TechPulse'23

Technical Magazine
Department of Electronics & Telecommunication

"Sometimes it seems that the fate of the world is decided entirely in the ether of electronic communications and corporate backroom deals." — Rebecca Solnit.

R. C. PATEL
INSTITUTE OF TECHNOLOGY
An Autonomous Institute

Department of
Electronics and Telecommunication Engineering

Vision-Mission

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through:

M1. Innovative and Interactive learning process and high quality, globally recognized instructional programs.

M2. Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3. Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of Professionalism.

M4. To contribute to nation's sustainable development.

Department Vision

To produce competent Electronics and Telecommunication Engineers with a commitment to serve society.

Department Mission

M1: Deliver innovative, ICT-enabled, and interactive learning, fostering excellence in electronics and telecommunication engineering.

M2: Cultivate scientific inquiry, ethical responsibility, and collaboration to address societal and technological challenges effectively.

M3: Empower diverse students with skills for employment, entrepreneurship, and research, nurturing professionalism and lifelong learning.

PEOs-PSOs

Program Educational Objectives (PEOs)

- **PEO1** Graduates will apply engineering knowledge and innovation to solve complex problems in Electronics and Telecommunication domains.
- **PEO2** Graduates will demonstrate ethical and social values while adapting to technological advancements for sustainable societal progress.
- **PEO3** Graduates will pursue careers through employment, entrepreneurship, or research, embracing professionalism and continuous learning throughout life.

Program Specific Outcomes (PSOs)

- **PSO1 Communication Systems:** Design and analyze analog and digital communication systems for wireless, optical, and network-based applications.
- **PSO2 Signal Processing and Embedded Systems:** Apply signal processing and embedded system design using modern tools to develop intelligent systems, automation, and smart electronic products.

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TECHPULSE'23

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ABOUT E & TC DEPARTMENT

Established in 2001, the Department of Electronics and Telecommunication Engineering at **R. C. Patel Institute of Technology (RCPIT), Shirpur,** stands as a beacon of academic excellence and technical innovation. As an autonomous department with a **NAAC 'A'** Grade, it is dedicated to producing globally competent engineers through an industry-aligned curriculum and state-of-the-art infrastructure. The department boasts a high density of doctoral faculty and world-class facilities, including the **e-Yantra Robotics Lab (in collaboration with IIT Bombay)** and the **Wipro-sponsored Embedded Systems Lab**. With a strong focus on research, evidenced by numerous patents and publications, and a consistent track record of university toppers, the department empowers students to excel in emerging fields like **IoT, AI, and VLSI.** Through its vibrant student association, ACES, and robust placement tie-ups with giants like **TCS and Wipro,** the E&TC department at **RCPIT** continues to bridge the gap between rural talent and global technology standards.

2022-23

MESSAGE BY DIRECTOR'S

Editorial Message

Technology is the engine of change, and at **R. C. Patel Institute of Technology,** we ensure our students are the drivers of that change. As we move further into the era of Autonomy, our focus remains steadfast on **'Global Excellence with a Local Heart.'** This magazine is a vibrant reflection of our students' intellectual curiosity and their ability to apply engineering principles to real-world problems. We take pride in providing a world-class ecosystem—from advanced research labs to industry partnerships—that empowers our youth from rural backgrounds to compete on global platforms. I applaud the editorial team for capturing the essence of our technical achievements. I urge all students to keep **experimenting, keep failing, and keep learning**, for that is the true path to becoming a successful engineer. Let us continue to innovate for a better and more sustainable future.

— **Prof. Dr. J. B. Patil, Director, R.C. Patel Institute of Technology, Shirpur**

MESSAGE BY Dy. DIRECTOR'S

Innovation is not just about a single discovery; it is a continuous journey of disciplined learning and creative thinking. In our pursuit of academic excellence at **R. C. Patel Institute of Technology,** we have always prioritized a hands-on technical culture that bridges the gap between classroom theory and industrial application. This technical magazine serves as a mirror to the immense potential our students possess, showcasing their ability to think critically and design solutions that are both technologically advanced and socially relevant.

As we progress as an **Autonomous institution,** our focus is to nurture **'T-shaped'** engineers—those who possess deep technical expertise along with a broad understanding of multidisciplinary skills. I am delighted to see our students exploring emerging domains like **AI, IoT, and high-end Telecommunications.** I congratulate the entire editorial team and the student contributors for their hard work in bringing this publication to life. I encourage every student to utilize the state-of-the-art facilities available here to transform their ideas into reality. Keep striving for excellence and let your passion for engineering be your guide.

-Prof. Dr. P. J. Deore, Dy. Director, R. C. Patel Institute of Technology, Shirpur

MESSAGE BY
Head of Department

I feel privileged to present our department's **"Tech Pulse '23"** Technical magazine. This magazine is intended to bring out the hidden literary talents among the students and the faculty and teach leadership skills to them. Each year, our team works extensively to bring out the technical report-writing skills of the students.

The magazine elaborates on the advancement in the field of technology. It will be a source of inspiration for the budding writers among the students. It will direct their creativity to new dimensions of mature expression. The magazine's primary focus has been geared at covering articles reflecting the student's knowledge and associations with the latest and leading-edge technologies.

I am thankful to all the staff and students of the E&TC department for their contributions in making **"Tech Pulse'23"** and I hope to build on this ethos just as much during the upcoming academic years. I thank our **Director, Dr. J. B. Patil, & Dy. Director Dr. P. J. Deore** for their continuous support in preparing these magazine issues.

Lastly, I thank all the student authors who have sent their articles

— Prof. Dr. V.S.Patil Head Of Department E&TC, R. C. Patel Institute of Technology, Shirpur.

MESSAGE BY
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E&TC

2022-23

Staff Article

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Section - Staff Article

Prof. Dr. J. B. Jadhav
Associate Professor-E&TC

Introduction

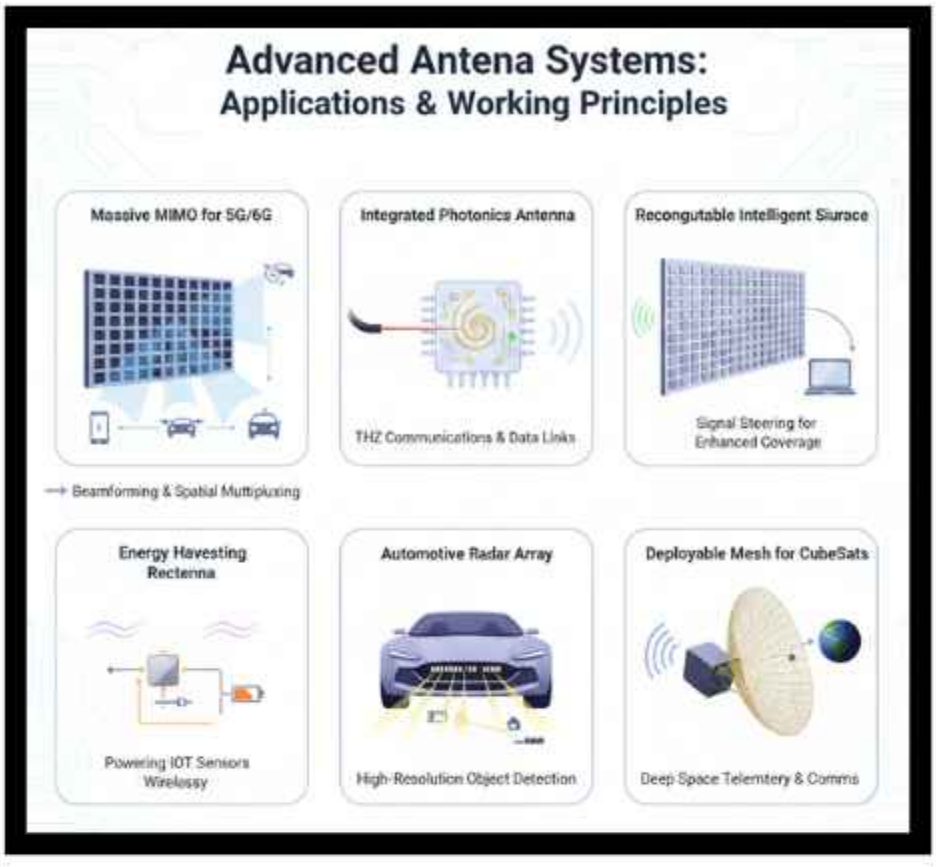
Antennas serve as the fundamental "gate" in modern telecommunications, acting as transducers that convert electrical signals into electromagnetic waves and vice versa. In our increasingly wireless world, they are the indispensable link between electronic circuitry and the physical environment, enabling everything from simple FM radio to complex satellite links.

As we move deeper into the era of the Internet of Things (IoT) and 5G/6G connectivity, antenna engineering has shifted from basic signal transmission to sophisticated spatial processing. The demand for high-speed data, low latency, and massive device connectivity requires antennas that are not only efficient but also compact enough to fit within the ever-shrinking footprint of modern gadgets.

Literature Survey

Recent research highlights a significant evolution in antenna design to meet the needs of emerging technologies:

- Miniaturization and Integration: Recent studies (e.g., Bhande et al., 2025) emphasize the transition toward Microstrip Patch Antennas and Antenna-in-Package (AiP) technologies. These designs allow antennas to be printed directly onto PCBs, which is critical for the compact form factors of smartphones and wearable medical sensors.
- Broadband and Multiband Capabilities: Literature surveys from 2024-2025 focus on Log-Periodic and Slotted Octagonal designs. These are being researched to cover the diverse spectrum of 5G, which spans from sub-6 GHz bands to millimeter-wave (mmWave) frequencies, ensuring that a single device can maintain connectivity across different network standards.
- Smart and Reconfigurable Systems: Modern research in Massive MIMO (Multiple Input Multiple Output) has demonstrated that using large arrays of antennas can significantly increase network capacity. Current trends involve "Intelligent Reflecting Surfaces" (IRS), which are smart surfaces that can steer signals toward users, overcoming the line-of-sight challenges inherent in high-frequency 5G and 6G signals.

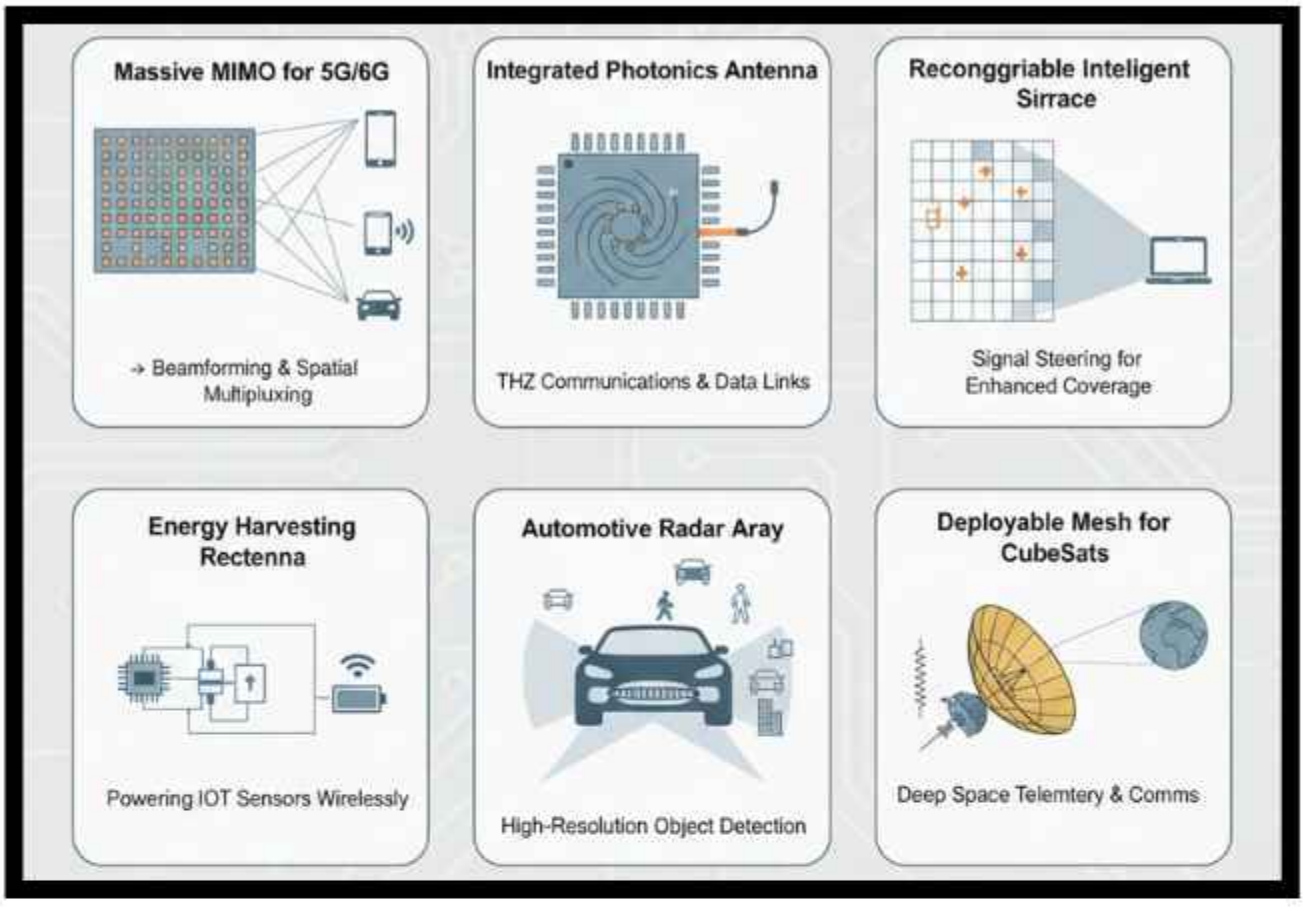


Working Principles & Mechanism

The working of an antenna is rooted in the principle of Electromagnetic Induction. When an alternating current (AC) flows through a conductive element (like a wire or patch), it creates oscillating electric and magnetic fields. At specific frequencies, these fields "detach" from the conductor and propagate through space as radio waves.

Key Types and Their Mechanics:

- Wire Antennas (Dipole/Monopole): These work on the principle of resonance. A half-wave dipole, for instance, has a physical length equal to half the wavelength ($\lambda/2$) of the signal, creating a standing wave that maximizes radiation efficiency.
- Aperture Antennas (Horn/Parabolic): These use physical shapes to "guide" waves. A horn antenna flares out a waveguide to match the impedance of free space, while a parabolic dish uses a reflector to focus all incoming waves into a single focal point, much like a flashlight lens.
- Array & MIMO Antennas: Instead of one element, these use multiple radiators. By adjusting the phase of the signal sent to each element (Phase Shifting), the antenna can "steer" the beam in a specific direction without moving the hardware.



Future Scope

- The future of antenna technology is moving toward "Intelligent Environments" where the antenna is no longer just a component but part of the architecture:
- 6G and Terahertz Communication: Research is moving toward the Terahertz (THz) spectrum, requiring antennas made of graphene or other nano-materials to handle extremely high frequencies.
- Space Exploration & CubeSats: With the rise of private space ventures, there is a growing need for deployable helical and mesh antennas that can fold during launch and expand in orbit for deep-space telemetry.
- Energy Harvesting: Future "Rectennas" (Rectifying Antennas) will not only receive data but also harvest RF energy from the air to power low-energy IoT sensors, eliminating the need for batteries.
- Autonomous Vehicles: High-resolution Radar antennas integrated into car bumpers will be essential for 360-degree sensing and vehicle-to-everything (V2X) communication.

Conclusion

Antennas remain the backbone of the wireless revolution. From the simple wire dipoles of the past to the intelligent MIMO and beamforming systems of today, they have evolved to meet the rigorous demands of global connectivity. As we look toward 2030 and the rollout of 6G, antenna engineering will continue to be a vital field, blending materials science, electromagnetics, and artificial intelligence to connect the world more seamlessly than ever before

Prof. N. L. Lokhande
Assistant Professor-E&TC

Introduction

The rapid growth of Artificial Intelligence (AI) applications has created unprecedented demand for high-performance and energy-efficient computing platforms. Traditional general-purpose processors struggle to meet the computational and power requirements of modern AI workloads, leading to the emergence of specialized AI accelerators. These accelerators rely heavily on advanced Very Large Scale Integration (VLSI) design techniques to achieve high throughput, low latency, and reduced energy consumption. This article discusses the key VLSI design challenges associated with AI accelerators, highlighting architectural, power, memory, scalability, and technology-related issues that must be addressed to support next-generation intelligent systems.

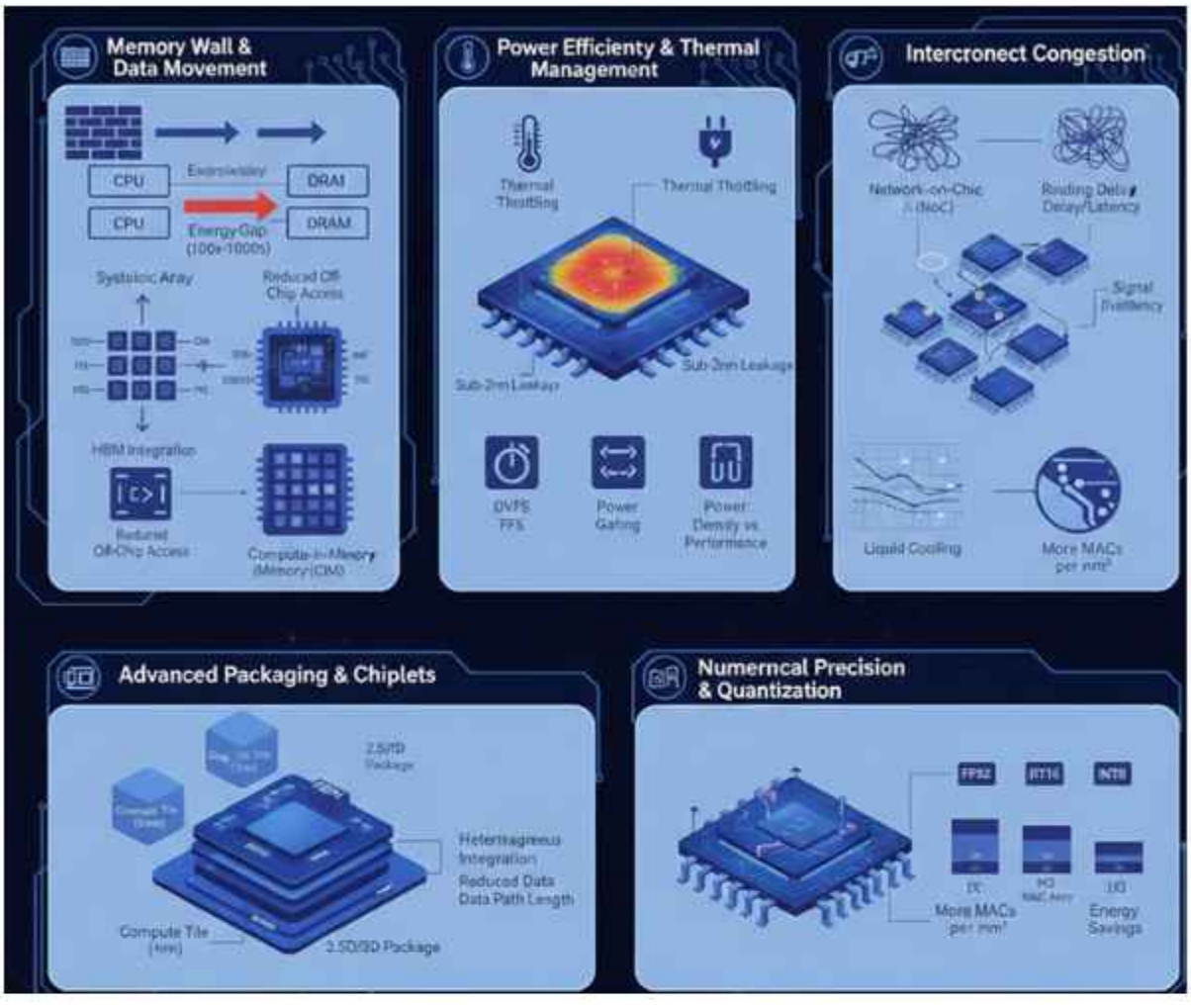
Artificial Intelligence has become a driving force behind applications such as computer vision, speech recognition, autonomous systems, medical diagnostics, and edge intelligence. AI workloads, particularly deep learning models, involve massive parallel computations, high memory bandwidth requirements, and frequent data movement. Conventional CPU-based architectures are inefficient for such workloads, motivating the development of dedicated AI accelerators such as GPUs, TPUs, NPUs, and domain-specific integrated circuits (ASICs).

From an Electronics and Telecommunication engineering perspective, the design of AI accelerators presents unique challenges at the VLSI level. Designers must balance performance, power, area, scalability, and reliability while accommodating rapidly evolving AI algorithms. As a result, VLSI design for AI accelerators has emerged as a critical and active research area.

Architecture-Level Challenges

One of the primary challenges in VLSI design for AI accelerators is selecting an optimal architecture. AI workloads require massive parallelism, which leads to architectures with thousands of processing elements operating simultaneously. Designing scalable and efficient data paths while minimizing control overhead is non-trivial.

Different AI models exhibit varying computational patterns. Convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformer-based models each impose distinct architectural requirements. Supporting multiple workloads on a single accelerator without sacrificing efficiency remains a major challenge. Designers must also decide between fixed-function accelerators, which offer high efficiency, and programmable architectures, which provide flexibility at the cost of performance and power.



Power and Energy Efficiency Constraints

Power consumption is a dominant concern in AI accelerator design, especially for edge devices and embedded systems. High computational density leads to increased dynamic and leakage power, making thermal management difficult.

VLSI designers employ techniques such as voltage scaling, clock gating, power gating, and approximate computing to reduce energy consumption. However, aggressive power optimization can impact performance and reliability. Achieving an optimal trade-off between energy efficiency and computational accuracy is a key design challenge, particularly in safety-critical applications like healthcare and autonomous driving.

Memory and Data Movement Bottlenecks

Memory access and data movement consume significantly more energy than computation itself. AI accelerators require frequent access to large volumes of data, including weights, activations, and intermediate results. Limited on-chip memory capacity forces frequent off-chip memory access, resulting in high latency and power consumption.

Designing efficient memory hierarchies, including on-chip buffers, caches, and high-bandwidth memory interfaces, is essential. Techniques such as data reuse, compression, and near-memory or in-memory computing are being explored to reduce data movement overhead. Nevertheless, integrating large memory blocks within area and power constraints remains a major VLSI challenge.

Technology Scaling and Physical Design Issues

As semiconductor technology scales to advanced nodes, physical design challenges become increasingly complex. Issues such as interconnect delay, signal integrity, process variations, and reliability significantly impact AI accelerator performance.
Routing congestion and clock distribution are particularly challenging in large accelerator designs with dense compute arrays. Moreover, advanced nodes introduce higher design costs and manufacturing variability, affecting yield and reliability. VLSI designers must adopt robust physical design methodologies and design-for-manufacturability techniques to ensure consistent performance.

Scalability and Flexibility

AI algorithms evolve rapidly, often rendering fixed-function hardware obsolete within a short time. Designing accelerators that can scale with increasing model sizes and adapt to new algorithms is a critical challenge.
Reconfigurable architectures, parameterizable designs, and hardware–software co-design approaches are gaining importance. However, incorporating flexibility often increases design complexity, area, and power consumption. Striking a balance between specialization and programmability remains an open research problem in VLSI-based AI accelerators.

Reliability, Security, and Trust

AI accelerators are increasingly deployed in mission-critical systems, making reliability and security essential design considerations. Hardware faults, soft errors, and aging effects can lead to incorrect AI inference results with serious consequences.
In addition, AI accelerators are vulnerable to hardware-level security threats such as side-channel attacks and model theft. Integrating fault tolerance, error detection, and hardware security mechanisms into VLSI designs without excessive overhead is a significant challenge. Trustworthy and explainable AI hardware is becoming an important research direction.

Emerging Trends and Research Directions

Several emerging trends aim to address current VLSI challenges in AI accelerator design. These include neuromorphic computing, analog and mixed-signal AI accelerators, 3D integration, and chiplet-based architectures. Edge AI accelerators optimized for low power and real-time processing are also gaining attention.
Advances in Electronic Design Automation (EDA) tools and AI-assisted VLSI design are expected to play a key role in managing design complexity. Collaborative hardware–software optimization will be essential to fully exploit the potential of future AI accelerators.

Conclusion

VLSI design for AI accelerators is a complex and multidisciplinary challenge that lies at the intersection of electronics, communication, computer architecture, and artificial intelligence. Achieving high performance, energy efficiency, scalability, and reliability requires innovative architectural choices, advanced power management techniques, and robust physical design methodologies. As AI continues to permeate diverse application domains, addressing these VLSI challenges will be crucial for enabling next-generation intelligent systems. For E&TC engineers and researchers, AI accelerator design offers exciting opportunities to shape the future of computing.

Prof. S. D. Patil
Assistant Professor-E&TC

Introduction

Environmental monitoring has become a critical global requirement due to increasing concerns related to climate change, air and water pollution, deforestation, and natural disasters. Wireless Sensor Networks (WSNs) provide an efficient and scalable solution for continuous, real-time monitoring of environmental parameters over large geographical areas. By integrating low-power sensors, wireless communication, and distributed data processing, WSNs enable autonomous and cost-effective environmental observation. This article discusses the architecture, key technologies, applications, and challenges of wireless sensor networks for environmental monitoring, highlighting the significant role of Electronics and Telecommunication engineering in sustainable environmental management.

Environmental monitoring involves the systematic observation of physical, chemical, and biological parameters to assess the state of natural ecosystems. Traditional monitoring methods often rely on manual data collection, which is time-consuming, expensive, and limited in spatial and temporal coverage. The emergence of Wireless Sensor Networks has revolutionized this field by enabling automated, real-time, and large-scale data acquisition.

A WSN consists of a large number of sensor nodes deployed in an environment to sense parameters such as temperature, humidity, air quality, soil moisture, water quality, and seismic activity. These nodes communicate wirelessly to transmit data to a central base station or gateway for analysis. From an E&TC perspective, WSNs represent an important convergence of sensors, embedded systems, signal processing, and wireless communication technologies.

Architecture of Wireless Sensor Networks

A typical WSN architecture for environmental monitoring includes the following components:

Sensor nodes: Equipped with sensors, microcontrollers, wireless transceivers, and power sources
Communication network: Wireless links based on protocols such as Zigbee, LoRa, or IEEE 802.15.4
Sink or base station: Collects data from sensor nodes

Data processing and storage unit: Performs analysis, visualization, and decision-making
Sensor nodes are usually deployed in harsh or remote environments, making low power consumption, robustness, and self-organization essential design requirements.Communication Technologies in WSNs

Low-Power Wireless Protocols

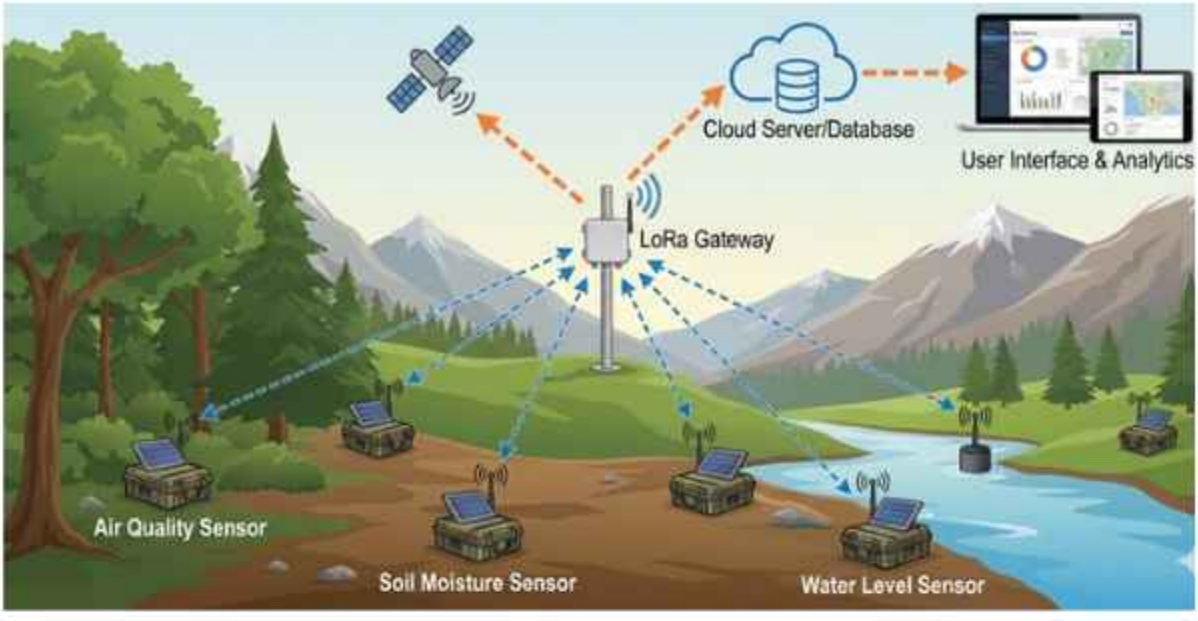
Environmental monitoring applications typically involve low data rates but require long operational lifetimes. Hence, low-power communication protocols are preferred, including:

- **Zigbee / IEEE 802.15.4 for short-range, low-power networks**
- **LoRa and LoRaWAN for long-range, low-data-rate communication**
- **NB-IoT for cellular-based environmental sensing**

These protocols enable energy-efficient data transmission while supporting large-scale deployments.

Multi-Hop Communication and Routing

In large monitoring areas, sensor nodes often use multi-hop communication to transmit data to the base station. Energy-aware routing protocols are employed to balance energy consumption across the network and extend overall network lifetime. Routing decisions are influenced by factors such as residual energy, link quality, and network topology.



Sensing and Data Acquisition

- WSNs support a wide range of environmental sensors, including:
- Temperature and humidity sensors
- Gas and air quality sensors
- Soil moisture and pH sensors
- Water quality sensors (turbidity, dissolved oxygen)
- Seismic and vibration sensors
- Efficient data acquisition strategies such as periodic sampling, event-driven sensing, and adaptive sampling are used to reduce unnecessary data transmission and conserve energy.

Data Processing and Signal Analysis

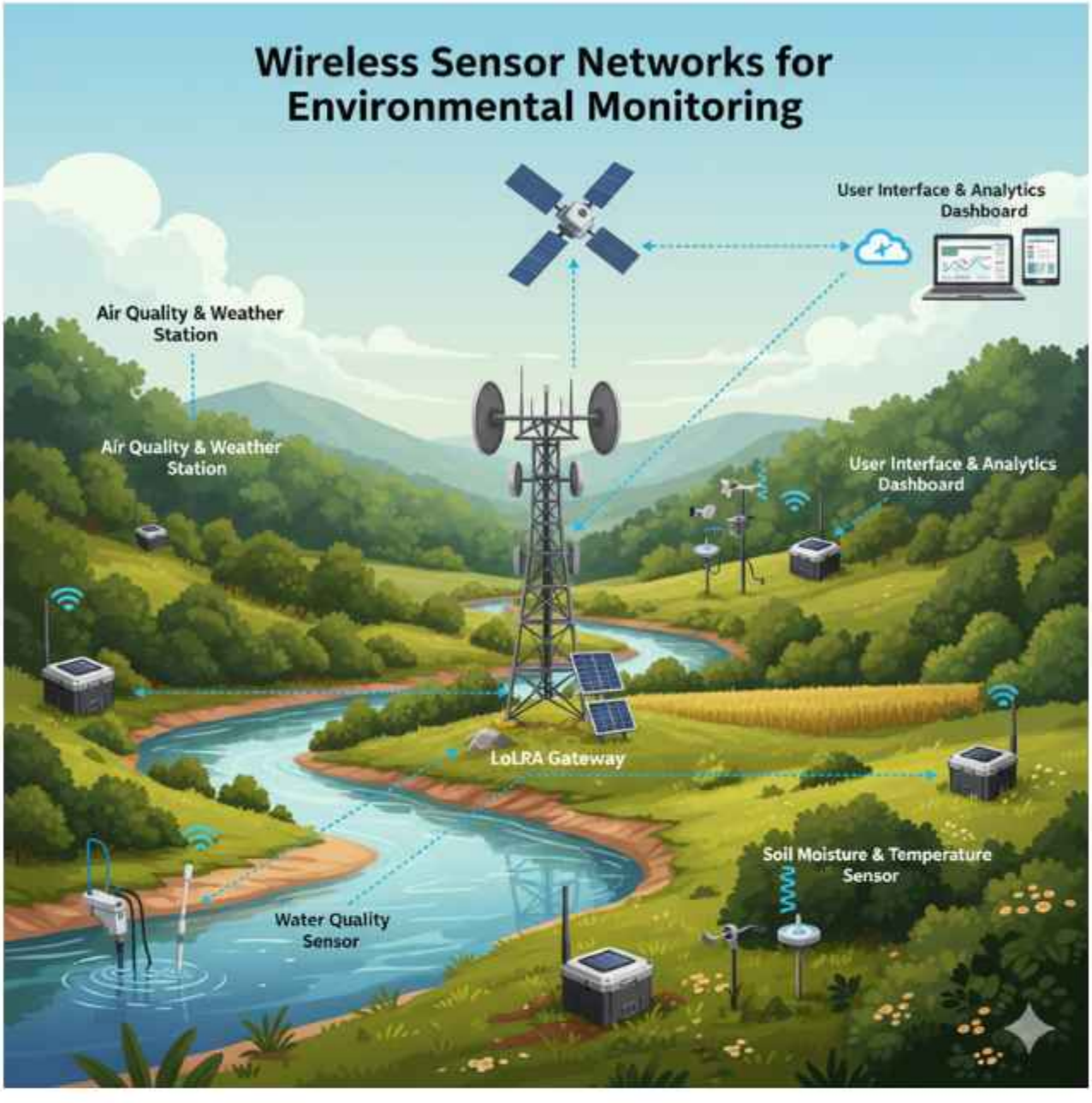
Raw sensor data often contains noise and redundancy. Signal processing techniques such as filtering, aggregation, and compression are applied at sensor nodes or intermediate nodes to reduce data volume. Edge processing enables preliminary analysis close to the data source, minimizing communication overhead and improving response time for critical events such as pollution spikes or natural disasters.

Applications of WSNs in Environmental Monitoring

- Wireless Sensor Networks are widely used in various environmental applications, including:
- Air quality monitoring: Detection of pollutants and harmful gases
- Water quality monitoring: Monitoring rivers, lakes, and reservoirs
- Agricultural monitoring: Soil moisture and microclimate observation
- Forest monitoring: Early detection of forest fires and deforestation
- Disaster monitoring: Earthquake, flood, and landslide detection
- These applications contribute to environmental protection, disaster preparedness, and sustainable resource management.

Challenges in WSN-Based Environmental Monitoring

- Despite their advantages, WSNs face several challenges:
- Limited energy resources and battery replacement issues
- Harsh environmental conditions affecting sensor reliability
- Data security and integrity in wireless communication
- Scalability and network maintenance
- Trade-off between sensing accuracy and energy consumption
- Addressing these challenges requires advances in low-power electronics, robust communication protocols, and intelligent network management.



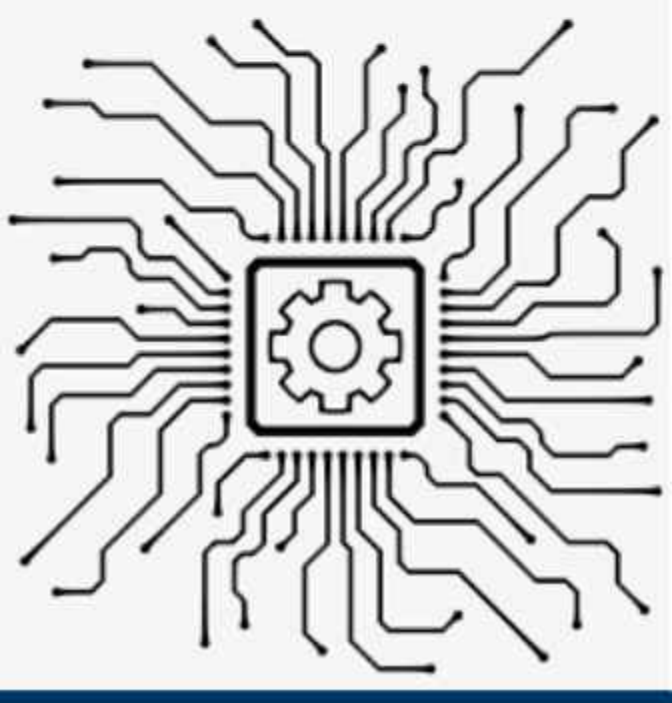
Emerging Trends and Future Directions

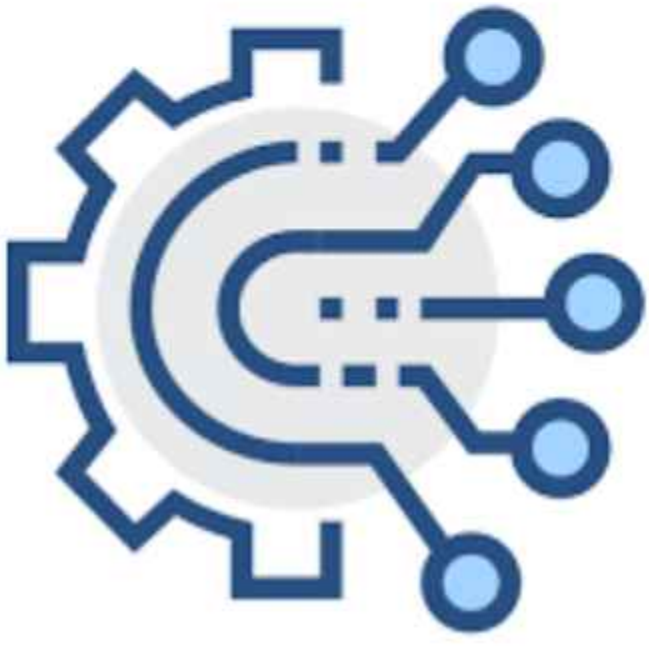
Future WSNs for environmental monitoring will increasingly integrate artificial intelligence and machine learning for predictive analysis and anomaly detection. Energy harvesting techniques such as solar and wind energy will enable long-term, sustainable operation. The integration of WSNs with IoT platforms, cloud computing, and satellite communication will further enhance coverage and data accessibility.

Conclusion

Wireless Sensor Networks have emerged as a powerful technology for environmental monitoring by enabling continuous, real-time, and large-scale data collection. Through energy-efficient communication, intelligent sensing, and distributed processing, WSNs provide valuable insights into environmental conditions and support sustainable development initiatives. For Electronics and Telecommunication engineers, WSN-based environmental monitoring offers significant opportunities to apply communication and sensing technologies for the benefit of society and the environment.

Student Article





CONTENTS

Section – Student Article

Sagar Tadvi
Vaishnavi Deore
Yogesh Pawar
B.Tech (E & TC)

Introduction

Now a day the advancement in technology various new designed smarts makeused. But Wi-Fi technology is mostly used to transmit images from one mobile to another mobile purpose. The various applications are done by robot car like doing different works on the command ex- switching on the lights when the robot is given the command by the Wi-Fi enabled device. smart Servant robot is a line follower robot as well as controlled by mobilephone. That is used over industrial purposes in transportation Department. A linefollower is a robot which follows either black or white line. It detects particular line and keep following it. Here we go with an idea, using a line follower which follows the line over each section and programmed to sense any obstacle over the path and choose its path automatically
It is an electronic college project that allows users to control a robot with their mobile phone. This robot can be used in various places, such as schools, colleges, and meeting halls, to help perform various tasks. It can be programmed to do anything from cleaning and organizing to helping with security and monitoring. It is also equipped with advanced sensors to detect changes in its environment and react accordingly. The robot is powered by a rechargeable battery, making it an eco-friendly and cost-effective alternative to traditional methods of automation.

Welcome to the world of smart servant robots! In this era of advanced technology, the integration of Node MCU and L298N motor driver brings forth an incredible opportunity to create a sophisticated and efficient robot. With four motors at its disposal, this intelligent servant robot is poised to revolutionize everyday tasks and provide unparalleled assistance in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables.

Ease of Use

Robotic evolution starts with some basic ideas. It minimizes human efforts, and it can be deployed in a lot of fields like military, surveillance applications, Indus- trial Pick and Place Robots latest Humanoid robots are developed in the modern world. Now a day's robotic cars are developed using Wireless technology. Wireless technology in Robotics starts with Wi-Fi, and Zigbee Communication. Based on the Requirement and Application they deployed the communication in Projects. And we have numerous android Applications in the Play store to control a robot car. Blynk is a Popular App used in this Project it has a lot of Features like buttons sliders, an accelerometer, terminal, arrow keys, metrics, and voice control Features also. By using Wi-Fi technology, we can connect a greater number of Robotic Cars to control it.

Maintaining the Integrity of the Specifications

- The concept of a smart servant robot is an intriguing one. It is an innovative idea that has the potential to revolutionize the way we interact with our surroundings.
- A smart servant robot is an automated device that can be programmed to perform a variety of tasks and follow pre-programmed lines. It can be controlled remotely.

Literature survey

A literature survey on smart servant robots reveals a wide range of research and development efforts in this field. The following is a summary of some key research papers and trends in the area of smart servant robots: "RoboCup Home: Domestic Service Robot League" by Luis Almeida et al. (2019): This paper discusses the RoboCup@Home competition, which focuses on developing autonomous robot systems capable of performing various domestic tasks. It highlights the importance of perception, cognition, and human-robot interaction in the design of smart servant robots An Intelligent Domestic Robot for Assisting Elderly People" by Feng-Tso Sun et al. (2019): The paper presents a domestic service robot designed to assist elderly people with daily activities. The robot incorporates features such as voice recognition, object recognition, and a user-friendly inter- face to enhance human-robot interaction and provide personalized assistance. Robotics for Smart Homes: A Survey" by Sanjay S. et al. (2020): This survey paper provides an overview of the different robotic technologies and systems used in smart homes. It covers various aspects of smart servant robots, including navigation, object recognition, manipulation.

Working

The Software description tells about the different software used in the project. Based on the literature survey on smart servant robots, an implementation statement for a project in this area could be as follows: The goal of this project is to design and implement a smart servant robot capable of providing personalized assistance and performing various domestic tasks in a smart home environment. The robot will incorporate state-of-the-art perception, cognition, and human-robot interaction technologies to enhance its functionality and user experience. Key features to be implemented include object recognition, voice recognition, natural language processing, navigation, manipulation, and a user- friendly interface. The project will focus on addressing the challenges of environment perception, adaptive behavior, and seamless interaction with users. Through this implementation, we aim to develop a reliable and intelligent smart servant robot that can assist users in their daily activities, enhance their quality of life, and promote independent living example, write "Magnetization (A/m)" or "Magnetization (A (m(1)," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K."

Fig: Robot

Emergency Brake System for Bus Safety

Aniket Patil
Manjusha Patil
Mamata Khairnar
B.Tech (E &TC)

Introduction

The proposed bus accident prevention system using sensors sounds like an innovative approach to enhancing road safety, particularly on dangerous mountain roads with curves. The system utilizes various components such as the Node MCU ESP8266 board, ultrasonic sensors, LED lights, and a buzzer. The functioning of the system seems to be as follows: when two buses approach each other from opposite sides of a mountain curve, the ultrasonic sensors detect the presence of the buses. As a result, the LED lights change to red, indicating danger, and the buzzer is activated, providing an audible warning. This system aims to address the visibility challenges faced by drivers on curve roads, especially when vehicles or obstacles from the opposite direction are not easily visible. By alerting drivers to the presence of another bus on the curve, it helps them to exercise caution, control their speed, and prevent accidents, such as falling off a cliff due to high speeds or lack of visibility. Implementing road safety systems like this can contribute to reducing the number of accidents and enhancing overall safety on dangerous roads. It's important to consider that while such a system can be beneficial, it should ideally be supplemented by other road safety measures, including driver education, strict traffic regulations, regular road maintenance, and effective enforcement of traffic rules. Additionally, the system should undergo thorough testing and validation to ensure its effectiveness and reliability in real-world conditions. Collaborating with transportation authorities, road safety experts, and engineers can help refine and optimize the system for maximum impact. Overall, combining technological advancements with road safety measures is crucial for addressing the growing challenges posed by increasing population, vehicle usage, and road accidents.

There are several reasons why roads in mountainous areas are often built with curves instead of being straight. Firstly, it's because large vehicles like trucks and semitrucks have difficulty navigating steep hills. Secondly, during cold seasons, the road surface can become icy, making it challenging for vehicles and even pedestrians to move safely up and down on a slippery surface. If the road were straight, accidents would be very common because vehicles would slide all over the place. Therefore, roads are designed with curves to prevent such accidents and ensure safer travel in challenging terrain. There are various types of dangerous roads around the world, such as mountain roads, narrow curves, and T-roads. Mountain roads are often narrow and filled with numerous curves. For instance, there is a place called Kolli Hill, also known as the 'Mountain of Death', located in Madras. Another example is the three-level zigzag road in Sikkim. When roads are located in remote areas, there is a risk of encountering animals on the road, which can be dangerous for drivers as they may not see them in time. In many curve roads, drivers cannot see what's on the other side of the curve due to obstacles like trees or rocks in the middle. These obstacles pose a risk to drivers and can lead to accidents and loss of life.

LITERATURE SURVEY

According to projections, the number of road traffic fatalities is expected to increase in the coming decade. Currently, there are over 1.3 million deaths, and this figure is anticipated to rise to more than 1.9 million by 2022. The Commission for Global Road Safety emphasizes the need to urgently address this alarming and preventable surge in road injuries. The first step is to put a stop to this increase and then strive for yearly reductions. By significantly increasing investments in road safety at global, regional, and national levels, it is estimated that we could prevent 5 million deaths and 50 million serious injuries by 2022. This highlights the importance of prioritizing road safety measures to save lives and protect people from harm. Every year, approximately 1.3 million individuals lose their lives due to road traffic collisions.

This equates to over 3,000 deaths occurring daily, and shockingly, more than half of these victims are not even traveling in a bus. Additionally, between 20 to 50 million people suffer non-fatal injuries from these accidents, leading to disabilities that significantly impact their lives. It's concerning to note that 90% of road traffic fatalities happen in low and middle-income countries, despite these nations having less than half of the world's registered vehicles. What's more, road traffic injuries rank among the top three causes of death for individuals aged between 5 and 44 years. Unless immediate and effective measures are taken, road traffic injuries are projected to become the fifth leading cause of death worldwide, resulting in an estimated 2.4 million fatalities annually.

This situation is partly due to the rapid growth in motorization without adequate improvements in road safety strategies and land use planning. It is crucial to address these issues promptly to save lives and reduce the impact of road traffic accidents. In India, there has been a simultaneous increase in mobile phone usage and personalized vehicles at a similar growth rate. To put it into perspective, if all the buses in India were lined up in a single lane, they would stretch from New Delhi to New York. However, this trend of vehicle usage is projected to lead to an unsustainable and problematic situation in terms of both traffic congestion and safety. Over the past ten years, while India's population increased by 17.64 percent, the number of licensed vehicles rose by a staggering 132 percent. It is worth noting that the following statistics pertain to the year 2022: According to official records, the number of road traffic fatalities in India reached a distressing figure. Unfortunately, the situation has worsened in recent years, with traffic fatalities increasing at a rate of about 5.5 in proportion to the growing number of vehicles on the road. This can be attributed, in part, to the absence of a coordinated official policy to effectively control this problem. 443 Deaths and 1301 injuries per day due to Traffic Accidents. 367 Deaths per day and 1290 injuries per day due to Road Accidents. 73 Deaths per day by Truck/Lorry and 77 deaths by two-wheeler. Between the years 2010 to 2021, the number of motor vehicles on Indian roads continued to increase rapidly. This growth was fueled by more people owning and using vehicles. However, along with the increase in vehicles came greater risks and exposure to traffic accidents. During this period, there were numerous road accidents in India. The exact number of accidents and their outcomes may vary, but it is evident that they had significant impacts. These accidents resulted in the loss of many lives and caused injuries to a large number of individuals. The impact of these accidents on the Indian economy remained significant. In the past, it was estimated that fatalities and injuries from road accidents accounted for a considerable portion of the country's Gross Domestic Product (GDP). The age group most affected by road accidents during this time was individuals between 25 and 65 years old. They accounted for a significant percentage of the victims. Pedestrians, bicyclists, and two-wheeler riders continued to be the most vulnerable road users, comprising a significant portion of the fatalities. With the steady increase in the number of vehicles on Indian roads, the risk of accidents has continued to rise.

Methodology

This section includes the project details the block diagram with detailed description of components used in the project and about the working of the circuit.

The block diagram consist of the following main blocks

1. Ultrasonic Sensor
2. Battery
3. Buzzer
4. Node MCU ESP8266
5. L298N Motor diver module
6. LED
7. Jumper wire

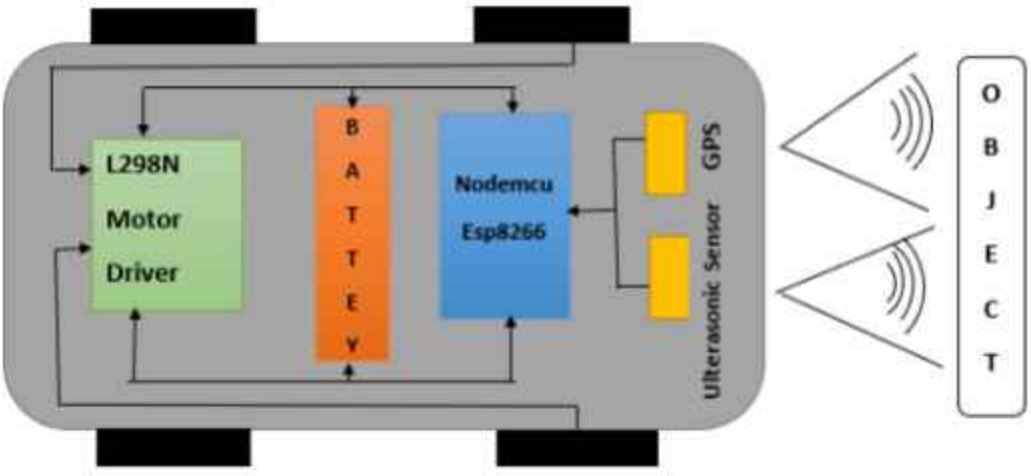


Fig.: Block diagram

Components

Ultrasonic Sensor

Ultrasonic devices that chase and detect waves using high

Working Voltage - DC 5 V

Working Current -15mA

Working Frequency - 40Hz Max

Range - 4m Min Range - 2cm

Measuring Angle - 15 degree

Trigger Input - Signal 10uS TTL

pulse Echo Output - Signal Input TTL lever signal and the range in proportion Dimension - 45*20*15 mm

Ultrasonic Transducer

The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high-frequency ultrasonic sound, which bounces off any nearby solid objects, and the receiver listens for any return echo. That echo is then processed by the control circuit to calculate the time difference between the signal being transmitted and received. This time can subsequently be used, along with some clever math, to calculate the distance between the sensor and the reflecting object Object detection.

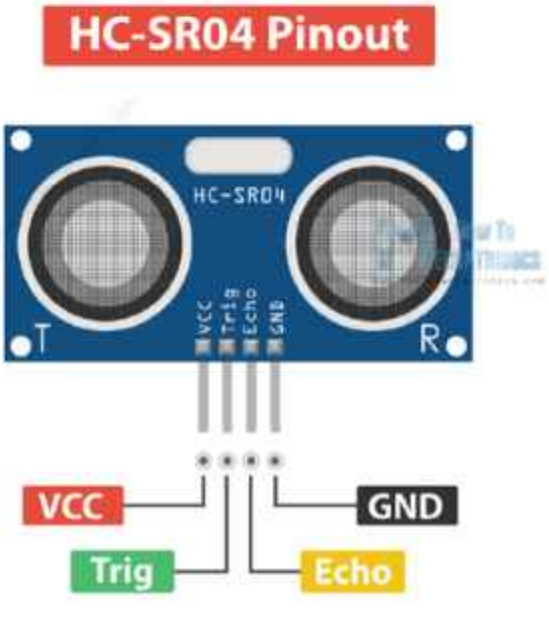


Fig.: Ultrasonic Transducer

Battery

Today lithium batteries are finding increased applications in electronics, electric buses, and solar markets. Given its lightweight, high-energy density and efficiency, lithium batteries are used in a wide range of portable consumer electronic devices, medical equipment, power backups, solar storage and in electric vehicles. Lithium Battery is one of the rechargeable battery. The working and function is same as any other battery. First we need to know what is a cell ? Cell is a closed entity which has 3 components: Anode, Cathode and a Separator. Anode simply understand - positive (+) terminals, Cathode means negative (-) terminal and Separator which is a porous membrane that physically separates anode and cathode. There are four components in a lithium-ion cell = anode, cathode, separator, and the nonaqueous electrolyte. Different chemistries are used; the anode is graphite, the cathode is an oxide (LiCoO2), and the alternating layers of anode and cathode are separated by a porous polymer separator, which is generally made of polypropylene (PP), polyethylene (PE), or a laminate of PP and PE. In all cases a critical feature of the separator is a controlled amount and uniform size of porosity in the separator.

NodeMCU ESP8266

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module. It has two control pins i.e, EN, RST. It regulated on 3.3V power supply. NodeMCU can be powered through the USB port. NodeMCU has four pins available for SPI communication (SD1, CMD, SD0, CLK). NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C. NodeMCU has 16 general purpose input-output pins on its board The NodeMCU ESP8266 is a popular development board that combines an ESP8266 Wi-Fi module with a microcontroller, making it suitable for various IoT applications. It can be utilized in an emergency brake system for bus safety, playing a role in communication, data processing, and control. Here's how the NodeMCU ESP8266 could work within such a system:

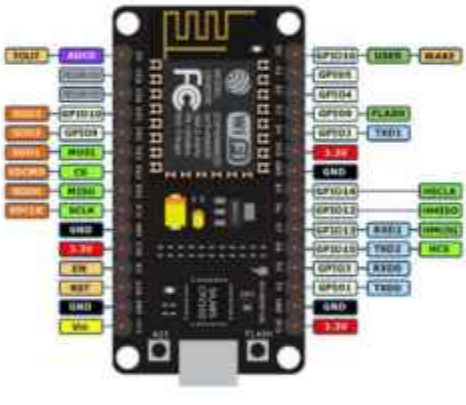


Fig. NodeMCU ESP8266

Sensor Integration:

The NodeMCU ESP8266 can interface with various sensors relevant to the emergency brake system. For example, it can connect to GPS modules, proximity sensors, accelerometers, or collision detection sensors. These sensors provide critical data about the bus's position, speed, proximity to obstacles, or potential collisions.

Data Processing:

The ESP8266 microcontroller on the NodeMCU board can receive data from the integrated sensors and process it. It can perform calculations, analyze sensor data, and make decisions based on predefined safety parameters or algorithms.

Communication:

The ESP8266 module has built-in Wi-Fi capabilities, allowing it to establish a wireless connection with external systems or a central control unit. It can send real-time data, such as GPS coordinates, sensor readings, or system status, to the control unit or receive commands and instructions from it.

L298N Motor Diver Module

This L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control. The L298N motor driver module is a popular motor control board that can be used in various applications, including emergency brake systems for bus safety. While the specific implementation of the L298N module may vary depending on the system design, here's a general overview of how it can work within an emergency brake system.

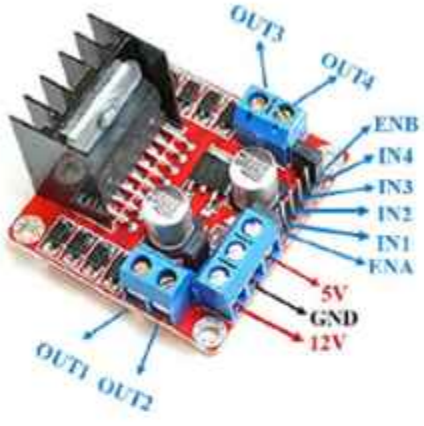


Fig: L298N Motor Diver Module

GPS Module

The Global Positioning System (GPS) is a satellite-based navigation system that provides location and time information. The system is freely accessible to anyone with a GPS receiver and unobstructed line of sight to at least four of GPS satellites. A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites. GPS is nowadays widely used and also has become an integral part of smartphones. The GTPA010 module is easy to use, having RS232 as well as a USB interface. It operates over a 3.2 to 5V supply range thus enabling interfacing with microcontrollers with 3.3V as well as 5V. One of the global positioning systems (GPS) devices utilizes data from satellites to locate a specific point on the Earth in a process named trilateration. Meanwhile, a GPS receiver measures the distances to satellites using radio signals to the trilateral. And trilateration is similar to triangulation, which measures angles, depicted in this illustration (Tim Gunther, 2020). The emergency brake system for a bus safety project typically involves the integration of various technologies, including a GPS (Global Positioning System) module. The GPS module is responsible for providing accurate positioning information about the bus's location in real time. This information is crucial for the emergency brake system to function effectively.

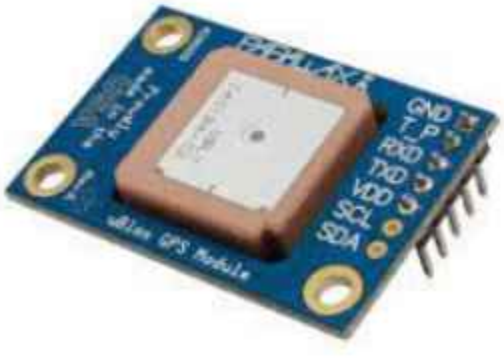


Fig: GPS Module

IMPLEMENTATION

Work Flow:

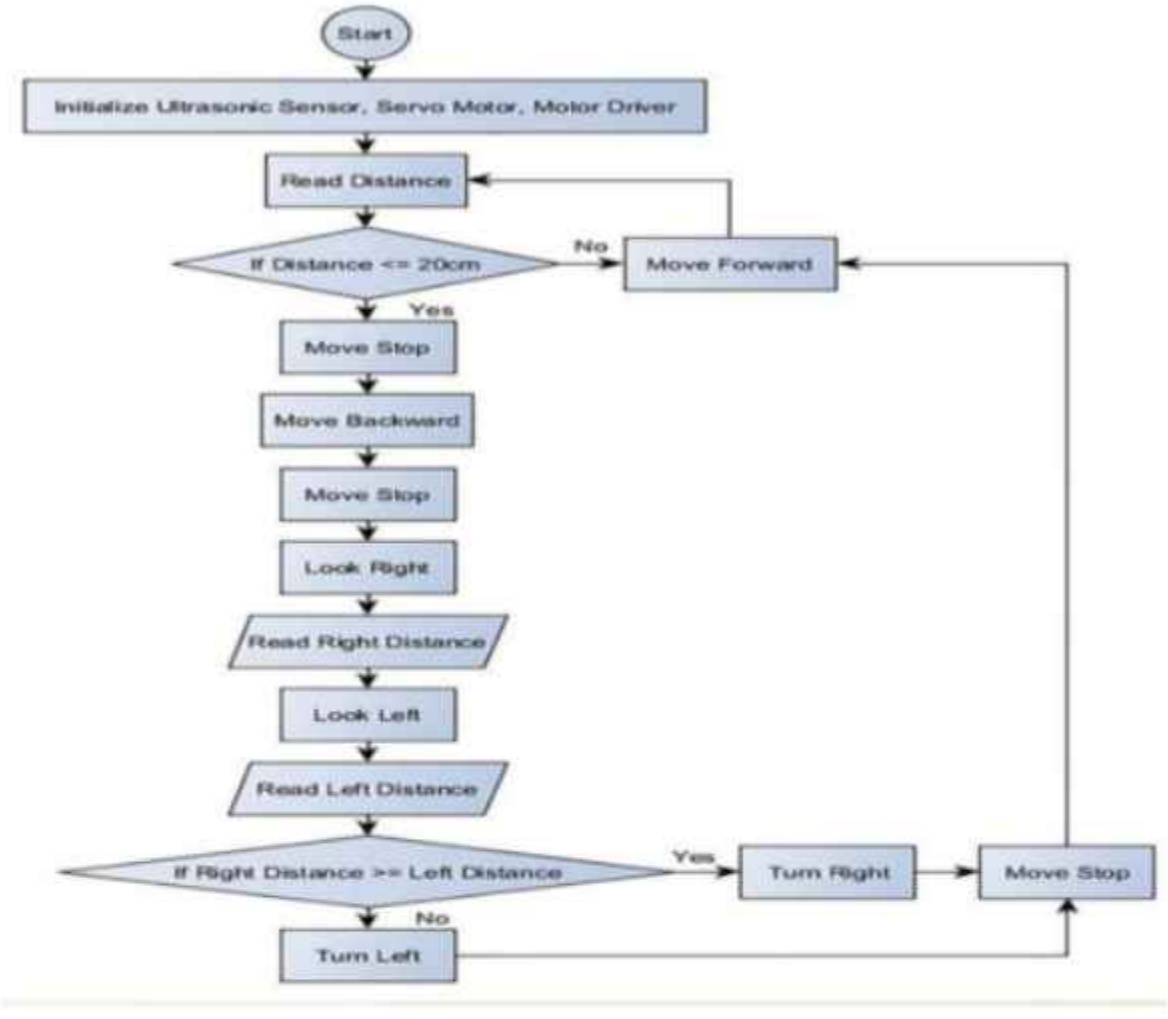
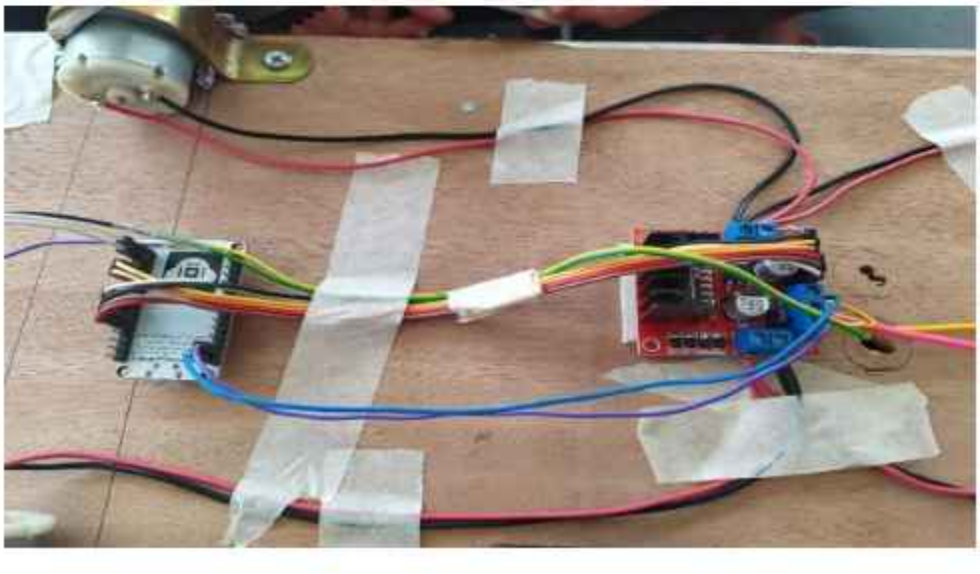


Fig. : Work flow of the system

RESULTS AND DISCUSSIONS

In testing part we connect the main component with NodeMCU ESP8266 and check the functional of component and take the readings for future design.

NodeMCU ESP8266 Interface with L298N Motor Diver:



CONCLUSION AND FUTURE WORK

In conclusion, the development and implementation of an emergency brake system for buses have proven to be a significant advancement in enhancing the safety of bus passengers and reducing the occurrence of accidents. The project has successfully achieved its objectives by designing a reliable and efficient emergency brake system that can detect potential collision scenarios and apply immediate braking to prevent or minimize the impact of accidents. The emergency brake system utilizes advanced sensor technologies, such as radar, lidar, and cameras, to continuously monitor the surrounding environment and detect potential hazards. It integrates with the bus's existing braking system and employs sophisticated algorithms to analyze sensor data and make split-second decisions to engage the emergency brakes when necessary. This quick response time significantly reduces the stopping distance and increases the chances of avoiding collisions. The implementation of the emergency brake system has demonstrated several key benefits. First and foremost, it has significantly enhanced passenger safety by providing an additional layer of protection against accidents caused by human error, such as distracted driving or delayed reaction times. Second, it has contributed to the reduction of property damage, injuries, and fatalities associated with bus accidents. Third, it has increased public confidence in using buses as a safe and reliable mode of transportation.

EV BMS Charge Monitoring and Fire Protection.

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Introduction

Electric vehicles surely are the future of transportation, but EV technology has not been fully developed with respect to efficiency and safety as of 2022. We come across electric vehicle battery fire and similar incidents as the EV market expands. Most electric vehicle fire incidents occur due to battery blast or fire. So here we attempt to solve the problem by using some sensors and battery pack based system powered by an STM32 controller. The system is designed to protect batteries from various parameters that may incite a fire. The system is designed to constantly monitor battery voltage current temperature and instantly cut off the input or output from battery as soon as any unusual behavior is detected. When connected to a load the current sensor keeps track of current drawn from battery and displays the parameter on LCD Display. The temperature sensor is used to monitor temperature of battery while charging as well as discharging. If the battery temperature is observed to deviate from standard values, the system automatically cuts off input as well as output supply and displays the temperature as well as a buzzer alert on the LCD display. Thus the system allows for a smart and efficient battery charging as well as protection system.

Electric vehicle companies are enabling modern technologies like Artificial Intelligence and IOT to improve efficiency. Nowadays, vehicles are essential in the day to day life and for industrial use as well. Sufficient effort is being done to withdraw the combustion engines by electric motors (Liu et al., 2016). A
system with IOT will definitely streamline the performance of EV charging and looks the impacts. IOT will improve the city planning and makes the city life easy. Automotive/transportation sector is undergoing a phenomenal course of rapid, change. This transformation is enabled by similar factors that are driving advancements in the Internet of Things including increased computing resources and ubiquitous connectivity. They're easier on the environment. EV's don't even have an exhaust system, meaning they have zero emissions. And since gas-powered vehicles are large contributors to greenhouse-gas buildup in the earth's atmosphere, making the switch to an electric car can help contribute to cleaner air and a healthier planet. Electric vehicles (EVs) burn no gasoline and have no tailpipe emissions, but producing the electricity used to charge them does generate global warming emissions.

A Battery Management System, or BMS, is a system that helps to prolong the life of your batteries and keep them operating at peak efficiency. It does this by monitoring the battery cells and making sure that they are all working together within their ideal voltage and temperature range. The BMS will also balance the cells so that they all degrade at the same rate. This prolongs the life of your batteries and ensures that they will provide consistent power output over their lifetime. The basic function of a battery management system is to monitor and protect the cells in a battery pack. Each cell in a lithium-ion battery pack has its own voltage, current, and temperature characteristics that must be managed in order to ensure the safe, efficient, and long-term operation of the battery pack. A BMS does this by constantly monitoring the voltage, current, and temperature.

LITERATURE SURVEY

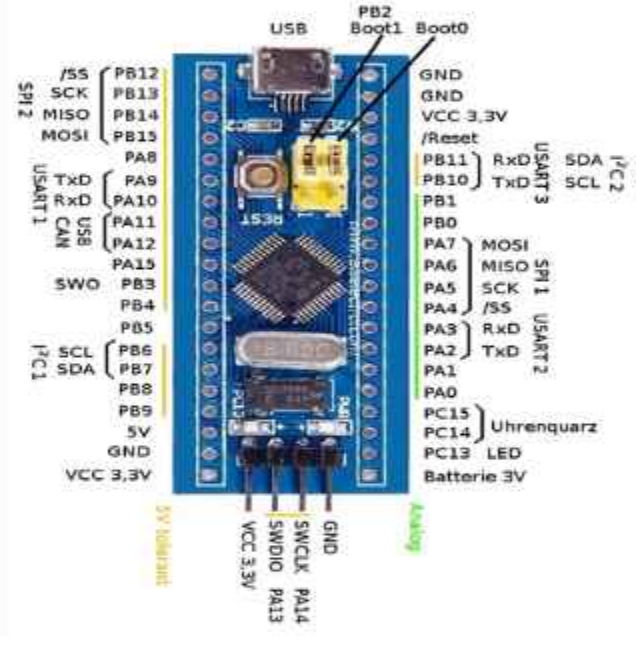
Transport sector dependent mostly on oil and fuel, which their prices are unstable and their reserves are severely depleted. Moreover, the use of these forms of energy pollutes the environment and causes the emission of greenhouse. Much research has been interested by the economic efficiency of the integration of electric vehicles. They present an overview of the impact of the increasing penetration of the EV into vehicle market. Focusing of the electricity system and the emergence of vehicle to grid technologies, batteries and EV recharge infrastructure conclude the need for standardization to facilitate safe transition with economically efficient and environmentally abiding. And estimate costs of plug-in electric vehicles and their work shows the advantages of smart electric vehicles compared to the dumb electrical vehicles which that appear most in timing of charging and discharging of EVs..

To improve vehicle performance various researches deal with the optimization of energy management for the new generation of vehicle Battery is one of the energy storage management systems in HEV or EV. The battery provide power when vehicle accelerating and absorb power when vehicle braking. So the cruse range and accelerate performance depend on the battery. Usually, there is a battery management system (BMS) in battery pack of vehicles. The BMS monitor the statues of the battery, and communicates with vehicle control unit(VCU), to ensure the battery not in abused, such as over-charged, over discharged or over-temperature. And BMS play a vital role in hybrid and electric applications, since the importance of BMS have a significant impact on the energy efficiency and the battery's life.

IMETHODOLOGY

MICROCONTROLLER:

The STM32 is a very common type of microcontroller used in numerous types of devices. It also provides facilities to linking with other types of microcontrollers. The STM32 series of MCUS which created by the STMicroelectronics consists of ARM Cortex-M thirty two-bit processor core. In this microcontroller series and parallel communication system exit through which numerous external devices such as camera, sensors, motors, etc can be connected. Every STM32 MCU also consists of inner flash memory and random access memory.



Features include:

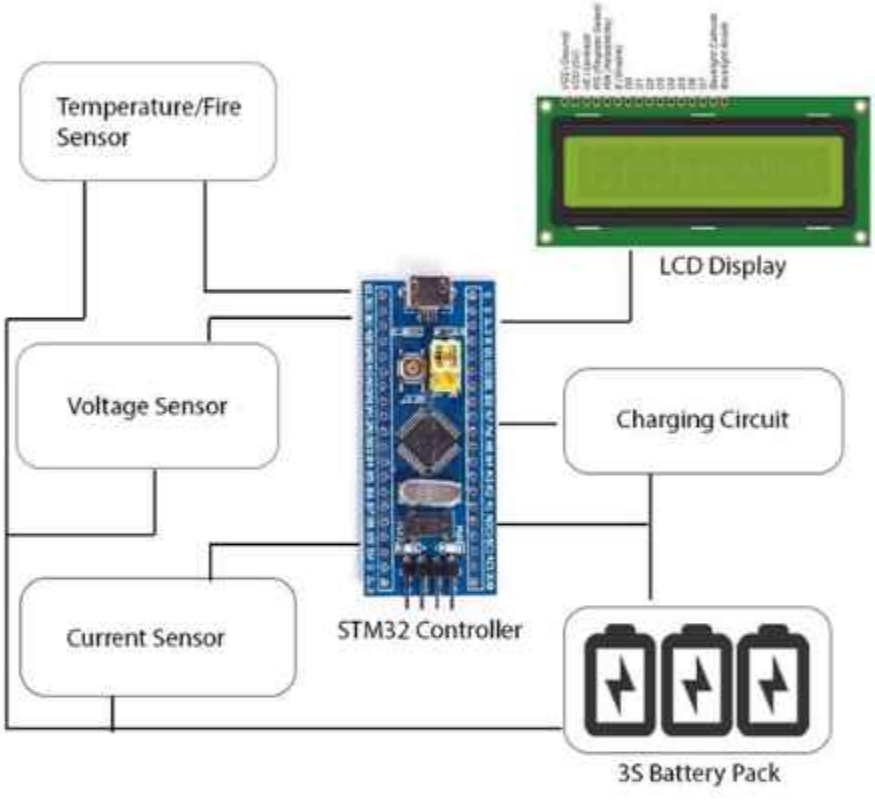
- High Performance, Low Power Design.
- Up to 20 MIPS throughput at 20 MHz.
- 32 x 8 working registers.

BLOCK DIAGRAM

During testing, the BMS successfully monitored the battery voltage, charging or discharging current, and battery temperature. The system accurately measured and displayed these parameters, allowing for real-time monitoring of the battery's status. SBMS designers have difficulties determining the most desired solution, as there is no evaluation method for SBMS. To address this issue, this paper presents an IEEE P2668 compatible evaluation strategy for SBMSs, namely SBMS-ES. The SBMS-ES identifies five essential attributes for SBMSs and defines grading principles for each attribute. Furthermore, a final score between 0 and 5 for the SBMS is obtained using a weighted calculation of the sub-scores, where the weighting is given using the AHP. With the quantitative evaluation scores, designers can compare the different solutions of SBMSs, regarding the scenario, and determine the best candidate. Moreover, the disadvantages of their SBMSs that may induce failure can be found when evaluating the attributes and making the related adjustments.

When the slow charging option was selected, the BMS effectively controlled the charging process by limiting the current to a lower level. This ensured a gradual and safe charging of the battery, preventing any potential overloading or overheating. Switching to the fast charging option resulted in the BMS increasing the charging current to a higher level. The system efficiently managed the faster charging process while closely monitoring the battery's voltage and temperature. Once the battery reached its full charge, the BMS automatically switched off the charging to prevent overcharging and potential damage. By activating the DC motor, the BMS allowed for controlled battery discharging. The system accurately measured and displayed the amount of current consumed by the motor, providing valuable information about the battery's power output.

During testing, simulated battery overheating scenarios were introduced while charging or discharging. The BMS responded swiftly and effectively to the detected temperature increase. The temperature sensor promptly detected the rise in temperature and activated the appropriate relays to interrupt the charging or discharging process, ensuring the battery's safety and preventing any damage or accidents.



CONCLUSION

In this way we are developing the system model for battery management in electric vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of health, state of life, temperature. It is every important that the BMS should be well maintained with battery reliability and safety. The design teams selected a batteries based on size and power output, and designed dependent systems for heating the batteries, charging them, powering the motor from the batteries, and switching between circuits. The battery heating is accomplished via heating pads that activate to warm the batteries to a safe temperature while the vehicle is in use, extending the operable temperature range of the design. When the battery state of charge runs low, the user may activate the power supply to recharge them, allowing for continued operation beyond what would normally be achievable. The design teams added power supplies to the design to allow the batteries to drive the vehicle, and designed and implemented an intricate system of cabling and microcontroller-driven relays to ensure only the appropriate systems would activate when called upon, and to isolate the batteries from the motor when the power
supply is active.

FUTURE SCOPE

Building upon the achievements of the current project, several future enhancements can be considered. Advanced charge monitoring algorithms can be implemented to monitor charging voltage, current, and state of health (SoH). Compatibility with fast-charging and adaptive algorithms can optimize charging speed while ensuring battery longevity. Additionally, integrating wireless communication capabilities would enable remote monitoring of the charging process. Enhanced fire protection is another area of future development. This involves the creation of a comprehensive fire protection system with early detection of thermal runaway events. The integration of flame retardant materials and insulation will minimize the risk of fire propagation within the battery pack. Furthermore, implementing a fire suppression system that can activate automatically during a fire event is crucial for enhanced safety. Vehicle-to-Grid (V2G) integration presents another exciting opportunity. Enabling bidirectional power flow allows the EV battery to serve as a power source for external applications during peak demand or emergencies. Protocols and communication interfaces need to be developed for seamless integration with smart grids and energy management systems. Predictive maintenance and prognostics can further enhance the BMS. Advanced algorithms can monitor battery health, predict failures, and schedule maintenance proactively. Real-time diagnostics and prognostics capabilities can detect potential issues before they become critical, ensuring optimal performance and safety. Energy management and optimization play a vital role in maximizing the efficiency of EVs. Developing intelligent energy management algorithms that consider driving conditions, traffic, and user preferences will optimize battery usage. Integration of machine learning techniques, learning from historical data, will allow the system to adapt its behavior to the driver's needs and driving patterns.

FM Radio Station

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Avinash Sapkale
B.Tech (E & TC)

Introduction

The main intention of the project is to build a portable, small radio station that can broadcast and display FM radio signals. The Arduino Uno microcontroller board acts as the central control unit, providing the necessary processing power and interfacing capabilities. The FM transmitter module is responsible for broadcasting the audio signals generated by the Arduino to nearby FM radios. The Nokia LCD display enhances the user experience by providing real-time information such as frequency, station name and signal strength. The project involves the integration of multiple components, including the Arduino Uno, FM transmitter module and Nokia LCD display. The Arduino is programmed to generate the desired audio signals, which are then transmitted through the FM transmitter module. The Nokia LCD display is utilized to show relevant information related to the FM radio station. The implementation of this project requires knowledge of Arduino programming, interfacing with external modules and basic electronics. The Arduino IDE can be used to develop the necessary code, while the libraries specific to the FM transmitter module and Nokia LCD display should be installed and utilized. The resulting FM radio station provides a cost-effective and versatile solution for broadcasting audio content within a limited range. Its portability and compact design make it suitable for various applications, such as community radio stations, educational projects or personal use. The use of Arduino Uno, FM transmitter module and Nokia LCD display offers flexibility, ease of use and expandability for future enhancements

The FM radio station project uses the general clock output on an Arduino Uno to produce frequency modulated radio communication. It is a very useful computer that can be used for many different things. The FM Transmitter play the sound over the air. This device normally works like real radio station. We can use this device in real life, suppose in an area where our phone network as well as internet is not working to communicate, in those area we can install this device for communication purpose on the other hand it is a low-cost device we can used in our daily life to communicate in locality. With rising speeds of internet and thus internet streaming services, radio technology, which was once the sole way of broadcasting and communicating long range instantaneously, has seen a decline in the use. The Internet which once did not have a large enough bandwidth to send messages at once, or took long time to send images has seen a great boost in its bandwidth.

Only about 3% of the population had access to internet in 1998 whereas in 2016, it increased to 48%. Unlike radio, internet has a vastly greater range. Data can be shared globally, is much less noisy and can be encrypted accordingly. Internet is suited for broadcasting, end to end communication as well as multicasting. This makes it a better channel for sharing of information than radio which is only used for broadcasting and end to end casting. There are very few ways in which radio is a better medium of communication and this project discusses a few of those ways, Radio requires very little infrastructure to be used. A radio transmitter and radio receivers by the listeners can be used for broadcasting. Both the transmitter and receiver consume very little electricity. Both the components can be made using simple electronic parts and complicated protocols are not required to engage in smooth flow of information. Wiring between the receiver and transmitter is not required. As it consumes very little electricity, it can be reliably used during power cuts with the use of batteries. Receivers require lesser energy than transmitter so it can be used by anyone with a receiver and a couple of AAA batteries During emergencies, there is a possibility of power cut which will result in people not being able to use their internet. At those times, FM/AM radio can be heavily used to direct the population and give them information which they otherwise cannot receive.

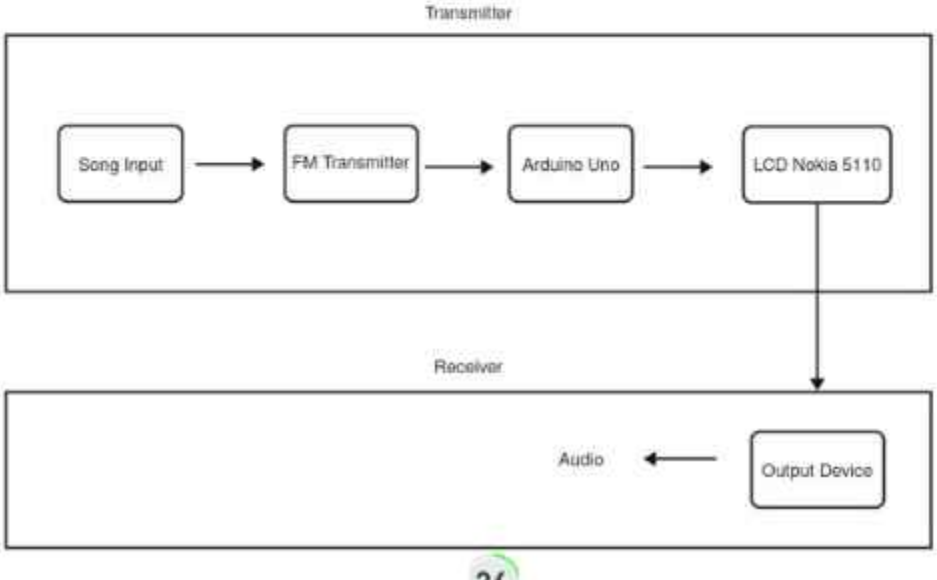
The FM (Frequency Modulation) radio station is a broadcasting platform that uses frequency modulation to transmit audio signals to a wide audience. FM radio stations have been a popular medium for entertainment, news, music and information dissemination for decades. Here is an introduction to FM radio stations. FM radio stations utilize radio waves in the FM band of the electromagnetic spectrum to transmit audio signals. These signals are received by radio receivers, such as car radios or standalone receivers and converted back into sound. FM radio stations employ frequency modulation, a method of encoding audio signals onto a carrier wave by varying its frequency. This modulation technique allows for high-fidelity audio transmission with reduced susceptibility to noise and interference compared to other modulation methods. FM radio stations operate under regulatory frameworks established by government bodies, such as the Federal Communications Commission (FCC)in the United States. To establish and operate an FM radio station, licenses are required, and specific guidelines regarding frequency allocation, signal power, coverage area and content regulations must be followed. FM radio stations use powerful transmitters and antennas to broadcast their signals. The transmitter converts the audio signal into an FM signal and amplifies it to a suitable power level.

LITERATURE SURVEY

1. S. F. M. Sahari et al. (2017): This project presents the design and implementation of an FM radio transmitter using Arduino Uno board and an FM transmitter module. It discusses the hardware setup, Arduino code development and the integration of a Nokia LCD display for frequency and status display. The study includes experimental results and performance analysis.
2. A. M. Ismail et al. (2018): This project focuses on developing an FM radio using Arduino Uno and an FM transmitter module, along with a LCD display. It covers the hardware connections, Arduino code development and the integration of a Nokia LCD display for frequency display and station information. The project presents experimental results and discusses the feasibility of the system.
3. A. F. M. Tariqul Islam et al. (2016): This project describes the implementation of an FM transmitter using Arduino Uno and FM transmitter module. It discusses the hardware setup, Arduino programming and the use of a Nokia LCD display for displaying frequency and transmission status. The project provides experimental results and analyzes the performance of the FM transmitter.
4. T. Raja et al. (2015): This project focuses on the receiver side of an FM radio, it provides insights into the overall FM radio system using Arduino. It discusses the hardware setup, Arduino programming for frequency tuning and the use of a Nokia LCD display for frequency display and station information. The study includes experimental results and a discussion on the feasibility and limitations of the system.
5. R. Padmalatha and S. S. V. N. Sarma (2020): This project presents the development of an FM radio transmitter using Arduino Uno and FM transmitter module. It covers the hardware connections, Arduino programming for frequency modulation and the integration of a Nokia LCD display for frequency display and station information. The study includes experimental results and a performance evaluation of the FM transmitter. These literature references should provide valuable insights into the design, implementation and performance evaluation of an FM radio station using Arduino, FM transmitter module and a Nokia LCD display. They discuss the hardware setup, Arduino programming techniques and the integration of the LCD display for visual feedback.

METHODOLOGY

Following block diagram describes the process:



Arduino Uno: The Arduino Uno acts as the central control unit for the FM radio station. It processes incoming signals, controls the FM transmitter module and manages the display on the Nokia LCD. The most standard and popular board used over time is Arduino UNO. The ATmega328 Microcontroller present on the UNO board makes it rather powerful than other boards. There are various types of Arduino boards used for different purposes and projects. The Arduino Boards are organized using the Arduino (IDE), which can run on various platforms. Here, IDE stands for Integrated Development Environment.

FM Transmitter Module: The FM transmitter module is responsible for transmitting the audio signals generated by an Arduino Uno to the FM radio receivers in the vicinity. It takes the audio input from the Arduino uno and modulates it onto a specific frequency for broadcasting.
Nokia LCD Display: The Nokia LCD display is used to provide visual feedback and information to the user. It can display various details such as the current frequency, station name, volume level and other relevant information about the FM radio station.

Audio Input: The audio input source could be a microphone or any other audio device connected to the Arduino Uno. The audio signals are processed by the Arduino uno before being sent to the FM transmitter module.

Control Interface: The control interface consists of buttons, switches or a user interface (e.g. keypad) connected to the Arduino Uno. It allows the user to interact with the FM radio station, change the frequency, adjust volume levels and navigate through different settings.

Power Supply: The FM radio station requires a stable power supply to operate. This could be provided by a battery, DC power adapter or any other suitable power source.

Antenna: The antenna is an essential component for transmitting the FM signals efficiently. It is connected to the FM transmitter module and helps broadcast the signals over a specific range.

FM Radio Receivers: These are the devices that can tune in and receive the FM signals transmitted by the FM transmitter module. Users in the vicinity can use their FM radios to tune in to the station and listen to the broadcasted audio.

LCD Nokia 5110 PCD8544: This is a monochrome LCD display driver typically used in the Nokia 5110 LCD display (84x48), but also the 5120, 5130, 5160, 6110, 6150, 3210, 3310, 3315, 3330, 3350, 3410 and 6210. The LCDs are available (pre-mounted on PCBs) cheaply from via various suppliers online. They draw very small amounts of power - around 200uA - making them extremely good for use in battery powered devices.

S**ize and Resolution:** The display has a resolution of 84 pixels in width and 48 pixels in height. Each pixel can display black or white, offering a clear and readable monochrome display.

Display Technology: The Nokia 5110 LCD uses a low-power, passive matrix LCD technology. It provides good visibility and contrast, even in various lighting conditions.

Backlight: The display includes a built-in backlight that can be controlled through software. The backlight enhances visibility in low-light environments and can be adjusted to suit the user's preferences.

SPI Interface: The Nokia 5110 LCD is interfaced using the Serial Peripheral Interface (SPI) protocol. This allows for fast and efficient data transfer between the display and the micro-controller.

Voltage Level: The display operates at a voltage level of 3.3V, making it compatible with many microcontrollers and development boards.

FM Transmitter module V2.0:

A personal FM transmitter is a low-power FM radio transmitter that broadcasts a signal from a portable audio device (such as an MP3 player) to a standard FM radio. Personal FM transmitters are commonly used as a workaround for playing portable audio devices on car radios that don't have an Auxiliary "AUX" input jack or Bluetooth audio connectivity. They are also used to broadcast a stationary audio source, like a computer or a television, around a home.

Frequency Range: The module supports a frequency range of 88MHz to 108MHz, allowing you to select a suitable FM frequency for transmission.

Adjustable Power Output: The module provides adjustable power output levels, allowing you to control the transmission range and signal strength according to your requirements.

Stereo Audio Input: It has a stereo audio input interface, typically using a 3.5mm audio jack. This enables you to connect various audio sources such as smartphones, MP3 players or other audio devices.

·LED Indicators: The module features LED indicators that provide visual feedback on the power status and signal transmission, making it easy to monitor its operation.

Compact Size: The FM Transmitter module has a small and compact form factor, making it easy to integrate into your projects or prototypes.

Easy to Use: The module is designed to be user-friendly and easy to operate. It can be powered with a DC power supply or batteries and it typically requires minimal setup and configuration.

Stable Transmission: It utilizes a stable PLL (Phase-Locked Loop) circuit to ensure a consistent and reliable transmission signal, minimizing interference and signal drift.

TESTING AND RESULTS

Connect the FM Transmission Module: Connect the power supply pins (VCC and GND) of the FM transmission module to the corresponding pins on the Arduino board. Connect the data pin (usually the data input or signal pin) of the FM transmission module to a digital output pin on the Arduino board. Note the specific pin used for data transmission.

Connect the Audio Source: Connect the audio source (microphone or audio playback device) to the Arduino board. You may need an amplifier circuit to boost the audio signal if required.

Program the Arduino: Use the Arduino IDE to write the code for the FM transmission station. The code should read the audio input signal and modulate it to generate the FM signal. Depending on the FM transmission module you are using, you may need to install additional libraries or reference the module's documentation for specific functions and methods. The code should control the digital output pin connected to the FM transmission module to modulate the audio signal and transmit it as an FM signal.

Upload the Code and Test: Connect the Arduino board to your computer and upload the code. Ensure that the audio source is providing an appropriate input signal. Connect an antenna to the FM transmission module.

Tune and Listen: Use FM receiver (such as a car stereo or FM radio) to tune to the frequency set by the FM transmission module. Adjust the output power and frequency range of the FM transmitter module, if possible, to optimize the transmission and ensure clear reception.

CONCLUSION

In conclusion, the implementation of FM station transmission using Arduino provides a practical and cost-effective solution for wireless audio broadcasting. By utilizing Arduino's capabilities and FM transmitter module, we were able to generate FM signal and transmit audio content to nearby FM receivers. The project involved hardware setup, Arduino code development, testing and optimization to achieve a functional FM station. Throughout the implementation, we successfully established the necessary connections between the Arduino board and FM transmitter module, developed code for audio modulation, and ensured compliance with local regulations. We conducted testing to evaluate the range, audio quality and signal strength of the FM transmission and made adjustments to modulation parameters to optimize performance.

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Introduction

In our daily lives, accurate weather forecasting has become crucial, offering useful information about the weather conditions to help us organise our activities. In this study, we suggest a thorough weather forecasting system utilising an arduino, microcontroller, specifically the light sensor, rain sensor, air speed sensor, P10 display, ESP8266 module, and DHT22 temperature and humidity sensors, temperature and humidity are measured via the DHT22 sensor, which provides essential information for precise weather forecasting. The rain sensor recognises the presence of rain, allowing the system to forecast precipitation and anticipate it. When predicting weather conditions, especially during storms and severe gusts, the air speed sensor detects wind speed.

Keywords—ESP8266, P10 Display, Arduino nano, DHT22, light sensor, rain detector sensor, air speed sensor.

The ability to predict the weather has a significant impact on a variety of daily activities, including transportation, tourism, agriculture, and personal planning. Making informed judgements and reducing potential hazards require accurate and timely weather information. Smart weather forecasting systems have arisen as a result of technological improvements, combining multiple sensors, microcontrollers, and display technologies to deliver real-time weather information. The DHT22 temperature and humidity sensor, the rain sensor, the air speed sensor, the P10 display, the ESP8266 module, and the light sensor are all integrated into the full smart weather forecasting system that we propose in this study using Arduino microcontroller boards. Due to its adaptability, affordability, and simplicity of use, the Arduino microcontroller platform has grown in popularity in a variety of applications. Data on temperature, humidity, and other variables can be gathered by combining Arduino boards with a variety of sensors. All of these factors—rain, wind speed, and ambient light levels—are essential for precise weather forecasting. The DHT22 sensor, often called the AM2302, is frequently used to accurately measure temperature and humidity conditions. The system can analyse patterns and trends to forecast future weather conditions by constantly monitoring these parameters.

Precipitation is a crucial aspect in weather forecasting in addition to temperature and humidity. Our system's built-in rain sensor recognises when it is raining, enabling the forecasting of precipitation events. The system can provide insights into the likelihood and intensity of rainfall by fusing this data with other weather variables, allowing users to make informed plans for outdoor activities. The air speed sensor also detects wind speed, which is a crucial factor in determining the weather, particularly during storms, hurricanes, or severe gusts. This information is essential for identifying potential risks and issuing the required cautions. Our system includes a P10 display to give consumers weather information in an easily accessible way. Light-emitting diodes (LEDs), which have high brightness, wide viewing angles, and low power consumption, are the foundation of this display technology.

The P10 display can show real-time weather information such temperature, humidity, likelihood of rain, wind speed, and general weather conditions, providing consumers have quick access to complete information. The system's usability and user experience can be improved by readily configuring the display to the user's preferences.

LITERATURE SURVEY

Prediction of precipitation One of the crucial components which analyses future values using temperature, rainfall, and humidity data is can be advantageous to both the economy and society. Among the work in this field: In order to anticipate the weather, Ms. Ashwini Mandale, Mrs. Jadhawar B.A., and colleagues[1] developed effective data mining approaches. These algorithms include Artificial Neural Network and Decision Tree Algorithms. The effectiveness of this method would be evaluated against common performance indicators. It employed two strategies: an empirical strategy and a dynamic strategy.

using CART to predict future values of parameters given the Month and Year, then comparing the results. Ankita Joshi, Bhagyashri Kamble, and others [2] proposed a decision tree algorithm data mining technique. Predicting complex weather occurrences with scant observations is a difficult problem. Meteorologists have created approximation atmospheric models employing mathematical equations in order to predict the weather numerically. They discovered a form of rainfall prediction to be 82% accurate.

M. Viswambari and Dr. R. Anbu Selvi [3] used data mining techniques to predict rainfall, wind pressure, and humidity in order to anticipate meteorological data for the past, present, and future. The goal of classification is to determine the categories that a new observation falls under using training data made up of observations whose category membership is known. Any supervised learning algorithm seeks a correct output to reduce errors as much as possible. The back propagation algorithm was described by Manisha Kharola and Dinesh Kumar[4]. For small-scale, imprecise datasets, ANNs can produce reliable forecasts of meteorological variables. With the use of the back propagation training technique, the actual network output is subtracted from the desired outputs in order to produce an error signal. Kanwal Garg, Dr., and Nikhil Sethi [5] the empirical statistical technique is used to develop the rainfall forecast model. It is employed the multiple linear regression (MLR) method to predict rainfall early on. For the purpose of predicting rainfall, there are two methods. One is an empirical method, and the other is a dynamic one. The findings demonstrate a strong correlation between the amount of rainfall that was forecast and what really occurred. Agrawal et al. (1980) explained the phenomena for time series regression models for forecasting the yield of rice in Raipur district on weekly data using weather parameters [7].

In [2] the author Kuo and Sun, (1993) was used to Associate in having intervention model for average10 days stream flow forecast and synthesis that was investigated by to effect the extraordinary phenomena caused by typhoons and different serious irregularities of the weather of the Tanshui geographical area in Taiwan. The variables which describes weather conditions vary continuously with time in this explanation we found that the author [8], describing time series of each and every parameter and can be used to develop a forecasting model either statistically or using some new means that uses this time series data (Chatfield 1994; Montgomery and Lynwood 1996). Several authors have discussed the fuzziness associated with the weather systems. In [9] Chaotic features are associated with the atmospheric phenomena also have fascinated the attention of the modern scientists (Sivakumar 2001; Sivakumar et al. 1999; Men et al. 2004)

COMPONENT

ESP8266:

The ESP8266 is a low-cost System-on-a-Chip (SoC) that forms the basis of the open-source NodeMCU (Node Micro Controller Unit). The ESP8266, created and manufactured by Espress if Systems, has every component necessary for a computer, including CPU, RAM, wireless networking, even a modern operating system and SDK. Because of this, it's a great choice for all kinds of Internet of Things (IoT) projects.

Fig: ESP8266

However, using the ESP8266 as a chip is challenging. You must solder wires with the required analogue voltage to its pins in order to perform even the most basic functions, such as turning it on or sending a keystroke to the "computer" on the chip. Furthermore, it must be programmed using low-level machine instructions that the chip hardware can comprehend. At this level of integration, using the ESP8266 as an embedded controller chip in mass-produced devices is not problematic.

Arduino Nano:

A microcontroller board called Arduino Nano is based on the ATmega328P. It contains 6 analogue inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC-to-DC adapter, or a battery to power it. Without too much concern, you can experiment with your Nano; in the worst case, you can replace the chip for a few dollars and start over dollars and The Arduino Nano is an open-source microcontroller board created by Arduino.cc and first made available in 2010. It is based on the Microchip ATmega328P microprocessor.

A variety of expansion boards (shields) and other circuits can be interfaced with the board's sets of digital and analogue input/output (I/O) pins. The board features 6 analogue I/O pins, 6 digital I/O pins, and 14 digital I/O pins, six of which can be used for PWM output. It can be programmed using the Arduino IDE (Integrated Development Environment) with a type B USB connector.A barrel connector that can handle voltages between 7 and 20 volts, such as a square 9-volt battery, or a USB cable are both options for powering it.

Fig: MPU6050

Rain Detector Sensor:

A sensor module named Raindrops Detection is used to detect rain. It is used to determine how heavily it is raining as well. AO and output signals from a rain sensor can be used in a range of weather monitoring applications. Arduino Raindrop Detection Module, etc. Weather Module for Rain With a rain sensor, which can also generate fixed output signals and analogue output, several meteorological factors can be monitored. It has a printed circuit board (a control board) that "collects" the raindrops. As raindrops gather on the circuit board, parallel resistance channels are created, which the op-amp employs to measure.

DHT 22 Sensor:

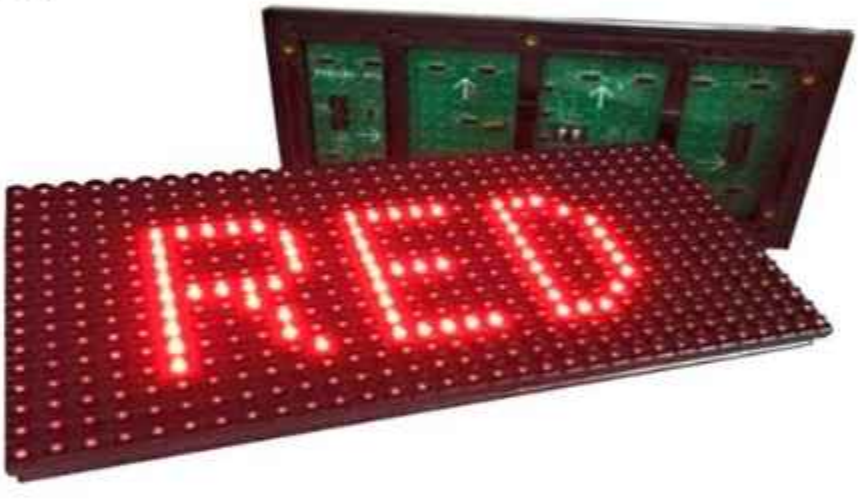
The DHT22 is a simple, lo nd humidity sensor. It uses a thermistor and a capacitive humidity sensor to monitor the air's humidity, and it generates a digital signal on the data pin (there are no analogue input pins required). Although relatively simple to use, data collection calls for exact timing. The DHT22 capacitive humidity sensing digital temperature and humidity module is one that includes the compound that has been calibrated digital signal output of the temperature and humidity sensors.

Fig: DHT 22 Sensor

A capacitive sensor with wet components, a high-performance 8-bit CPU, and temperature measuring equipment are all included in the sensor. The equipment is extremely pricey, of high quality, responsive, and jamming resistance is strong. Rapid and easy system integration; standard single-bus interface.

P10 Display:

A dot matrix LED display is the P10 display. A bunch of LEDs arranged in a two-dimensional array, also known as a 2D matrix array, is referred to as a dot matrix LED. Each dot in this image depicts a set of round lenses in front of LEDs. Shops frequently utilise running text displays or dot matrix displays to market their goods. There are 512 LEDs in all in the module we are utilising. They are capable of displaying a variety of characters, symbols, and messages, such as "Hello, World." These display kinds can be linked together in a matrix format (i.e., ROW and COLUMN arrangement).



Light Sensor:

The light sensor, sometimes referred to as a photodetector or photoresistor, is an element that gauges the amount of light present in its immediate surroundings. It is made to recognise variations in light levels and transform them into electrical signals that can be processed by electrical apparatus.

The photoelectric effect serves as the foundation for how the light sensor operates. It often includes of a semiconductor material that changes electrical conductivity in response to changing light levels, such as silicon or cadmium sulphide (CdS).

Air Speed Sensor:

An element used in weather monitoring and forecasting systems to gauge air or wind speed is the air speed sensor. It offers useful information that aids in evaluating weather conditions and foreseeing changes to atmospheric patterns. The air speed sensor commonly uses anemometers or pitot tubes as its foundation.

PROJECT DESIGN AND IMPLEMENTATION

Circuit Diagram:

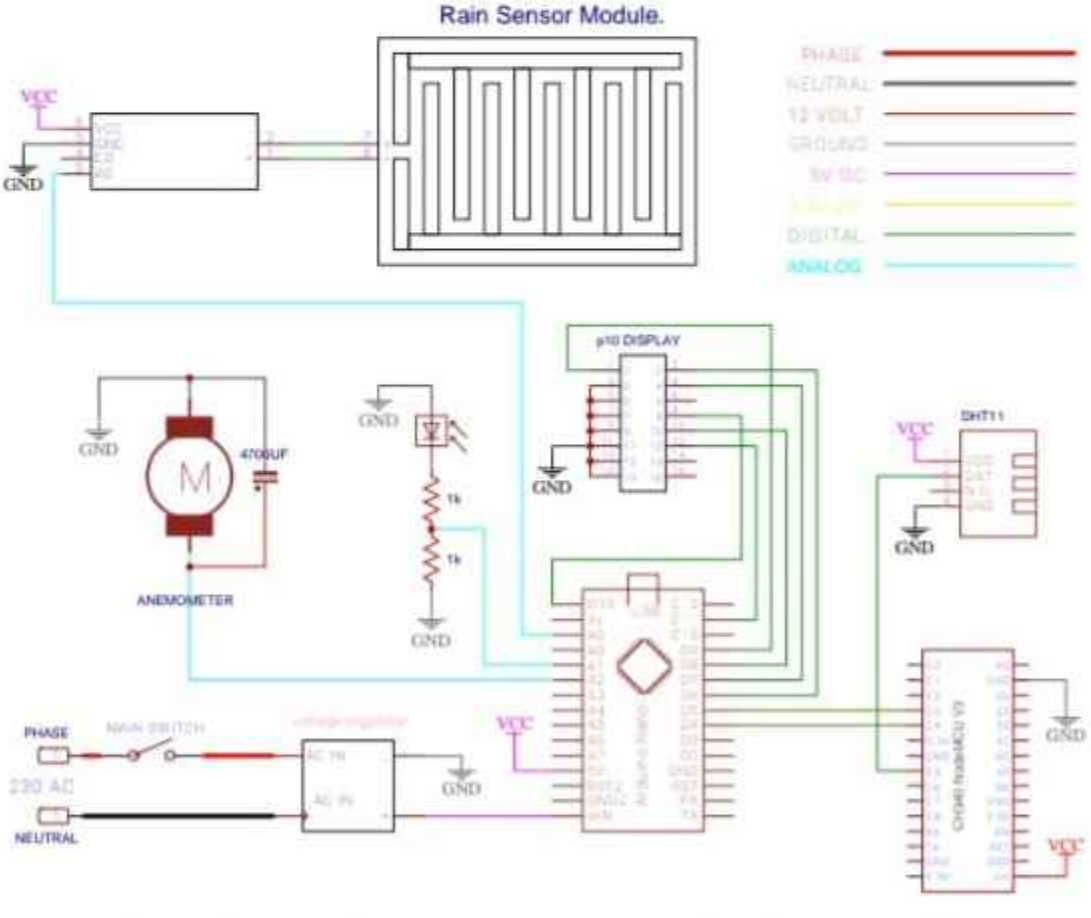
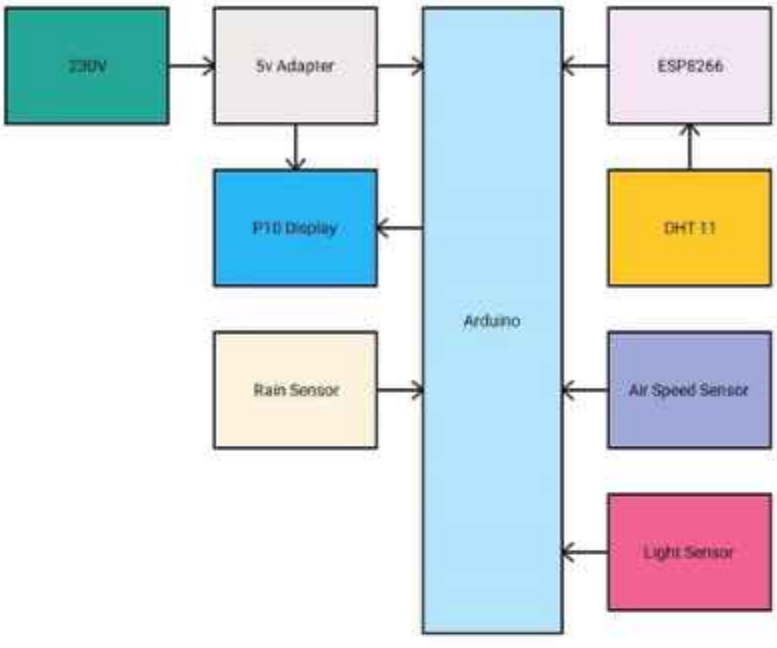


Figure 1.1: Weather Station

Fig : Circuit Diagram

Block Diagram:



A block diagram is a type of visual representation that shows how a system's parts are connected to one another. The DHT22 temperature and humidity sensor, the rain sensor, the air speed sensor, the P10 display, and an Arduino-based smart weather forecasting system are examples of components.

RESULT AND VERIFICATION

Testing and verification of the smart weather forecasting components, including Arduino, DHT22 sensor, rain sensor, air speed sensor, P10 display, ESP8266 module, and light sensor, are crucial to ensure their proper functionality and accuracy. Here are some approaches for testing and verifying these components:

A) Integration Testing:
Connect the sensors and components to the Arduino board according to the system's design. Develop and upload a test firmware or program that integrates all the components and performs basic functionalities, such as collecting sensor data and displaying it on the P10 display. Validate the communication and data exchange between the Arduino and the various sensors, ensuring the correct transmission and reception of data.

B) System Testing:
Create test cases that reflect various weather conditions, such as shifting levels of temperature, humidity, rain, wind, and lighting.
To confirm the accuracy of the measurements, gather data from the sensors and compare it to predicted values or reference data.
Verify the system's capacity to analyse the information gathered and produce precise weather forecasts or predictions.
Confirm the successful retrieval and integration of online weather data by testing the ESP8266 module's interaction with external data sources.
Analyse the P10 display's usability and responsiveness in showing weather information.

C) Performance Testing:
Perform performance tests to determine how quickly the system responds, how quickly it processes data, and how reliable it is overall.
Evaluate how the system manages the processing and display of data under various loads or stress circumstances by simulating real-world usage scenarios.

D) Field Testing:
Install the intelligent weather forecasting system in actual locations, such as farms or weather stations.
Over a long period of time, check the system's accuracy and performance.
Gather user or stakeholder feedback to spot any possible problems or opportunities for development.

CONCLUSION

To sum up, integrating an Arduino, DHT22 temperature and humidity sensor, rain sensor, air speed sensor, P10 display, ESP8266 module, and light sensor into a smart weather forecasting system offers a number of advantages and breakthroughs in weather monitoring and forecasting prediction.
The system may gather real-time data on temperature, humidity, rainfall, wind speed, and ambient light levels by utilising these components. Particularly for farmers and other users who significantly rely on weather information for their business, this data is essential for precise weather forecasting.
As the main controller, the Arduino board collects data from the numerous sensors and processes it to produce thorough weather forecasts. A deeper understanding of regional microclimates is made possible by the exact readings of these variables provided by the DHT22 temperature and humidity sensor.

FUTURE SCOPE

The future scope of smart weather forecasting is promising and encompasses several key areas:
a) Improved Accuracy: New data collection methods, including satellite technology, drones, and Internet of Things (IoT) devices, will offer a more thorough and current comprehension of weather patterns. Weather forecasts will become more accurate and precise as a result.
b) Machine Learning and AI: To analyse enormous amounts of meteorological data, smart weather forecasting systems will increasingly use machine learning and artificial intelligence algorithms. With the help of these tools, severe weather occurrences can be predicted with more accuracy and be foreseen earlier.
c) Individuals will obtain weather forecasts that are customised to their unique location and preferences with the aid of smart devices and personalised apps. people will be able to make informed judgements and schedule their activities properly thanks to these forecasts, which will include pertinent information including microclimate conditions, pollen counts, and UV indices.

Omni-Directional Robo Car Using Mecanum Wheels Controlled by Bluetooth

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Introduction

Mobile robotic systems are mechatronic devices that are currently getting more and more complex. To design such a system, a combination of expertise from the fields of mechanical, electrical, and computer engineering are required. This paper describes our custom omni-directional robotic platform designed for both indoor and outdoor use that contains a lot of prototypic hardware. All designed components are interesting as they allow the robot to be controlled as a complex mechatronic system. The main objective was to use a larger number of smaller control subsystems rather than than a central one, which is more advantageous from the control point of view. The The electronics of the robot consist of microcontroller-controlled distributed subsystems. that are able to communicate with the master system. The following sections offer an insight into the control structures of the mobile robot. Omni-directional robot is capable of driving in any direction. Most non-holonomic robots cannot drive in a direction perpendicular to their driven wheels. For example, a differential drive A robot can drive forward or backward, in a curve, or turn on the spot, but it cannot drive sideways. The omni-directional robots introduced in this chapter, however, are capable of driving in any direction in a 2D plane.

In this project, I would like to share how to build an RC car using mecanum wheels. The mecanum wheel is an omnidirectional wheel that can move in any direction. The unique mobility of the robot is achieved by using a special type of wheel called mecanum wheels. This wheel is specially designed, so its shape is different from a normal wheel. The wheel consists of a rubber roll with an angle of 45 degrees along the rim. The car is controlled by Bluetooth, so we can adjust the car's movements with our Android phone, and with the gyro feature, the car will have a camera for monitoring, so we can watch a live stream on our Android phone. Out of the great diversity of mobile robots that exist, the omni-directional mobile robots have the ability to move instantly in any direction from any configuration. An important role in their construction is held by their special (omni-directional) wheels. Out of the large number of omni-directional wheels, the mecanum wheels proved to be the best choice in driving vehicles in order to achieve maximum omni-directional efficiency. This type of wheel is used in robotics applications that require a high level of maneuverability. An omni-directional mecanum wheel has 3 DOFs (Degrees of Freedom). These are: wheel rotation (the first DOF), roller rotation (the second DOF), and rotational slip about the vertical axis passing through the point of contact (the third DOF). wheel consists of roll rubber with an angle of 45 degrees.

Literature Survey:

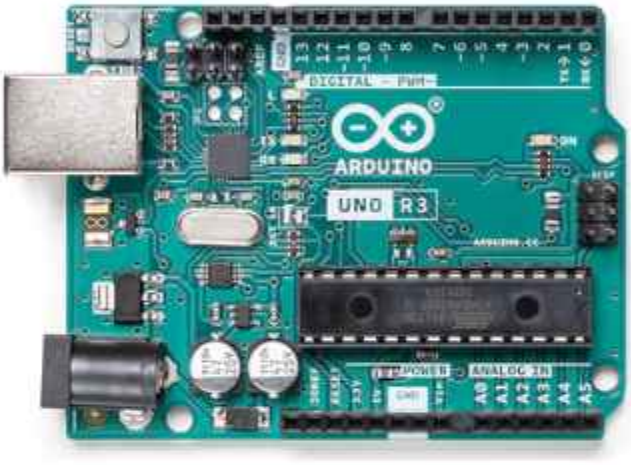
The paper presents a particular case of an omni-directional drive system for industrial autonomous ground Ground Vehicles, giving more insights on Mecanum wheels and ground contact issues. If most of the literature in this area offers analytical and experimental information regarding the kinematics, command, and control of this type of AGV or robot, this study was conducted to highlight the influence of frictional coefficient on the wheel's behaviour in motion and the importance of materials, shape, and thickness of the Mecanum wheel's rollers covering layer when running on a flat surface. The results offer new insightsr case of an omni-directional drive system for industrial autonomous ground vehicles, giving more insights on Mecanum wheels and ground contact issues. If most of the literature in this area offers analytical and experimental information regarding the kinematics, command, and control of this type of AGV or robot, this study was conducted to highlight the influence of frictional coefficient on the wheel's behaviour in motion and the importance of materials, shape, and thickness of the Mecanum wheel's rollers' covering layer when running on a flat surface. The results offer new insights on the modelling and simulation of the Mecanum wheels, including information regarding the frictional contact in the kinematic analysis.

Concluding results were also achieved in the Rigid Dynamics environment, offering information on roller behaviour during a complete rotation of the Mecanum wheel. Research on other rim-roller materials has to be performed, as "Rubber 1" from the software library has proven to be too deformable when higher loads are applied. This could be possible either by modifying an existing material in order to reduce its elasticity or by defining a new one based on experimental data. The shape of the rollers and the thickness of their covering material could also have a significant influence on the AGV's mobility in a specific industrial environment

COMPONENT

Aduino Uno:

Arduino Uno is a micro-controller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), and 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button. It contains everything necessary to Support the microcontroller; simply connect it to a computer with a USB cable or Power it with an AC-to-DC adapter or battery to get started.



Can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario You can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of the Arduino Software (IDE) were The reference versions of Arduino have now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards and the reference model for the Arduino platform; for an extensive list of current, past, or outdated boards, see the Arduino index of boards.

L293D motor driver Shield:

L293D use 16 pin DIP package, its internal integration is bipolar H - bridge circuit. This kind of bipolar pulse width method has many advantages, such as the current continuous, or micro current vibration when the motor stops, which as a lubrication effect. It can eliminate the dead zone of static friction when positive and negative.Motor Drivers or H-Bridges: Motor drivers or H-bridges are electronic circuits that control the speed and direction of the motors. They take input signals from the microcontroller (in this case, the ESP32 board) and deliver the appropriate power to the motors. Look for motor drivers or H-bridges compatible with the voltage and current requirements of your motors.

The L293D motor driver shield is a popular motor driver module that is commonly used to control DC motors and stepper motors in various robotic and automation projects. It provides an easy-to-use interface between a microcontroller or development board and the motors, allowing precise control over their speed and direction. Here's some detailed information about the L293D motor driver shield

C. HC-05 Bluetooth module:

The HC-05 is a Bluetooth transceiver module with TTL output. The HC-05 6-Pin Wireless Serial Bluetooth Module is a Bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly. This Bluetooth module is a completely qualified Bluetooth V2+Enhanced Data Rate (EDR). It is 3Mbps Module with 2.4GHz radio transceiver and baseband. It has CSR Bluecore 04, an external single-chip Bluetooth system with CMOS technology and AFH, Adaptive Frequency Hopping, feature. The HC-06 module is a slave only device. This means that it can connect to most phones and computers with Bluetooth but it cannot connect to another slave-only device such as keyboards and other HC-06 modules. To connect with other slave devices a master module would be necessary such as the HC-05 version which can do both master and slave. To enable wireless control of your robot car, you'll need a Bluetooth module that is compatible with the ESP32 board. Common options include modules based on the Bluetooth Low Energy (BLE) protocol, such as the HC-05 or HC-06 modules. Ensure that the Bluetooth module supports the necessary communication protocols for project.

The block diagram shows the basic working of the Wi-Fi based raspberry pi in which the block describes the working. The proposed system consist of two units mainly a robotic unit and a remotely control unit. The robotic unit is consisting of the webcam, Wi-Fi dongle and the heart of the paper, raspberry pi along with the PCB containing motor driven IC and voltage regulator circuitry. The controlling unit consists of a PC within the Wi-Fi range. HTML page is designed having options of controlling the dc motors and stepper motors. It shows the live video streaming of the environment. At the robotic unit, Raspberry pi is used for the control of DC motors and stepper motors. Raspberry Pi requires 5 volt supply with minimum of 1500-2000MA current. This raspberry pi is powered through micro USB cable. ARM11requires 3.3 volt of supply which it takes with the help of linear regulator. 5 volt is required for the USB ports. The wheels of robot are controlled by DC motors and the movement of camera by the stepper motors. These motors are connected with the raspberry pi controller through a driver IC L293-D as shown in the architecture of the system. With the help of web browser, one can easily controls the robotic unit and can monitors video streaming of the surrounding environment of that robotic unit. The robot captures the images using a webcam and stores them into the memory. A webcam is connected to one of its USB ports. A Wi-Fi dongle is provided so as raspberry can communicate over Wi-Fi. Internet can be provided to the raspberry through this.

Circuit Diagram:

The below diagram shows the complete circuit diagram of the system. In this system have used a Raspberry pi is used as a minicomputer and acts as a brain of the system. Raspberry pi is used to control and monitor the robotic unit. Raspberry Pi has a strong processing capacity because of using the ARM11 architecture and Linux-based system there are simple and easy-used open source peripheral driver libraries. A webcam is connected to one of its USB ports. A Wi-Fi dongle is provided so as raspberry can communicate over Wi-Fi. Internet can be provided to the raspberry through this. All the interfacing peripheral devices are connected with the raspberry pi microcontroller. The webcam is also interfaced with the microcontroller which is used to capture the video streaming of the room or the area where the system is implemented. This webcam records the video and sends it over the internet through a Wi-Fi modem interfaced with the raspberry pi in this system. In this system we have used a servo motor which is to tilt the camera for the video capturing. In this system we have used two DC motors for the movement of the robot. These motors are connected with the raspberry pi micro controller as shown in the above circuit diagram of the system. These DC motors are driven by a driver IC used in this system. This driver IC is interfaced with the raspberry pi micro controller. Here we have used L293-D motor driver IC to drive the motors.

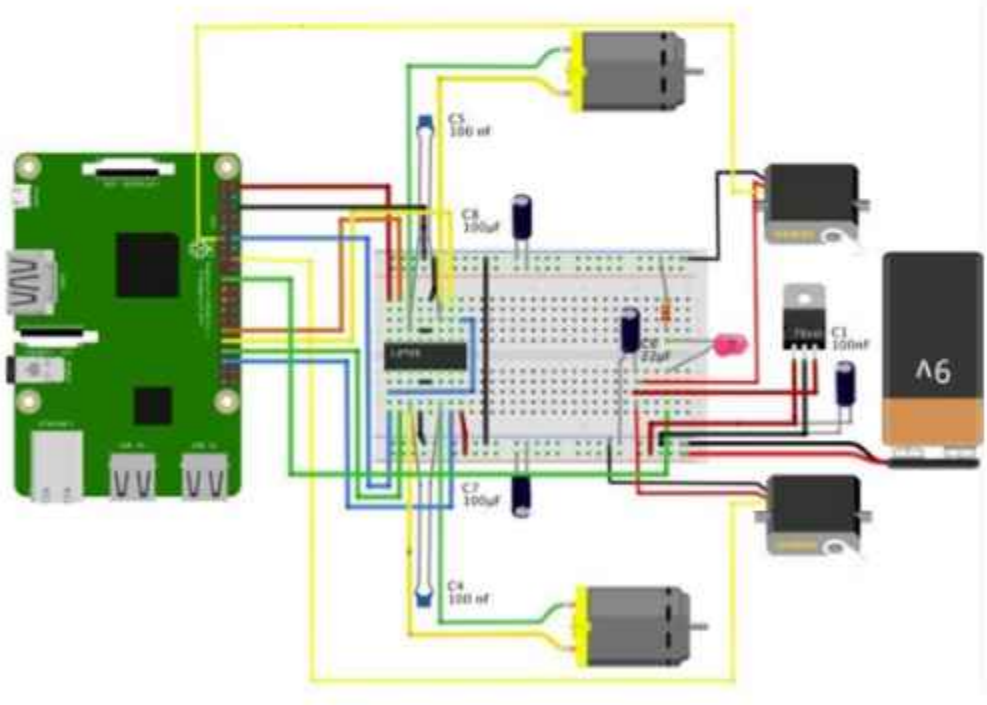


Fig: circuit Diagram

Testing and Verification:

The motion is detected through the PIR sensor and the camera captures images and videos. After that the buzzer was sending sound message to indicate receiving massage. The raspberry pi is save images and videos in its storage unit, then the image is going to be displayed on the laptop or the monitor at same time sent to the user's email

Fig 3: When is in normal position

Fig 4: Final Setup with pi camera

Fig 5: Final setup with PCB

Fig 6: Visual snap

Conclusion:

Using this robotic system a remote area can be monitored easily from remote end. One can easily monitor as well as control the activity of the robotic unit. This system conditions and areas where it is difficult for the security forces to reach it can monitor the areas. As the communication is done with the help of internet so limitation of range of operation does not arise and thus we can monitor any remote areas. If this robot is within the Wi-Fi range there is no need of internet too. We control the robot using the Wi-Fi as a medium. The smart surveillance framework has been structured so that it can satisfy the requirements of the client for a specific surveillance territory. It has endless applications and can be utilized in various conditions and situations.

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