SPECIAL FEATURE

IoT-Enabled
ECG Monitoring System

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Industry 5.0: The Dawn of Human-Centric Innovation

The industrial landscape is evolving at an unprecedented pace. While Industry 4.0 revolutionized manufacturing through automation, artificial intelligence (AI), and the Internet of Things (IoT), a new paradigm is emerging—Industry 5.0. Unlike its predecessor, which prioritized efficiency and connectivity, Industry 5.0 focuses on human ingenuity, collaboration, and sustainability. Industry 4.0 introduced smart factories where machines operated with minimal human intervention. However, this created concerns about job displacement, depersonalization, and ethical challenges surrounding AI. Industry 5.0 addresses these issues by emphasizing human-machine collaboration. Instead of replacing workers, advanced technologies—such as cobots (collaborative robots), AI-driven assistants, and augmented reality (AR)—enhance human capabilities. This allows for greater personalization, creativity, and problem-solving in production. For instance, in manufacturing, skilled workers will oversee AI-powered systems, ensuring precision while adding an artistic and emotional touch that machines lack. This shift is particularly crucial in industries such as healthcare, fashion, and custom manufacturing, where personalization is the key.

Industry 5.0 also brings a strong commitment to sustainability. As the world grapples with climate change and resource depletion, businesses must rethink their production models. This new industrial era promotes circular economies, energy-efficient processes, and ethical sourcing of materials. AI-driven analytics help optimize supply chains, reducing waste and carbon footprints while maintaining profitability. Moreover, companies are now expected to uphold social responsibility. Consumers and stakeholders demand transparency in sourcing, fair wages, and eco-friendly production. Industry 5.0 encourages businesses to go beyond profits and prioritize people and the planet. While Industry 5.0 promises a more inclusive and sustainable industrial future, challenges remain. Workforce upskilling is crucial—employees must adapt to new technologies and develop hybrid skill sets combining technical expertise with creativity and problem-solving. Additionally, businesses must address ethical concerns related to AI bias, data privacy, and the impact of automation on traditional jobs. Governments and educational institutions are vital in preparing society for this transformation. Policies supporting lifelong learning, responsible AI use, and ethical business practices will ensure a smooth transition into this new era. Industry 5.0 represents a much-needed balance between technology and humanity. By fostering collaboration between humans and machines, emphasizing sustainability, and promoting ethical practices, this industrial shift ensures that progress benefits everyone—not just corporations. As we step into this new phase of innovation, embracing Industry 5.0 is not just an option but a necessity for a more humane and responsible future. Industry 5.0 is not just about technological advancements but about redefining the role of humans in an increasingly automated world. By prioritizing human creativity, ethical innovation, and environmental responsibility, this new industrial era has the potential to create a smarter, more compassionate, and sustainable future for all.

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IoT-Enabled ECG Monitoring System

Abstract *– This study presents the development of a cost-effective ECG (Electrocardiogram) monitoring system leveraging the AD8232 sensor and an Arduino microcontroller platform. The system aims to provide real-time monitoring of cardiac activity for early detection of abnormalities, facilitating timely intervention and management of cardiovascular conditions. The AD8232 sensor offers high signal fidelity and ease of integration, making it suitable for portable and wearable applications. The Arduino platform serves as the central processing unit, enabling data acquisition, signal processing, and display functionalities. The proposed system undergoes calibration to ensure accurate ECG signal acquisition and employs digital filtering techniques to remove noise artifacts. Additionally, signal processing algorithms are implemented for heart rate calculation and waveform analysis. The processed ECG data is displayed in real time on a graphical interface, providing visual feedback to users. The system's compact design and low power consumption make it suitable for remote monitoring and ambulatory care settings. Overall, the developed ECG monitoring system offers a practical solution for continuous cardiac monitoring, contributing to early diagnosis and improved management of cardiovascular health.*

Keywords *— AD8232 sensor, Arduino, electrodes, ECG*

I. Introduction

The Electrocardiogram (ECG) is a vital diagnostic tool used in healthcare for assessing cardiac function and detecting abnormalities in heart rhythm. With the advancement of technology, there's a growing demand for portable and cost-effective ECG monitoring solutions to enable continuous cardiac monitoring outside clinical settings. This paper introduces the development of an ECG monitoring system utilizing the AD8232 sensor and Arduino microcontroller platform, offering a low-cost yet reliable solution for real-time cardiac monitoring.

The AD8232 sensor is chosen for its high signal quality and ease of integration, making it suitable for wearable and portable ECG monitoring devices. Coupled with the Arduino platform, which provides a flexible and programmable environment, the system offers a versatile platform for data acquisition, processing, and display. This combination allows for the creation of a compact and user-friendly ECG monitoring system suitable for home-based monitoring or ambulatory care.

The motivation behind this work stems from the need for accessible and affordable cardiac monitoring solutions, particularly for individuals at risk of cardiovascular diseases or those with pre-existing cardiac conditions. By leveraging off-the-shelf components and open-source hardware and software, the proposed system aims to democratize access to cardiac monitoring technology, empowering individuals to take proactive steps toward their cardiovascular health.

M.M. Rahman et al. [1] designed an Arduino-based ECG monitoring system using a Bluetooth module to offer real-time signal collecting and transmission. Their approach aimed for simplicity of use and cost, so fitting for home-based monitoring. Similarly, Prasad and Kavanashree [2] employed an ECG system using the AD8232 sensor, which offers minimal design and good signal collection. Ideal for wearable technologies, this method reduces battery consumption while nevertheless boosting signal quality.

A. Rahman et al. [3] proposed an IoT-based ECG monitoring system that allows healthcare workers to remotely see cloud-stored ECG signals. This technology enhances patient care by analyzing ECGs in real time and responding to irregularities. However, cloud-based ECG data transfer security challenges remain. A smartphone-based ECG monitoring system with mobile apps for viewing and analysis was demonstrated by Priya and Chitra [4]. This approach improves mobility and convenience, but battery life, signal interference, and processing limits require further research.

These studies demonstrate ongoing efforts to improve ECG monitoring reliability, convenience, and accessibility. Embedded systems and wireless technologies have improved ECG capture and real-time monitoring, but data security, signal accuracy, and energy economy need more study. Future research should prioritize integrating AI and ML for automated ECG analysis to improve cardiac disease detection.

In this study, we will discuss the design and implementation of the ECG monitoring system, including the hardware setup, signal processing algorithms, and user interface development. We will also explore the system's performance characteristics, such as signal fidelity, accuracy, and power consumption. Furthermore, we will discuss potential applications of the developed system in clinical practice, telemedicine, and remote patient monitoring.

Overall, the development of an ECG monitoring system using the AD8232 sensor and Arduino platform represents a significant step towards democratizing cardiac monitoring technology, bringing affordable and accessible healthcare solutions to a wider population.

II. Methodology

Integrate an AD8232 sensor with Arduino to create an ECG monitoring system. Attach the sensor to the power supply and analog pin of the Arduino board. Place electrodes on the left, right, and left legs and attach them to the sensor. To read sensor data and convert it to voltage, use Arduino code. Utilize filters and algorithms to evaluate signals, measure heart rate, and spot anomalies. Display the results and set up alerts to notify of any abnormalities. Put safety first by making sure you're properly isolated and by adhering to medical device procedures. With the accuracy of the AD8232 and the flexibility of the Arduino, this unique solution provides real-time ECG monitoring that may be used for a variety of purposes.

a. Electrocardiography

Electrocardiography (ECG) [5] is a non-invasive medical procedure that records the electrical activity of the heart over some time. It involves placing electrodes on the skin, which detects the electrical impulses generated by the heart as it contracts and relaxes. These impulses are then amplified and recorded, producing a visual representation known as an ECG or EKG (electrocardiogram). ECGs are commonly used to diagnose various heart conditions, such as arrhythmias, heart attacks, and abnormalities in the heart's structure or function. They are an essential tool in cardiology, providing valuable insights into cardiac health and guiding treatment decisions.

b. Arduino UNO

The Arduino Uno is a versatile microcontroller board renowned for its ease of use and wide range of applications. The Arduino Uno is shown in Fig. 1. Featuring an ATmega328P microcontroller, and offers ample computing power for various projects. With a simple programming interface and abundant community support, it's ideal for beginners and experts. Its numerous input/output pins allow interfacing with sensors, actuators, and other peripherals, making it suitable for robotics, automation, IoT, and more. The Uno's compact size, affordability, and compatibility with a vast array of shields and modules make it a staple in the maker community and a go-to choice for prototyping and educational purposes.

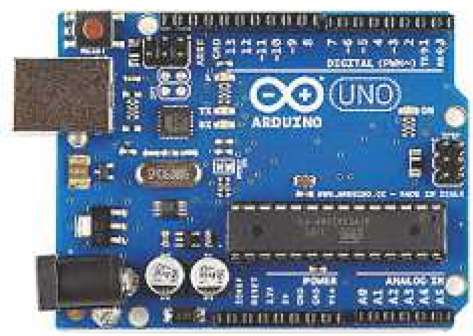

Figure 1: Arduino UNO

c. AD8232 Sensor

The AD8232 sensor [5] is renowned for its exceptional signal quality and seamless integration, making it ideal for wearable ECG monitoring devices. Fig. 2 shows the AD8232 sensor. When paired with the Arduino platform, it provides a versatile and programmable environment for data acquisition and processing. This combination facilitates the creation of compact and user-friendly ECG monitoring systems suitable for home-based or ambulatory care. The motivation behind utilizing this sensor lies in the quest for accessible and cost-effective cardiac monitoring solutions, particularly beneficial for

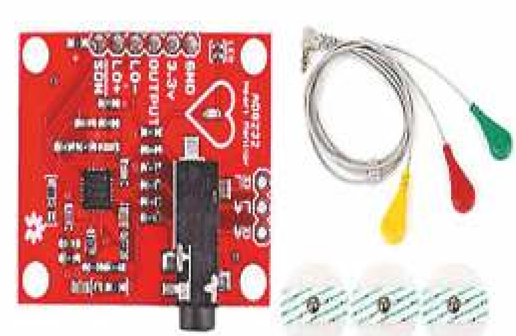

Figure 2: AD8232 Sensor (ECG Sensor)

individuals at risk of cardiovascular diseases or those with existing cardiac conditions. This innovative integration aims to democratize access to cardiac monitoring technology, promoting proactive cardiovascular health management.

d. Electrodes

In ECG monitoring, dry electrodes offer a non-invasive solution, eliminating the need for gels or adhesives and enhancing user comfort and convenience. These electrodes utilize innovative materials and designs to establish reliable electrical contact with the skin, ensuring accurate signal acquisition. Dry electrodes facilitate seamless integration into wearable and portable ECG monitoring devices by mitigating skin irritation and simplifying application, promoting prolonged use and patient compliance. Their effectiveness in capturing physiological data, coupled with their user-friendly nature, contributes to the advancement of accessible and user-centric cardiac monitoring solutions, catering to diverse healthcare needs without compromising signal quality or patient comfort.

III. Circuit Diagram / Connection between Arduino and Ad8232

From the integrated circuit[6], the AD8232 Heart Rate Monitor involves nine connections. The circuit connection between Arduino and AD8232 is shown in Fig. 3. Although these connections are essentially holes to which wires or header pins can be soldered, we refer to them as "pins" because they originate from the pins on the integrated circuit. Five of the board's nine pins will be connected to Arduino. We require the following five pins: GND, 3.3v, OUTPUT, LO-, and LO+, which are described in Table 1.

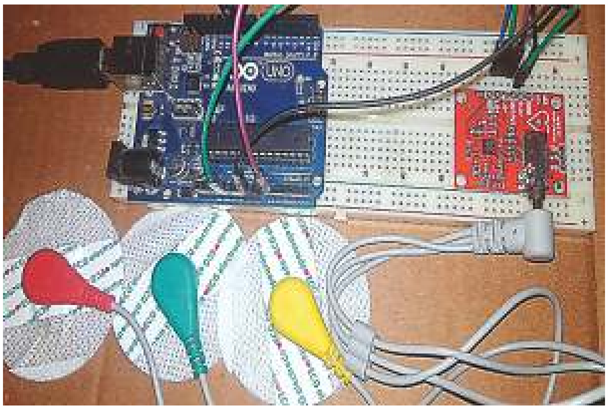

Figure 3: Circuit Connection between Arduino and AD8232

Table 1 – Pin Configuration and Arduino Connections

Board Label	Pin Function	Arduino Connection
GND	Ground	GND
3.3v	3.3v Power Supply	3.3v
OUTPUT	Output Signal	A0
LO-	Leads-off Detect -	11
LO+	Leads-off Detect +	10
SDN	Shutdown	Not used

IV. AD8232 ECG Sensor on Body

Before applying to the body, it is advised to snap the sensor pads onto the leads. The better the measurement, the closer the pads are to the heart. To assist in determining correct placement, the cables are color-coded, as shown in Fig. 4.

Red : Right Arm (RA)

Yellow : Left Arm (LA)

Green : Right Leg (RL)

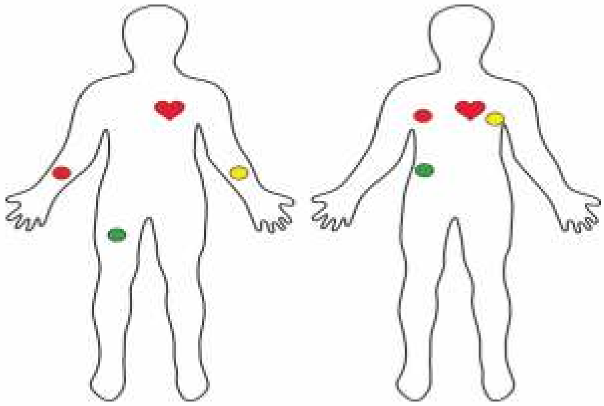

Figure 4: ECG Sensor placement on body

V. Result Analysis

The result analysis of the ECG monitoring system involves a comprehensive evaluation of the data acquired from the Arduino Uno, AD8232 sensor, and ECG electrodes setup. Initially, the quality of the ECG signals is assessed, ensuring clarity and minimal interference. Subsequently, heart rate measurement is computed based on detected R-wave peaks, facilitating the assessment of cardiac rhythm and detection of anomalies like tachycardia or bradycardia. Furthermore, analysis extends to identifying irregularities in heart rhythm, such as arrhythmias or atrial fibrillation, by scrutinizing waveform patterns and inter-beat intervals. Special attention is given to the ST segment for signs of myocardial ischemia or infarction, with deviations from baseline meticulously examined. Throughout the process, artifacts or disturbances within the ECG signal are pinpointed and filtered out to maintain result accuracy. Fig. 5 & 6 shows a graphical representation of the heart's electrical activity during each cardiac cycle. Comparisons with established normal standards guide interpretation, helping discern potential cardiac abnormalities necessitating further evaluation. Finally, the system may generate alerts for abnormal findings, facilitating timely clinical intervention or follow-up. Overall, the result analysis of the ECG monitoring system serves to provide valuable insights into cardiac health status, enabling proactive management of potential issues.

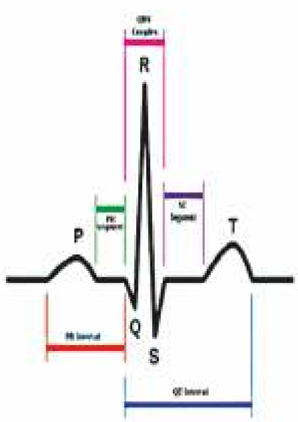

Figure 5: Representative ECG Signal

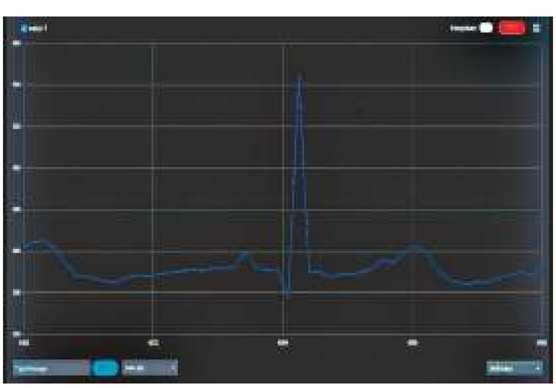

Figure 6: Actual Signal Obtained

VI.Transmitter Design

Using the Integrated Drive Electronics (IDE) interface[4], the code created based on these pin connections is loaded into Arduino. The transmitter's algorithmic processes are displayed below.

- Start/Stop libraries and pins: Select the RF pins for the transmitter, the communication channel, and the sensor's input pins. Radio configuration starts with the transmitter: Decide on the data rate, RF power level, and channel count.
- Start of loop: Read the analog port value from the sensor pins, write the port value to the RF module's input, and use RF to send the port value in M bits.
- There are times when recordings contain noise. Among the causes of noise are respiration, quantization, channel noise, 50 Hz noise, movement noise, noise from misaligned electrodes, and breathing noise.

VII. Conclusions

The implementation of an ECG monitoring system utilizing the AD8232 sensor, Arduino, and electrodes proves to be an efficient and reliable method for real-time cardiac monitoring. By interfacing the AD8232 sensor with Arduino, raw ECG signals are captured accurately, and noise interference is minimized, ensuring the fidelity of the data. The electrodes facilitate the non-invasive acquisition of cardiac signals, enhancing the system's usability and comfort for the patient.

Through signal processing algorithms integrated into the Arduino code, the obtained ECG signals are filtered and processed to extract relevant cardiac information such as heart rate, rhythm, and abnormalities. Real-time visualization of the ECG waveforms on a display provides immediate feedback to healthcare professionals or patients, enabling timely intervention if necessary.

Moreover, the compact and portable nature of the system allows for remote monitoring, empowering patients to manage their cardiac health proactively. Additionally, the affordability of the components makes this solution accessible in resource-limited settings.

In conclusion, the ECG monitoring system incorporating the AD8232 sensor, Arduino, and electrodes demonstrates promising potential in healthcare applications, offering accurate, cost-effective, and user-friendly cardiac monitoring capabilities.

VIII. Future Scope

The future scope of ECG monitoring systems utilizing the AD8232 sensor, Arduino, and electrodes is promising. This innovative technology offers real-time cardiac health tracking, enhancing preventive healthcare measures. Its compact design and low power consumption make it suitable for continuous monitoring in various settings, including hospitals, homes, and remote locations. With advancements in data analysis and machine learning algorithms, these systems can provide early detection of cardiac abnormalities, leading to timely interventions and improved patient outcomes. Moreover, integration with telemedicine platforms can enable remote consultations, extending healthcare access to underserved communities. This holistic approach signifies a paradigm shift towards personalized and proactive cardiac care.

Acknowledgment

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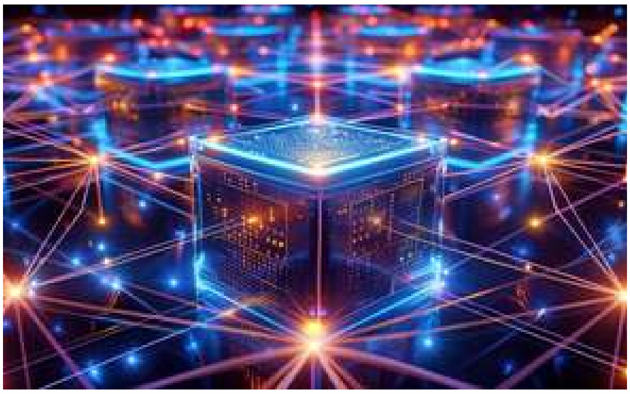
Oracle's AI pricing features to financial software

Oracle has approached AI differently than competitors like Microsoft, other than rushing toward general-purpose virtual assistants. Oracle has decided to include specific features that expedite routine but time-consuming operations, such as entering a brief account of how a sales meeting went into a corporate records system. Another such task that is common in the business world is giving a customer a price quote on a complicated purchase that might have a lot of options when a sales professional would need to sift through materials to come up with a price.

(Source: The Indian Express)

Distributed Quantum Computer



Scalability is one of the main issues with quantum computing. A quantum computer would have to process millions of qubits (atomic-scale carriers of quantum information) to be genuinely revolutionary. But it would take a massive, unfeasible technology to fit that many qubits into a single machine. The Oxford University Physics team has successfully demonstrated distributed quantum computing, which is a significant step toward making quantum computing feasible on a broad scale. A single fully integrated quantum computer is being produced by utilizing a photonic network interface to link two distinct quantum processors. This novel method connects tiny quantum processors in a network so that they can share the computing load. Modules with a limited quantity of trapped-ion qubits constitute the foundation of the scalable architecture. These are connected by optical fibers, and data is sent between them using light (photons) as opposed to electrical impulses. By allowing qubits in different modules to become entangled, these photonic linkages enable quantum teleportation, which enables the execution of quantum logic across the modules. This innovation makes it possible to solve difficult issues that were previously unsolvable.

(Source: SciTechDaily)

Durable and Recyclable Plastic

Cornell University has created a recyclable substitute for thermoset polymers, a robust family of materials frequently found in bowling balls, car tires, and replacement hip joints. A crosslinked polymer structure that guarantees remarkable strength and durability is what distinguishes thermosets. Traditional, petrochemical-based thermosets, which make up about 15% to 20% of all polymers manufactured, are unable to be recycled due to this similar structure. To overcome that environmental obstacle, a bio-sourced substitute is being developed that is easily recyclable and biodegradable while possessing the toughness and malleability of crosslinked thermosets. Dihydrofuran (DHF), is a monomer that can be produced from biological resources and may someday compete with feedstocks derived from petroleum. A double-bonded circular monomer DHF is employed, as a starting point for two subsequent polymerizations. The second polymerization produced a crosslinked polymer that is recyclable through heating and will break down organically in the environment. DHF thermosets exhibit similar qualities to commercial thermosets, such as ethylene propylene rubber (used in garden hoses and automotive weather stripping) and high-density polyurethane (found in electronics instruments, packaging, and footwear, for instance). Unlike existing petrochemical thermosets, the materials based on DHF provide a cyclic economy of use.

(Source: The Indian Express)

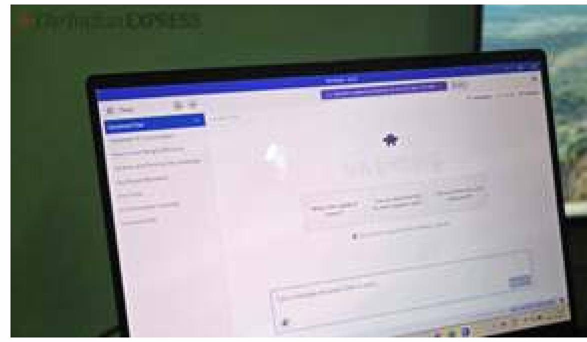
Innovative Data Storage Material

Flinders University has developed a low-cost, high-density polymer that can store data efficiently using nanoscale indents and can be erased and reused multiple times. This innovative material, made from sulfur and dicyclopentadiene, promises greater storage capacities compared to traditional storage devices, and its ability to be quickly recycled offers a sustainable alternative for the future of data storage. More data can be stored on this inexpensive polymer than on traditional hard disk drives because it forms nanoscale patterns that resemble small "dents." The polymer can be reused several times and can have its data wiped in a matter of seconds using short heat bursts. The use of straightforward, renewable polysulfides in probe-based mechanical data storage is made possible by this research, potentially providing a more sustainable, high-density, and low-energy substitute for existing systems. The ability to write, read, and erase data repeatedly was made possible by the polymer chemistry approach, which is crucial for computers and data storage. Computer behemoths like IBM, LG Electronics, and Intel have already investigated the idea of storing data as indents on the surface of materials. The energy requirements, prices, and complexity of the data storage materials are some of the obstacles to commercializing the technology, even though this mechanical data storage technique produced some extremely promising storage demonstrations and breakthroughs.

Source: SciTechDaily

DeepSeek AI Locally on any PC

A PC can run several open-source AI models like DeepSeek or Llama 3 natively. One of the greatest and most cost-effective tools for Linux, Mac, and PC is



LM Studio. Smaller models with fewer parameters can be run on any device; however, it is recommended to use a PC with at least 16 GB of RAM, a reasonably strong CPU, and a GPU. Advanced language models such as Llama 3.2, Mistral, Phi, Gemma, DeepSeek, and Qwen 2.5 can be run locally on your PC for free with LM Studio. Please take note that it is advised to use distilled models, which are smaller models with fewer than 10 billion parameters. These models are quicker and more effective versions of their larger counterparts because they are compressed utilizing a technique known as distillation, which condenses all of their knowledge into a smaller package. To guarantee that they produce superior outcomes, these models are optimized. Because the resources needed to run an LLM(Large Language Model) must be downloaded to your computer, you may need about 10 GB of data and storage space on your PC, depending on the AI model you select. After downloading everything, you can use the AI models offline as well.

(Source: The Indian Express)

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Task Scheduling & Virtual Machine Placement in Cloud Data Centers using QoS Parameters

Abstract – *This study addresses the process of scheduling the tasks and the placement of virtual machines (VMs) in cloud data centers using Quality of Service (QoS) parameters. By integrating QoS factors such as deadlines, priority levels, and resource needs, the proposed task scheduling algorithm ensures tasks meet their QoS requirements. Similarly, the VM placement strategy optimizes resource utilization and energy efficiency by considering the QoS demands and the current state of physical hosts. Experimental results show that these QoS-aware approaches enhance performance, reliability, and resource management in cloud services, ultimately reducing operational costs and improving overall efficiency in cloud data centers.*

Keywords – *Task Scheduling, Virtual Machine Placement, Resource Utilization, Cloud Services, Reliability.*

I. Introduction

The cloud paradigm has revolutionized the traditional way of accessing and managing computational resources, offering scalability, flexibility, and cost-efficiency. Despite these benefits, efficient resource management, particularly in task scheduling and virtual machine (VM) placement, presents significant challenges [1]. Task scheduling involves assigning tasks to VMs to optimize performance metrics like response time and resource utilization. This is complex due to the heterogeneous and dynamic nature of workloads. Incorporating the Quality of Service (QoS) parameters like deadlines, priority levels, and resource needs—ensures that tasks meet their performance requirements.

Similarly, VM placement involves allocating VMs to physical hosts within a data center, considering factors like CPU, memory, storage, and network bandwidth. Effective VM placement enhances resource utilization and energy efficiency while minimizing resource contention. This paper explores innovative methods for task scheduling and VM placement by integrating QoS parameters, aiming at improving the performance, reliability, and efficiency of cloud data centers. The proposed approaches and their impacts are discussed in subsequent sections.

The problem involves optimizing the task scheduling mechanism and the process of VM placement in the cloud data centers. Current methods inadequately consider QoS parameters, leading to suboptimal enactment. The challenge is to develop QoS-aware strategies that enhance performance, resource utilization, and energy efficiency, ensuring reliable and efficient cloud services [2].

This study endeavors to optimize the process of scheduling tasks and VM placement in the cloud arena by integrating QoS parameters. The primary objectives include enhancing performance metrics, exploiting the utilization of the resources, and plummeting operational costs. In contemporary cloud environments, where diverse workloads and user demands are prevalent, efficient resource management is paramount.

The motivation for this research stems from the escalating demand for highly efficient and reliable cloud services. With an increasing reliance on cloud computing across various industries, there's a pressing need to handle dynamic workloads effectively while meeting stringent performance requirements. By incorporating QoS parameters such as deadlines, priority levels, and specific resource needs, the study seeks to address these challenges.

Furthermore, the study aims to improve service reliability by ensuring that tasks are executed within their stipulated QoS bounds. This is crucial for meeting user expectations and maintaining high levels of customer satisfaction. Additionally, the integration of QoS-aware strategies in task scheduling and VM placement can contribute to cost-efficiency and sustainability in data center operations. By maximizing resource utilization and minimizing energy consumption, cloud data centers can operate more economically and environmentally responsibly.

Ultimately, this research aims to advance the capabilities of cloud infrastructure to better support the evolving needs of various applications and industries reliant on cloud computing services. By attaining these objectives, the research seeks to deliver a competitive advantage in the cloud computing market, positioning cloud service providers as leaders in delivering efficient, reliable, and cost-effective solutions to their customers.

II. Literature Review

The existing works on optimizing the consumption of energy are reviewed and the drawbacks are analysed. Numerous ways investigated to control the usage of energy, energy-saving strategies, and implementations. The implementation of Dynamic Voltage and Frequency Scaling (DVFS) in a kernel module of the Linux operating system has gained general adoption as the result of numerous research efforts aimed at creating effective algorithms for controlling CPU power utilization. Furthermore, Shuja et al. [3], emphasized research challenges related to the conflicting demands of improving cloud services' quality of services (QoSs) while reducing data center resources' energy usage. The servers consume the majority of the energy [4], but they produce heat and need to be cooled.

The exponential growth in data collection and consumption is driving up demand for data centers. On a pay-per-use basis, cloud computing typically makes use of numerous data centers and computers to serve a large number of customers. These resources are widely distributed and require a significant quantity of electricity for a variety of purposes, including server farms, networking devices, cooling technology, and displays. In addition to outlining the causes and challenges of excessive power and energy consumption, Beloglazov et al. [5] provided a taxonomy of energy-efficient computing system architecture at the operating system, hardware, virtualization, and data center levels. An investigation of the energy consumption of cloud computing was published by Baliga et al. [6]. Both public and private clouds are examined, along with the energy used for communication and switching, information processing, and storage. Clients are not required to construct or manage infrastructure on their websites. All they need to quickly access their apps is a fast network. SaaS providers use the same software and infrastructure to serve a range of enterprises [7].

Miyazaki [8] utilized Bayesian optimization (BO) to optimize a graphics processing unit (GPU) cluster system for the Green500 list, a prominent energy-efficiency rating of supercomputers. By defining the search space in advance with the least amount of information and previous tests, BO may be able to acquire an excellent configuration. There are several options for server system composition, such as putting a server in-house, establishing a server at a data center [9] outside of town, and utilizing cloud computing. Relatively obscure "embedded data centers" account for approximately half of the total energy consumption of data centers, representing about 1% of all energy produced in the United States. Typically, embedded data centers are defined as facilities with an IT demand of less than 50 kW. L Shang et al. have developed a model for powering down servers using DVFS [10]. DVFS manages the power state of the server based on the current workload, adjusting the CPU's energy consumption accordingly. However, this method is limited to affecting only the CPU's power usage, making it essential to track the behavior of each virtual machine.

III. Proposed Methodology

The Emperor Penguin Colony algorithm (EPC) is a nature-inspired metaheuristic optimization technique based on the social and cooperative behavior of emperor penguins, particularly how they huddle together to survive the harsh conditions of the Antarctic environment. Developed by researchers to solve complex optimization problems, the algorithm mimics the energy-saving strategies and dynamic huddling behavior of these penguins [11]. Emperor penguins exhibit remarkable cooperative behavior to withstand extreme cold. They form large huddles, where individuals rotate between the cold outer layer and the warm inner region, minimizing energy loss and maintaining an optimal temperature for survival. This dynamic movement ensures that all penguins benefit from the warmth generated within the huddle, promoting an even distribution of warmth and resources among the group. In dynamic cloud environments, efficient VM placement is crucial to optimize resource usage, minimize costs, and ensure quality of service. Objectives include balancing server loads, reducing energy consumption, and minimizing active servers [12]. The proposed virtual machine placement algorithm is mentioned in the Algorithm 1. Let the set of ***m*** data centers be represented as a set $D = \{d_1, d_2, d_3, \ldots, d_m\}$, where each $d_i \in D$, such that $1 \leq i \leq m$. Each data center has n number of physical servers, i.e. $S = \{s_1, s_2, s_3, \ldots, s_n\}$, where $s_j \in S$, such that $1 \leq j \leq n$. Each server allocates p number of VMs portrayed as set $VM = \{vm_1, vm_2, vm_3, \ldots, vm_p\}$, where $vm_k \in VM$, such that $1 \le k \le p$. R is the set of q requests, i.e. $R = \{r_1, r_2, r_3, \ldots, r_q\}$, where $r_l \in R$, such that $1 \le l \le q$. The consumption of energy by a server s_j in a data centre d_i can be represented as $E_{i,sj}$ and is defined by the Eqn. (1) :

$$E_{i,sj} = E_{j,Idle} + (E_{j,Max} - E_{j,Idle}) \times U_{sj} \quad (1)$$

Here, $E_{j,Idle}$ and $E_{j,Max}$ are the energy consumed by the server s_j at idle time and peak time respectively. u_{sj} is the utilization of j^{th} server. The energy consumption of a datacenter (E_{di}) may be considered as the energy consumed in total by all the servers of that datacenter, as mentioned in the Eqn. (2):

$$E_{di} = \sum_{j=1}^{n} E_{I,sj} \quad (2)$$

The energy consumed by all the datacentres E_D is formulated as in Eqn. (3):

$$E_D = \sum_{i=1}^{m} E_{di} \quad (3)$$

Algorithm – 1

Virtual Machine Placement

Input: The set $\boldsymbol{S}$ of servers $\boldsymbol{s_j}$ with size $\boldsymbol{n}$, the set of $\boldsymbol{VM}$ virtual machines $\boldsymbol{vm_k}$ with size $\boldsymbol{p}$, the upper threshold of server capacity $\boldsymbol{Th_{UB}}$, and the lower threshold of server capacity $\boldsymbol{Th_{LB}}$.

Output: Runtime VM migration for VMP inside the data center to allocate the VMs to the appropriate servers.

for $\boldsymbol{s_j}$ in $\boldsymbol{d_i}$ do

if $\boldsymbol{Cap_{i,sj}} < \boldsymbol{Th_{LB}}$ then

for $\boldsymbol{vm_k}$ in $\boldsymbol{s_j}$ do

Insert $\boldsymbol{vm_k}$ to vm_migration list

(In descending order of priority)

end for

$\boldsymbol{s_j}$ goes to ***sleep*** 0 mode

else if $\boldsymbol{Cap_{i,sj}} > \boldsymbol{Th_{UB}}$ then

for $\boldsymbol{vm_k}$ in $\boldsymbol{s_j}$ do

if $\boldsymbol{vm_k}$ is requesting for scaling up resources **then**

Insert $\boldsymbol{vm_k}$ to vm_migration list

(In descending order of priority)

end if

end for

else

j = j + 1

end if

end for

The capacity of a VM vm_k in a server s_j , i.e. $Cap_{j,vmk}$ can be portrayed as given in Eqn. (4):

$$Cap_{j,vmk} = num(PEs)_{vmk} \times MIPS(PEs)_{vmk} + BW_{vmk}. \quad (4)$$

where $num(PEs)_{vmk}$ is denoted as the count of processing elements in k^{th} VM, $MIPS(PEs)_{vmk}$ stands for the million instructions per second of all the processing elements of k^{th} VM, and BW_{vmk} represents the bandwidth of k^{th} VM.

Hence, the capacity of a server s_j in a datacentre d_i can be represented as in Eqn. (5):

$$Cap_{i,sj} = \sum_{k=1}^{p} Cap_{j,vmk} \quad (5)$$

On regular intervals, the proposed technique calculates the values of energy consumption and capacity of the servers of the data center for the VMP. This modified priority-based EPC algorithm efficiently manages VM placement by dynamically migrating VMs based on server load conditions. Underloaded servers go to sleep mode and place their VMs on a migration list, while overloaded servers also send the VMs requesting more resources to the migration list. Algorithm 1 ensures that VMs in the migration list, are reallocated to servers with balanced loads, optimizing resource utilization and maintaining overall system performance.

Algorithm – 2

Task Scheduling

Input: The set $\boldsymbol{R}$ of tasks $\boldsymbol{r_l}$ with size $\boldsymbol{q}$, the set $\boldsymbol{VM}$ of virtual machines $\boldsymbol{vm_k}$ with size $\boldsymbol{p}$, the upper threshold of VM capacity $\boldsymbol{Th_{UB}}$, and the lower threshold of VM capacity $\boldsymbol{Th_{LB}}$.

Output: Runtime task migration for task scheduling inside the data center to allocate the tasks to the appropriate Vms.

for $\boldsymbol{vm_{kin}}$ in $\boldsymbol{s_j}$ do if $\boldsymbol{Cap_{i,vmk}} < \boldsymbol{Th_{LB}}$ **then**

for $\boldsymbol{r_l}$ in $\boldsymbol{vm_k}$ do

Insert $\boldsymbol{r_l}$ to task_migration list in descending order of priority

end for

$\boldsymbol{vm_k}$ goes to ***sleep*** 0 mode

else if $\boldsymbol{Cap_{i,vmk}} > \boldsymbol{Th_{UB}}$ **then**

for $\boldsymbol{r_l}$ in $\boldsymbol{vm_k}$ do

if $\boldsymbol{r_l}$ is requesting for scaling up resources **then**

Insert $\boldsymbol{r_l}$ to task_migration list in descending order of priority

end if

end for

else

$k = k + 1$

end if

end for

for $\boldsymbol{r_l}$ to task_migration list **do**

for vm$_k$ in $\boldsymbol{s_j}$ **do**

if $\boldsymbol{Th_{LB}} \leq \mathbf{Cap}_{j,vmk} \leq \boldsymbol{Th_{UB}}$ then

Allocate $\boldsymbol{r_l}$ *to* $\boldsymbol{vm_k}$

else

$k = k + 1$

end if

end for

end for

The algorithm-2 describes the Task Scheduling of the virtual machine. This modified priority-based EPC algorithm efficiently manages task allocation by dynamically migrating tasks based on VM load conditions. Underloaded VMs go to sleep mode and place their tasks on a migration list, while overloaded VMs also send the tasks requesting more resources to the migration list to be reallocated to appropriate Vms.

IV. Performance Evaluation

CloudSim is a versatile simulation framework tailored for modeling and analyzing cloud computing systems. Its experimental setup allows researchers and developers to replicate real-world cloud environments, facilitating the evaluation of various algorithms and strategies. Users can define parameters such as data center characteristics, virtual machine configurations, and workload patterns to simulate diverse cloud scenarios. With CloudSim, experiments can explore resource allocation policies, scheduling algorithms, energy management strategies, and scalability assessments. Its modular and extensible architecture enables customization to specific research objectives, while its high-level abstractions simplify the modeling process. CloudSim serves as an invaluable platform for both academic and industrial purposes, providing a controlled environment for studying cloud computing phenomena and advancing the development of efficient cloud-based solutions.

Figure 1 shows the comparison of energy consumption with three existing algorithms, Sine Cosine Algorithms and Slap Swarm Algorithms (SCA-SSA), Genetic Algorithm and Tabu Search Algorithm (GATA) Order exchange and Migration and Ant Colony System (OEMACS). The EPC algorithm efficiently divides the entire search space and consumes less energy.

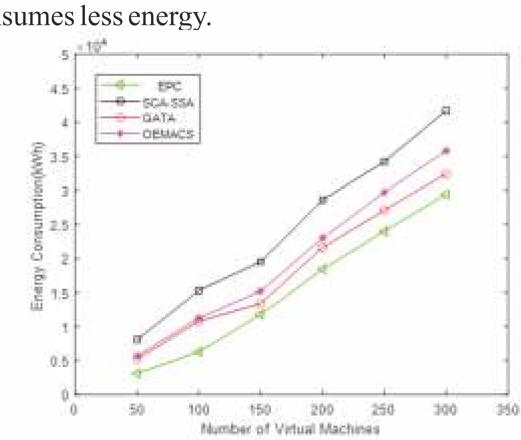

Fig 1. Comparison of Energy Consumption

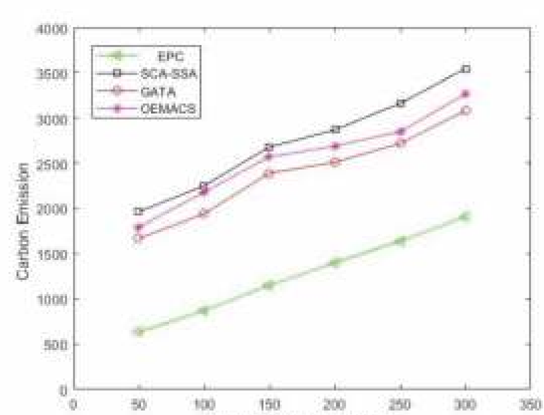

Fig 2: Comparison of Carbon Emission

Figure 2 exhibits the carbon emission in the case of the mentioned algorithms. It is found that EPC emits less carbon emission footprints as it consumes less energy and also utilizes renewable energy sources.

V. Conclusion and Future Scope

In this study, we delved into the application of the Emperor Penguin Colonial Algorithm (EPCA) within dynamic cloud environments to optimize virtual machine placement. Through rigorous experimentation and analysis, we have demonstrated the efficacy of EPCA in enhancing resource allocation and Quality of Service (QoS) parameters. Furthermore, we introduced a modified version of EPCA tailored specifically to address energy conservation concerns in dynamic cloud settings. Our research underscores the potential of EPCA and its adapted variant in tackling the intricacies of dynamic resource management in cloud computing. By harnessing the collective intelligence of penguin colonies, our approach exhibits promising outcomes in terms of energy efficiency, resource utilization, and QoS improvement.

Acknowledgment

We extend our heartfelt appreciation to Dr. Bivas Ranjan Parida, Silicon University, Odisha for his continuous support and invaluable assistance throughout this research. His guidance has been instrumental in the development of our model.

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Upasana Taku: A Visionary Entrepreneur Transforming Digital Payments

Upasana Taku, co-founder of MobiKwik, is a pioneering figure in India's rapidly growing digital payments sector. A native of Gujarat, her academic journey began with a Bachelor's degree in Industrial Engineering from the National Institute of Technology (NIT), Jalandhar. She then pursued a Master's degree in Management Science and Engineering from Stanford University, which equipped her with a global perspective and advanced skills in finance and technology.

Her professional career took shape at renowned organizations such as HSBC and PayPal. During her time at PayPal, she gained expertise in e-commerce systems, payment solutions, and financial services. These experiences deepened her understanding of the fintech industry and motivated her to return to India to create impactful change in the financial ecosystem.

In 2009, alongside Bipin Preet Singh, Upasana co-founded MobiKwik, which began as a mobile wallet designed to simplify digital transactions. Over the years, the company expanded its scope to become a fintech powerhouse, offering services such as payment gateways, credit disbursements, mutual funds, and insurance. The platform has played a vital role in bridging the gap between urban and rural users, making financial solutions more inclusive and accessible.

As an influential leader, Upasana has been at the forefront of MobiKwik's success. Her efforts have helped the platform gain the trust of over 120 million users and more than 3 million merchants. Her forward-thinking strategies and relentless dedication have earned her numerous accolades, including being named Fortune India's "Most Powerful Women in Business" and Forbes Asia's "25 Emerging Women Entrepreneurs".

Beyond her entrepreneurial success, Upasana is a staunch advocate for women's representation in business and technology. She has consistently spoken about breaking down gender barriers in male-dominated industries and has encouraged women to take up leadership positions in startups and tech enterprises.

Upasana Taku's remarkable journey exemplifies the power of vision, resilience, and innovation. From founding a startup to steering it into one of India's most prominent fintech companies, her story is a source of inspiration for aspiring entrepreneurs and innovators aiming to create meaningful change in their respective fields.

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Towards Socio-Political Choreographing: The Dialectics of Contemporary Indian Non-Fiction

Social and political commentaries are the acts of using rhetorical means to interpret social and political issues in a society. The evident purpose is to implement or promote socio-political transformation by informing the general populace about the existing problems and appealing to their sense of justice. Such commentaries can be produced through all forms of communication, e.g., fiction, non-fiction, polemic writing, music, discussions, propaganda, and so forth.

Although polemics is a representation of one aspect of reality, i.e., the problems in society, and the writer's reaction to them, reality may be either objectively presented by the polemicist or the representation is carefully choreographed by the writer. If events, actions, and people are misrepresented this way, then the text is likely to contain the author's hidden agenda. The writer may misrepresent reality to fulfill specific personal goals or he/she may be influenced by other agencies to do so.

This research examines selected works of three Indian writers who have written a prolific number of polemical texts. They are front-runners of contemporary Indian socio-political polemics. The writers selected for the research include a renowned Indian historian and columnist, a Booker Prize winner novelist and a political activist involved in human rights and environmental causes, and an Indian journalist, author, and politician famous for exposing several major scandals. Their writings deal with issues of power, dominance, inequality, and bias.

The research question analyzes contemporary, polemical non-fiction texts as socio-political commentaries to understand author motivations embedded in such texts and to establish if these are constructed to bring about positive transformations in society or if the texts have been carefully orchestrated to project author positions on the socio-political issues from their perspective.

Despite dealing with power issues directly, the texts chosen for this research have not been explored for the study of power and ideology. The tools of critical discourse analysis, which specifically study power and ideology in discourse, have been underused in relation to contemporary Indian polemical texts, rendering a pioneering status to this research.

This study analyses the discursive sources of power, dominance, inequality, and bias embedded in select non-fiction texts. It examines how the authors perceive and present power. Do they present unbiased views, or do their opinions exemplify bigotry? The research also explores other intentions embedded in the texts.

It is mainly a qualitative study that analyzes issues of power and ideology using the theories of Critical Discourse Analysis (CDA). It analyses relevant stretches of language from the select texts at three levels viz. the micro-, meso-, and macro-levels to gain an understanding of power relations, dominance, and ideology. The analysis uses linguistic tools such as syntax, vocabulary, rhetoric, implicature, foregrounding, suppression, quoting verbs, modals, metaphors, social actor representation, and other aspects of language use that create power relationships dominance, and similar socio-political orchestrations in interaction.

This research augments the scope of CDA application and enriches the comprehensive study of polemical texts. It testifies that language use should not be considered for the superficial layer of meaning.

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Ecosystems and the Economy

Climate change can worsen bark beetle outbreaks, which are killing trees and disrupting ecosystems in the various parts of the world. Ecosystems and their benefits are generally known as Ecosystem services which support key aspects of human existence. As a result, they are the foundation of large parts of the economy. Globally, ecosystem services are worth an estimated $125 to $145 trillion per year.

Climate change impacts affect the livelihoods of millions of people, including fishers, loggers, ranchers, and farmers. For example, the stress caused by rising water temperatures and ocean acidification could cost the shellfish industry hundreds of millions of dollars. Shifting ranges for certain fish mean that fishers may need to travel farther to catch them or purchase new equipment to reach those areas. These shifts are projected to result in losses of hundreds of millions of dollars each year by the year 2100.

Agriculture in the world will experience economic impacts with climate change. More frequent and severe heatwaves, droughts, and extreme rainfall events along with expanding pest ranges can disrupt agriculture in many ways. Overall, warming is expected to have negative effects on the yields of major crops, though crops in some individual locations may benefit from earlier springs and milder winter weather. Disruptions to agriculture and food supply chains can have economic impacts on farmers and farmworkers and affect the price of food.

Climate change also affects the tourism and recreation industries. Harmful algal blooms already cost nearly $1 billion each year from the loss of recreational fishing and boating revenue. Damage to coral reefs due to climate change is projected to result in $140 billion in total lost revenues to the recreation industry by 2100. The communities that depend on tourism will feel these economic impacts the most.

Source: https://www.epa.gov/climateimpacts/climate-change-impacts-ecosystems

Revealing the Dynamics of Electron Acceleration: A Multiscale Approach to Shock Waves

Introduction

Collisionless shock waves are among nature's most potent particle accelerators, found across diverse environments such as supernova remnants, interstellar and stellar domains, and planetary systems. Despite significant progress, understanding how charged particles achieve relativistic energy levels remains a critical challenge in astrophysics. This study, combining in situ satellite measurements and theoretical advances, introduces a reinforced shock acceleration model, offering new insights into the phenomenon of electron injection and acceleration.

Background: The Electron Injection Problem

Particle acceleration mechanisms, such as Shock Drift Acceleration (SDA) and Diffusive Shock Acceleration (DSA), have been extensively studied. While SDA is capable of energizing electrons to suprathermal levels, it cannot fully explain relativistic electron observations. DSA requires pre-energized particles, creating a critical electron injection threshold typically ranging from 10 to 100 keV. Resolving the electron injection problem—understanding how electrons achieve this threshold—is a central goal of modern plasma physics. Figure 1 [1] shows the detailed plot of the main electron acceleration event and wave analysis. The dynamics of collisionless shocks are influenced by the angle (θBn) between the shock normal and the magnetic field in the upstream plasma. Quasi-parallel shocks (θBn ≤ 45°) have been identified as more efficient accelerators compared to quasi-perpendicular shocks (θBn ≥ 45°), particularly in their ability to generate foreshock regions characterized by variable plasma and transient structures.

Methodology

Observational Data

The study utilizes data from two NASA missions [2] :

1. Magnetospheric Multiscale (MMS): This mission captured high-energy electron activity upstream of Earth's bow shock.
2. ARTEMIS: Focused on the lunar plasma environment, ARTEMIS provided complementary upstream measurements, particularly of seed electron populations.

A notable event on December 17, 2017, served as a

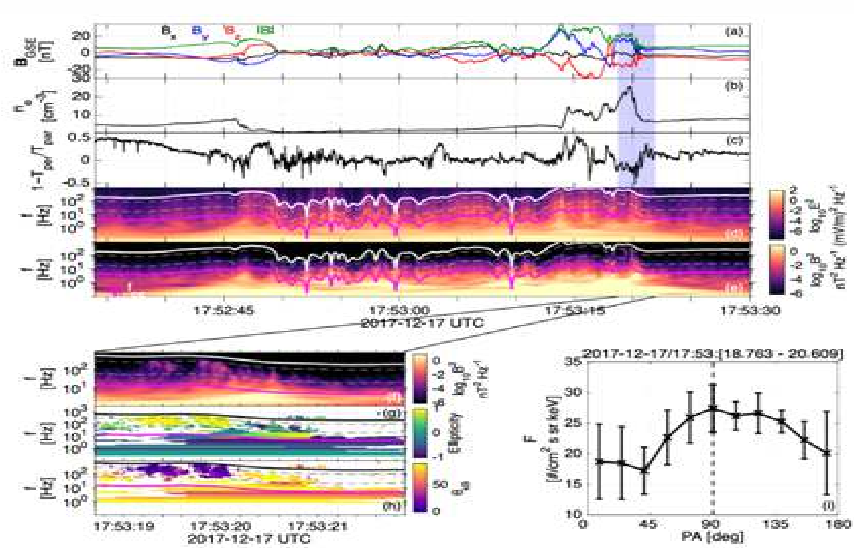
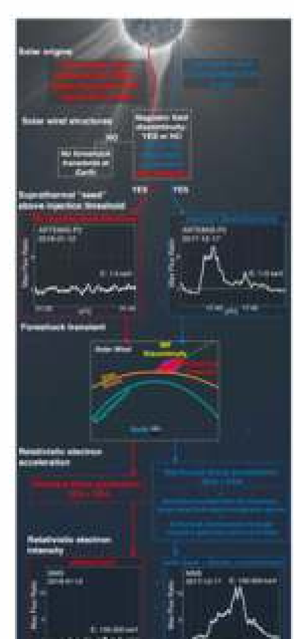


Fig. 1 Detailed plot of the main electron acceleration event and wave analysis



primary focus. MMS observed relativistic electrons exceeding 500 keV—unprecedented in such contexts—in the absence of major solar disturbances. ARTEMIS confirmed the presence of a seed population of suprathermal electrons associated with fast solar wind conditions.

Analytical Approach

Key techniques included:

- Measuring magnetic field variability and wave activity within foreshock transients.
- Analyzing pitch angle distributions to confirm wave-particle resonance mechanisms.
- Statistical evaluations of solar wind properties to link fast solar wind origins with enhanced electron acceleration.

Results

Multiscale Acceleration Processes

The study identified a multistep acceleration process operating across several scales:

1. Foreshock Transients: Discontinuities in the interplanetary magnetic field interacting with Earth's bow shock formed transient structures rich in wave activity.
2. Electromagnetic Waves: High-frequency, high-amplitude whistler-mode waves facilitated wave-particle interactions, enabling electrons to reach relativistic energies.
3. Confinement and Scattering: The geometry of the foreshock transient provided ideal conditions for electron confinement, enhancing repeated shock crossings and further energy gain.

Relativistic Electron Generation

The primary event analyzed showed suprathermal electron populations (1–5 keV) acting as seeds for relativistic acceleration. The observed acceleration efficiency was approximately 5%, with electrons reaching energies beyond 500 keV through a combination of SDA, DSA, and wave-particle interactions.

Discussion

Implications for Cosmic Ray Origins

The findings highlight quasi-parallel shocks as critical contributors to relativistic electron populations, potentially influencing the cosmic ray spectrum observed on Earth. The mechanism proposed could operate not only in Earth's magnetosphere but also in other planetary and astrophysical systems, including gas giants and young stellar environments.

Broader Applications

The model's generalization to other astrophysical contexts suggests that larger planetary systems and stronger magnetic fields could sustain electron energies up to the TeV range. For example, systems with ultrahot Jupiters may exhibit enhanced shock acceleration capabilities, warranting further investigation.

Conclusion

This study provides a unified framework for understanding electron acceleration at collisionless shocks, addressing the long-standing electron injection problem. By incorporating multiscale processes, the reinforced shock acceleration model advances our understanding of both heliophysical and astrophysical plasma environments, offering new directions for future research.

Future Work

Ongoing and future missions such as the Parker Solar Probe and Solar Orbiter, combined with global simulations, will be pivotal in validating and extending the findings. Cross-disciplinary collaborations between heliophysics and astrophysics are essential to explore the broader implications of shock acceleration mechanisms.

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Load Flow Analysis of Silicon University's Residential Building

Abstract *– Power flow analysis is a crucial process for managing and improving both current and future electrical systems. By understanding how power flows through a system, we can ensure its efficient and reliable operation. This analysis is essential for planning the expansion of systems and managing new connections, loads, or transmission lines. It helps us predict the effects of changes in the system, ensuring that it can handle new demands without issues. In this work, we are focusing on conducting a load flow analysis for the residential buildings within the institute. To achieve this, we will develop a detailed model of the electrical distribution system in these buildings. This model will take into account various factors such as connected appliances, lighting, and other electrical loads present in the buildings. By using advanced simulation tools, specifically MiPower application software, we will perform the load flow analysis.*

Keywords *– Power flow analysis, load flow analysis, electrical distribution system, simulation tools, single line diagram.*

I. Introduction

The cornerstone of modern electrical engineering lies in the efficient and reliable distribution of electrical power. Load flow analysis stands as a foundational pillar in power system analysis [1], offering invaluable insights into the steady-state behavior of electrical networks. This study explores the intricacies of load flow analysis [2] of Silicon University's residential building. In this introductory section, we delineate the significance of load flow analysis in power system engineering. We aim to unravel the complexities of electrical networks, deciphering the flow of power and voltage across transformers and distribution networks. Leveraging computational tools and methodologies, we conduct comprehensive load flow analyses, bridging theory with practice. Through numerical algorithms, simulation techniques, and software implementations, we elucidate the underlying principles governing load flow computations and their real-world implications. Our work transcends the theoretical realm by delving into practical applications and case studies, showcasing the relevance and efficacy of load flow analysis in diverse scenarios.

II. Case Study

Before conducting the load flow analysis of Silicon University's residential building, it's crucial to comprehend the entire power system and its distribution within the university. This entails understanding various essential data points, such as the loads within the hostel buildings, An 11 kV voltage as shown in fig. 1 is stepped down to 440 V using a 500 KVA transformer located near Silicon Hill. Subsequently, this stepped-down power is supplied to the main LT panel, from where it is distributed to different hostel buildings across the university. Six different building loads are supplied from a three-phase bus bar. These include Boys Hostel 1 (BH1), Boys Hostel 2 (BH2), Girls Hostel (GH), Boys Hostel

Fig 1. 11KV Transformer

1AC (BH 1AC), Boys Hostel 2AC (BH 2AC), and Girls Hostel AC (GH AC). Each hostel building has individual supplies for its air conditioner floor and non-air conditioner floors. Additionally, individual capacitor banks and diesel generators are connected to each hostel to provide backup power in case of a line outage. The conductor was used for transportation of power from the LT panel to different hostels and various other parts of the university. The conductor used are 3.5C*120mm sqr type conductor. A 3.5-core conductor typically refers to a cable or wire with three insulated conductors for power transmission distribution, along with an additional core for grounding or neutral purposes.

III. Collection of Data

In order to perform the load flow analysis different loads consumed by each of the buildings need to be measured and the data need to be interpreted to the MiPower software database for performing the appropriate operation. In summary, a 3.5-core 120 sq. mm conductor is a cable with three insulated conductors, each having a cross-sectional area of 120 square millimeters, and an additional core, possibly for grounding or neutral purposes. This type of conductor is commonly used in electrical power systems for various applications, including underground and overhead power transmission and distribution.

IV. Designing Single Line Diagram

Figure 2 shows a single-line diagram (SLD), also known as a one-line diagram, and is a simplified graphical representation of an electrical system or network. It depicts the electrical components and their interconnections using standardized symbols and lines, typically arranged in a single line format. Single-line diagrams are widely used in the electrical engineering field for design, analysis, planning, and documentation purposes.

Manual Sketching: Historically, engineers and

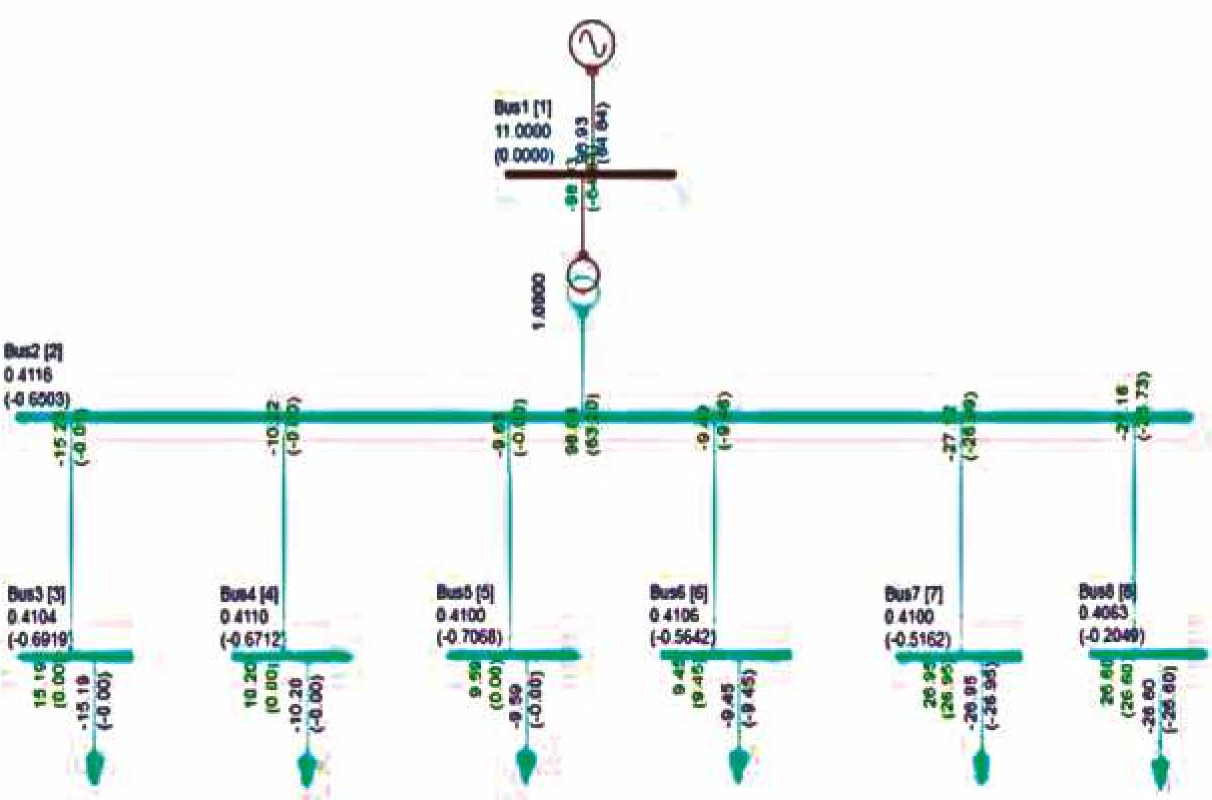

Fig. 2 Single line diagram

designers would create single-line diagrams manually using drafting tools. This method involves drawing symbols for components such as transformers, generators, circuit breakers, switches, and loads, and then connecting them with lines representing conductors. While this method is traditional, it can be time-consuming and prone to errors.

Mi Power software: MiPower is a power system analysis [3, 4] software developed by Power Analytics Corporation.

V. Database of the Components

All the components of the single line diagram are configured with their specifications and characteristics stored in the simulation folder's database. Information on transformers, loads, transmission lines, and bus bars is available within the software interface [5]. Accessing this database within MiPower software typically requires access to the software itself or its documentation. Users can find details about various components like energy meters, sensors, controllers, and actuators compatible with MiPower. If you're a MiPower user, you can access this information through the software interface or its documentation. Alternatively, contacting MiPower directly can provide assistance in accessing or obtaining information about the component database. However, without direct access to MiPower's internal databases [6] or documentation, specific details about the components within the software cannot be provided. Figure 3 and Figure 4 show the two winding transformer and generator data.

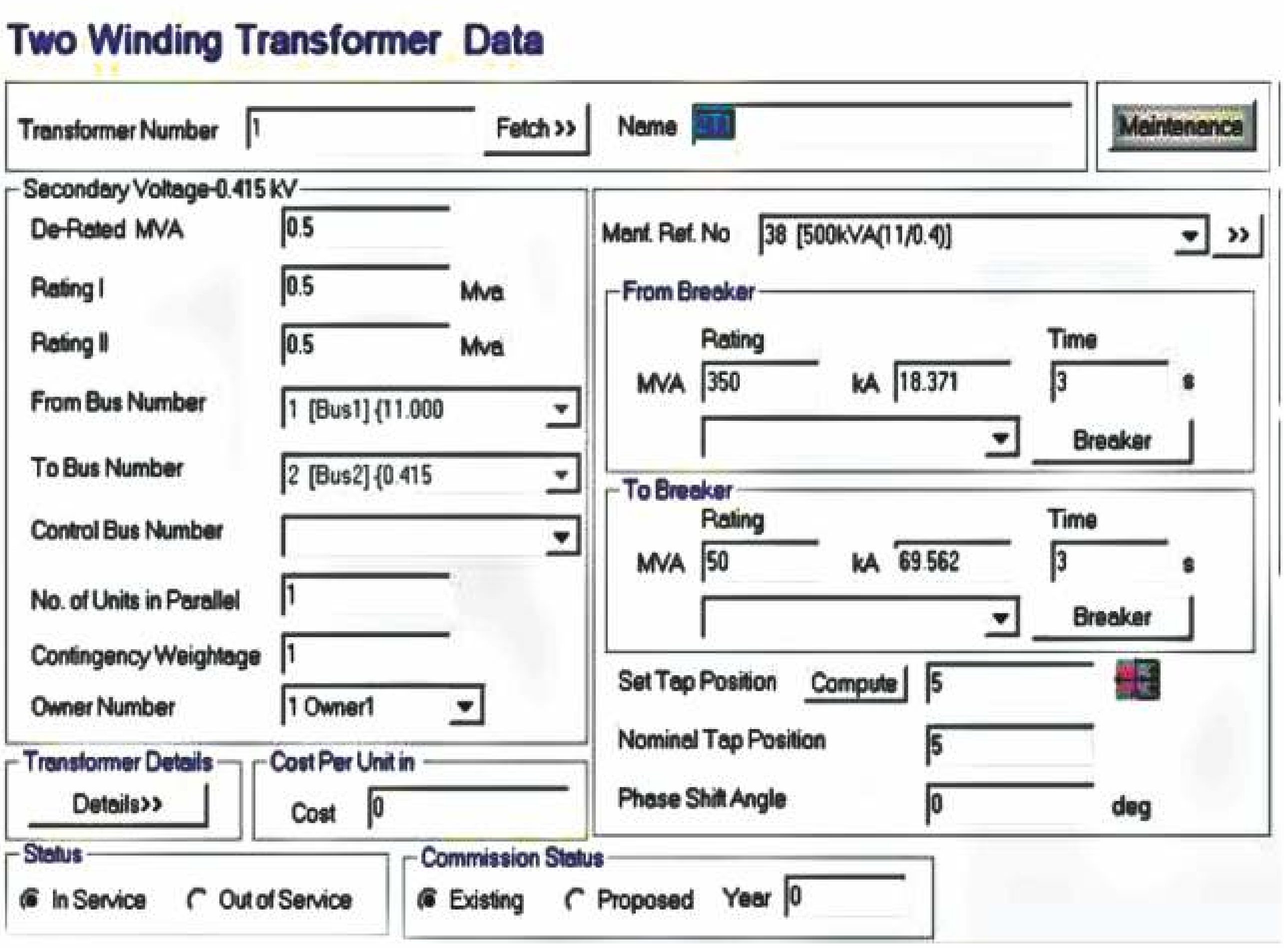

Fig. 3 Two winding Transformer data

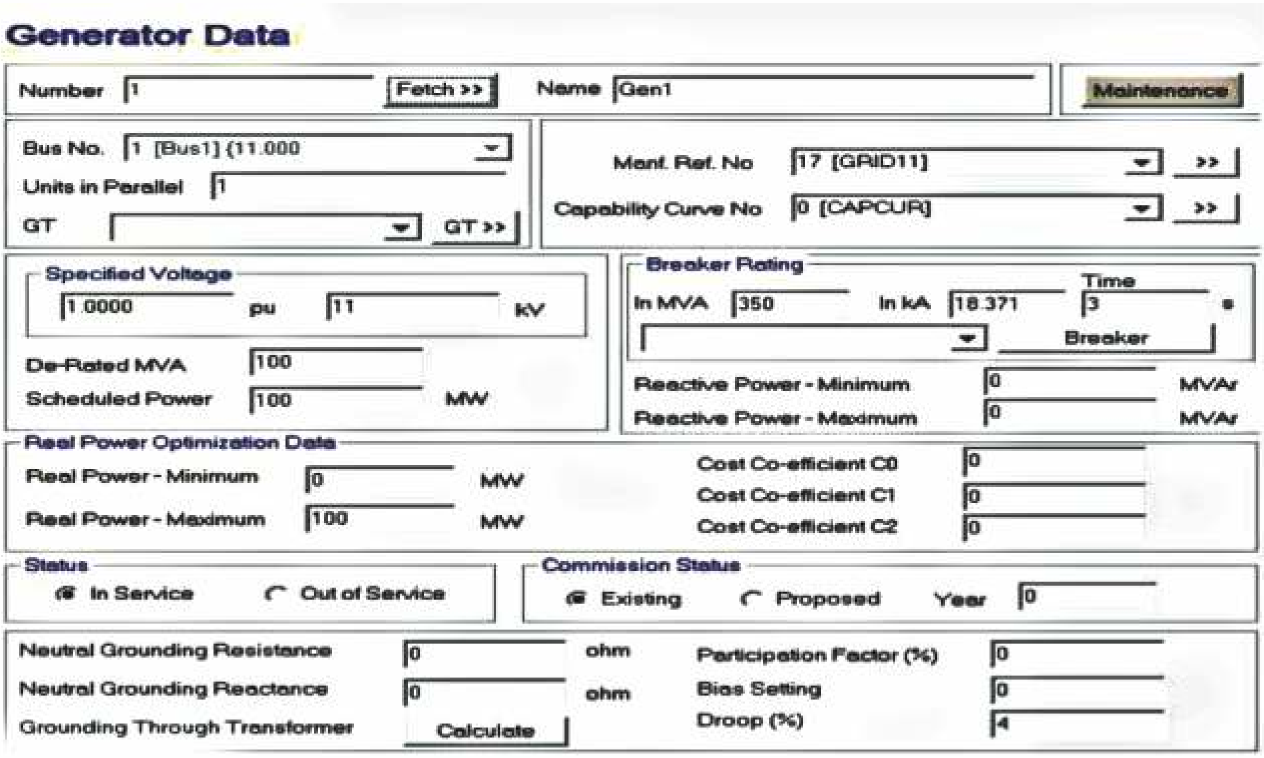

Fig. 4 Generator Data

VI. Result report of Case – 1 (9 AM)

The different data at different locations and different locations are as follows. For case 1 Table 1 shows the bus data, Table 2 shows the transmission line data, Table 3 shows the load data, Table 4 shows the bus voltages and power, Table 5 shows the summary result for case1.For case 2 Table 6 shows the bus data, Table 7 shows the transmission line data, Table 8 shows the load data, Table 9 shows the bus voltages and power, Table 10 shows the summary result for case1.

BUS NO.	AREA	ZONE	BUS kV	VMIN (p.u.)	VMAX (p.u.)	NAME
1	1	1	11.000	0.950	1.050	Bus1
2	1	1	0.415	0.950	1.050	Bus2
3	1	1	0.415	0.950	1.050	Bus3
4	1	1	0.415	0.950	1.050	Bus4
5	1	1	0.415	0.950	1.050	Bus5
6	1	1	0.415	0.950	1.050	Bus6
7	1	1	0.415	0.950	0.050	Bus7
8	1	1	0.415	0.950	0.050	Bus8

Table 2: TRANSMISSION LINE DATA

STA	CKT NODE	FROM NODE	FROM NAME*	TO NODE	TO NAME*	LINE PARAMETER R(p.u.)	X(p.u.)	B/2(p.u.)	MVA	RATING KMS
3	1	2	Bus2	3	Bus3	18.87070	4.67992	0.00000	1	0.10
3	1	2	Bus2	4	Bus4	14.15300	3.50994	0.00000	1	0.07
3	1	2	Bus2	5	Bus5	40.57190	10.06180	0.00000	1	0.22
3	1	2	Bus2	6	Bus6	20.75770	5.14792	0.00000	1	0.11
3	1	2	Bus2	7	Bus7	11.32240	2.80795	0.00000	1	0.06
3	1	2	Bus2	8	Bus8	37.74130	9.35985	0.00000	1	0.20

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Table 3: LOAD DATA

Sl.No. *	FROM NODE	FROM NAME*	REAL MW	REACTIVE MVAr	COMP MVAr	COMPENSATING MVAR MIN	MAX	STEP	VALUE NO.	CHAR F/V NO.
1	3	Bus3	0.015	0.000	0.000	0.000	0.000	0.000	0	0
2	4	Bus4	0.010	0.000	0.000	0.000	0.000	0.000	0	0
3	5	Bus5	0.010	0.000	0.000	0.000	0.000	0.000	0	0
4	6	Bus6	0.009	0.000	0.000	0.000	0.000	0.000	0	0
5	7	Bus7	0.027	0.000	0.000	0.000	0.000	0.000	0	0
6	8	Bus8	0.027	0.000	0.000	0.000	0.000	0.000	0	0

Table 4: BUS VOLTAGES AND POWERS

NODE NO.	FROM NAME	V-MAG p.u.	ANGLE DEGREE	MW GEN	MVAr GEN	MW LOAD	MVAr LOAD	MVAr COMP
1	Bus1	1.00000	0.000	0.099	0.001	0.000	0.000	0.000
2	Bus2	0.9993	-0.66	0.000	0.000	0.000	0.000	0.000
3	Bus3	0.9965	-0.70	0.000	0.000	0.015	0.000	0.000
4	Bus4	0.9979	-0.68	0.000	0.000	0.010	0.000	0.000
5	Bus5	0.9954	-0.72	0.000	0.000	0.010	0.000	0.000
6	Bus6	0.9974	-0.69	0.000	0.000	0.009	0.000	0.000
7	Bus7	0.9963	-0.71	0.000	0.000	0.027	0.000	0.000
8	Bus8	0.9892	-0.81	0.000	0.000	0.027	0.000	0.000

Table 5: Summary result for case 1

Parameter	Value
Total real power generation	0.099MW
Total reactive power generation	0.001 MVAr
Generation p.f	1.0
Total real power load	0.098MW
load p.f	1.00
Total real power loss	0.000528 MW
Percentage real loss	0.536
Total reactive power loss	0.001239 MVAr

V. Result report of Case – 2 (1 PM)

Table 6: BUS DATA

BUS NO.	AREA	ZONE	BUS kV	VMIN (p.u.)	VMAX (p.u.)	NAME
1	1	1	11.000	0.950	1.050	Bus1
2	1	1	0.415	0.950	1.050	Bus2
3	1	1	0.415	0.950	1.050	Bus3
4	1	1	0.415	0.950	1.050	Bus4
5	1	1	0.415	0.950	1.050	Bus5
6	1	1	0.415	0.950	1.050	Bus6
7	1	1	0.415	0.950	1.050	Bus7
8	1	1	0.415	0.950	1.050	Bus8

Table 7: LINE DATA

STA	CKT	FROM NODE	FROM NAME*	TO NODE	TO NAME*	LINE PARAMETER R (p.u.)	X(p.u.)	B/2(p.u.)	RATING MVA	KMS
3	1	2	Bus2	3	Bus3	18.87070	4.67992	0.00000	1	0.10
3	1	2	Bus2	4	Bus4	14.15300	3.50994	0.00000	1	0.07
3	1	2	Bus2	5	Bus5	40.57190	10.06180	0.00000	1	0.22
3	1	2	Bus2	6	Bus6	20.75770	5.14792	0.00000	1	0.11
3	1	2	Bus2	7	Bus7	11.32240	2.80795	0.00000	1	0.06
3	1	2	Bus2	8	Bus8	37.74130	9.35985	0.00000	1	0.20

Table 8: LOAD DATA

Sl.No. *	FROM NODE	FROM NAME*	REAL MW	REACTIVE MVAr	COMP MVAr	COMPENSATING MVAR MIN	MAX	STEP	VALUE NO.	CHAR F/V NO.
1	3	Bus3	0.014	0.000	0.000	0.000	0.000	0.000	0	0
2	4	Bus4	0.011	0.000	0.000	0.000	0.000	0.000	0	0
3	5	Bus5	0.010	0.000	0.000	0.000	0.000	0.000	0	0
4	6	Bus6	0.012	0.000	0.000	0.000	0.000	0.000	0	0
5	7	Bus7	0.024	0.000	0.000	0.000	0.000	0.000	0	0
6	8	Bus8	0.029	0.000	0.000	0.000	0.000	0.000	0	0

Table 9: BUS VOLTAGES AND POWERS

NODE NO.	FROM NAME	V-MAG p.u.	ANGLE DEGREE	MW GEN	MVAr GEN	MW LOAD	MVAr LOAD	MVAr COMP
1	Bus1	1.0000	0.00	0.101	0.001	0.000	0.000	0.000
2	Bus2	0.9993	-0.68	0.000	0.000	0.000	0.000	0.000
3	Bus3	0.9967	-0.72	0.000	0.000	0.014	0.000	0.000
4	Bus4	0.9978	-0.70	0.000	0.000	0.011	0.000	0.000
5	Bus5	0.9952	-0.74	0.000	0.000	0.010	0.000	0.000
6	Bus6	0.9968	-0.71	0.000	0.000	0.012	0.000	0.000
7	Bus7	0.9965	-0.72	0.000	0.000	0.024	0.000	0.000
8	Bus8	0.9883	-0.84	0.000	0.000	0.029	0.000	0.000

Table 10: Summary result for case 2

Parameter	Value
Total real power generation	0.101MW
Total reactive power generation	0.001 MVAr
Generation p.f	1.0
Total real power load	0.098MW
load p.f	1.00
Total real power loss	0.000574 MW
Percentage real loss	0.569
Total reactive power loss	0.001303 MVAr

VI. Conclusion

In conclusion, the process of analyzing Silicon University's power system using MiPower software involves several key steps. These include creating a detailed network model encompassing generators, transformers, loads, and transmission lines. Additionally, inputting accurate initial conditions reflecting the system's actual operating state is crucial. Selection of an appropriate load flow algorithm, convergence settings, and execution of the load flow analysis are essential for obtaining reliable results. Once the analysis converges, reviewing and interpreting the results helps identify areas for improvement and optimization. Scenario analysis allows for assessing the system's response to various changes, while documentation and reporting ensure that findings and recommendations are effectively communicated. Overall, this comprehensive approach enables a thorough understanding of the power system's behavior and facilitates informed decision-making for enhancing its performance and reliability.

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Rolling The Dice - A Gambler's Woes Led to the Formulation of the Laws of Probability

Mid-17th Century France was a time of social upheaval, and the height of monarchy; 'commoners' wanted to mingle with the upper echelons of society. One such individual was Antoine Gombaud, who assumed the noble title of Chevalier de Mere. He was a Salon Theorist, who believed that answers to insightful problems were best attained by discussions among intelligent and educated people, in Salons.

Unfortunately, he was also a compulsive gambler. Chevalier de Mere's predicament involved two games of dice. In the first one, de Mere made a bet with even odds (the payout amount is the same as the bet) on getting at least one six on four rolls of a fair die. He reasoned correctly that the chance of getting a six in one roll of a die is 1/6. He then incorrectly deduced that in four rolls of a die, the chance of getting one six would be 4/6. Despite his flawed reasoning, he made a significant amount of money over the years with this bet.

Buoyed with the success of the first game, he came up with a second game, betting on getting at least one double six on 24 rolls of a pair of dice. He reasoned correctly that the chance of getting a double six in one roll of a pair of dice is 1/36. However, his faulty analysis led him to believe that in 24 rolls of a pair of dice, the chance of getting one double six would be 24/36 or 2/3.

In the second game, he lost a lot of money. He went back to the Salon, seeking help from a famous mathematician of that time, Blaise Pascal, to come up with a solution. Pascal solicited the opinion of his friend Pierre de Fermat, another renowned scientist. In a series of letters between Pascal and Fermat, de Mere's problem was finally solved and the foundations of the laws of probability were laid from this joint effort.

(Content excerpted from Wikipedia and "One gambling problem that launched modern probability theory", by Dan Ma)

PS: Any idea why he lost money in the second game, but not in the first game?

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