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To be part of the universal human quest for development and progress by contributing high-caliber, ethical, and socially responsible engineers who meet the global challenge of building a modern society in harmony with nature.

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1. To attain excellence in imparting technical education from the undergraduate through doctorate levels by adopting coherent and judiciously coordinated curricular and co-curricular programs.
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4. To develop a scientific temper and spirit of inquiry to harness innovative talents.
5. To develop a constructive attitude in students toward the task of nation-building and empower them to become future leaders.
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7. To involve the students and the faculty in solving local community problems.

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To be recognized as a premier education center providing state of art education and facilitating research and innovation in the field of electronics and communication engineering.

DEPARTMENT MISSION

We are dedicated to providing high quality holistic education in electronics and Communication engineering that prepares the students for successful pursuit of higher education and challenging careers in industry, R& D and Academics

MESSAGE FROM THE PRINCIPAL

My heartiest congratulations to the department of ECE for continual issues of the **"ECE INNOVATIONS"** magazine. The extraordinary vision and immaculate planning of the HOD, **Dr. Ayesha Naaz,** coupled with the skills of the staff, have made the issue of the magazine bolder year after year.

This magazine, as in its previous issues, brings about the notable achievements of the staff and students in research/projects. I am sure; the tradition of excellence will continue in the future editions as well.

Dr. Mahipal Singh Rawat,
Principal, MJCET

MESSAGE FROM THE HEAD OF THE DEPARTMENT

I congratulate the ECE Department for producing this magazine. The variety of projects showcased demonstrates the talent and skills of our staff and students. This magazine will surely inspire and motivate more contributions in the future. Let's continue to build on this momentum and raise the magazine's standards even higher.

Editorial Team of ECE Innovations 2021

Dr. Ayesha Naaz
Professor, ECE Department

Dr. Afshan Kaleem
Senior Assistant Professor, ECE Department

S.NO **TITLE**

IOT BASED SMART ENERGY METER MONITORING AND THEFT DETECTION

MOHAMMED SAQAWATH ALI (1604-20-735-107)
MOHAMMAD ABDULARSHAD (1604-20-735-111)
ABDUL QUADIR OMER (1604-20-735-112)

Under the guidance of
Mr. SASIDHAR
Project Guide
Assistant Professor, Department of ECE, MJCET

ABSTRACT

Power theft at the low voltage distribution end is a serious issue, causing distribution companies to lose billions of dollars annually. With the development of **smart grid technologies**, smart meters integrated with **Information Communication Technology (ICT)** offer a solution for detecting and preventing power theft.

This project explores the application of the **Internet of Things (IoT)** in power theft detection and real-time **smart energy meter monitoring**. A **Linear Regression** method is used to detect power theft by continuously monitoring data from both the consumer and distribution end smart meters.

A **web cloud platform** is developed for tracking consumption and billing information of consumers, and to alert authorities in the event of theft. The system can detect power theft caused by **meter bypass**, **meter tampering**, and **direct line hooking**. Additionally, the system allows direct control of smart meters by distribution authorities, enabling them to provide or deny power supply to individual consumers.

A prototype circuit was developed using the **ATmega328P microcontroller** along with **Arduino as a Wi-Fi module**, to validate the proposed system.

TERRAEXPLORER: A ROVER FOR EARTH-CENTRIC APPLICATIONS

ZAFEER AHMED QADEER (1604-20-736-053)

Under the guidance of
Mrs. B. SUCHARITHA
Assistant Professor, Department of ECE, MJCET

ABSTRACT

The exploration of challenging and remote terrains on Earth, such as deserts, mountains, and disaster-stricken areas, requires specialized vehicles capable of navigating and collecting critical data. **TERRAEXPLORER** is a rover designed specifically for Earth-centric applications. It is equipped with advanced technologies for autonomous navigation, environmental monitoring, and data collection in extreme conditions.

The rover utilizes a combination of **sensors**, **GPS**, and **machine learning algorithms** to navigate complex terrains and avoid obstacles. It is also equipped with high-definition cameras and sensors for capturing environmental data such as temperature, humidity, and air quality. Additionally, TERRAEXPLORER can be deployed for applications like **disaster relief**, **environmental monitoring**, and **scientific exploration** in remote locations.

TERRAEXPLORER's modular design allows for the integration of specialized equipment based on mission requirements, making it a versatile tool for a wide range of Earth-centric applications. The rover's use of **solar energy** for power ensures sustainability in long-duration missions. Its ability to communicate with a control center via satellite makes it ideal for real-time data transmission and remote monitoring.

This project aims to provide a comprehensive solution for addressing the challenges of terrestrial exploration and monitoring, offering a practical tool for researchers, scientists, and emergency responders.

SMART CANTEEN MANAGEMENT SYSTEM USING IOT

SABAHAT MAHEEN (1604-20-735-004)
YASMEEN FATIMA (1604-20-735-302)

Under the guidance of
DR. SALMA FOUZIA
Assistant Professor, Department of ECE, MJCET

ABSTRACT

In today's fast-moving world, there is a need for quick and efficient service in every sector of life for the public in general. As we know, many employees and students use canteen and food facilities in their workplaces and institutions on a daily basis, and there is a need to provide quick service at billing counters. This project focuses on developing an efficient **smart canteen management system** to counter delays during billing services.

The proposed system uses **radio frequency identification (RFID)** to detect and authenticate users of the system, allowing access and automating the debit process at the end of the month or on low balance. This system is ideal for large industries, universities, and government offices, as it is more time-efficient compared to existing systems. The results reveal that the proposed system offers **cost-effectiveness** in addition to a quick and easy-to-use service.

The **smart canteen management system** using the **Internet of Things (IoT)** is a revolutionary approach designed to enhance the efficiency, convenience, and overall experience of canteen operations. By integrating various IoT technologies, the system automates key processes such as **ordering, billing, inventory management, and user feedback**. Key components include **RFID** and **NFC tags** for cashless transactions and user authentication, **sensors** for monitoring environmental conditions and food quality, and **smart appliances** for automated kitchen operations. The backend infrastructure relies on **cloud computing** for data storage, processing, and analytics, while user interfaces are facilitated through **mobile applications, web portals**, and **kiosks**.

The implementation of IoT in canteen management offers significant benefits, including **operational efficiency** through automation, **cost savings** via optimized inventory management, and enhanced user satisfaction through personalized services. **Data analytics** and **artificial intelligence (AI)** further contribute by providing insights into user preferences and predicting demand, helping in strategic planning and reducing waste.

However, the deployment of such a system faces challenges such as ensuring **data security and privacy**, integrating with existing legacy systems, managing the **high initial**

investment costs, and achieving user adoption. Despite these challenges, successful case studies from university, corporate, and public canteens demonstrate the system's effectiveness.

SMART SAFETY ID CARD

DIYAAGARWAL(1604-20-735-002)
HAFSAJAZIBA(1604-20-735-012)
MOHAMMED BIN OMER KALDI (1604-20-735-041)

Under the guidance of
Dr. Ayesha Naaz
Internal Head, Professor & Head, Dept. of ECE, MJCET, Hyderabad

ABSTRACT

The **Smart Safety ID Card** represents an innovative solution aimed at enhancing personal security and identity verification. Designed for both individual and institutional use, this advanced ID card integrates multiple layers of security features, providing a reliable method for verifying identity in various scenarios. The Smart Safety ID Card is embedded with advanced technology that ensures the authenticity of the user through secure, non-intrusive verification methods.

The card employs sophisticated **encryption** and **data protection mechanisms**, making it highly resistant to unauthorized access and counterfeiting. It is equipped with a unique identification code that can be swiftly and securely read by compatible devices, ensuring quick and accurate identity verification. Additionally, the card's robust design includes **tamper-evident features** that provide immediate indication if the card has been compromised.

The **Smart Safety ID Card** is versatile and can be used across a range of applications, including **access control**, **attendance tracking**, and **emergency response**. Its implementation in schools, workplaces, and public institutions can significantly enhance safety protocols by ensuring that only authorized individuals gain access to secure areas. The card's user-friendly interface and compatibility with existing security infrastructure make it an ideal choice for organizations seeking to improve their security measures.

Furthermore, the card's capacity to store essential **personal information securely** ensures that, in the event of an emergency, first responders and security personnel have immediate access to critical data. This can greatly expedite response times and improve the effectiveness of emergency interventions.

In summary, the **Smart Safety ID Card** is a cutting-edge solution designed to provide robust security and identity verification, enhancing safety and efficiency across various domains. Its secure design, ease of use, and adaptability make it an essential tool for modern security needs.

LI-FI BASED VEHICLE SAFETY SYSTEM

SYED AHMED KHASIM GHOURI (1604-20-735-118)
MOHAMMED SAMIUDDIN (1604-20-735-095)
SYED KHAJA FAKHRUDDIN (1604-20-735-085)

Under the guidance of
MRS. RAFATH UNISSA
Assistant Professor, Department of ECE, MJCET

ABSTRACT

Recent developments in wireless communication technologies have opened new possibilities for improving vehicular safety and traffic management. This project, entitled **"Li-Fi Based Automatic Speed Limiter for Vehicles"**, explores the application of **Light Fidelity (Li-Fi)** technology in the design and construction of an automated speed control system. Compared to other low interference data transmission technologies like **visible light communication (VLC)** and **visual positioning**, Li-Fi offers a high-speed data transfer rate, making it an optimal solution for **vehicle-to-infrastructure (V2I)** communication.

The primary objective of this project is to design and implement a **Li-Fi-based Intelligent Speed Limiter**, which can automatically adjust the speed of a vehicle based on real-time data transmitted by roadside Li-Fi-enabled transmitters. These transmitters, using **LED lights**, beam speed limit details to passing vehicles. The onboard Li-Fi receiver in the vehicle captures this data and communicates it to the vehicle control system, which enforces the speed limit.

The system is designed to improve road safety by encouraging the observance of speed limits, thereby minimizing accidents caused by speeding. It offers a flexible solution that can be integrated into current traffic management systems with minimal adjustments. This project involves the design and testing of Li-Fi transmitters and receivers, interfacing them with vehicle control systems, and validating the system through simulation and real-world trials.

The integration of **Light Fidelity (Li-Fi)** technology into vehicular safety systems presents a transformative approach to enhancing road safety and communication efficiency. Li-Fi, a wireless communication technology that uses **light-emitting diodes (LEDs)** to transmit data, offers **high-speed**, **secure**, and **interference-free** communication capabilities. This paper proposes a **Li-Fi-based vehicle safety system** designed to improve real-time data exchange between vehicles and infrastructure, reducing the risk of accidents and improving traffic management. Experimental results demonstrate that the Li-Fi-based safety system significantly enhances **vehicle-to-vehicle (V2V)** and **vehicle-to-infrastructure (V2I)** communication efficiency compared to traditional **radio frequency (RF)-based** systems.

SMART WHEELCHAIR WITH REAL-TIME MONITORING

MOHD MEHRAJ AHMED (1604-20-735-094)
SHOAIB MINHAJ KHAN (1604-20-735-089)
MOHD ADNAN PASHA (1604-20-735-117)

Under the guidance of
Dr. AFSHAN KALEEM
Sr. Assistant Professor, Department of ECE, MJCET

ABSTRACT

This paper presents the development and implementation of a **smart wheelchair system** designed to enhance mobility and independence for individuals with disabilities. The system integrates three primary functionalities: **hand gesture navigation control**, **Bluetooth control**, and **health monitoring**.

The **hand gesture navigation control** utilizes a set of predefined hand movements detected by sensors to direct the wheelchair, providing a seamless and intuitive method for users to maneuver the device. This innovation addresses the limitations of traditional joystick controls, offering an alternative that is particularly beneficial for users with severe motor impairments.

The **Bluetooth control feature** allows for remote operation of the wheelchair through a smartphone application. This functionality is particularly useful for caregivers or users who may need to operate the wheelchair from a distance, ensuring greater flexibility and safety. The integration of Bluetooth technology ensures reliable and efficient communication between the smartphone and the wheelchair, enhancing user convenience.

Additionally, the smart wheelchair is equipped with a comprehensive **health monitoring system**. This system continuously tracks vital signs such as **heart rate**, **body temperature**, and **oxygen saturation**. The collected health data is displayed in real-time on a connected device and can be transmitted to healthcare providers for remote monitoring. This proactive health management feature is designed to alert users and caregivers to potential health issues, facilitating timely medical intervention and improving overall health outcomes.

The integration of these advanced functionalities into a single platform transforms the traditional wheelchair into a multifunctional device that supports enhanced mobility, user independence, and health management. The smart wheelchair represents a significant advancement in assistive technology, combining ease of use, remote operability, and health

monitoring to meet the diverse needs of users. This innovative approach holds promise for improving the quality of life for individuals with mobility challenges and reducing the burden on caregivers and healthcare systems.

EFFICIENT MICROSTRIP MONOPOLE ANTENNA DESIGN FOR MULTI-TECHNOLOGY WIRELESS APPLICATIONS

ALLA SWAPNIKA SRI (1604-20-735-005)
SYEDA HUZAIFAH YOUNUS (1604-20-735-013)

Under the guidance of
Ms. MALIHA NAAZ
Assistant Professor, Department of ECE, MJCET

ABSTRACT

In this project, we present an approach to **microstrip monopole antenna design**, tailored to meet the growing demand for compact and efficient wireless communication solutions. By utilizing a set of **design equations**, the proposed antenna achieves remarkable performance across the **3GHz** and **6GHz** frequency bands, setting a new standard for antenna efficiency and versatility. This innovation addresses the need for antennas capable of supporting multiple communication standards and opens avenues for enhanced connectivity in various applications, from **IoT devices** to **high-speed data transmission systems**.

Moreover, our research extends to **array antennas**, where two microstrip monopoles are combined to unlock superior **gain** and **radiation characteristics** compared to single-element designs. Through careful experimentation and optimization of **substrate materials**, the antenna performance is tailored to meet specific wireless standards such as **Wi-Fi**, **LTE**, and **WiMAX**. This multidimensional approach ensures adaptability to diverse communication ecosystems and positions these antennas at the forefront of wireless technology advancements, shaping the future of **wireless connectivity**.

This project introduces two small and efficient **microstrip monopole antennas** for wireless communication, designed using novel design equations and tested with the simulation tool **CST Studio**. The project categorizes existing **multiband monopole antennas** according to their frequency coverage and substrate dimensions, highlighting their relevance in various wireless applications. These monopole antennas are simple, compact, and versatile, supporting various wireless technologies such as **Wi-Fi**, **LTE**, and **WiMAX**. Additionally, the antenna will be optimized by generating arrays in different dimensions to achieve better gain and performance

PIPELINE DATA CONVERTER USING NEURAL NETWORKS

SAMEEHA HAMEED (1604-20-735-064)
HURMATH SARA (1604-20-735-068)
ZAINAB SULTANA (1604-20-735-069)

Project Guide
Mr. Noorullah Khan
Assistant Professor, Department of ECE, MJCET, Hyderabad

ABSTRACT

Analog-to-Digital Converter (ADC) design has been an active research topic for the past few decades, driven by the scaling down of **Complementary Metal-Oxide-Semiconductor (CMOS)** Integrated Circuit (IC) fabrication processes, which offer continued opportunities for performance improvements. The proposed **memristor-based pipeline ADC**, coupled with a **modular neural network ADC architecture**, provides a promising solution to overcome the limitations of current ADCs. By employing a pipeline of multiple converters, the system maintains advantages such as **noise tolerance**, **power optimization**, **mismatch self-calibration**, and **application reconfiguration**, while achieving higher resolution and throughput.

This approach represents a significant advancement in the design of **high-speed**, **high-precision**, and **low-power** mixed-signal systems. In this work, a **10-bit digital output** pipeline ADC architecture, operating at **1.8 V**, has been developed using **180 nm CMOS technology**. The design showcases significant improvements in performance, ensuring scalability and flexibility for a variety of applications.

The simulation results of the sub-blocks demonstrate that the **Opamp** achieves a **42 dB gain**. A systematical design analysis of a **10-bit, 50 MS/s** pipelined ADC is presented. Utilizing the **opamp-sharing technique**, the power consumption is drastically reduced. Simulated in a **180-nm CMOS process**, the ADC achieves a **58.9 dB Signal-to-Noise Ratio (SNR)**, **9.3 Effective Number of Bits (ENOB)**, and **64 dB Spurious-Free Dynamic Range (SFDR)**, with a sinusoidal input of **4.858 MHz**, 1-Vpp at 50 MS/s, and consumes less than **24 mW** from a **1.2-V** power supply.

VOICE AUTOMATED ROBOTIC ARM WITH GOOGLE ASSISTANT

MOHAMMED MAAZ WAHEED (1604-20-735-052)
MOHD GHOUSE TAZEEM (1604-20-735-058)
MOHD ABDUL JAMEEL (1604-20-735-305)

Under the guidance of
Dr. SALMA FAUZIA
Assistant Professor, Department of ECE, MJCET

ABSTRACT

This project report outlines the comprehensive design and implementation process of a **voice-controlled robotic arm**, leveraging the **Internet of Things (IoT)** technology. The system utilizes **Google Assistant** for voice command input, which is seamlessly processed through **IFTTT (If This Then That)** and the **Blynk IoT platform**. This integration enables users to control the robotic arm with simple voice commands, making the interaction intuitive and user-friendly.

The architecture of the system is a sophisticated blend of various components, including **servo motors** for precise movement, a **microcontroller** for processing inputs, and a robust **mechanical structure** for stability and durability. These elements work in unison to provide accurate and real-time control over the robotic arm's movements.

The report delves into the intricacies of these components and how they are harmoniously integrated to form a cohesive system capable of performing complex tasks with high precision. Furthermore, the report covers the entire **development life cycle** of the project,

including the methodology adopted, the implementation steps, testing phases, and a thorough evaluation of the system's performance.

The findings underscore the practicality and efficiency of using **voice control** in robotics, highlighting its potential for various applications. Through detailed analysis and testing, the report validates the effectiveness of this approach, demonstrating how IoT and voice control can enhance the functionality and accessibility of robotic systems.

6G COMMUNICATION – RIS AIDED THZ COMMUNICATION

SYED ARHHANN AHMAD (1604-20-735-104)
MOHAMMED AMAAN ALI (1604-20-735-105)
MOHAMMED TAQUIUDDIN (1604-20-735-108)

Under the guidance of
Dr. Nazeerunnisa
Senior Assistant Professor, ECE Department, MJCET

ABSTRACT

Reconfigurable Intelligent Surface (RIS)-aided **terahertz (THz)** communication is emerging as a promising technology for future **sixth-generation (6G)** wireless systems. By exploiting the extremely large bandwidth and scalability of RIS, **RIS-aided THz communications** face a critical challenge known as the **beam split effect**, where the generated beams fail to align with the target physical direction across the entire bandwidth, leading to a significant **array gain loss**.

This paper analyzes the beam split effect in the presence of RIS and proposes a novel **sub-connected RIS architecture** to mitigate this issue. The key innovation is the introduction of **time-delay (TD) modules** and **phase shifters** into the RIS elements, which transforms classical phase-only precoding into **joint phase and delay precoding**.

Additionally, a **wideband precoding design** is introduced to compensate for the severe array gain loss, with performance analysis provided for the array gain. The paper further explores emerging scenarios where **massive antennas** are equipped at the base station (BS), leading to a phenomenon known as **double beam split**, where beam split occurs both at the BS and RIS.

The decomposability of the array gain is demonstrated, enabling the **double beam split effect** to be addressed by separately optimizing wideband precoding at both the BS and RIS. Simulation results show that the proposed sub-connected RIS significantly alleviates the beam split effect with a minimal number of TD modules, achieving near-optimal performance in terms of achievable rates, with acceptable hardware cost and power consumption.

ADVANCED ELECTRONIC VOTING MACHINE USING FINGERPRINT SENSOR & ARDUINO

MOHAMMED SALMAN AHMED (1604-20-735-311)

Under the guidance of
Mr. IFTEKHARUDDIN
Associate Professor, Department of ECE, MJCET

ABSTRACT

Elections are a major and essential part of a democratic country and a fundamental right of every citizen. Voting is one of the critical tasks in electing a government in any democratic country. A **biometric authentication system** is secure, reliable, and privacy-protected for the purpose of an electronic voting machine (EVM). This paper presents the design of a **fingerprint-based electronic voting machine**. The developed system verifies the voter's identity and checks whether the voter is authentic during the election process. This project aims to replace the manual verification system with a **biometric verification system**.

The system also ensures that voters can only vote once and prevents multiple votes by the same individual. The system operates independently without the need for any third-party service, making it cost-effective, flexible, and easy to operate. Different components of the developed system have been tested under various operational conditions, ensuring that **identity verification** is secure and unique, which can be implemented in a voting machine to achieve **high-security elections**. The proposed method aims to replace manual verification with **biometric verification** to ensure secure and authentic elections.

This paper provides a comprehensive overview of an electronic voting machine integrated with **identity verification** using a fingerprint sensor, highlighting the benefits of enhanced security and efficiency in the voting process.

INTERNET OF THINGS BASED BABY MONITORING SYSTEM USING SMART CRADLE

MD FURQAN HASAN (1604-20-735-072)
AHSAN BASEER (1604-20-735-074)
MOHAMMED NABEEL (1604-20-735-079)

Under the guidance of
Mr. Md. Muneeruddin
Assistant Professor, Department of ECE, MJCET

ABSTRACT

This project presents the design and implementation of an **IoT-based baby monitoring system** using a **smart cradle**. The system leverages the **Arduino platform** to integrate various sensors and communication modules, providing a comprehensive solution for monitoring and ensuring the safety and comfort of infants. The smart cradle features multiple sensors, including **temperature** and **humidity sensors** to monitor the ambient environment, a **microphone sensor** to detect the baby's cries, and a repurposed **soil moisture sensor** to monitor diaper wetness.

A **servo motor** is used to automate gentle rocking of the cradle, and a **DC fan** is incorporated to maintain optimal temperature conditions. Central to the system's functionality is the **ESP8266 Wi-Fi module**, which enables remote monitoring and control via a smartphone app or web interface. Parents can receive **real-time alerts** and updates on their baby's status, ensuring peace of mind even when they are not physically present. Additionally, the **SIM900 GSM module** provides **SMS-based communication**, offering a reliable alternative when Wi-Fi connectivity is unavailable.

The design prioritizes **efficient power management** to ensure sustained operation. Careful consideration was given to the power requirements of each component, optimizing the system's overall energy consumption. The smart cradle was tested in various real-world scenarios, demonstrating its effectiveness in maintaining a comfortable and safe environment for infants. The system automatically adjusts environmental conditions and notifies parents of any irregularities, such as high temperatures or prolonged crying.

This project showcases the potential of **IoT technology** in enhancing infant care through smart systems. It provides a robust framework for future developments in **baby monitoring solutions**, offering a secure and user-friendly experience for parents.

STATIC TIMING ANALYSIS ON A PROCESSOR USING 45NM TECHNOLOGY

Mohammed Abdul Khadeer (1604-19-735-305)
Syed Waqaruddin (1604-19-735-010)
Gujjula Priyanka (1604-19-735-301)

Under the guidance of
Dr. Mohammed Abdul Raheem
Assistant Professor, Department of ECE, Muffakham Jah College of Engineering and Technology, Hyderabad

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ABSTRACT

Timing is the main concern of a digital designer tasked with designing a semiconductor chip. **Static Timing Analysis (STA)** is a critical step in the design of any digital integrated circuit. This project presents an approach to **Static Timing Analysis** in the **ASIC design flow** on a processor. The design is verified and subjected to all stages of the **ASIC design flow**, ensuring that the processor meets all timing requirements.

Key stages include the analysis of **setup-time**, **hold-time**, and other critical parameters, ensuring the processor's reliability and efficiency when operating under real-world conditions.

IOT BASED PATIENT VITALS MONITORING SYSTE

Neha Tabassum (1604-19-735-003)
Md Sameer Ahmed (1604-19-735-050)
Shaik Wasi Adnan (1604-19-735-051)

Under the guidance of
Mrs. Shubhangi Saxena
Assistant Professor, Department of ECE

ABSTRACT

With advancements in technology and the miniaturization of sensors, new opportunities have emerged to enhance the quality of human life, particularly in healthcare. The rising costs of healthcare services, especially in developing countries, necessitate innovative solutions. This project aims to tackle this issue by developing a remote healthcare system using IoT. The system comprises three main components: detecting patient vitals using sensors, transmitting the data to cloud storage via an ESP-32 microcontroller, and providing remote access for healthcare professionals.

The use of IoT in this system allows for real-time monitoring of patients, offering smart, reliable, and effective healthcare services. The system is designed to be affordable, utilizing locally available sensors, making it feasible for mass production. The data collected is

processed and analyzed in the cloud, and any critical changes in a patient's condition can trigger alerts for doctors or guardians. This project represents a significant step towards improving healthcare accessibility and quality, leveraging IoT technology to offer enhanced patient care.

ANTENNA ARRAY SIGNAL DIRECTION OF ARRIVAL ESTIMATION ON DSP PROCESSOR

Shaheddunnisa Begum (1604-17-735-004)
Syed Reeha (1604-17-735-007)

GUIDED BY:
Dr. Ayesha Naaz

ABSTRACT
Antenna arrays have become crucial in digital signal processing applications for their ability to accurately locate signal sources. Direction of Arrival (DOA) estimation is a primary function of array signal processing, essential for various applications. Despite the development of multiple algorithms for DOA estimation, their high computational complexity limits their application in real-time scenarios. This project focuses on designing and developing an efficient parallel implementation of DOA on a Digital Signal Processor (DSP), widely utilized in embedded systems.

The MUSIC (Multiple Signal Classification) algorithm, known for its potential parallelism, was chosen for 2-D DOA estimation. The project identifies and parallelizes two computational cores within the MUSIC algorithm. It proposes vectorization of multiple single-precision floating-point operations to leverage the 128-bit vectors on the DSP C6678

processor. The parallel DOA estimation algorithm was successfully implemented on a single core of the DSP C6678, the latest version of this processor.

Experiments were conducted on both 1-D and 2-D antenna array signals, showcasing significant performance improvements. This advancement indicates the feasibility of using the MUSIC algorithm in real-time applications, enhancing the efficiency and reliability of signal processing tasks in embedded systems.


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