



ECE INNOVATIONS 2023

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY

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A COLLECTION OF RESEARCH ARTICLES IN

ELECTRONICS AND COMMUNICATION

RESEARCH

DEVELOPMENT

NEEDS

SOLUTIONS

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### **VISION OF THE INSTITUTION**

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

### **MISSION OF THE INSTITUTION**

- 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**
- 2. To foster partnership with industry and government agencies through collaborative research and consultancy**
- 3. To nurture and strengthen auxiliary soft skills for overall development and improved employability in a multi-cultural work space**
- 4. To develop scientific temper and spirit of enquiry in order to harness the innovative talents**
- 5. To develop constructive attitude in students towards the task of nation building and empower them to become future leaders**
- 6. To nourish the entrepreneurial instincts of the students and hone their business acumen.**
- 7. To involve the students and the faculty in solving local community problems**

**DEPARTMENT VISION**

**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**

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### MESSAGE FROM THE DIRECTOR

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. Kaleem Fatima, which coupled with the skills of the staff made the issue of the magazine boldlv year after



This magazine as in its previous issues brings about the notable achievements of the staff and students in research / projects. I am sure; the

### MESSAGE FROM THE HEAD OF THE DEPARTMENT

It is my pleasure to congratulate the ECE DEPARTMENT that has taken the initiative for producing this magazine. It is great to find a considerable number of projects, certainly prove that our staff and students are adequately equipped and possess necessary skill sets to express their talent.

Reading this magazine would definitely be an inspiration and motivation for all students and staff to contribute even more to the forthcoming issues.

I hope that everyone would continue to give their full efforts to keep the momentum and continue to



# CONTENTS :

S. No	TITLE	PAGE NO
1.	Risc-V Processor	05
2.	Predicting Memory Compiler Performance Using Machine Learning	05
3.	Smart Energy Meter Using IOT & GSM	06
4.	Smart Street Lighting	07
5.	Designing 64 Bit ALU Using Vedic Mathematics	08
6.	Unmanned Ground Vehicle	09
7.	Assembly Line Robot	10
8.	RIS Based UAV Assisted THZ Communication System	11
9.	AAGCOM- Aerial Agriculture Companion	12

**Editorial Team of ECE INNOVATIONS 2023:**

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## **RISC-V PROCESSOR**

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- Project Guide: Dr. ARIFUDDIN SOHEL**

**ABSTRACT:**

Reduced instruction set computer (RISC) is a design system which supports simple and elementary instructions that gets executed within less amount of time. A 32 bit RISC processor with 5 five stage pipelined architecture is implemented by using Verilog modelling and it can be verified using UVM test bench methodology. The proposed design consists of several blocks such as ALU of 32 bit, data memory unit, bank registers and five stage pipeline structures. The proposed design here is based on Von-Neumann architecture that is having one shared memory for both data and instruction. The proposed design with pipelined architecture contains 16 bit instructions and which is very simple straightforward and easy to investigate.

## PREDICTING MEMORY COMPILER PERFORMANCE USING MACHINE LEARNING

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**Project Guide:** Dr. Mohd. Sabir Hussain

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### Abstract:

Typical semiconductor chips contain thousands of memories, most of which are small. These memories account for 25% to 40% of a product's overall power, performance, and area (PPA), making it crucial to carefully design them to meet system specifications. **Memory compilers** are commonly employed to enhance PPA in semiconductor design.

This project proposes the training of fully connected **feedforward neural networks** to predict PPA outputs, enabling efficient optimization despite the long run times of compilers. By using **deep learning algorithms**, PPA-optimal parameters can be determined in seconds based on neural network predictions.

To validate our approach, we calculated performance metrics and compared error percentages with those reported in various research papers. Existing methods for predicting error percentages in memory compilers tend to be inaccurate, costly, and time-consuming. To address these shortcomings, researchers from different fields are searching for more efficient alternatives.

Our project seeks to improve upon current methods by utilizing advanced algorithms and processing large datasets to achieve higher accuracy. The model is trained on a dataset and then tested to assess how well it predicts error rates. Our prime concern is minimizing the error percentage, and we have made significant strides in improving this compared to existing techniques.

By leveraging **Open RAM** memory compiler data, we categorized relevant data points and focused on key parameters, such as area and power leakage, to predict error percentages more accurately. The proposed technique has successfully predicted error rates with higher precision than existing methods.





## SMART ENERGY METER USING IoT & GSM

### Project Team:

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**Project Guide:** Mr. Iftekharuddin

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### Abstract:

The demand for power has exponentially increased over the past century. Addressing today's energy challenges requires reducing electricity consumption, especially in households. This project proposes an alternative strategy for measuring and charging energy consumption, moving away from conventional methods. With the increasing integration of distributed generation and renewable energy sources, **smart grid technologies** have become essential for optimizing energy management.

The proposed **smart energy meter** system incorporates an embedded controller and a **GSM module** to send real-time data on energy usage (in kWh), generated charges, and security alerts via the GSM mobile network. The system continuously reads energy meter data and sends alerts, such as low-balance or zero-balance notifications, to the registered number through the GSM modem.

One of the most pressing issues in developing nations like India is power theft, which leads to significant energy losses and infrastructure damage. These issues strain the power grid and utility companies, increasing operational costs. Preventing power theft could help conserve energy and protect valuable resources. This can be achieved through the **Smart Energy Meter (SEM)**.

The **Smart Energy Meter (SEM)** is an electricity measurement device equipped with an energy meter chip to record power consumption. It is also integrated with a wireless setup that transmits data via **IoT protocols** for real-time communication. This paper presents a solution for **automatic metering, theft detection, and data management** through IoT. The GSM network is utilized to send SMS notifications to local authorities, providing updates on power usage and potential theft incidents.

This system enables remote monitoring of energy meters, allowing energy providers to access meter data without the need for manual meter readings. The SEM replaces traditional

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methods, ensuring more efficient, accurate, and frequent monitoring, all while eliminating the need for on-site visits.

## **SMART STREET LIGHTING**

**Project Team:**

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**Project Guide: Dr. AYESHA NAAZ**

**ABSTRACT:**

The proposed smart street lighting system combines the inputs from the LDR sensor, vibration sensor, and IR sensor to optimize energy usage and ensure the right amount of lighting for specific situations. By adapting to environmental conditions and human presence, the system reduces energy waste, enhances safety, and improves overall efficiency. Furthermore, the integration of these sensor technologies opens up possibilities for future enhancements and connectivity to larger smart city infrastructure

## Designing 64-bit ALU using Vedic Mathematics

### Project Team:

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**Project Guide:** Dr. Kaleem Fatima

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### Abstract:

The **Arithmetic Logic Unit (ALU)** is the core of any processor or complex system. To enhance system performance, it is necessary to increase the ALU's speed while minimizing power consumption. For portable devices, achieving this balance is crucial. **VLSI design techniques** play a key role in reengineering digital electronic circuits, and in this project, a **low-power 64-bit ALU** is designed using **Verilog**.

The ALU's power efficiency is achieved through the use of a **Vedic Multiplier** and an **Energy Recovery Adder**, as the performance of the ALU is heavily dependent on the functioning of these components. The design approach is inspired by **Vedic Mathematics**, specifically utilizing the **Urdhva Tiryakbhyam Sutra** to reduce circuit complexity and power consumption.

As processor performance demands increase due to the need to handle complex algorithms and multifunctionality, all processor cores are integrated onto a single chip. However, the burden on the main processor remains high. To address this, **coprocessors** can be introduced to assist with numerical operations like addition, multiplication, and DSP applications. The speed of the main processor is directly influenced by the coprocessor's efficiency.

**Vedic Mathematics** offers a set of 16 unique formulas (sutras) that provide fast solutions for various operations. This project presents the design of a **64-bit ALU** based on Vedic Sutras, such as **Urdhva Tiryakbhyam** and **Nikhilam**, which prove to be highly effective for multiplication operations. The results demonstrate that Vedic sutras are applicable for multiplication operations, significantly reducing delays.

In this project, we have implemented an ALU using **Verilog HDL** and synthesized it in **Xilinx ISE**. The performance analysis reveals enhanced performance and reduced delay due to the use of Vedic Sutras. Additionally, the **multiplication unit**, a key component of the ALU,

controls various logical functions within the circuit. Although several algorithms exist for multiplication, Vedic mathematics-based implementations have not gained sufficient recognition. This technique proves to be beneficial in reducing computational path delays, and reutilization of resources helps minimize area overhead.

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## Unmanned Ground Vehicle

### Project Team:

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**Project Guide:** Mrs. Shubhangi Saxena

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### Abstract:

An **Unmanned Ground Vehicle (UGV)** is a battery-powered, remote-controlled robot on wheels, designed primarily for traversing various terrains and capturing visual information. The UGV can handle steep and gentle slopes, navigate through narrow corridors, and even tow objects to access hazardous or challenging areas. Equipped with a robotic arm, the UGV can lift and move objects to different locations and remove obstacles from its path. Its connectivity to the Internet allows for remote control over a broad range, making it highly versatile.

The integration of **Internet of Things (IoT)** into robotics has given rise to a new generation of machines, including UGVs. These machines combine advanced IoT and robotic technologies, enabling them to perform tasks such as remote control, live video streaming, and autonomous navigation.

The UGV in this project is equipped with a robotic arm and an **ESP-32 cam module**, a microcontroller that allows for live video transmission and real-time task execution based on user commands. The primary function of this robot is to explore designated areas, capture live video footage, and transmit it to authorized personnel remotely. The footage can then be used to carry out specific actions as required.

With its ability to perform multiple functions, the UGV has a wide range of applications in areas such as defence, healthcare, apartment security, and more. This paper presents the implementation of these advanced machines, which are recognized for their usefulness, low maintenance requirements, and ease of deployment.

**Keywords:** Surveillance, monitoring, inspecting, robot, IoT, IIoT, live video streaming, robotic arm.

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## Assembly Line Robot

### Project Team:

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**Project Guide:** Dr. Arifuddin Sohel

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### Abstract:

This project focuses on the development of a **4-degree-of-freedom assembly line robot** designed to carry out tasks in an assembly environment. The robot is developed for assembly applications and is capable of operating in both manual and automatic modes. In manual mode, the robot functions based on inputs provided by the user, while in automatic mode, it executes tasks based on pre-set coordinate positions.

The robot is equipped with the ability to undertake **repetitive tasks**, making it highly suitable for assembly lines that require precision and consistency. One of the key applications of this robot is the assembly of components such as placing **mobile screens** onto **mobile bodies**.

The primary objective of the robot is to streamline the assembly process, reduce human intervention, and improve the efficiency of repetitive assembly tasks.

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# RIS Based UAV Assisted THz Communication System

## Project Team:

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## Abstract:

The future of wireless networks relies heavily on **drones** to extend coverage and achieve high data rates in the **THz frequency band**. However, **THz communications** face significant challenges due to **channel impairments** and **blockage effects**, which become even more pronounced when drones are in motion. This project proposes a **deep learning solution** using a **Deep Temporal Convolutional Neural Network (DTCN)** to proactively predict the optimal **serving base station** or **Reconfigurable Intelligent Surface (RIS)**, along with the appropriate **serving beam** for each drone based on its location or beam trajectory. This approach significantly reduces beam training overhead and associated latency, making it a viable solution for **time-critical applications**.

THz communications are particularly vulnerable to channel impairments and blockage, which are exacerbated by drone mobility. Moreover, determining optimal beamforming vectors in **large antenna array mm Wave systems** involves substantial training overhead, adversely affecting the efficiency of mobile systems. Narrow beams, combined with the sensitivity of **mm Wave signals** to blockage, severely impact coverage and the reliability of highly mobile links. Additionally, mobile users in dense mm Wave deployments must frequently perform hand-offs between **Base Stations (BSs)**, contributing to critical control and latency issues.

To address these challenges, this project presents a **DTCN-based solution** that anticipates the appropriate **base station** or **RIS** and **beam** for each drone. This proactive prediction is based on prior observations of drone position or beam trajectory, allowing for efficient beam training and significantly reducing latency. The proposed system enhances the reliability and coverage of THz communications and mitigates the inefficiencies caused by high training overhead, making it suitable for dynamic and high-mobility environments.



## AAGCOM - Aerial Agriculture Companion

### Project Team:

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### Abstract:

Drones, originally developed for military purposes and known by various names such as **Unmanned Aerial Vehicles (UAVs)** or **Flying Mini Robots**, have now found widespread use in sectors like business, infrastructure, farming, entertainment, and more. The application of **small unmanned aerial vehicles** in **agribusiness** has grown rapidly, offering immense potential for improving agricultural operations.

These UAVs are particularly useful in **agricultural planning**, allowing farmers to monitor crops and animals more efficiently. With their ability to cover large areas quickly, drones provide real-time data, enabling better decision-making and resource management in farming.

The use of UAVs in agriculture represents a significant advancement in precision farming, offering solutions for monitoring field conditions, assessing crop health, and optimizing farming practices. **AAGCOM** is designed to be an **Aerial Agriculture Companion**, assisting farmers in improving productivity and reducing labour costs through automated aerial monitoring.

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