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# Foot Step Power Generation using Piezoelectric Sensor

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***Abstract:*** ***Since the dawn of time, humans have required and utilized increasing amounts of electricity for survival and well-being. As a result, many electrical resources have been depleted and wasted. The concept of harnessing waste electricity generated by human movement, particularly through foot energy, is especially relevant and important in densely populated countries like India, where train stations, temples, and other public spaces are continuously crowded. When piezoelectric flooring is used, ground sensors detect the pressure exerted by footsteps and convert it into electrical energy. This energy is then stored and used as a power source through piezo transducers. This energy can be applied in various areas such as agriculture, household applications, public lighting, and charging vehicle sensors. This study focuses on how humans walk and generate energy through their footsteps. Consider how much energy is wasted as people walk. The idea is to convert this mechanical energy into electrical energy. The goal of an energy-generating floor is to convert kinetic energy into electric power. With the current energy crisis being one of the world's most urgent problems, this research aims to find a solution. For instance, if a floor can produce 100 watts from just 12 steps, then with 100 such floors installed, it would be possible to generate 1 megawatt of power. Achieving this would be a significant accomplishment.***

***Keywords: piezo; kinetic energy; energy***

## I. INTRODUCTION

There are many different ways to produce energy, and one of them—footstep electricity technology—may be an environmentally friendly way to do it. The most common type of human activity is walking. A person loses electricity to the street floor in the form of effect, vibration, and sound because his weight is transferred to the floor by foot falls throughout each step. It is possible to capture this energy and transform it into something useful, such as electricity. This tool can change the foot impact if it is positioned inside the path, electricity into electricity driven by electricity. Since the dawn of mankind, human-powered mobility has encompassed walking, running, and swimming. However, the modern period has made it possible for technology to exploit human strength more effectively. Since the 19th century, pedal electricity has been a super source of electricity that makes use of the body's strongest muscles. Ninety percent of the pedalling effort is transformed into electrical power. Pedal electricity is an affordable, accessible source of electricity that may be utilized for a variety of purposes. On the other hand, human kinetic electricity may be used in a variety of ways, including electrical technology through a variety of applications. Businesses are already doing this.

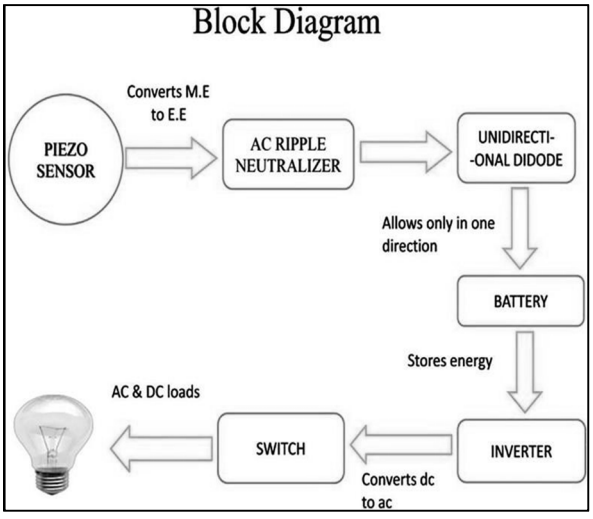



Fig 1: Block Diagram of Foot Step of Power Generation

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*1)* Our paper's essential running premise is primarily based totally on a piezoelectric sensor.
*2)* We adjust the timber plates above and beneath the sensors and adjustable springs to do this.
*3)* Footstep-primarily based totally non-traditional electricity converts mechanical electricity to electric electricity.
*4)* Stepping board, it is made of sixteen piezoelectric sensors which might be stressed in series.
*5)* When strain is implemented to the sensors, mechanical electricity is transformed to electric electricity.
*6)* This electric electricity may be saved in a 12-volt rechargeable battery.
*7)* Inverter.
*8)* We're additionally the use of a conventional battery charging unit to energy the circuits.
*9)* This inverter converts 12 volts DC to 230 volts AC. The voltage is 230 Volts A.C.

The idea of utilizing waste strength from human motion is particularly pertinent and important in densely populated global locations such as China and India, where hundreds of thousands of people walk around every hour on highways, bus stops, educational institutions, temples, and first-rate public areas. Crowd strength farms might be very useful strength resources in densely populated nations if all of this wasted human and bioenergy can be used. For those who are idle and want to improve their health while earning money, strolling around a "Crowd Farm" might be enjoyable. The energy from these farms may be utilized throughout the surrounding region.

## II. FOOT STRENGTH WASTE STRENGTH IS HIRED AT THE ELEMENT OF HUMAN MOBILITY

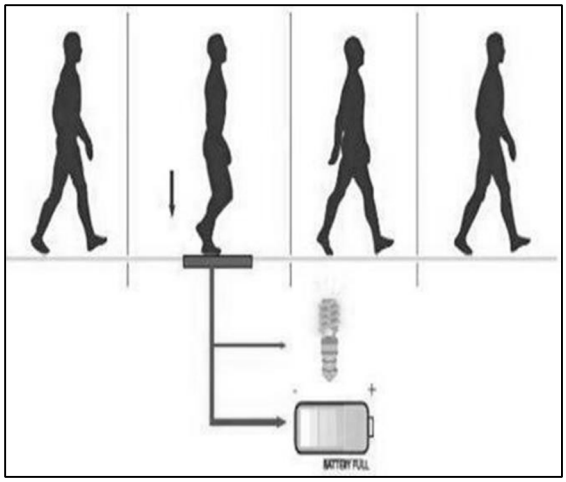


Fig 2: Schematic Representation

A power garage device might be used to store the power produced by the footstep generator. The generator's output is connected to a 12 V lead acid battery via an ac-dc converter bridge. The battery quickly ran out of power. Power is conserved in the battery as soon as the FSEC is activated by applying foot pressure. A 100 W, 230V lightbulb is connected to the batteries via an inverter. The setup is verified in Figure 4.

Table 1: Confirms the lights time, bulb for big form of footfall and associated power saved.

| NO. of foot steps | Duration of lighting 100watt 230 Volt bulb (s) | Total energy (J) | Energy / step(J) |
|---|---|---|---|
| 250 | 6 | 600 | 2.4 |
| 500 | 12 | 1200 | 2.4 |
| 750 | 18 | 1800 | 2.4 |
| 1000 | 25 | 2500 | 2.5 |

The anxiousness of the piezoelectric material is turning into electric energy. Anxiety can be caused by the weight of cars passing through it or by people walking across it. The output of a piezoelectric material fluctuates. A bridge circuit is used to convert this fluctuating voltage to a linear value. To get rid of any larger output variations, an AC ripple smooth out is used as unexpectedly as possible. The output voltage is then noted and kept in a rechargeable battery.

A collection of piezo films is investigated since the energy production of an unmarried piezo film is inadequate. Each collection connection and parallel was found in relation to the test. The voltage output from the parallel connection did not significantly rise. More piezo movies were generated from the collection.

## III. MAXIMUM THEORETICAL VOLTAGE GENERATED

A charge is created when a piezo fabric is under stress. Because of this, it is significantly less expensive to believe it is an amazing capacitor. It is therefore equivalent to any capacitor formula. Three piezo are connected in a collection on a single tile in this project. In parallel, ten such collection connections are associated collectively. Consequently, three linked piezoelectric discs have the same capacitance.

$1/ Ceq = 1/ C1 + 1/ C2 + 1/ C3$

We Know, $Q = C * V$

So, $C = Qv$

Finally, $Veq = V1 + V2 + V3$

As a result, the sum of the individual voltages generated across each piezoelectric disc equals the net voltage generated in a series connection. The piezo disc's output voltage is 13 volts.

Thus, $Veq = V1+V2+V3 = 13 +13+13= 39$ V

Thus, the maximum voltage that can be generated across the piezo tile is around 39V.

## IV. ANALYSIS DONE ON THE PIEZOTILE

To take a look at the Piezo tile's voltage producing capacity, humans weighing forty to seventy-five kg have been forced to stroll on it. Figure eight depicts the connection among a person's weight and the quantity of energy developed. Maximum voltage is created even if most weight/pressure is applied, as proven withinside the graph. Even with a weight of seventy-five kg on it, the tile generates a most voltage of 40V throughout. Figure eight: Piezo tile weight vs. energy graph

## V. POWER GENERATION PIE CHART

A sensor is a tool that detects a bodily quantity and converts it right into a sign which could be tested the usage of an observer or instrument. The useful aid of mercury is used to remodel temperature into liquid increase and contraction, which can be decided the usage of a calibrated glass tube. A thermocouple is a tool that transforms temperature right into a voltmeter-readable output voltage. Most sensors are calibrated in opposition to mentioned requirements for accuracy. SENSOR

The emergence of piezoelectric generation is because of a number of inherent benefits. Many piezoelectric substances have an excessive modulus of elasticity that opposition that of many metals, carrying out 10e6 N/m2. Despite the fact that piezoelectric sensors are electromechanical systems that respond to compression, the sensing elements display almost no deflection. This is why piezoelectric sensors are so long lasting and feature this kind of excessive herbal frequency.

With incredible linearity over the whole amplitude variety Furthermore, piezoelectric generation is evidence in opposition to electromagnetic fields and radiation, permitting measurements to be taken in tough settings. Some of the substances employed (in particular gallium phosphate and tourmaline) are thermally robust, permitting sensors to characteristic at temperatures as excessive as one thousand stages Celsius. In addition to the piezoelectric effect, tourmaline has piezoelectricity, or the capacity to generate an electrical sign as the temperature of the crystal changes. That may be a not unusual place incidence in piezoceramic substances.

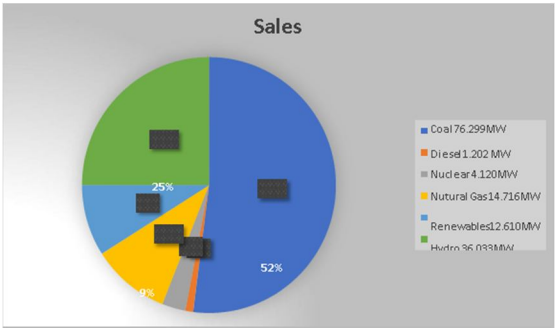



Fig 3: Pie Chart of Piezoelectric Sensor

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A device that uses the piezoelectric impact to transform pressure, acceleration, or fear into an electrical signal is called a piezoelectric sensor. Piezoelectric sensors have shown themselves to be useful size tools in a wide range of applications. They are used in many different industries for significant assurance, process control, and research and development. The piezoelectric impact gained notoriety for commercial business sensing in the 1950s. The popularity of this sizing strategy has increased since then. As of right now, it appears to be a developed technology with genuine intrinsic dependability. It has been used as a pressure sensor in mobile phone touchpads, nuclear, aviation, and medical applications.

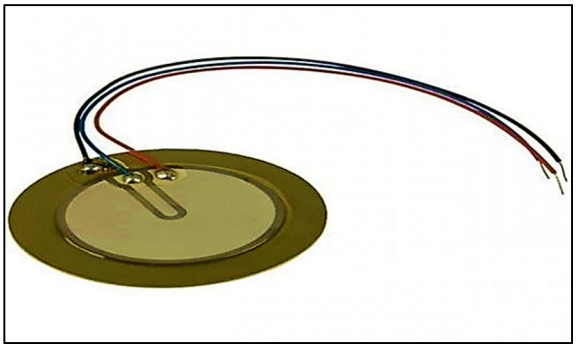


Fig 4: Piezoelectric Sensor

## VI. BATTERY

In my perspective, a battery (energy) is a hard and fast electrochemical cell that can store energy in an unmarried device. In an electrical battery, one or more electrochemical cells work together to transform chemical energy into electrical power. Batteries can be refilled and used for years in standby energy systems, or they can be used quickly and then discarded. While large batteries provide backup power for laptop data centers and mobile phone exchanges, little batteries power wristwatches and other devices.
Lead-acid batteries are the most well-known in photovoltaic systems since they have a lower starting cost and can be found almost anywhere in the world. The fact that lead-acid batteries are deep cycle batteries is their most important characteristic. Lead-acid batteries come in two varieties: sealed, which doesn't require maintenance, and wet-cell, which requires. Lead-acid batteries are long-lasting, reliable, and reasonably priced, due to the fact that lead acid batteries' capacity to store energy is highly dependable, stand as tons as shock, vibration, overcharge, and overdischarge. Our batteries are non-perishable and leak-proof since we employ cutting-edge work sealing techniques. The batteries' large electrolyte capacity, slow self-discharge, and moderate rate acceptance make them ideal for low-maintenance systems. Lithium- ion batteries are they CAD(Computer Aided Design) -designed and tested?. These batteries had been showed to perform in hostile situations and are applied in inverter and UPS structures. The batteries have electrolyte capability, Separators, and are housed in robust packing containers that prevent leaks and corrosion.

## VII. RECTIFIER

Because we use cutting-edge sealing procedures, our batteries are leak-proof and non- perishable. The batteries' immoderate rate acceptance, huge electrolyte volume, and occasional self-discharge purpose them to best for applications that require little maintenance. Lithium-ion batteries Are they CAD-designed and examined? (CAD) stands for Computer Aided Design. These batteries had been examined to perform in adverse situations and are applied in inverter and UPS systems. The batteries have electrolyte capacity, PE Separators, and are housed in robust boxes that prevent leaks and corrosion. D1 and D3 behaviour at some stage in the fantastic 1/2 of the enter ac voltage cycle, whilst D2 and D4 continue to be OFF. Because the engaging in diodes are linked to the weight resistance, the weight cutting-edge will glide throughout RL. During the terrible 1/2 cycle of the enter ac voltage, diodes D2 and D4 behaviour whilst D1 and D3 are switched off. The show Because RL is coupled to diodes D2 and D4, cutting-edge will tour the identical course as withinside the first a part of the cycle. A bidirectional wave will become a unidirectional wave due to this transformation.

## VIII. UNIDIRECTIONAL CURRENT CONTROLLER INVERTER

This circuit best permits present day to go along with the waft in a single direction, because of the reality the choice suggests. Some gadgets that paintings with unidirectional present day are indexed below.

*1)* Diodes
*2)* Thyristors

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In this venture, we're going to rent a diode as a unidirectional current control device. As all of us know, the maximum now not unusual place feature of a diode is to permit an electric powered contemporary to journey in best one way (the diode's ahead direction). While preventing the go along with the waft of power withinside the alternative direction (the opposite direction). The diode can therefore be concept of as an electrical take a look at valve. The diode used on this venture is D-IN4007. A non-save you amount is transformed right proper right into a discrete temporal virtual example through way of method of an analog-to-virtual converter (abbreviated ADC, A/D, or A to D). An ADC also can offer a remoted measurement. A virtual-to-analog converter reverses the process (DAC). A virtual integer proportional to the significance of an analogue voltage or contemporary is transformed right proper right into a virtual integer the usage of an ADC. ADCs can, however, embody non-digital or partly digital additives like rotary encoders.

## IX. INVERTER

An inverter converts direct cutting-edge (DC) to alternating cutting-edge (AC) the utilization of appropriate transformers, switching, and manage circuits (AC). The converted AC might also additionally have any voltage and frequency you choose.
From small switching energy assets in pc structures to large electric powered utility high-voltage transmission lines, solid-state inverters are applied in a considerable type of applications. Applications that use direct cutting-edge to transport large portions of energy. To convert DC energy from solar panels or batteries into AC energy, inverters are commonly utilised. During Inverters are categorized into groups. The output of a changed sine wave inverter is equal to that of a rectangular wave inverter, besides that it in short is going to zero volts in enhance than switching first-class or negative. It's easy to apply and cheap, and it virtually works with nearly all electric powered devices, apart from touchy or specialized device like laser printers. A natural sine wave inverter produces an almost perfect sine wave output this is almost equal to grid power (with plenty an awful lot much less than 3% fashionable harmonic distortion). As a result, it's far nicely relevant with any AC-powered digital device. This form of inverter is carried out in grid-tie inverters. Its form is extra sophisticated, and it costs five to ten instances extra regular with unit of power. The electric powered system,

### *A. Advantages*

*1)* It simplest takes some steps to generate electricity. There isn't any want for fuel. This isn't always your common setup.
*2)* Because there aren't any shifting parts, the product has an extended carrier life. Because it's miles self- generating, no outside electricity is necessary. Although little, it's miles noticeably sensitive.
*3)* Dependable, affordable, and inexperienced non- renewable strength intake is decreased. Running or running out on the step generates strength. The generated strength is saved in a battery. With almost little noise, the dynamic variety is extraordinarily wide.

### *B. Disadvantages*

*1)* Only legitimate in that precise place.
*2)* This approach has an excessive preliminary investment. The manufacturing is affected. through the temperature. This approach has a excessive preliminary investment.

### *C. Applications*

*1)* Footstep-generated strength may be used for agricultural, domestic, and streetlighting purposes.
*2)* In the occasion of a strength outage, footstep strength manufacturing may be utilised. Metros, rural applications, and so forth
*3)* It may be utilised in each alternating present day and direct present day applications. It's extensively utilized at faculties and universities.

It may be utilized in times in which there's a strength outage, inclusive of hospitals

## X. CONCLUSION

The challenge "power generation using foot step" has been very well investigated and carried out, and it's far through a way the maximum cost- effective, powerful, and approachable energy choice to be had to the overall population.
This may be used for numerous responsibilities in rural regions wherein strength is scarce or non-existent. Strength manipulates is a main assignment in India due to the fact it's far a rapidly developing USA. with a huge population.

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This challenge may be used to pressure each A.C and D.C. loads primarily based totally at the stress we understand at the piezoelectric sensor A 40V piezo tile has been produced. When evaluating the residences of several piezoelectric materials, PZT is the clean winner.

Furthermore, a series-parallel combination connection become determined to be extra suited. The weight carried out to the tile and the following voltage are examined, and it's far determined that they have got a linear connection. It's nice utilized in busy regions. This may be used to illuminate roadways without the want for lengthy strength cords. Alongside the sidewalk, it is able to additionally be used as charging stations and lighting fixtures.

Renewable electricity debts for best 11% of our overall energy. If this mission is carried out, we can be capable of now no longer best remedy the electricity crisis, however additionally make contributions to global warming.

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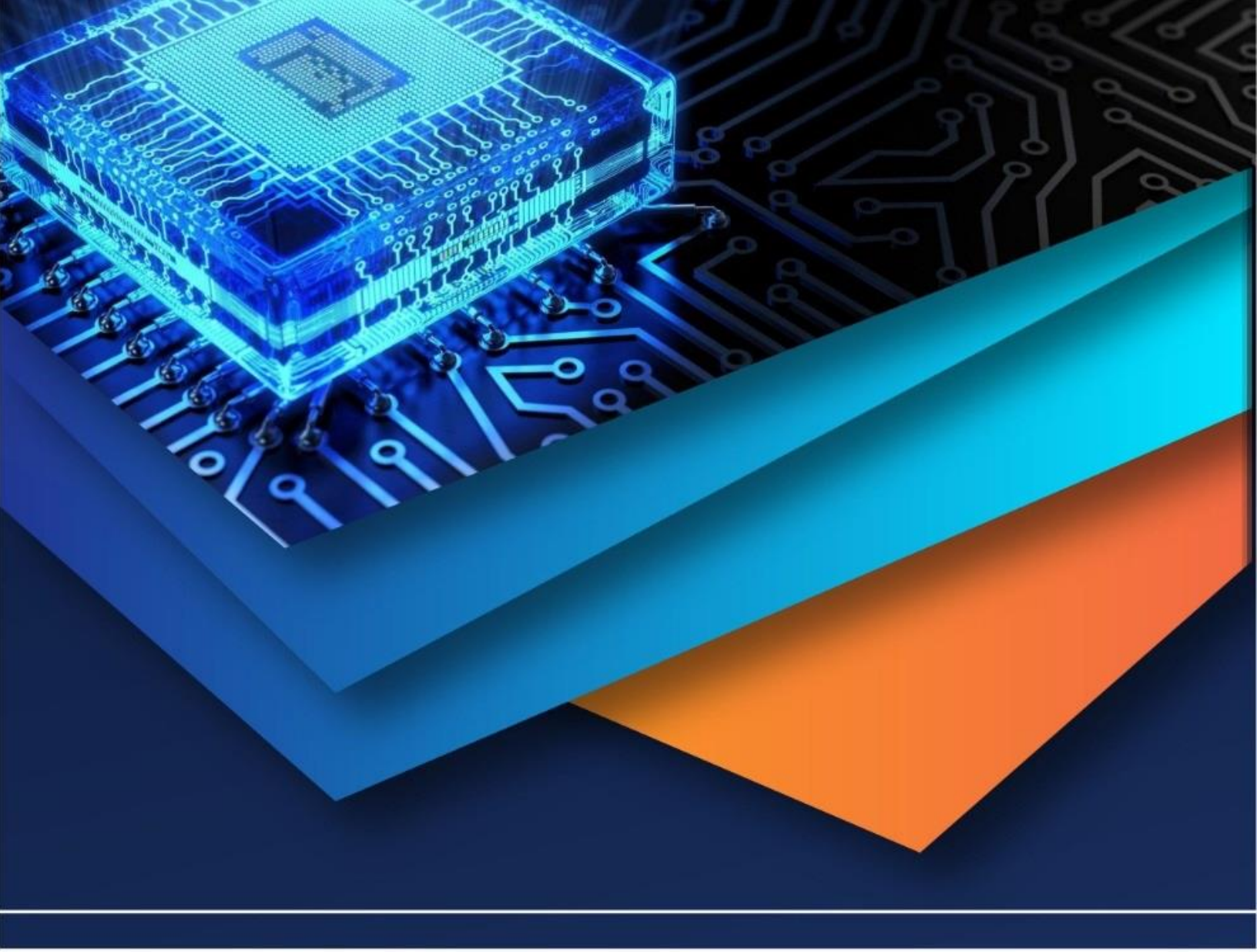
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