sensors.
- The literature review contains a thorough examination of battery-free wireless sensor technologies that have been suggested for monitoring temperature and humidity.
- Discussions on various energy harvesting methods, such as RF (radio frequency), thermal, and piezoelectric harvesting, as well as their benefits and drawbacks, are also covered.

[6] Raisa Tahseen; MD Arifur Rahman, (2020), An IoT based Real-time Data-centric Monitoring System for Vaccine Cold Chain, date added to IEEE Xplore , ISBN:978-1-7281-9899-6.

- The proposed system gives information about the contaminated contents present in the food. This system is developed for the people so that they can identify the quality of food.
- Paper gives a brief overview of the significance of keeping vaccines in the cold chain to ensure their efficacy and safety.
- They draw attention to the drawbacks of conventional manual monitoring techniques, including the possibility of human mistake, the dearth of real-time data, and the difficulty in detecting temperature excursions. These issues have made IoT-based monitoring systems necessary.
- The authors highlight the potential uses of IoT-based monitoring systems in the management of the cold chain for vaccines, including real-time monitoring of

vaccine storage facilities, transportation equipment, and remote sites. They also talk about these systems' drawbacks and difficulties, including issues with sensor calibration, communication dependability, data security, and scalability.

- The final section of the literature review highlights the potential of IoT-based monitoring systems for vaccine cold chain management to ensure vaccine quality and safety while summarising the main findings.

[7] Atkare Prajwal (1), Patil Vaishali (2), zade payal (3), Dhapudkar Sumit(4), (2020), FOOD QUALITY DETECTION AND MONITORING SYSTEM, 2020 IEEE International Students' Conference on Electrical, Electronics and Computer Science 978-1-7281-4862-5/20/$31.00 ©2020 IEEE, ISBN:978-1-7281-4862-5.

- Information on the contaminated components that have been discovered in the food is provided by the proposed system.
- This technique was created so that people could determine the food's quality.
- The application of numerous sensors in the food sector. The status of food may be determined with the use of sensors such as pH sensors, gas sensors, and temperature sensors.
- This system has a strong presence in homes, small businesses, and eateries.

[8] Robin Raju, Greg E. Bridges, and Sharmistha Bhadra, (2020), Wireless Passive Sensors for Food Quality Monitoring, 1045-9243/20©2020IEEE, ISSN: 1045-9243.

- The present state of near-field and ultrahigh frequency (UHF) wireless passive sensors for tracking food quality indices and food deterioration indicators is discussed in this article. solutions based on UHF chipless RFID sensors and coupled-coil resonators.
- The authors give a brief overview of the significance of monitoring food quality for guaranteeing food safety and minimizing food waste.
- They draw attention to the drawbacks of conventional approaches to monitoring food quality, such as invasive sensors or human inspection, and the need for wireless passive sensors as a non-intrusive, affordable alternative.
- The authors suggest possible future paths for research in the field of Sensors that check food quality wirelessly.

- This includes recommendations for additional research on enhancing sensor dependability and accuracy, creating sophisticated data analysis and decision-making methodologies, integrating multiple sensing parameters, and addressing the difficulties involved with integrating these systems in real-world food supply chain scenarios.

[9] SEYED SHAHIM VEDAEI 1, AMIR FOTOVVAT 1, MOHAMMAD REZA MOHEBBIAN 1, (2020), COVID-SAFE: An IoT-Based System for Automated Health Monitoring and Surveillance in Post-Pandemic Life, ISSN: 2169-3536.

- An inexpensive and lightweight IoT node, a mobile application (app), and fog-based Machine Learning (ML) tools for data analysis and diagnosis make up the suggested framework.
- The smartphone app is updated to reflect the user's health circumstances when the IoT node records health data including body temperature, cough rate, respiratory rate, and blood oxygen saturation.
- Authors examine research on automated surveillance systems for infectiousillnesses, such as COVID-19, that have been suggested or put into practise.
- This covers talks of various surveillance techniques, like contact tracking, symptom monitoring, and crowd monitoring, as well as the use of technologies for datagathering and analysis, like GPS (Global Positioning System), Bluetooth, and mobileapps.
- The paper talk about the privacy and security issues raised by IoT-based surveillance and health monitoring devices.
- The challenges and constraints of guaranteeing privacy and security in such systems are covered, as well as topics like data privacy, data security, data ownership, and data sharing.

[10] Hitendra Patel, Sajan Sheth, S M Farhad, (2019), Cloud Based Temperature and Humidity Alert System to Prevent Food Poisoning, 2019 Cybersecurity and Cyberforensics Conference (CCC), ISBN:978-1-7281-2600-5.

- The Internet of Things (IoT), a new technology, has advanced technological systems for automation to new heights.

- In order to prevent food poisoning, we have created a prototype of a monitoring and alarm system for temperature and humidity.
- The limitations of cloud-based temp and humidity alarm systems are discussed by the authors, along with their technological, legal, and financial difficulties.
- Additionally, they suggest potential future research topics, including the creation of sophisticated alert generation algorithms, attention to security and privacy issues, and investigation of novel uses and settings for these systems.

[11] Fengyi Zheng and Zhihong Li, A DISPOSABLE ARRAY CHIP USING TEMPERATURE-RESPONSIVE COLOR CHANGE TO RECORD TEMPERATURE HISTORY IN TERMINAL COLD CHAIN TRANSPORTATION, 978-1-5386-8104-6/19/$31.00 ©2019 IEEE.

- This study introduces a low-cost disposable array chip that can track and reflect temperature changes during terminal cold chain transit.
- The supply chain that regulates temperature for the shipping and storage of temperature-sensitive goods such medicines, vaccines, and food is referred to as the "cold chain." It is important to protect the safety and quality of perishable goods because is essential to maintain the proper temperature range throughout the cold chain.
- Therefore, to guarantee that the cold chain is maintained throughout the shipping process, reliable and affordable temperature monitoring solutions are crucial.
- The authors suggest a disposable array chip that will alter colour in response to changes in temperature. The chip consists of a collection of color-changing units, each of which contains materials that change colour in response to temperature. Because the colour change is persistent, a permanent record of the temperature history can be made.
- The suggested chip has a number of benefits, including affordability, usability, and data integrity.
- The widespread use of such disposable array chips for temperature monitoring in the cold chain industry could result from further research and development in this field, which would improve quality assurance and the safety of perishable items during transportation.

[12] Shaik Shabana Anjum, Rafidah Md Noor, Ismail Ahmedy, Performance evaluation of energy autonomous sensors for air quality monitoring in Internet of Vehicles, 978-1-7281-1217-6/19/$31.00 ©2019 IEEE, ISBN:978-1-7281-1217-6

- Internet of things (IoT) technical breakthroughs have set the path for the development of internet of vehicles (IoV), where objects are substituted with cars through empowering technologies.
- The performance assessment of energy autonomous sensors is covered in the study, along with criteria for energy efficiency, sensing precision, and dependability.
- Additionally, they examine the prior work on data fusion, compression, and transmission for energy autonomous sensors in the IoV, which are essential for maximising the energy usage and communication effectiveness of these sensors.
- Various energy harvesting devices, sensing strategies, and data processing and communication approaches are highlighted in the review along with obstacles and accomplishments in this area.
- An developing concept called the Internet of cars (IoV) combines cars, infrastructure, and other entities to allow for intelligent and effective communication and coordination between them.

[13] Mengyao Yuan, Rami Ghannam, Petros Karadimas and Hadi Heidari, School of Engineering, University of Glasgow, G12 8QQ, UK, Flexible RFID Patch for Food Spoilage Monitoring, 2018 IEEE Asia Pacific Conference on Postgraduate Research in Microelectronics and Electronics, ISBN:978-1-5386-9591-3.

- The objective of this study is to construct and simulate a wearable RFID patch for monitoring food spoilage in smart packaging. The patch will be able to be recognized and have temperature data read by a device that supports near field communication technology using an attached circular antenna.
- Due to its non-contact and non-intrusive nature, RFID technology, which employs wireless communication to track and identify objects, has emerged as a promising alternative for food deterioration monitoring.
- The literature review covers a wide range of topics connected to flexible RFID patches for tracking food spoilage, including several forms of RFID technology, including passive, semi-passive, and active RFID, as well as its benefits, drawbacks, and performance traits.

- The authors also discuss various sensor types, including gas sensors, temperature sensors, humidity sensors, and other pertinent sensors, that can be incorporated into RFID patches to monitor food decomposition.
- The literature review covers a wide range of topics connected to flexible RFID patches for tracking food spoilage, including several forms of RFID technology, Including passive, semi-passive, and active RFID, as well as its benefits, drawbacks, and performance traits. The authors also discuss various sensor types, including gas sensors, temperature sensors, humidity sensors, and other pertinent sensors, that can be incorporated into RFID patches to monitor food decomposition.

[14] Ceccato, P.1, Vancutsem, C.1,2, Temimi, M.3, (2010), MONITORING AIR AND LAND SURFACE TEMPERATURES FROM REMOTELY SENSED DATA FOR CLIMATE-HUMAN HEALTH APPLICATIONS, 978-1-4244-9566-5/10/$26.00 ©2010 IEEE, ISBN:978-1-4244-9566-5

- The suggested method makes sure that the vaccine cold chain is continuously tracked during the whole process of conveyance to wellness centers, and because it is completely computerized, it makes sure that the entire process is transparent and effective.
- The literature review on environment-human wellness possibilities of monitoring the atmosphere and earth's surface temperatures using remotely sensed data provides an in-depth examination of the becoming research and accomplishments in this field.
- The review focuses on the platforms, sensors, processing methods, applications, and possible advantages of using remotely sensed temperature data for research on the environment and human health.
- For researchers, practitioners, and policymakers involved in climate change, human health, and remote sensing, the results of this literature review can be a useful resource.
- They can offer guidance for the creation of strategies that will effectively monitor and mitigate human health impacts of climate change.

CHAPTER 3

PROPOSED WORK

3.1 PROBLEM STATEMENT

In the areas of medicine, food, beverages, and transportation, we lack an efficient, adaptable, and versatile temperature monitoring system, so we must modernize. This system, which is based on one of our compatible models, provides an end-to-end remote tracking and management solution.

3.2 OBJECTIVES

- Our main objective is to stop damage before it starts, hence we want to be able to sense and control the product's temperature to stop temperature-related damage.
- Wireless, lightweight, compact, affordable solution with precise and reliable sensors for a crucial variable
- Alimentary response in an emergency system, which includes a prompt recall and early detection of possible risks.
- At every phase of decision-making, there are features for continuous monitoring and data collecting on food safety.
- Automatic transmission of the results to the cloud for online viewing in an understandable presentation format.

3.3. METHODOLOGY

All of the components in this project interface with the node mcu, which is utilized as a microcontroller and allows us to control all of the components. When the temperature is excessive, the cooling fan and buzzer will turn on, and a message will be sent to the registered mobile number using GSM and GPS to track the location. Temperature sensors are used to measure the temperature in the atmosphere. On LCD, all data is displayed. By using the thingspeak app on an Android phone, we can view real-time data. Using this idea, you can travel with food and medicine intact.

As shown in figure 3.3.1, the proposed approach includes a cooling fan, temperature sensor, node microcontroller, LCD display, GPS, and GSM. The block diagram for the suggested method is displayed in the picture below.

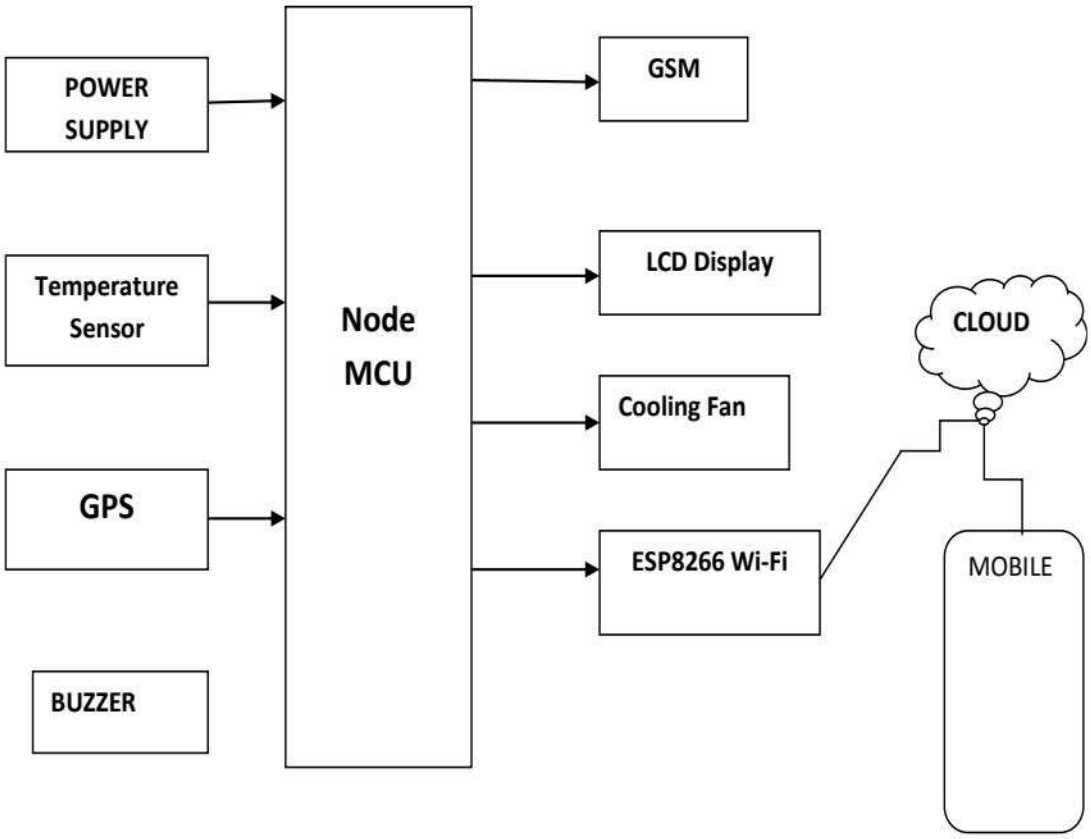

Fig. 3.3.1: Block Diagram of Temperature monitoring in pharma/food.

The proposed temperature monitoring and control system utilizes Node MCU controllers, temperature sensors, and a web-based dashboard for remote monitoring and control. The Node MCU controllers, equipped with temperature sensors, are placed in the shipping containers, storage facilities, and other key locations in the cold-chain logistics process. These Node MCU controllers continuously monitor the temperature and send the data to a centralized web-based dashboard in real-time. The web-based dashboard provides a user-friendly interface for remote monitoring and control of temperature conditions. Users can access the dashboard through a website, allowing for data logging, alarms for out-of-range temperature circumstances, and real-time monitoring of temperature. The system is automated and can also be further integrated as remotely controlled.

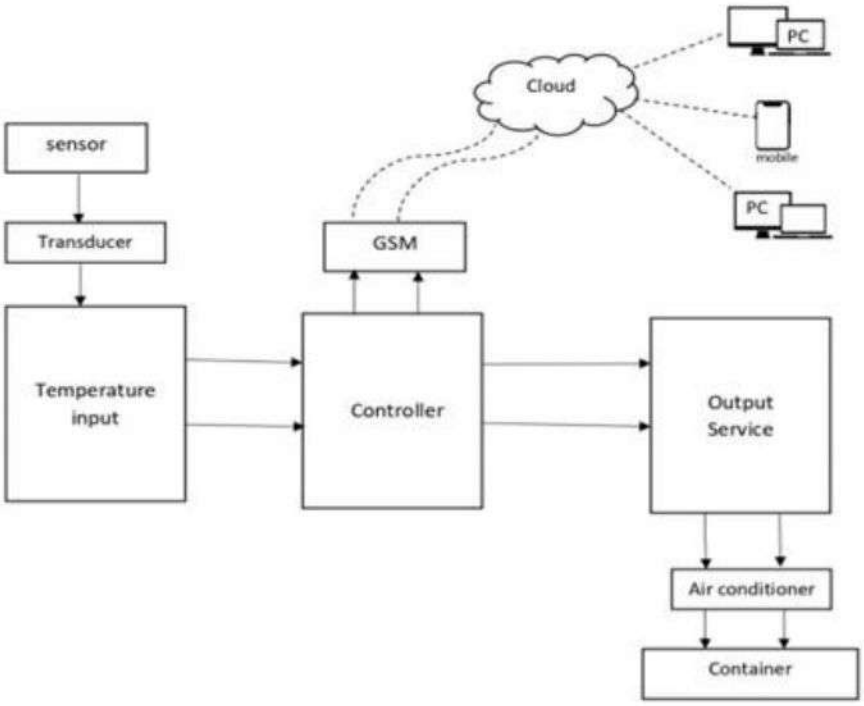

Fig. 3.3.2: The architecture of the proposed system.

3.4 FLOW CHARTS

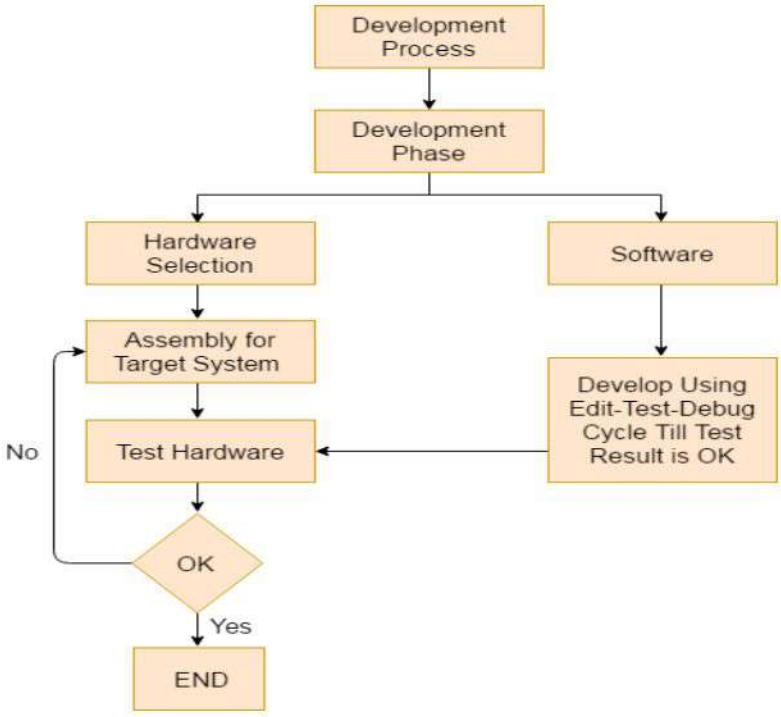

Fig. 3.4.1: Flow chart of development of Embedded system.

The above Fig 3.4.1 represents the flowchart of stages in embedded system development design. In contrast to designing another electronic system, designing an embedded system involves different steps. The stages in the flow chart that must be taken to construct an embedded system.

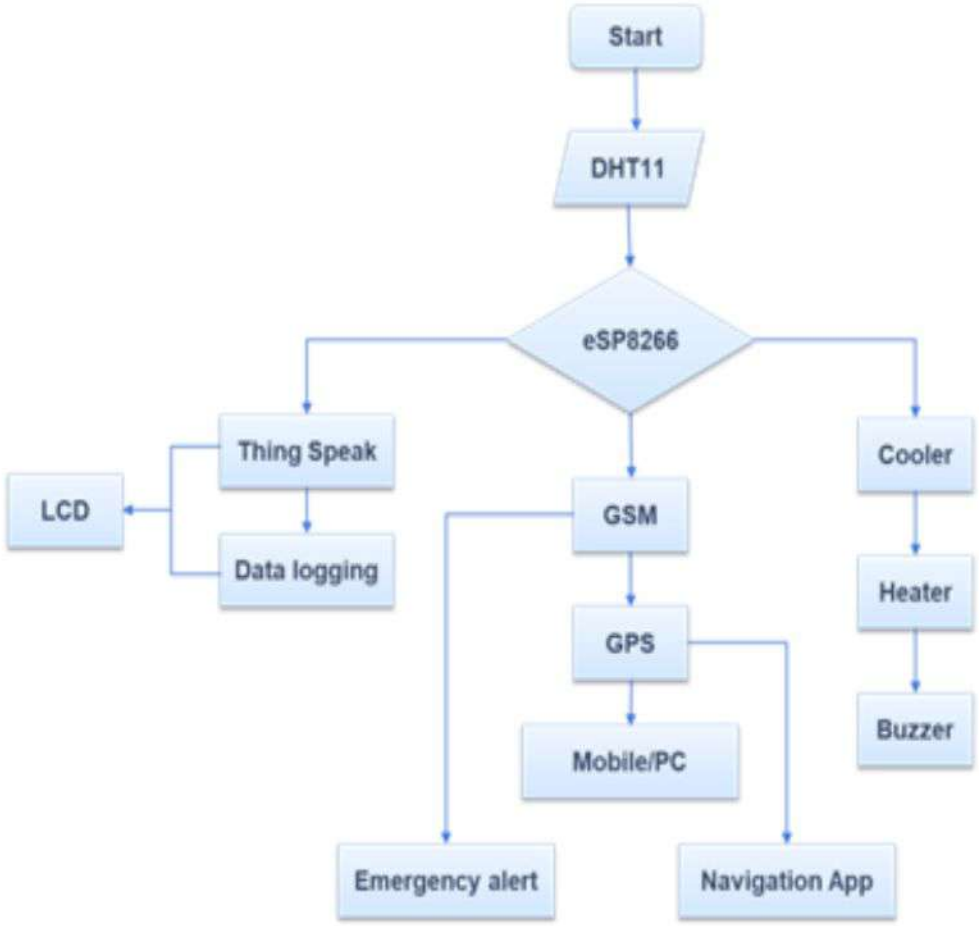

Fig. 3.4.2: Flowchart of proposed system.

Fig 3.4.2 describes as the process as:

- Start: The process starts by initializing the temperature sensor, GPS module and GSM module.
- Read temperature: The temperature sensor reads the current temperature of the storage area or container where the food or pharmaceutical products are kept.
- Check temperature: The system then checks if the temperature is within the safe range. If the temperature is less than 31 degrees Celsius, an SMS alert is sent to the user, “Your food is not safe, and we are working on it.” The blub will on at this condition to maintain the temperature.

- If the temperature is 35 degrees Celsius or greater, the system sends an SMS alert, "Your food is safe, and we deliver you the freshness of food." The cooler fan will on to maintain the temperature between 31 to 35 degrees Celsius.
- Log data: The temperature data is then logged and stored in the database.
- Update ThingSpeak: The system updates the ThingSpeak dashboard with the current temperature reading.
- GPS Location: The current location of vehicle will be sent to the host.
- Display on LCD: The temperature reading and humidity is also displayed on an LCD screen for quick monitoring.
- Sleep: The system then goes to sleep for a specified period before repeating the process.
- End: The process ends.

3.5. Embedded System processors

Processors receive sensor responses from transducers in the form of digital data, which are the major part of embedded systems that process sensor responses to deliver output within instantaneous surroundings.

It is crucial for an embedded system developer to be knowledgeable about both microprocessors and microcontrollers.

Processors inside a system:

Two crucial components make up a processor in a system:

- **Control unit**: This processing unit handled the task of controlling programme flow within an embedded system. The control unit also serves as a fetching unit to get the set of instructions that are stored in a memory.
- **Execution unit**: This unit is utilized to carry out the different activities that are carried out by processors. It primarily consists of an arithmetic and logical unit (ALU), as well as a circuit that carries out programme control operations inside processors using the instruction sets.

Types of processors:

An embedded system's processors fall into one of the following categories :

- Applications-dependent systems processors, or ASSPs, are used in embedded systems

to handle signals. They are known as Application Specific Systems Processors (ASSP). Thus, each programme that completes a job requires a new set of system processors.

- Application-dependent instruction processors are referred to as "Application Specific Instruction Processor" (ASIP). It is employed to process the various instruction sets in the combinational circuit of an embedded system.
- General Purpose Processor (GPP) in an embedded system, GPP is used to manage the way through the address bus, structure bus, and data bus in order to process signals from input to output.

Different types of general–purpose processor are:

- Microprocessor
- Microcontroller
- Digital signal processor
- Analog signal processor

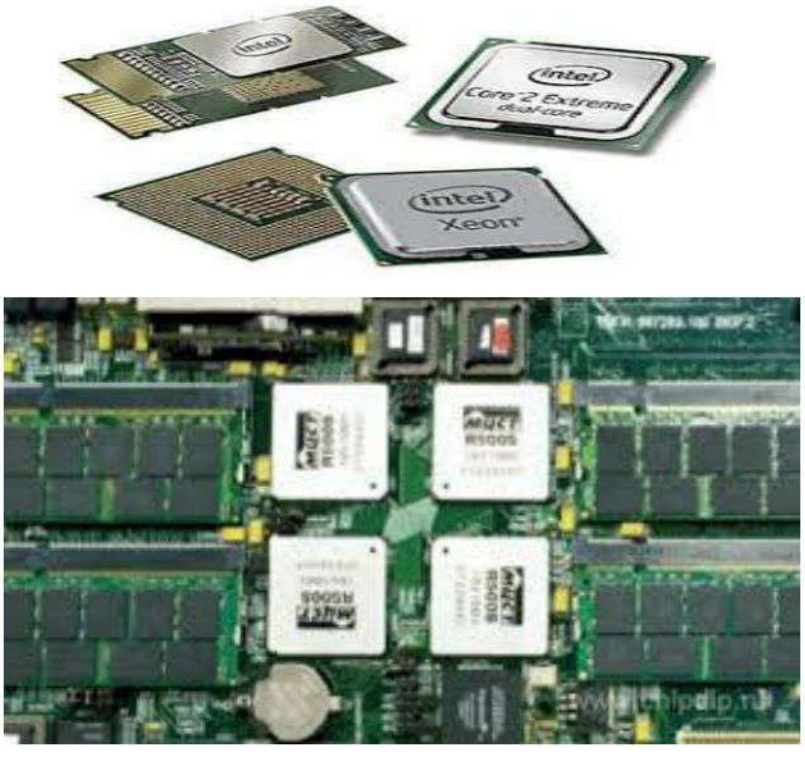

Fig. 3.5: General purpose processors.

Embedded System Tools

Compiler

A compiler converts the source code of a high-level programming language into a low-level programming language. It transforms code written in a high-level programming language into machine or assembly code. Producing software that can be executed is the primary driver of conversion.

The operations carried out by the compiler are:

- Code generation
- Code optimization
- parsing
- Syntax direct translation
- Preprocessing

Decompiler

Programmed are translated from low-level to high-level languages using a decompiled. High-level programming languages are converted into machine code or assembly language using this method.

Assembler

An embedded system tool called an assembler is used to convert assembly language-written computer instructions into a pattern of bits that the computer processor may employ to carry out its fundamental operations. By converting assembly language commands into a collection of mnemonics for describing each low-level machine activity, an assembler generates an object code.

Debugging

A tool for lowering the number of errors or flaws in manufactured electronic devices or computer programmes is debugging. Compact subsystems are challenging to debug because even little changes can result in errors in other systems. In terms of development time and debugging capabilities, embedded system debugging varies.

Simulators

An embedded system can be simulated using a simulator. Code simulation on the host computer was used to test the microcontroller unit's code. A simulator is used to simulate the entire microcontroller's functionality in software.

3.6 Thing Speak App

An assortment of "connected things" in a network make up the Internet of things (IoT). A built-in operating system and a communication link for the internet or other nearby devices are often features of the items. A platform called ThingSpeak for the Internet of Things (IoT) enables users to gather, examine, and display data from various IoT gadgets and sensors. It offers a collection of tools and APIs that make it simple for users to build IoT apps and services as well as a cloud-based infrastructure. Here is a thorough description of the ThingSpeak app:

"ThingSpeak" is one such IoT application platform that provides a wide range of analytical, monitoring, and defense capabilities.

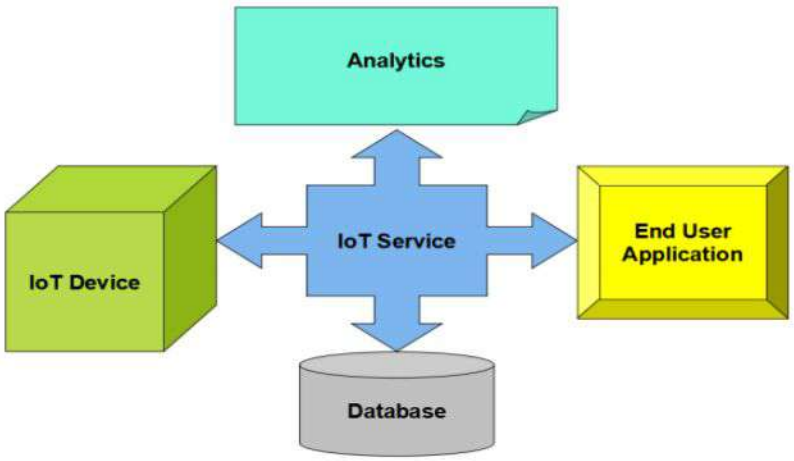

Fig. 3.6: Working of ThingSpeak

The platform ThingSpeak was created specifically for those who wish to build IoT apps and provides a number of features. ThingSpeak has an intuitive online interface that enables both technical and non-technical individuals to utilise it. It functions as an all-encompassing IoT platform, including capabilities for data collecting, storage, analysis, visualisation, and application development. ThingSpeak enables customers to efficiently use IoT data for a variety of applications, including environmental monitoring, asset tracking, home automation, and industrial IoT, thanks to its rich feature set and flexibility.

The fundamental building block of ThingSpeak is a ThingSpeak Channel. The information that we supply to ThingSpeak is saved in a channel, which has the following elements:

- Eight fields can be used to hold data of any sort, including data from embedded systems and sensor data.
- There are three fields for storing location information: latitude, longitude, and elevation. They work well for tracking moving targets.
- Only one condition field: a brief statement summarising the data stored in the channel. In order to use ThingSpeak, we must create a username and password and a channel for ourselves.
- Data visualisation tools are available from ThingSpeak in the form of graphs, gauges, and charts. Users may build individualised dashboards to show their data in real-time or in historical perspectives. Understanding patterns, trends, and anomalies is made easier by this visual depiction of the data. To carry out sophisticated data analysis and visualisation, ThingSpeak also enables interface with other visualisation platforms and tools, such as MATLAB.

CHAPTER 4

SYSTEM REQUIREMENTS

4.1 SOFTWARE REQUIREMENTS

The software requirements for our project are as follows.

4.1.1 ARDUINO IDE:

The User-Friendly Interface: The Arduino IDE has an intuitive interface that makes writing and uploading code easier. Writing and debugging Arduino sketches (programmes) is made simpler by the inclusion of a text editor with syntax highlighting, code completion, and error checking. Cross-Platform Compatibility: The Linux, macOS, and Windows operating systems are all compatible with the Arduino IDE. This removes all limitations and enables users to interact with Arduino boards on their choice platform. Library management for Arduino: The IDE comes with a library manager that makes it simple for users to find, download, and manage libraries. Libraries offer pre-written code for a variety of components and functions, enabling users to easily add sophisticated functionality to their applications without having to start from scratch.

Board and Port Selection: A variety of Arduino boards are supported by the Arduino IDE. From the "Tools" menu, users may choose the appropriate board, which configures the IDE to build and upload code particularly for that board. Additionally, users may decide which port should be used to connect the Arduino board to the computer. Code Compilation and Uploading: The IDE includes a compiler that converts written code (a "sketch") into instructions that the Arduino board can understand. It also manages the board uploading procedure for the compiled code. Users only need to click the "Upload" button to send the code to the Arduino board that is currently attached.

- File
- Edit
- Sketch
- Tools
- Help

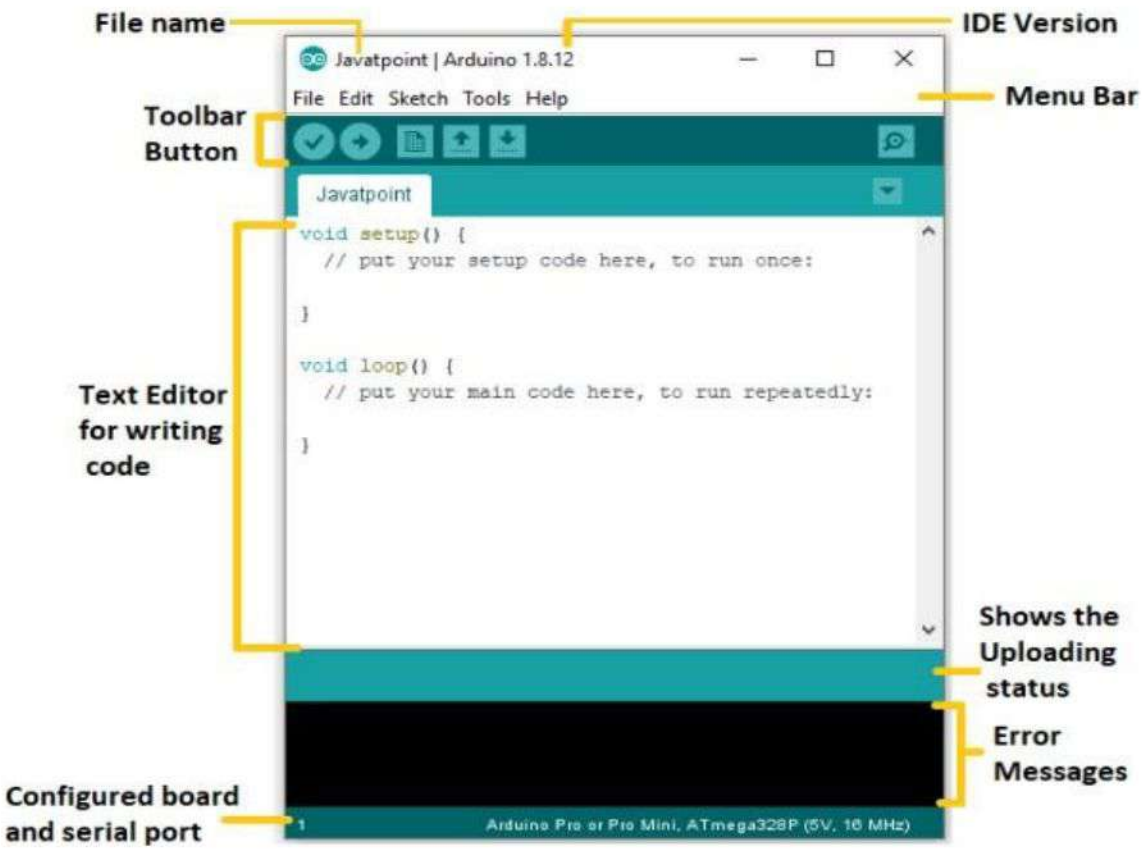

Fig. 4.1.1: Arduino IDE

File

- Make a new file for Arduino.
- A computer-based Arduino sketch should now be shown.
- Using the computer's CDs and folders, you may load a drawing file by selecting "Open."
- A simplified list of the most recent sketches that are accessible for viewing is displayed in accessible Recent.
- Notebook displays all active drawings kept in the sketchbook folder system; clicking on a sketch's label reveals it in a new editor instance.
- Examples this menu option lists every example provided by the Arduino Software (IDE) or library. To make it easier to find examples by topic or library, they are all organized into a tree.
- Close Arduino Software instance from which it is clicked is closed.

- The present title of the drawing is used to save it. If a name hasn't been assigned to the file yet, it will be shown in the "Save as" window.
- Save as... allows you to save the present sketch with an alternative name.
- The printing page setup box appears after setting up the pages.
- Print uses the options specified in Page Setup to send the active drawing to the printer.
- Choices opens the Preferences window, in which you may modify additional IDE settings as well as the language of the IDE interface.
- Quit Exits an IDE, closing all open windows. When the IDE is reopened again, it will launch by default with the same drawings that were open when Quit was chosen

Edit

- Code Editing: The Edit option in the IDE gives a variety of capabilities for editing code. Standard Cut: This action copies the chosen code to the clipboard after removing it.
- The code that has been chosen is copied to the clipboard. are included. These utilities make it simple to alter code snippets and modify the source.
- Find and Replace: The Find and Replace feature allows users to search their code for specified keywords or text and replace it with fresh values. This feature assists in quickly accessing specific areas of code or making global changes across the project.
- Code formatting settings are available in the Arduino IDE to ensure consistent and legible code. The auto-formatting tool allows users to automatically format their code depending on established style guidelines. This aids in the maintenance of a clean and standardized code structure.
- Proper indentation is vital for code readability. The Edit option in the IDE allows users to change the indentation of their code to better its visual structure. Personal preferences or code standards can be used to customize indentation settings.
- Commenting: An essential component of code documentation is commenting. Users can simply add comments to their code or uncomment portions of it that they want to temporarily disable by using the Edit option. This aids in giving the codebase explanations, directions, or notes.

- Navigation: To move quickly across the codebase, the Edit option additionally has navigational tools. Using line numbers or bookmarks, users can go to particular lines of code or sections of it. This makes finding and editing code in complicated projects simpler.

- Refactoring is the process of reorganizing code to increase readability or design without affecting functionality. Despite the Arduino IDE's lack of sophisticated refactoring capabilities, users can manually reorganize their code by renaming variables, functions, or classes using the Edit option.

Sketch

- Verify/Compile Checks your sketch for compilation issues and displays information about memory use for variables and code in the console area
- Assembles the current sketch's syntax into machine-readable instructions after checking it for mistakes.
- Deploy with a programmer's help Choose Tools > Burn Bootloader to replace the bootloader on the board and restart uploading to the USB serial connection. However, this allows In order to submit the built sketch later, you can export it as a binary file (.hex). this does NOT constitute an order to ignite the fuses. Run the Tools -> Burn Bootloader command to achieve this.
- Provides instructions that are machine-readable by compiling the present-day sketch's vocabulary while checking it for faults.
- It also handles the process of uploading the compiled code to the board. Users can simply click the "Upload" button to transfer the code to the connected Arduino board.
- By using plugins and other tools, the Arduino IDE may be enhanced. Users may install third-party libraries, add-ons, and debugging tools, for instance, to expand the IDE's functionality and speed up their development process.
- Just like an artist with a paintbrush, you wield the keyboard as your instrument. Each line of code becomes a stroke, delicately shaping the behavior of your creation. Do not be daunted by the vastness of the digital realm, for every sketch begins with a single line.
- Amidst the hum of transistors and the glow of LEDs, find solace in the knowledge that you are part of a vibrant community. Seek guidance when needed and share your discoveries with others. Collaboration amplifies the beauty of your sketches, connecting you with fellow creators who share your passion.

Tools

- Format Automatic This properly indents your code, aligns the opening and closing curly braces, increases the indentation of the statements within curly braces, and otherwise sets up your code.
- An archive Sketch saves a copy of their most recently taken sketch as a.zip file. The archive and the drawing may both be found in the exact same subdirectory.
- Any potential discrepancies between the editors's char map encoding and those of other operating systems are fixed by changing the encoding and reloading the page.
- Serial Watcher opens the serial monitor window, which begins the data transmission process. Users may easily add complicated functionality to their projects without having to create any new code thanks to libraries, which offer pre-written code for a variety of functions and components.
- Board Choose the board you are currently using.
- Port this menu contains a list of all serial devices on your computer, real or virtual. The top-level tools menu should immediately reload each time you use it.
- While programming a board or chip, the programmer should choose a hardware programmer over the onboard USB- serial connection.
- Remove Bootloader A bootloader can be burned into the Arduino board's microcontroller using the choices in this menu. Using an Arduino board regularly (which often arrive without a bootloader) is not necessary, though it is helpful if you buy a fresh ATmega microcontroller. Users may interface with the Arduino board through the serial port thanks to the IDE's integrated serial monitor. By allowing users to transmit and receive data between the Arduino and the computer, this function is helpful for debugging since it enables users to check the accuracy of the code and fix problems.

Help

Opens the official Arduino reference manual, which contains details on the libraries, functions, and programming language used by Arduino. Getting Started: Offers fundamental instructions and manuals to help new Arduino users get started.

- The only interactive option in the Help menu is "Search References," Provides answers to problems that Arduino users frequently encounter. What Arduino is: shows credits and details about the Arduino IDE version.

4.1.2 Sketchbook of Arduino IDE

T The "Sketchbook" in Arduino refers to a computer folder in which you may save and arrange your Arduino sketches (programmes). It is a specific directory where the Arduino IDE by default searches for sketches. The "Sketchbook location" is located under the "File" menu when you launch the Arduino IDE. This location is a representation of the computer folder that houses your sketchbook. The Sketchbook folder is often found in your computer's Documents directory. Your Arduino creations may be easily managed and arranged via the Sketchbook folder. Underneath the Sketchbook folder, you may create subfolders to organise your sketches according to various projects or topics. You may, for instance, make folders for projects involving robots and home automation.

4.1.3 Tabs , Multiple Files, and Compilation of Arduino IDE

Gives you the ability to work with drawings from various files, each with its own tab. They could be header files, C or C++ files, or ordinary Arduino code files (with no clear extension, like ".h").

In the same sequence as the tabs are presented prior to compilation, the standard Arduino code files (.ino and.pde) for the sketch are concatenated into a single file. The other file formats are left alone.

4.1.4 Uploading of code in Arduino IDE

You must adhere to a few straightforward procedures in order to upload code to an Arduino board using the Arduino IDE. Start by using a USB cord to link your Arduino board to your computer. Start your computer's Arduino IDE after that. Either create fresh code or open an old sketch in the IDE. You may start a new sketch by selecting "File" > "New." Go to "File" > "Open" and choose the sketch file (.ino) from your computer to open an existing sketch. Make sure you choose the appropriate Arduino board model from the "Tools" > "Board" menu once your code is prepared. Then, from the "Tools" > "Port" menu, select the proper communication port. To find the new port that appears after attaching the Arduino board, you might need to check the port submenu both before and after. After that, you may compile the sketch by clicking "Sketch" > "Verify/Compile" or by clicking the "Verify" button. The message section at the base of the Arduino IDE window will show any issues or warnings. Once the code has been validated, upload the produced sketch to the Arduino board by selecting "Sketch" > "Upload" or by clicking the "Upload" button. You could see the Arduino board's internal LEDs flickering or flashing during the upload process. The Arduino board

must remain attached to the computer; it must not be disconnected or reset before the upload is complete. When the upload is finished, the code will begin to execute on the Arduino board, and you should witness the outcomes or behaviour that your code predicted.

4.1.5 Libraries of Arduino IDE

Libraries come in quite handy for giving the Arduino Module the extra functionality. By selecting Include Library from the menu bar's Sketch button, you can add libraries from a list.

Libraries can be used by drawings to offer extra functionality like the ability to work with hardware or change data. Choose a library from the Sketch > Import Library menu to be used in a drawing. This will enable you to construct your sketch together with the library by adding one or more #include statements at the top. Libraries enhance the amount of space you need for it because they are submitted to the board together with your sketch. Simply remove the #include declarations for the library from the beginning of your code if a sketch is no longer required.

The reference includes a list of libraries. The Arduino programming language comes with a few libraries. Others can be obtained from a variety of sites, including the Library Manager.

With the IDE version 1.0.5, you can use a library that you imported from a zip file in an open drawing. For information on how to install a third-party library, go to these instructions.

The majority of libraries are included in the Arduino programme. But there are other places where we can purchase them. Use the Library Manager to add a new library to your Arduino IDE. Open the IDE and select "Draw" from the menu. Manage Libraries > Include Library.

A list of libraries that are already installed or are available for installation appears at the top of the Library Manager. We'll set up the Bridge library in this case. Browse the list to find it, click on it, and then choose the library installation version. Sometimes the library will only have one copy available. Do not be alarmed if the version selection option does not appear

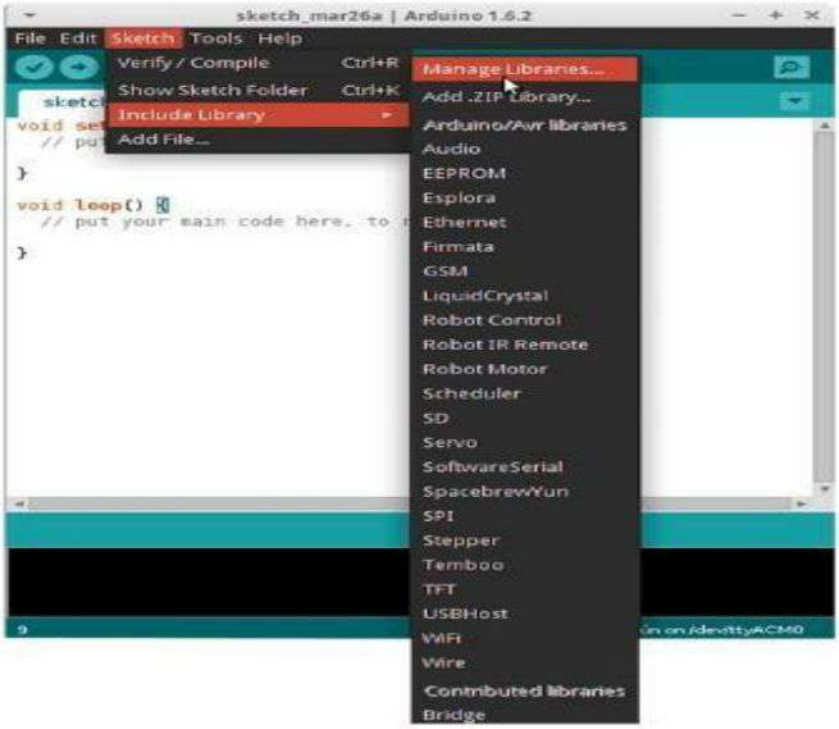

Fig. 4.1.5: Libraries of Arduino IDE.

Once the new library has been installed by the IDE, click "install" at the end. Depending on the speed of your connection, downloading could take some time. Once it's done, the Bridge library should have an Installed tag next to it. A shutdown of the library manager is possi

Fig. 4.1.5.1: Libraries of Arduino IDE.

4.1.6 Importing a .zip Library in Arduino IDE

Libraries are usually delivered via a ZIP file or folder. The library's name appears in the folder as well. The folder contains a.cpp file, a.h file, and frequently a keywords.txt file, an examples folder, and other files required by the library. As of version 1.0.5, you may now add third-party libraries to the IDE. Don't unzip the downloaded library; leave it alone.

In the Arduino IDE, select Sketch > Include Library > Add.ZIP Library. At the top of the screen, select "Add.ZIP Library" from the drop-down option.

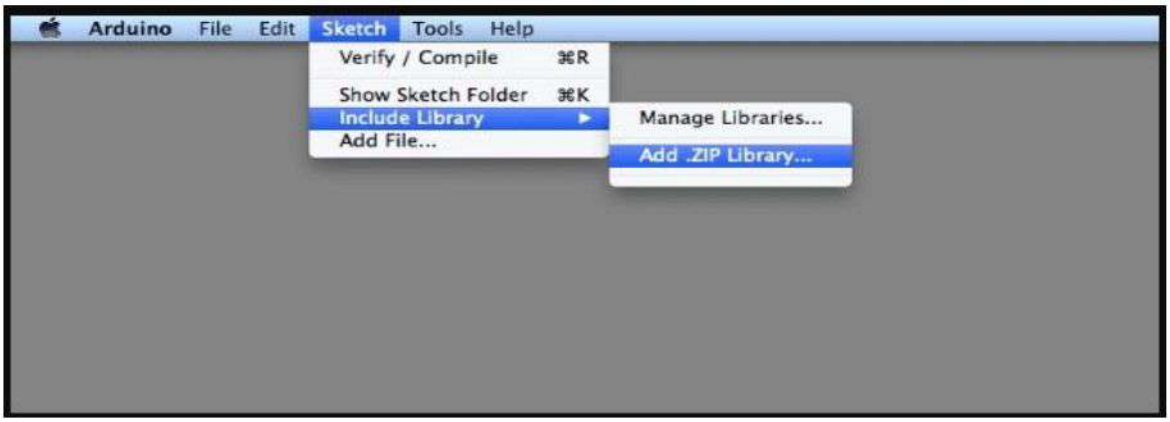

Fig. 4.1.6: Importing a .zip Library in Arduino IDE.

4.1.7 Manual installation of Library files in Arduino IDE.

We must download a library as a ZIP file, expand it, and then put it in the right directory in order to manually add a library. If the author provided usage examples, the ZIP bundle contains each one. Even if the library manager is set up to automatically install this ZIP file as described in the previous chapter, there are some circumstances in which you can choose to do the installation manually and place the library in Sketchbook's Libraries folder.

By selecting File > Preferences > Sketchbook location, you may view or change the location of your sketchbook folder.

The same is true for libraries that have been added to additional cores. Another important thing to keep in mind is that even if the version of the library you include in your sketchbook can be older than the one in the distribution or core files, it will still be the one used during compilation. When you choose a specific core for your board, the libraries located in the core's folder are utilised as opposed to the libraries located in the IDE distribution folder.

Important is also how the Arduino Software (IDE) updates itself. A new folder is created with fresh files after deleting every file in Programs/Arduino (or the location where the IDE was installed). So that they won't be deleted when the Arduino IDE is updated, we suggest you to only install libraries to the sketchbook folder.

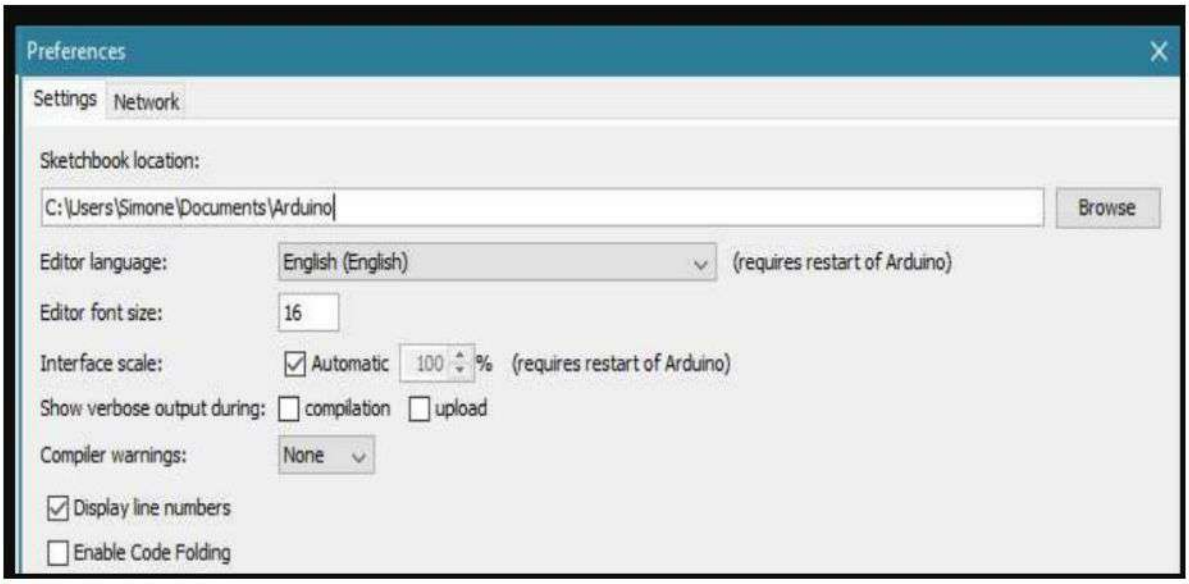

Fig. 4.1.7: Manual installation of Library files in Arduino IDE.

Go to the directory where you obtained the library's ZIP file.

Once the ZIP file with its whole folder structure has been extracted into a temporary folder, choose the main folder, which should contain the library's name. Copy it, then put it in the "library" section of your sketchbook. Select Sketch > Include Library when the Arduino IDE is running. Check to determine if the recently added library is included in the list.

Likewise, libraries that have been inserted into extra cores. Another crucial point to remember is that, even if the version of the library you include in your sketchbook is older than the one found in the distribution or core files, it will still be the version used during compilation. The libraries in the core's folder are used rather than the libraries when you select a specific core for your board.

The libraries folder in your sketchbook, the IDE installation folder, and the core folder are the three places where the Arduino libraries are kept organized. The distribution's libraries can be modified because of the way that they were chosen during compilation. This implies that adding a library to your sketchbook's "libraries" folder supersedes any other libraries' versions.

4.1.8 Serial Monitor of Arduino IDE.

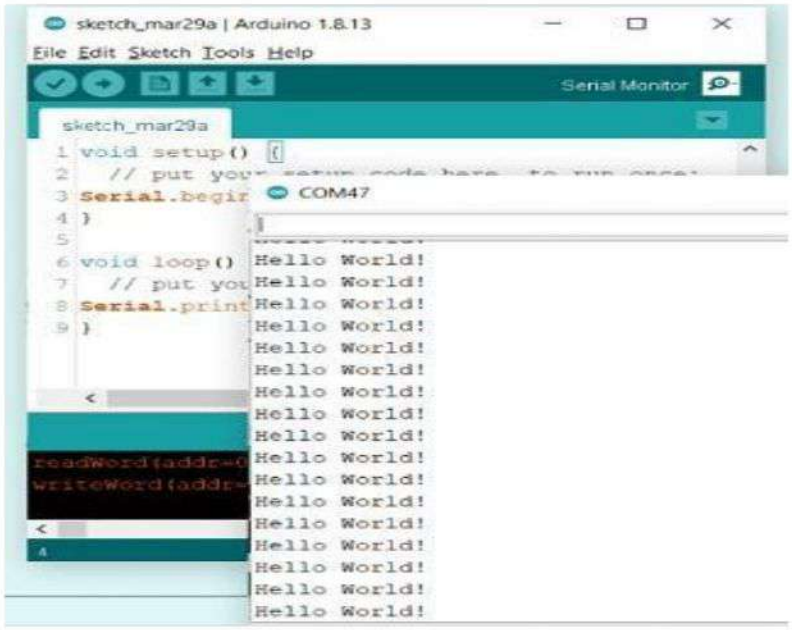

Fig. 4.1.8: Serial Monitor of Arduino IDE.

The Serial Monitor tool is integrated into the editor in the Arduino IDE, so using it doesn't need opening another window. This implies that you can open several windows, each with an own Serial Monitor.

4.2 EMBEDDED C:

The most popular programming language for creating electrical devices is5embedded C. Every electrical device has a connection to embedded software through its CPU. The effectiveness of the CPU in completing particular tasks is significantly influenced by embedded C programming. This book introduces and elaborates on topics relevant to embedded controllers, notablythe Arduino development board and associated Atmel AT Mega language right now may be C. That is sufficient justification in and of itself, but there is more: It is a standard, contemporary, organized language (ANSI).Because of its modularity, code can be reused. Because of its widespread support, source code can be utilized for numerous platforms by simply recompiling for the new target. Many third-party add-ons (libraries and modules) are available to "extend" the language as a result of its popularity. It has type checking, which aids in error detection. Because of its strength, you can go "near to the metal." In general, it produces extremely effective code (small space and fast execution).

A superset of C is C++. C++ emerged later, after C. Since C's increment operator is ++, the name C++ is actually a programming pun. C++ can thus be translated as "increment C" or "give me the next C." Everything that C canaccomplish, plus a lot more, is done in C++.

Embedded applications typicallycannot afford the overhead of these extra features because they are not provided for free. As a result, even if C++ and C are used for a lot of 8 Embedded Controllers desktop work, C is still the language of choice for embedded work. Usually referred to as C/C++ systems, desktop development systems can perform both tasks. It's possible for embedded development systems to only use C or even a variation of it.

Applications for desktop computers are the main emphasis of desktop development. Examples of these include word processors, graphing tools, games, CAD software, etc. When most people hear the word "computer," these are the first things that come to mind. The numerous, largely invisible applications that are all around us every day are the subject of embedded programming. Examples include the software that controls your cell phone, car's engine management system, and microwave oven, among many more. Desktop apps are vastly outnumbered by embedded program in terms oftotal units. Even if your home only has one or a few PCs, you almost certainlyutilize dozens of embedded apps on a daily basis. Compared to their PC counterparts, embedded microcontrollers are frequently significantly less expensive and less powerful. The various programming methodologies will be thoroughly examined because they are an essential component of this course002E

Efficiency: Embedded systems often operate with limited resources, such as memory, processing power, and energy. Embedded C emphasizes efficiency in terms of code size, execution speed, and resource utilization. It allows low-level access to hardware resources, such as registers and memory, enabling developers to optimize code for better performance.

Real-time capabilities: Many embedded systems require real-time processing, where tasks must be completed within specific time constraints. Embedded C supports real-time programming by providing features like interrupt handling, precise timing control, and task scheduling. It allows developers to write time-critical code and handle events in a deterministic manner.

Portability: Embedded C code needs to be portable across different hardware platforms. Although hardware-specific features are utilized in embedded programming, embedded C aims to maintain portability by providing a common set of language features and abstractions. This allows developers to write code that can be easily adapted to different embedded systems.

Debugging and testing: Embedded C supports debugging and testing techniques specifically tailored for embedded systems. It includes features like breakpoints,

In our daily lives, we use a variety of technological devices, such as our mobile phones, washing machines, digital cameras, etc. The microcontroller that powers all of these devices is programmed in embedded C..Hardware can monitor external events (via inputs and sensors) and respond by controlling external devices (through outputs) thanks to embedded software or programs. Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports, among other components of the internal architectureof the embedded hardware (often the processor) may need to be directly manipulated by the program for an embedded system during this processA system that is embedded is one which has technology built directly into the hardware of the machine, making it uniquely suited for a particular application, item, or part of a larger system.

A huge combinational system or a small independent system can both be embedded systems. It describes an automation system that uses a microcontroller to execute a certain action.

Three main elements combine to form an embedded system:

- **Hardware:** An embedded system is physically attached to hardware,which is a used component.

- **Real Time Operating system (RTOS):** How an embedded system operates is controlled by RTOS. It acts as a bridge between application software and hardware, managing the latter while offering a mechanism to plan CPU execution to lessen the impact of latency.

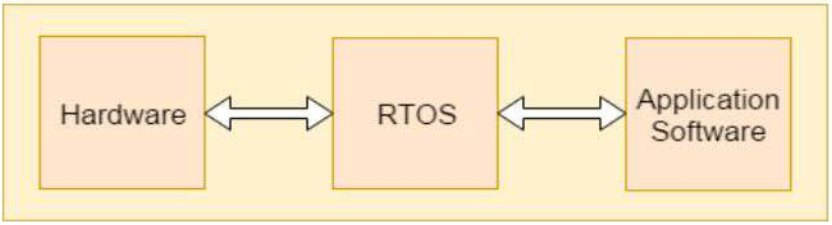

Fig. 4.2.3: Real time operating system (RTOS).

An embedded system's fundamental structure is depicted in the image below.

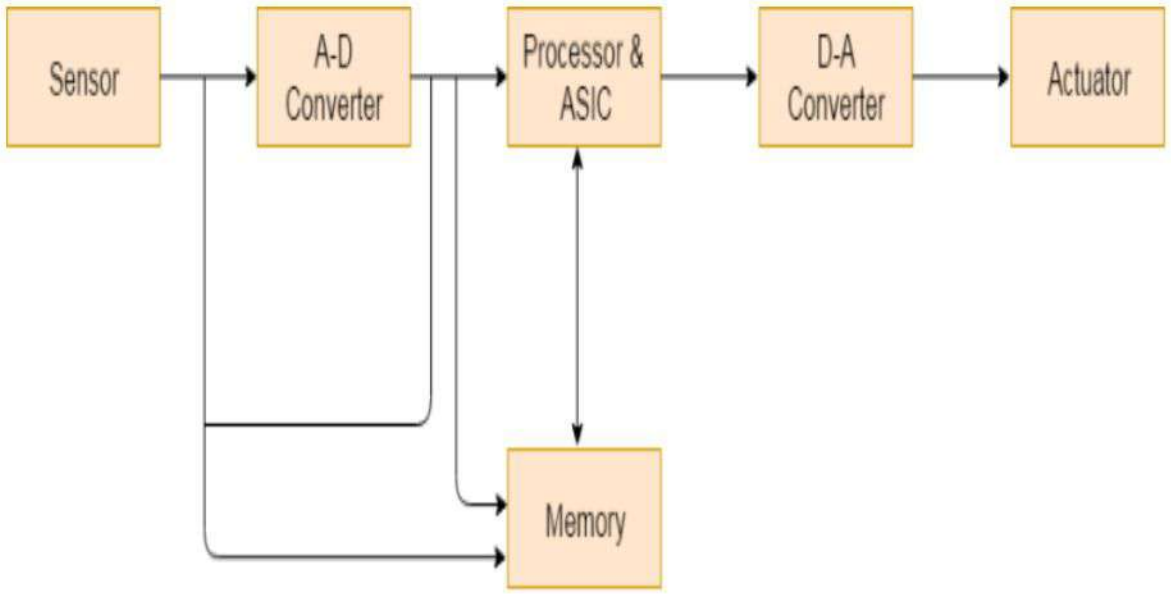

Fig. 4.2.4: Designing of an embedded system.

4.3 THINGSPEAK APP:

A web-based application called ThingSpeak App is made to gather, display, and examine data from Internet of Things (IoT) devices. It functions as a thorough tool for effectively organizing and processing IoT data, offering insightful knowledge and useful data. A robust and user-friendly solution for managing and analyzing IoT data, ThingSpeakApp enables users to get insightful knowledge, make wise choices, and optimize their IoT deployments. It is a great asset for IoT projects and applications in a variety of areas, including smart cities, agriculture, healthcare, and industrial automation, thanks to its user-friendly interface, extensive functionality, and automation capabilities.

You can access the sign-up page by choosing either the "Sign Up" button onthe far right or the "Get Started Now" button in the center of https://thingspeak.com/. After providing the required data, click the "Create Account" button. But ThingSpeak goes beyond data collection. It empowers you to take control of your data, providing you with a powerful analytics engine to unlock its hidden potential. With built-in MATLAB® analytics, you can apply advanced algorithms, perform computations, and gain valuable insights into the patterns and trends within your data.

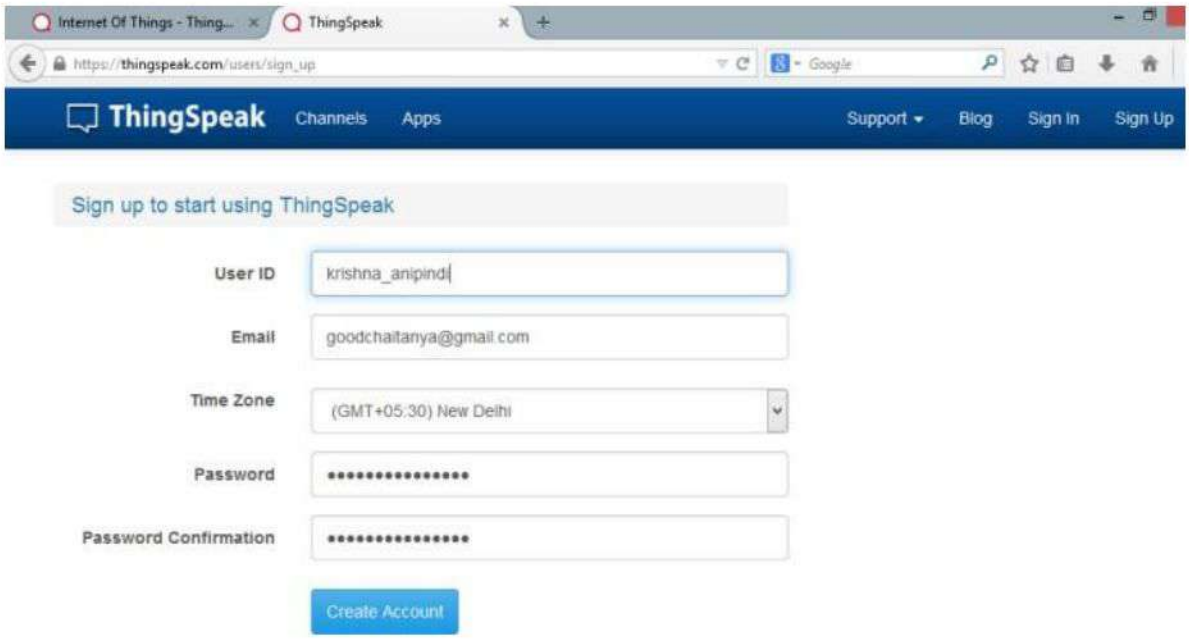

Fig. 4.3.1: ThingSpeak platform.

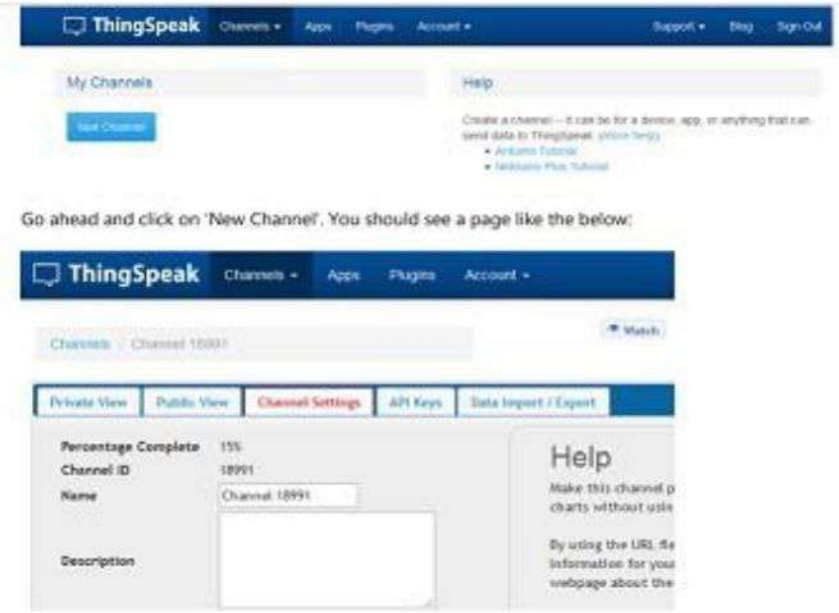

Fig. 4.3.2: ThingSpeak platform 2.

You may change the name to suit your needs and add a description tailored to the channel. The metadata column can be expanded to incorporate any more relevant information. Latitude, longitude, and elevation fields ought to be on the same page. You should also be able to see a "Make Public?" checkbox as you scroll down. Consider the functions of the various fields and tabs: Latitude, longitude, and elevation are three variables that describe a "thing's" location and are crucial for moving things in particular.

- Make Public ? - Anyone can see a channel's data stream and related charts when it is made public. The channel is private if this checkbox is not ticked, necessitating the user's provision of an API key for each read or write activity.
- URL – can be your blog or website's web address, and if provided, it will appear on the channel's public display.
- Video ID - Your Vimeo or YouTube ID will be associated with this ID. If indicated, the video appears in the channel's public view.

The sensor data sent by a "thing" or sensor corresponds to the fields numbered 1 through 8. Data must first be placed into a field before it can be saved there. Field 1 is added automatically. I Your request will still be allowed if you attempt to publish to a field that you haven't created, but you won't be able to view the field in the charts or the accompanying data. To add a field, click on the little box that appears before the word "add field". The text box next to each field has a preset label name when you click the "add field" button, and the "add field" wording changes to "delete field." You can change the field language that automatically displays when a field is added to make it more sensible. On the screen below, for instance, I modified the text for Field 2 to read "Sensor Input." To remove a newly added field, simply check the "delete field" box. When you click it, the text for that field is cleared, and "delete field" becomes "add field." These parameters' data are simultaneously received by the IOT module (ESP8266). Regardless of whether a threshold mismatch is found, the information is transmitted to the IOT at regular intervals

4.4 HARDWARE REQUIREMENTS

The hardware requirements for our project are as follows.

- Node mcu
- Buzzer
- LCD display
- GPS
- GSM
- Temperature sensor
- Power supply
- Cooling fan

4.4.1 NODE MCU

The Internet of Things (IoT) has seen a rise in popularity for the open-source development board NodeMCU. Based on the ESP8266 Wi-Fi module, it combines a microcontroller's functionality with onboard Wi-Fi connection. GPIO pins, a USB interface, and other interfaces like ADC, I2C, SPI, and UART are all included on the NodeMCU board. NodeMCU can connect to Wi-Fi networks, interact with the Internet, and communicate with other devices thanks to its potent microcontroller and Wi-Fi module. A variety of developers can use it since it can be programmed using the Arduino IDE or the Lua programming language. NodeMCU capabilities include GPIO pins for interface, MQTT protocol for Internet of Things connectivity, web server and client capability, and OTA updates.

Fig. 4.4.1: Node MCU.

Utilising a variety of actuators and sensors. It finds use in quick prototyping, IoT initiatives, and home automation. NodeMCU is a desirable option for developing Wi-Fi-enabled Internet of Things projects and investigating cutting-edge IoT applications because of its low cost, simplicity of usage, and large community support.

4.4.2 BUZZER

A voice signaling tool that can be mechanical, electromechanical, or piezoelectric is the buzzer or beeper. Common uses for buzzers and beepers include verifying user inputs such alerts, timers, and mouse clicks or pulsations. A piezoelectric audio amplifier or another source of audio signal can drive the piezoelectric element into vibration. Typically, a click, ring, or beep is used to signify that the button has been pressed.

Fig. 4.4.2: Buzzer range set in the coding it will give alert signal.

4.4.3 LCD DISPLAY

The operation of flat panel displays of the LCD (Liquid Crystal Display) kind primarily makes use of liquid crystals. Due to their extensive use in smart phones, televisions, computers, and instrument panels, LEDs have many applications for both consumers and companies.
Compared to the technologies they replaced, such as light-emitting diode (LED) and gas-plasma displays, LCDs represented a significant advance. Compared to what cathode ray tube (CRT) technology would have allowed, LCDs allowed panels to be significantly smaller. In contrast to LED and gas-display displays, LCDs operate on the idea of blocking light rather than emitting it, which results in a significant reduction in power consumption. An LCD's liquid crystals use a backlight to create an image instead of an LED's light source.

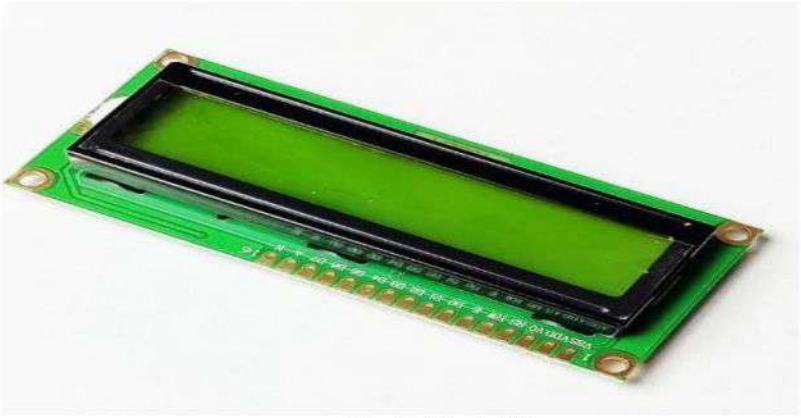

Fig 4.4.3: LCD.

Millions of pixels make up a display. In order to determine how high-definition a display is, its pixel count is frequently employed; for instance, a 4K monitor comprises pixels with a resolution of 3840 x 2160 or 4096 x 2160. Red, Blue, and Green, or RGB, subpixels combine to form a pixel. A distinct colour can develop when the subpixel colour combinations of a pixel change. Pixels on a display can be combined to create millions of different colours. To produce an image, the pixels are quickly turned on and off.

4.4.4 GPS

The US Department of Defence launched 24 satellites into orbit to construct after initially developing it for military use. GPS is always operational, no matter the weather, wherever in the world. The use of GPS is free of setup or continuing costs. As they complete two exact orbits of the earth each day, GPS satellites transmit signal data to the planet. The triangulation technique is used by GPS receivers to determine a user's precise location. In essence with as follows:

- little power usage
- powered with a 9–12-volt DC power supply
- RF The receiver's noise level is 2.5 dB
- 161 dB High Sensitivity (indoor)
- Seamless Outdoor/Indoor Operation Support standard NMEA-0183 V 3.01
- Free software is available to change the baud rate.
- Interfaces: DB-9 RS232 serial interface, TTL/3.3V serial breakout headers on PCB.

4.4.5 GSM

The widely used digital mobile communication system known as GSM, or Global System for Mobile Communications, offers wireless connectivity for speech and data transmission.

Oneof the most extensively used mobile communication standards in the world, it has completely changed how people communicate and turned mobile phones become an indispensable component of contemporary life.

A widely used mobile communication technology called GSM has completely changed how people communicate and maintain connections. With capabilities like voice and data transmission, roaming, security, and interoperability, it has become the cornerstone of contemporary mobile networks and made it possible for mobile phones and mobile services to proliferate all over the world.

A key issue for project reports in the realm of telecommunications and mobile communication, understanding the underlying concepts of GSM is essential for designing, implementing, and managing mobile communication projects.

To prevent unauthorized access and eavesdropping on speech and data communications, GSM has strong security features, such as authentication and encryption.

By doing this, user conversations and data are protected from prying eyes and misuse. The capacity of GSM to support global roaming, which enables users to use their mobile phones when travelling abroad, is one of its key benefits.

Most nations have GSM networks, allowing for seamless access across several networks and geographical areas.

4.4.6 TEMPERATURE SENSOR

A temperature sensor measures how hot or cold the environment is. Either direct contact or indirect contact can be used to sense temperature. Accurate measurements of the ambient temperature are made using the temperature sensor LM35. The voltage output of the LM35 sensor, an integrated circuit, is exactly proportional to the temperature in Celsius. Water level: A float sensor continuously monitors electricity has yet flowed through the wires. As the water level falls below a set level, the circuit completes itself and activates an alarm by sending electricity via the finished circuit.

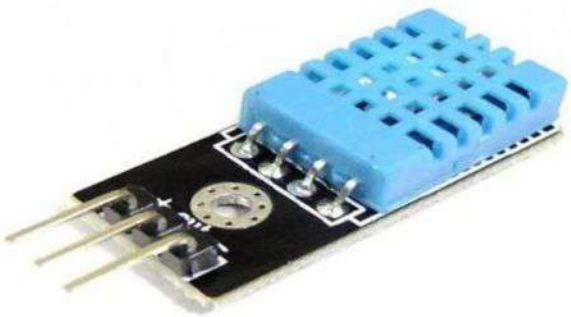

Fig. 4.4.6: Temperature sensor.

Features of Temperature Sensor:

1. Power supply input range: 3.3-5V.
2. 2.5mA is the highest amount of current used during conversion (while requesting data).
3. 20–80% accurate humidity readings with a 5% error range.
4. Accurate 0-to-50-degree Celsius temperature readings.

4.4.7 POWER SUPPLY

Many electronic and electrical systems require a power supply as it provides the necessary electrical power for the proper operation of various devices and machinery. It transforms the available input power from a power source—such as a battery or the mains power grid—into a controlled and stable output voltage or current that satisfies the needs of the associated load. For diverse electronic and electrical projects to run reliably and

Effectively, a well-designed and properly operating power supply is essential. Voltage regulation, which makes sure that the output voltage stays steady and within a certain range despite changes in the input voltage or load conditions, is a crucial component of a power supply. Voltage regulation is crucial to giving electronic equipment, which are sensitive to voltage changes, a steady and dependable power source.

Numerous power supplies also have current-limiting features that guard the connected load from an excessive current that can malfunction or harm it. Various techniques, such as using electronic circuitry or feedback loops, can be used to limit the amount of current flowing through a system, which helps to guarantee that the connected devices are operated safely.

Power supply efficiency is a crucial factor that affects a power supply's overall energy consumption and performance. It is defined as the ratio of output power to input power. Higher efficiency power supplies are less harmful to the environment and contribute to long-term energy cost reduction.

The greatest amount of power that power supplies can supply to the connected load is rated depending on their output power capacity. The powerrequirements of the connected devices are met, power supply ratings, which are commonly stated in watts (W) or volt-amperes (VA), should be carefully chosen.

In order to protect against potential risks and failures, modern power supplies frequently have a variety of protection features, including. The power supply & the linked devices are moredependable and safer thanks to these protection features.

.

4.4.8 COOLING FAN

In many electronic and electrical systems, cooling fans are a crucial part of the heat management process. Heat is produced when devices and equipment are operating. In order to dissipate heat and maintain ideal operating temperatures, they provide active cooling by circulating air or other cooling media. This prevents overheating and ensures the dependable and efficient functioning of electronic and electrical projects. For effective thermal management in a variety of projects, it is essential to understand the characteristics, uses, and applications of cooling fans.

A cooling fan's main job is to move air in order to remove heat from the system. The airflow rate of cooling fans is4measured in terms of cubic feet per minute (CFM) or litres per second (L/s), respectively. In order to overcome airflow resistance in the system, a fan's cooling capability is dependent on both its airflow rate and the static pressure it can produce. Axial fans, centrifugal fans, and blower fans are just a few of the different types of cooling fans, each with unique properties and uses. While centrifugal fans and blower fans are better suited for situations requiring higher static pressure or when space is at a premium, axial fans are frequently utilized for general cooling reasons. The overall performance of the system and the user experience may be hampered by the noise produced by cooling fans. Lower noise levels are preferred for projects where noise reduction is a priority, such as in audio or sensitive areas, as cooling fans are rated depending on their noise level, which is commonly stated in decibels (dB). Cooling fans are available in a variety of sizes, forms, and mounting configurations, enabling design freedom and incorporation into a range of applications. To ensure proper fit and compatibility with the system's requirements and layout, factors including fan size, mounting technique, and form factor should be taken into account.

In order to manage heat in electronic and electrical systems, avoid overheating, and ensure dependable and effective operation, cooling fans play a crucial role. For effective thermal management in projects, it is essential to comprehend the characteristics, uses, and control methods of cooling fans. The durability, performance, and dependability of electronic and electrical systems are influenced by properly chosen and integrated cooling fans, making them an important subject for project reports in industries including electronics, computer hardware, and thermal engineering.

A-D Converter:

A device known as an analog-to-digital converter transforms analogue electric input signals into their digital equivalents for further processing in embedded systems.

Processor & ASICs:

Processor utilized to process data and signals in order to quickly carry out the intended set of instructions. An embedded system's application specific integrated circuit (ASIC) is a type of integrated circuit that is made to carry out a specified purpose.

D-A Converter:

A digital-to-analog converter transforms digital electric input signals into analogue signals that can be processed further by an embedded system.

Actuators:

Actuators are a type of comparator that compares the level of an analogue input signal to the level of a desired output signal in order to produce a system output that is error-free.

CHAPTER 5

RESULT

5.1 Temperature monitoring

As a result, it should transfer its data to a server so that customers can access it remotely. The information we provide is continuously checked around-the-clock, and customers may track the progress of their orders up until they arrive at their destination.

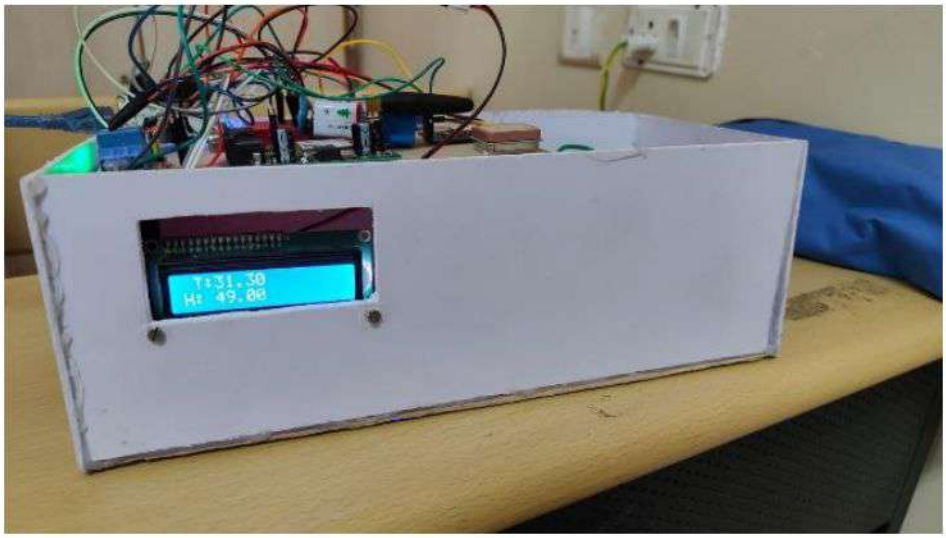

Fig 5.1: Prototype of proposed system.

Fig. 5.1 displays the whole project module in portable form. Continuously detected environmental conditions for temperature and humidity. Periodically, the system used the internet to send data from the sensors to the cloud platform. The data from the incoming sensors was continually monitored by the cloud platform. The GSM module delivers the SMS notice if the temperature and humidity are outside of the predetermined range. The system's temperature, humidity, and messaging may all be customized.

5.2 Monitoring Sensor Data on Cloud Platform

Data from the measured sensors has been kept on the cloud platform Thing Speak on college grounds in a real-time setting. The prototype gadget was put into use in the middle of the scene. The entire system was being watched, and the laptop and mobile device receiving warnings through GSM module, together with the answers from the cloud platform (ThingSpeak), were all functioning flawlessly.

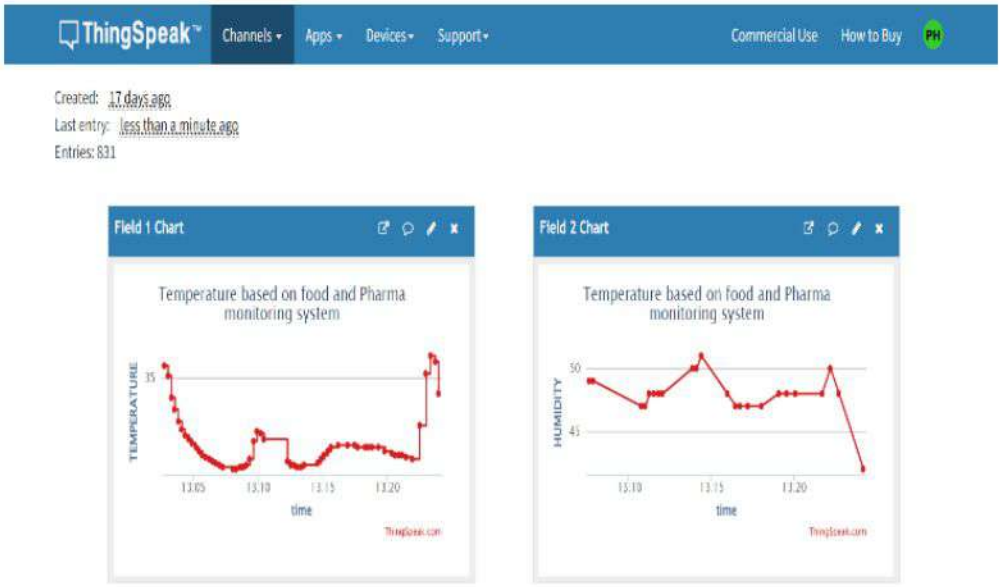

Fig 5.2: Sensor reading on a cloud platform- ThingSpeak.

An ESP8266 microcontroller with sensors, an internet-connected laptop, and a cloud platform (Thing Speak) were used to implement the temperature and humidity. For displaying the sensor data in certain ThingSpeak fields (Temperature and Humidity), a cloud-based dashboard has been set up. Fig.5.2 is an example of a graphical presentation.

5.3 Configuring message notification.

The message alert notification operates as illustrated in Fig. 6, where it activates the message alert system and delivers a message that reads "temperature is HIGH" when the temperature rises over the predefined set-point. Additionally, the system notifies us that the food is safe when the temperature is maintained. This is a fantastic feature since it lets us know where the food is at all times.

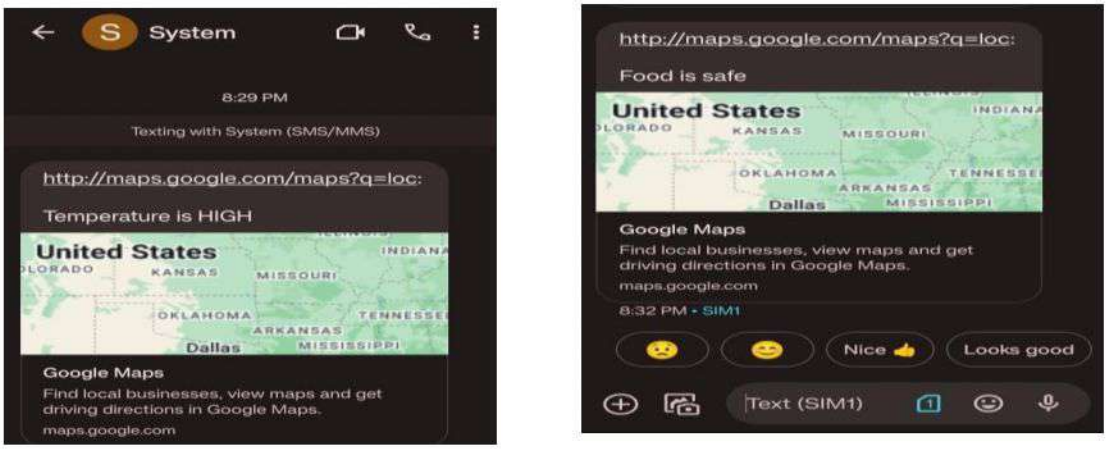

Fig 5.3: Configuring message notification.

Fig 5.3.1(a): When temperature is low. Fig 5.3.1(b): when the temperature HIGH.

Here above is the working as in fig 7a, the bulb will turn on when the temperature is low, and accordingly the fan will turn on when the temperature is HIGH in fig 7b. Temperature is sensed via the sensors present in it.

5.4 Advantages

- Continuous temperature monitoring can help ensure the safety, efficacy, and quality of pharma and food products, reducing the risk of spoilage, contamination, and product loss.
- Early detection of temperature fluctuations can allow for prompt corrective action, preventing costly product losses and regulatory penalties.
- Real-time temperature monitoring can improve operational efficiency by providing accurate temperature data that can be used to optimize product storage, reduce waste, and improve the supply chain.
- A temperature monitoring system can provide transparency and accountability throughout the entire product lifecycle, from production to distribution, providing a complete and traceable temperature record for each product.

5.5 Limitations

- The accuracy and precision of temperature sensors can vary, and the range of temperatures they can measure may be limited.
- The effectiveness of a temperature monitoring system can be limited by the quality of the hardware, software, and connectivity used.
- The initial cost of setting up a temperature monitoring system can be high, including the cost of temperature sensors, microcontrollers, and software development.
- Maintenance and calibration of the temperature monitoring system can also add to the ongoing costs The system can generate a large volume of temperature data, whichcan be challenging to manage and analyze.
- There can be a risk of false positives or false negatives in temperature readings, which can lead to unnecessary corrective actions or missed alerts.

5.6 Applications

- Monitoring the temperature is crucial for managing the cold chain, which is the act of keeping a constant temperature-controlled environment for perishable goods like medicines, foods, and vaccines. In order to prevent spoiling, deterioration, or loss of efficacy, these items must be transported, distributed, and stored within the appropriate temperature range.

- In order to stop the growth of dangerous microorganisms including bacteria, viruses, and fungus that can result in foodborne illnesses, temperature monitoring is essential throughout food processing, production, and storage.

- Food products are produced and stored at acceptable temperatures as they are being cooked, cooled, and stored. This helps to guarantee food safety by halting the spread of foodborne germs.

- To maintain their efficacy and safety, many pharmaceutical products, including vaccines, drugs, and biologics, are extremely temperature-sensitive and necessitate stringent temperature control.

- In pharmaceutical storage facilities, such as warehouses, distribution centers, and pharmacies, temperature monitoring is crucial to make sure that these items are kept within the designated temperature range to prevent deterioration or loss of

CONCLUSION

The experiment was successful, and as a result, we now know how to measure a space's temperature and humidity data. By utilizing this automated system in a cold storage, we are able to assess and keep track of the different data using our smartphones or PCs. Any external relay module that can control/condition the temperature and humidity inside a cold storage can be made to automatically turn on and off in the event of an interruption.

FUTURE SCOPE

The potential implementation of more sophisticated features like machine learning algorithms for preventative maintenance, cloud service integration for remote monitoring and control, and the use of wireless sensors for real-time data collection are all potential future directions for this project with NodeMCU processors. Additionally, the usage of NodeMCU processors may make it possible to create more affordable and energy-efficient systems for temperature monitoring in the pharmaceutical and food industries.

Some more future scopes are:

1. The cold-chain system is made more effective and reliable by integration with AI and machine learning algorithms that forecast and avoid temperature variations in real-time.
2. Blockchain technology implementation will improve data security and transparency in temperature monitoring and control, lowering the risk of fraud and assuring compliance with regulatory standards.
3. By utilizing cutting-edge sensors and actuators, the cold-chain system can be remotely monitored and managed, giving organizations more flexibility and scalability.
4. creation of a mobile application for real-time temperature monitoring and control, enabling convenient mobile access to and management of the cold-chain system.
5. Data storage, analysis, and sharing are made possible by integration with cloud-based systems, which enhances supply chain cooperation and decision-making.
6. Utilizing IoT and big data analytics to implement predictive maintenance approaches can help to decrease system downtime and maintenance expenses.
7. To enable location-based tracking and tracing of temperature-sensitive items, integration with GPS and RFID technology is used, increasing the visibility and effectiveness of the supply chain.
8. Reduce the carbon footprint of the cold-chain system and improve sustainability by using renewable energy sources like solar and wind power.

LIST OF PROJECTS PARTICIPATION

1. Selected for KSCST 46th Series of Student Project Programme with Reference Number:7.1.01/SPP/33 and Project Proposal Reference number: 46S_BE_4334
2. Participated State Level Student Project exhibition & competition (SPEC2023) Organized by Mechanical engineering & Department of Robotics & artificial intelligence, Bengalore Institute of Technology, Bengaluru-560004.

LIST OF PAPER PUBLICATIONS

1. Applied for paper publication in International Conference on IoT, Communication and Automation Technology (ICICAT 2023) organized by Buddha Institute of Technology, Gorakhpur (Uttar Pradesh), India.
2. Applied for paper publication in 14th International Conference on Computing Communication and Networking Technologies 20223 (14th ICCCNT 2023) organized by Indian Institute of Technology - Delhi, Delhi, India.

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APPENDIX

2. Pin Definitions

Figure 2-1 shows the pin layout for 32-pin QFN package.

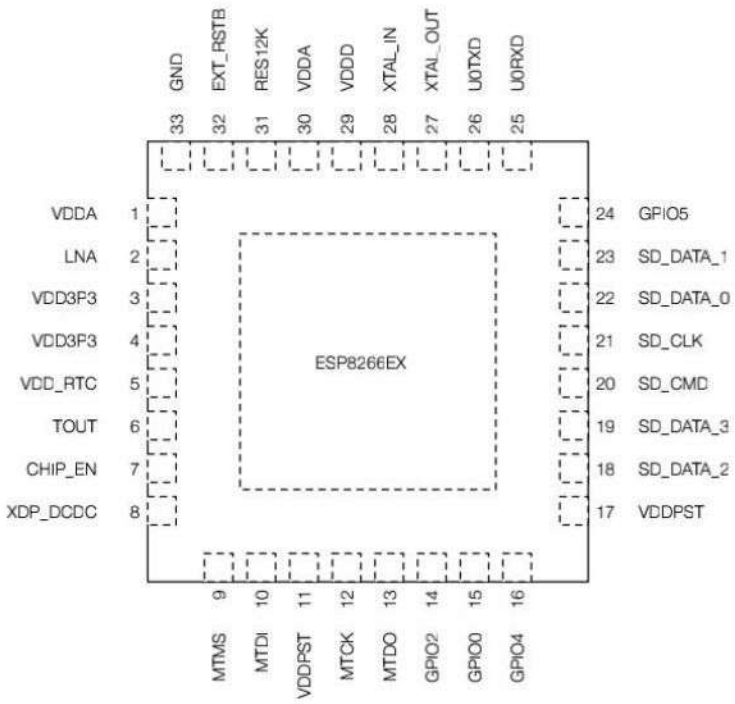
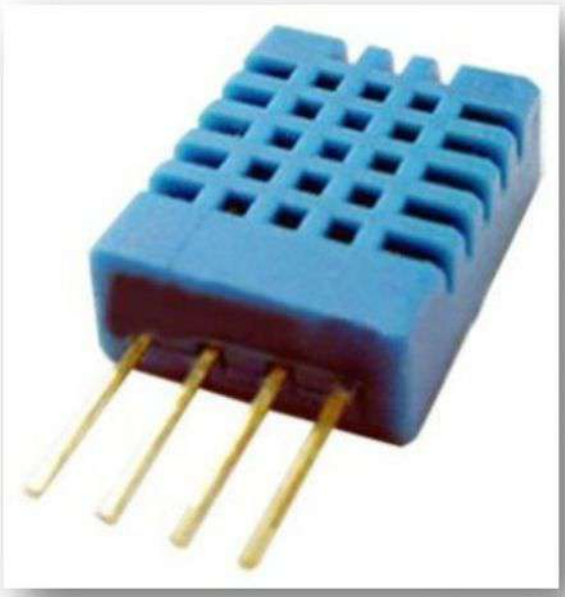


Figure 2-1. Pin Layout (Top View)

Table 2-1 lists the definitions and functions of each pin.

Table 2-1. ESP8266EX Pin Definitions

Pin	Name	Type	Function
1	VDDA	P	Analog Power 2.5V ~ 3.6V
2	LNA	I/O	RF antenna interface Chip output impedance=39+j6 Ω. It is suggested to retain the π-type matching network to match the antenna.
3	VDD3P3	P	Amplifier Power 2.5V ~ 3.6V
4	VDD3P3	P	Amplifier Power 2.5V ~ 3.6V
5	VDD_RTC	P	NC (1.1V)
6	TOUT	I	ADC pin. It can be used to test the power-supply voltage of VDD3P3 (Pin3 and Pin4) and the input power voltage of TOUT (Pin 6). However, these two functions cannot be used simultaneously.



Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

2. Technical Specifications:

Overview:

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50 ℃	±5%RH	±2℃	1	4 Pin Single Row

EPSON

S4E39860

GPS Receiver Module

Preliminary

- Ultra Low-Power consumption (100mW)
- Compact and Thin design
- Handles differential GPS

■OVERVIEW

GPS (Global Positioning System) having been used Car Navigation Systems, is now going to be used in mobile equipment as well. S4E39860 is the miniature GPS Receiver module developed for the purpose of built in the mobile equipment based on the battery-drive. Super-low consumption electric power, compact and thin size were realized by developing the special IC which built in Signal Processor, SRAM and RTC in the 32Bit RISC- CPU (SEIKO EPSON original).

■FEATURES

• GPS Receive Part Specification	
· Receiving frequency	1575.42MHz (L1),C/A code
· Receiving method	Multi-Cannels (8 channels)
· Sensitivity	-130dBm
· Update rate	1 second (shortest)
· Accuracy	Position:25m CEP (SA OFF), Velocity:0.1m/s (SA OFF)
· Measurement time (90% probability)	Cold start :5 minutes or less Warm start :50 seconds or less Hot start :10 seconds or less
· Interruption recovery time	2 seconds or less (90%)
· Dynamic capability	Velocity:350m/sec (max.), Acceleration:4G
· Measurement method	Corresponding to 2D/3D and Auto Measurement method
· Geodetic system	WGS84
• Electric Specification	
· Power supply voltage	3.1V ~ 3.6V (Typ 3.3V)
· Backup voltage	2.3V ~ VCC
· Power consumption	100mW (at 3.3V operation)
· At power saving	10 μA (+25℃)
• Temperature range	
· Operating temperature range	-30℃ ~ +80℃
· Storage temperature range	-40℃ ~ +85℃
• Interface Specification	
· Data output format	NMEA0183 (standard) or EPSON format
· Transfer rate	Serial interface, 9600bps
· I/O connector	DF14-6P-1.25H (HIROSE ELECTRIC)
· RF connector	U.FL (HIROSE ELECTRIC)
• Dimensions	34.8 × 24.8 × 6.0 (W × D × Hmm)

*Notes: Since the specification above are based on the under-developing product, they may be changed before actual manufacturing.

Detailed Specifications:

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
			8 Bit	
Repeatability			±1%RH	
Accuracy	25℃		±4%RH	
	0-50℃			±5%RH
Interchangeability	Fully Interchangeable			
Measurement Range	0℃	30%RH		90%RH
	25℃	20%RH		90%RH
	50℃	20%RH		80%RH
Response Time (Seconds)	1/e(63%)25℃, 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature				
Resolution		1℃	1℃	1℃
		8 Bit	8 Bit	8 Bit
Repeatability			±1℃	
Accuracy		±1℃		±2℃
Measurement Range		0℃		50℃
Response Time (Seconds)	1/e(63%)	6 S		30 S

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Dr. U T Vijay
Executive Secretary

24th April, 2023

Ref: 7.1.01/SPP/33

The Principal,
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Vidyanagara Cross,
Bengaluru – 562 157.

Dear Sir/Madam,

Sub : Sanction of Student Project - 46th Series: Year 2022-2023

Project Proposal Reference No. : 46S_BE_4324
Ref : Project Proposal entitled **TEMPERATURE MONITORING IN FOOD/PHARMA APPLICATION**

We are pleased to inform that your student project proposal referred above, has been approved by the Council under "Student Project Programme - 46th Series". The project details are as below:

Student(s)	Mr. VIKHYATH STHAVARMATH	**Department**	MECHATRONICS ENGINEERING
	Mr. PRAVEEN H N		
	Mr. TEJAS S		
	Mr. PRUTHVIK K R	**Sanctioned Amount (in Rs.)**	7,000.00
Guide(s)	Prof. MURUGESH DODAKUNDI		
	Dr. LATHA M S		

Instructions:

a) The project should be performed based on the objectives of the proposal submitted.
b) Any changes in the project title,objectives or students team is liable for rejection of the project and your institution shall return the sanctioned funds to KSCST.
c) Please quote your project reference number printed above in all your future correspondences.
d) After completing the project, 2 to 3 page write-up (synopsis) needs to be uploaded on to the following Google Forms link https://forms.gle/nWTaJjvrwzp3Wmvt6. The synopsis should include following:
   1) Project Reference Number
   2) Title of the project
   3) Name of the College & Department
   4) Name of the students & Guide(s)
   5) Keywords
   6) Introduction / background (with specific reference to the project, work done earlier, etc) - about 20 lines
   7) Objectives (about 10 lines)

8) Methodology (about 20 lines on materials, methods, details of work carried out, including drawings, diagrams etc)

9) Results and Conclusions (about 20 lines with specific reference to work carried out)

10) Scope for future work (about 20 lines).

e) In case of incompeted projects, the sanctioned amount shall be returned to KSCST.

f) The sanctioned amount will be transferred by NEFT to the bank account provided by the College/Institute.

g) The sponsored projects evaluation will be held in the Nodal Centre/Online Mode and the details of the same will be intimated shortly by email / Website announcement.

h) After completion of the project, soft copy of the project report duly signed by the Principal, the HoD, Guide(s) and studetn(s) shall be uploaded in the following Google Forms Link https://forms.gle/YWz56TrGg7fnSQgc7. The report should be prepared in the format prescribed by the university.

Please visit our website for further announcements / information and for any clarifications please email to spp@kscst.org.in

Thanking you and with best regards,

Yours sincerely,

(U T Vijay)

Copy to:

1) The HoD
MECHATRONICS ENGINEERING
SRI VENKATESHWARA COLLEGE OF ENGINEERING, BENGALURU

2) Prof. MURUGESH DODAKUNDI Dr. LATHA M S
MECHATRONICS ENGINEERING
SRI VENKATESHWARA COLLEGE OF ENGINEERING, BENGALURU

3) THE ACCOUNTS OFFICER
KSCST, BENGALURU

Rajya Vokkaligara Sangha

BANGALORE INSTITUTE OF TECHNOLOGY

K.R. Road, V.V Pura, Bangalore - 560 004

Certificate of Participation

Title of Paper : Revolutionizing Cold-Chain Management: An Innovative Approach to Temperature Monitoring in Pharma / Food Industry using Node M & U Processors

Team Members : Vikhyath Bhavanmath, Praveen H. N., Tejas S, Preethik K. R.

Guide : Mr. Murugesh Dodakundi, Dr. Latha M. S.

Institution : Sri Venkateshwara College of Engg., Bengaluru

has Presented/Participated in **State Level Student Project Exhibition & Competition(SPEC2023)** organized by Department of Mechanical Engineering and Department of Robotics and Artificial Intelligence, Bangalore Institute of Technology, Bengaluru, in association with BIT-IWS Student Forum held on 8th May 2023.

Dr. Chandrashekar A.	Dr. N. Satish	Dr. T. V. Sreerama Reddy	Dr. Aswath M. U.
Convener, Assistant Professor, R&AI	Prof. & Head, Dept. of R&AI	Prof. & Head, Dept. of ME	Principal, BIT

Paper 984 summary

1 message

Microsoft CMT <email@msr-cmt.org> Fri, Apr 28, 2023 at 3:43 PM
Reply-to: Microsoft CMT - Do Not Reply <noreply@msr-cmt.org>
To: vikhyath9@gmail.com

Hello.

Here is submission summary.

Track Name: Track-4 (special Session)

Paper ID: 984

Paper Title: Revolutionizing Cold-Chain Management: An Innovative Approach to Temperature Monitoring in Pharma/Food Industry using Node MCU Processors

Abstract:
The proper temperature control of sensitive products, such as pharmaceuticals and food, is crucial to maintain their quality and safety throughout the supply chain. Cold-chain logistics, which involve the transportation and storage of temperature-sensitive goods, present unique challenges that require advanced monitoring and control systems. In this paper, we propose a temperature monitoring and control system that utilizes Internet of Things (IoT) technology and a web-based interface to enable real-time monitoring and control of temperature in the cold-chain logistics of the pharma/food industry. The system incorporates NodeMCU controllers, temperature sensors, and a web-based dashboard for remote monitoring and control. The proposed system provides real-time temperature monitoring, data logging, and alerts for out-of-range temperature conditions, allowing timely intervention to prevent spoilage, contamination, and other temperature-related issues. The system also allows for remote control of temperature settings, ensuring that the desired temperature conditions are maintained throughout the supply chain. The system is scalable, cost-effective, and can be easily integrated into existing cold-chain logistics processes. We discuss the design, implementation, and evaluation of the proposed system, and highlight its potential applications in the pharma/food industry, cold-chain logistics, transportation of sensitive goods, storage facilities, and supply chain management.

Created on: Fri, 28 Apr 2023 10:09:21 GMT

Last Modified: Fri, 28 Apr 2023 10:09:21 GMT

Authors:
- vikhyath9@gmail.com (Primary)
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Secondary Subject Areas:

Submission Files:
Paper.temperature.pdf (572 Kb, Fri, 28 Apr 2023 10:03:26 GMT)

Submission Questions Response:

Thanks,
CMT Team.

14th ICCCNT 2023 submission 989

1 message

14th ICCCNT 2023 <14thicccnt2023@easychair.org> Sat, Apr 29, 2023 at 8:27 PM
To: Vikhyath Sthavarmath <vikhyath9@gmail.com>

Dear authors,

We received your submission to 14th ICCCNT 2023 (14th International Conference on Computing Communication and Networking Technologies -2023):

Authors : Vikhyath Sthavarmath, Praveen H N, Tejas S, Pruthvik K R, Mr. Murugesh Dodakundi and Dr. Latha M S
Title : Revolutionizing Cold-Chain Management: An Innovative Approach to Temperature Monitoring in Pharma/Food Industry using Node MCU Processors
Number : 989

The submission was uploaded by Vikhyath Sthavarmath <vikhyath9@gmail.com>. You can access it via the 14th ICCCNT 2023 EasyChair Web page

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Thank you for submitting to 14th ICCCNT 2023.

Best regards,
EasyChair for 14th ICCCNT 2023.

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Submission Information

Author Name	Tejas s
Title	Temperature monitoring in pharma food applicati..
Paper/Submission ID	745815
Submission Date	2023-05-19 12:15:04
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Document type	Others

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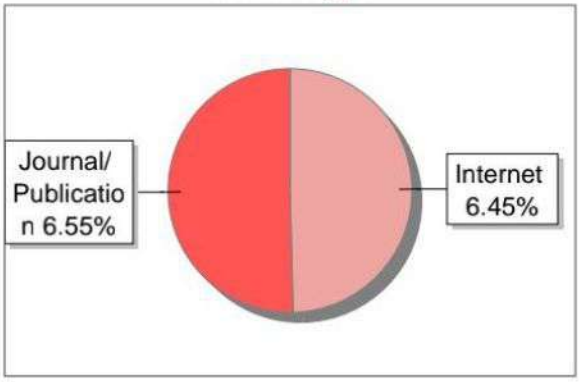

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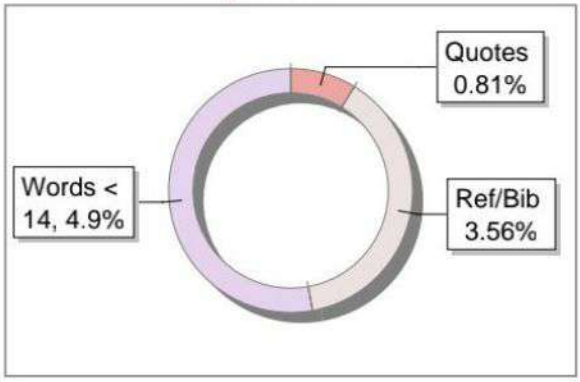

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