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Advanced Footstep Power Generation System Using RFID for Charging

Mrs.Lokeshwari H S[1], Mr Shubas S R[2], Rachana K N[3], Poorvika R[4], Sanju G P[5]
Electronics and Communication Engineering, Visvesvaraya Technological University

Abstract: Along with the nation's growing population, there is a growing need for power in many different ways. Therefore, the main way to meet future demands is to reorganize this energy so that it can be utilized again.

Power is produced by human footsteps in this project for the generation of footstep power, so as well as to store the electricity produced by piezo sensors to charge the battery. utilizing an RFID card, mobile phones are charged utilizing the battery's stored power. The ESP32 microcontroller powers this project, which also have an LCD, RFID sensor, USB cable, and Arduino IDE. The system switches to registration mode when the power is turned on. Three people can sign up. The system prompts users to connect the charger and swipe their cards after they have all logged in. The user is initially charged for five minutes by default. As soon as the card is swiped and When the user gives permission, the system starts charging the phone within a predetermined window of time.

I. INTRODUCTION

Concerns about climate change, environmental deterioration, and the depletion of traditional energy sources have led to a major increase in the demand for sustainable and renewable energy solutions in recent years. Using human movement to generate power, especially with footstep power generation systems, is a potential development in renewable energy. These devices seek to capture the mechanical force produced during running or walking and transform it into electrical energy that can be used. By doing this, footstep power generation provides a renewable energy source that doesn't require fuel, emits no emissions, or require any outside infrastructure to produce electricity. Footstep power generation is a promising technique, but it is frequently limited by how the energy is stored and used. This is when radio frequency technology come in handy. RFID identification can be very important. RFID, a wireless communication technology, is already in use in a number of industries, such as retail, healthcare, and logistics. It transfers data via electromagnetic fields. RFID technology's low power consumption and capacity to store and transfer data without physical contact make it very desirable. An easy way to charge electronic gadgets is to combine RFID technology with footstep power generation systems. Combining two cutting-edge technologies—RFID and footstep power generation—can result in a novel energy harvesting system that effectively charges gadgets with just basic human movement, opening up a more independent and sustainable energy source for a range of uses.

II. LITERATURE REVIEW

Understanding current research, fostering creativity, and establishing a solid project foundation are all facilitated by a literature review.Nilesh Sawant et al. (2023) concentrated on using piezoelectric materials to optimize ceramic tiles for improved energy generation.To increase efficiency, their study focused on tile characteristics including density and fracture strength.Perfect for transportation hubs, public areas, and smart buildings.

The use of RFID and piezoelectric transducers was suggested by Shreya Yadav and Sakshi Dahotre (2023).Following RFID authentication, gadgets were charged using footstep energy.Offered a user-specific and environmentally friendly charging option.To improve energy harvesting, Sahithi Reddy et al. (2022) presented the VCHSHI approach.It is more precise than earlier methods and operates without the need for external power.

III. PROBLEM STATEMENT

constraints of current systems by increasing durability, boosting energy efficiency, and incorporating intelligent features for useful applications in public areas, smart cities, and wearable technology. The suggested cutting-edge RFID-enabled footstep power generation system for an important advancement in intelligent and sustainable energy solutions is charging. This design delivers enhanced usability, durability, and efficiency by resolving the shortcomings of current systems, opening the door for wider implementation in contemporary smart surroundings.

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This Footstep power generating project uses piezo sensors to store the electricity produced by human footsteps, which is then used to charge a battery. utilizing an RFID card, mobile phones are charged utilizing the battery's stored power.

IV. EXISTING SYSTEM

Different systems with varying degrees of complexity have been created to capture the energy from human footsteps. One prominent example is the Pavegen system, which is situated in the UK and employs piezoelectric tiles to transform footstep energy into electricity for low-power applications and illumination in public areas like stadiums and airports. Piezoelectric systems and RFID technology have been used in academic research to allow for tailored charging through user authentication. Energy is stored in batteries and allocated to particular users. RFID is also used in emerging technologies for energy delivery, such as triboelectric nanogenerators (TENGs). For effective charging, hybrid RFID-piezoelectric systems improve user authentication and energy harvesting. Furthermore, piezoelectric energy-powered RFID-based access control has been investigated, indicating the possibility of environmentally benign, user-conscious energy solutions.

V. PROPOSED SYSTEM

The suggested solution creates a sophisticated footstep power generation and wireless charging system by combining RFID technology with piezoelectric sensors. Piezoelectric sensors use footsteps' mechanical energy to produce electrical power, which is stored in capacitors or batteries. When an RFID-enabled device is within range, RFID technology transfers energy via electromagnetic waves, allowing wireless charging of electronics. A microcontroller controls the system's communication, energy transfer, and storage. This technology can be applied to power wearables, sensors, and IoT devices in smart cities, smart buildings, and public transit. Despite being low-maintenance and sustainable, RFID charging's efficiency and restricted power generation present difficulties, particularly for high-power devices. Future improvements might incorporate smart grid integration and hybrid energy sources.

VI. PROJECT OBJECTIVES

The system should encourage the use of renewable energy in daily life by effectively charging a variety of portable electronic gadgets. To reduce its negative effects on the environment, it must put sustainability first by utilizing eco-friendly products and procedures. Feedback mechanisms can be used to engage users by informing them of their energy contributions and possibly providing incentives or rewards for doing so. The system should effectively use technologies such as piezoelectric, electromagnetic, or triboelectric systems to transform converting human footfall' mechanical energy into electrical energy. It lessens environmental damage and dependency on fossil fuels by supplying renewable energy. RFID technology also make it possible for low-energy devices, including wearables and IoTsensors, to be charged wirelessly and seamlessly, which improves user experience and promotes environmentally responsible energy solutions.

VII. METHODOLOGY

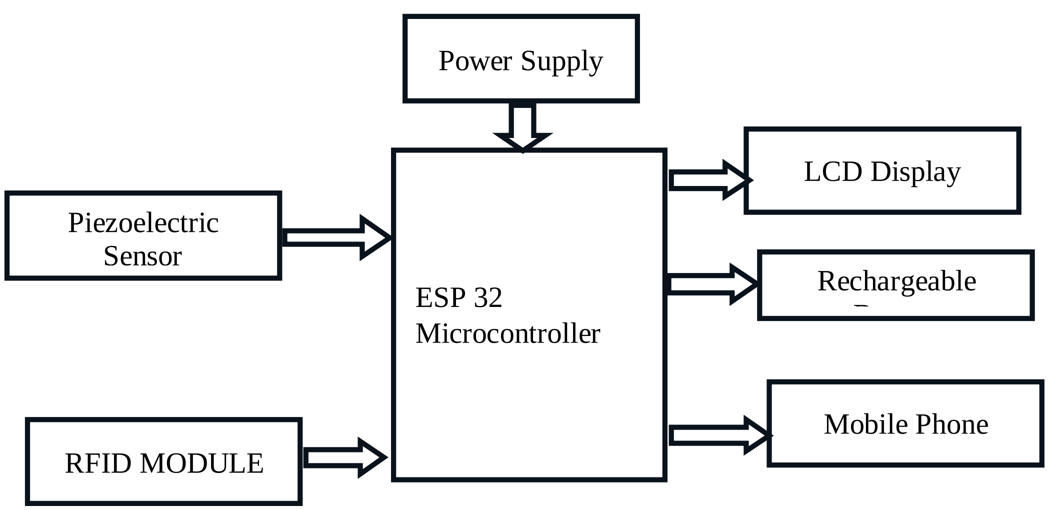

Figure1:Block Diagram

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Piezoelectric sensors are used in the planned Advanced Footstep Power Generation System to transform the mechanical energy of footsteps into electrical energy. When pressure is exerted, the floor's piezoelectric sensors produce voltage, which is subsequently rectified using a bridge rectifier to change the AC signal into DC. To guarantee a constant output, this energy is controlled by a voltage regulation circuit and stored in a supercapacitor or rechargeable battery. The microcontroller regulates the energy flow, shows the voltage on an LCD panel, and keeps an eye on the stored energy. When a mobile device is within range, the system's embedded RFID reader can wirelessly transmit the stored energy to the device for charging.

The circuits for rectification and regulation are connected after the parallel connection of the piezoelectric sensors, and the battery is connected for storage. The microcontroller controls the process, while an LCD panel shows the voltage. When the gadget is within range of the RFID reader, it can charge thanks to wireless energy transfer made possible by the technology. All of the project's components, including the energy storage, wireless charging by RFID, and footstep energy generation, must be carefully assembled on a board for testing. After the system is put together, it may be tested by generating energy with foot pressure, storing it in the battery, and confirming that the mobile device is charging. Low-power this system's applications include IoT sensors and smart building systems.

VIII. IMPLEMENTATIONS

The Advanced Footstep Power Generation System converts the energy from footsteps from AC to DC using a bridge rectifier and piezoelectric sensors. A rechargeable battery stores this energy, which is controlled by a voltage regulator (LM7805) to maintain a constant 5V. The voltage is tracked by an Arduino/ESP32 microcontroller and shown on an LCD panel. Furthermore, an RFID reader is included in for wireless charging; the system uses electromagnetic waves to transfer stored energy when an RFID-enabled item is close by. The microcontroller that regulates charging and voltage display, a battery for storage, and piezoelectric sensors coupled to a rectifier make up the overall system. The technology is tested by applying pressure to generate electricity, storing it, and verifying wireless charging of mobile devices through RFID communication.

IX. OUTPUT

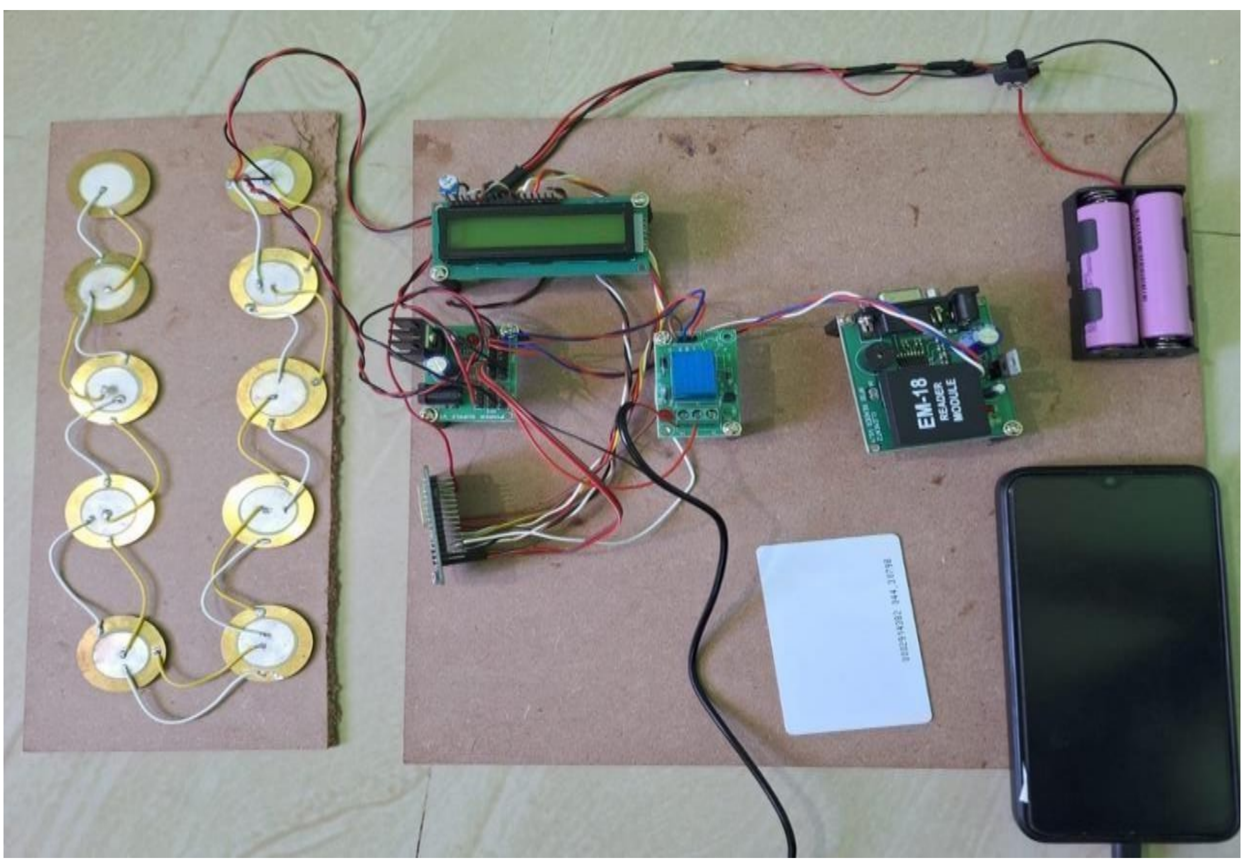

Figure 2:ImplementationofAdvancedFootstepPowerGenerationSystemusingRFIDfor Charging

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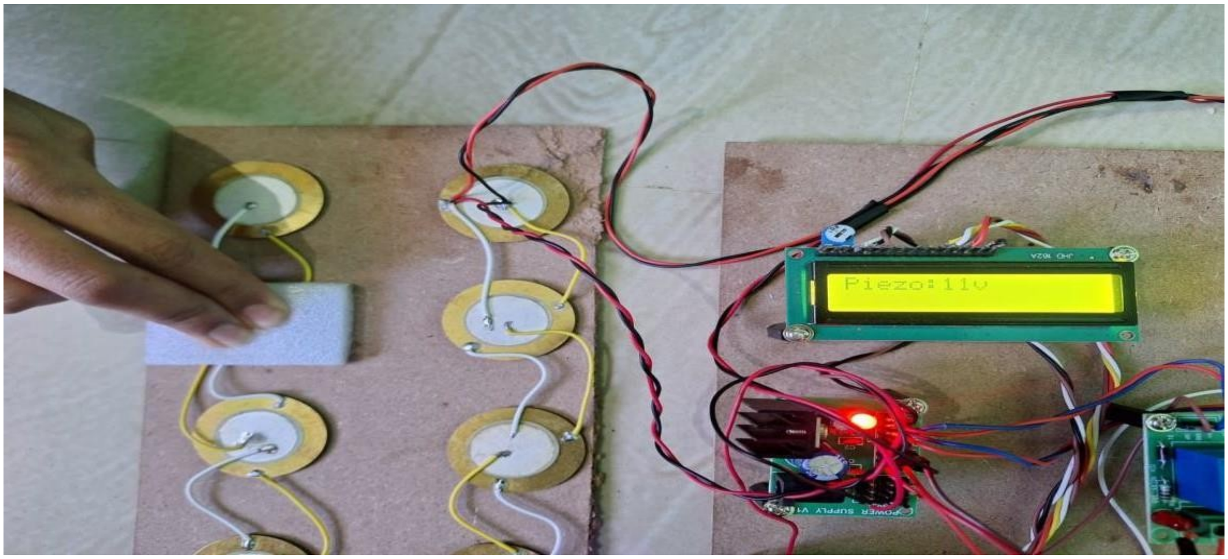

Figure 3:Electric charge generation

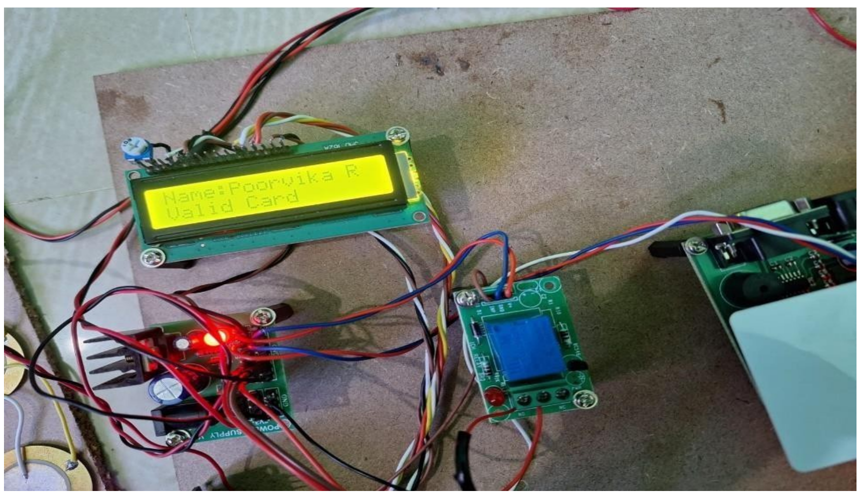

Figure 4:Validuserswipesthecard

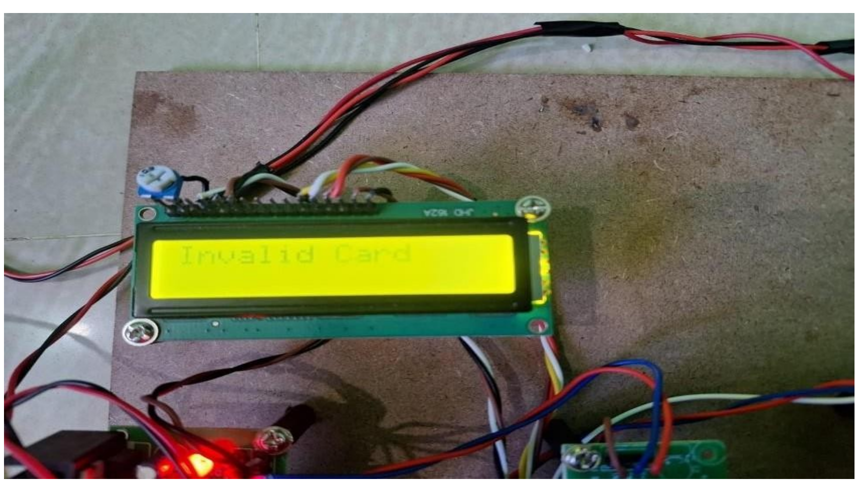

Figure 5:Invaliduserswipesthecard

X. RESULTS AND DISCUSSIONS

A effectively illustrates the chance of using human footsteps to generate energy. The electrical chargeis stored in a rechargeable battery and controlled to a steady voltage for usage, was effectively transformed into mechanical energy by the piezoelectric sensors. Real-time battery voltage was shown on the LCD, providing clear energy storage monitoring. The technology wirelessly delivered the stored energy to a mobile device that was within range of an RFID-enabled device, therefore charging the device. Although the efficiency varied depends onfrequency and intensity of footsteps, testing revealed that the quantity of the electricity generated was adequate for low-power applications like charging mobile phones. Although the technology has a lot of potential for sustainable energy collecting in busy places, larger devices or continuous charging would require an increase in capacity.

XI. CONCLUSION

Especially for remote locations with little to no access to electricity, this proposal provides a sensible, conservative solution to energy needs. India's enormous population makes energy management essential to its development. This technique drastically reduces energy use while limiting environmental impact by using of piezoelectric sensor to create both alternating current (AC) and direct current (DC) power. In areas with a high population density, this technique guarantees effective power generation without adding to pollution. Only 11% of energy currently originates from renewable sources, but this project might greatly raise that number, solving both regional energy issues and environmental issues on a worldwide scale. We can significantly improve the environment and energy sustainability by putting this concept into practice.

XII. FUTUREWORK

Optimising the applications of wasted energy is necessary for sustainable development in densely populated countries. One promising remedy is to install piezoelectric tiles beneath staircases to collect footsteps and store the energy in rechargeable batteries for later use, like charging phones on buses. These sensors can also be placed in high-foot traffic areas, such as airports, train stations, sports stadiums, and large public gatherings, to capture the energy from the vibrations caused by people walking. Another great opportunity for piezoelectric energy generation is sidewalks in densely populated countries, such as China and India, where the constant movement of people on crowded sidewalks can generate significant vibrations that can be converted into power to power various electronic devices, making efficient use of the energy.

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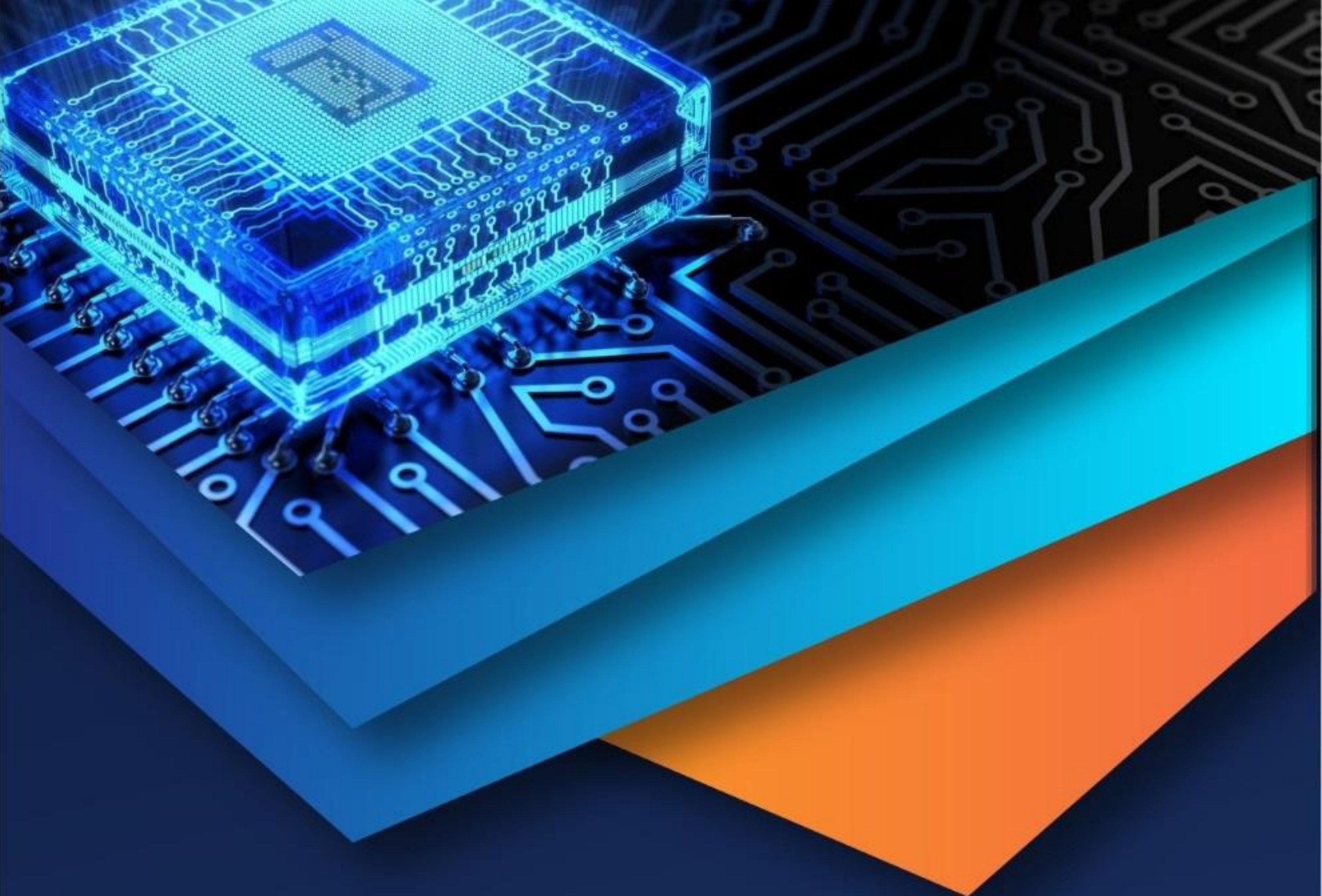

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