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# Development of Solar Smart Waste Management System Using IOT

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***Abstract:*** ***In the current situation, we frequently observe that the trash cans or dust cans that are located in public spaces in cities are overflowing due to an increase in the amount of waste produced each day. We propose to construct a "Smart Waste Management System utilising IoT" to prevent this because it leads to unclean conditions for people and produces a terrible stench in the surrounding area, which spreads some deadly diseases & human illness. In the proposed system, there are numerous trash cans scattered throughout the city or campus. Each trash can has a low-cost embedded device that tracks the level of the trash cans, and each one will also have a unique ID that makes it simple to determine which trash can is full. The device will broadcast the level and the supplied unique ID when the level hits the threshold limit. The concerned authorities can view these facts online from their location and take fast action to clean the trash cans.***
***Keywords: waste management , solar energy , IOT technology , smart dust bin etc.***

## I. INTRODUCTION

Rapid population development in recent years has increased the amount of rubbish that needs to be disposed of. So, it's essential to have a good waste management system to stop the spread of some fatal diseases. Monitoring the condition of the smart bins and making decisions based on that information. Municipal entities then collect up this rubbish and put it in landfills and disposal sites. Yet, some rubbish is not collected owing to a lack of resources or inadequate groundwork, posing a major health risk to the neighbourhood. Cleaning at the appropriate intervals could solve this issue. But, manually monitoring the status of the bin is a very challenging task. In the city or on the campus, there are several trash cans. In our system, the smart trash cans are connected to the internet so that we can access real-time data on them. These trash cans are connected to an ultrasonic sensor-equipped arduino uno controller system. The same signals are encoded and sent to the application where the ultrasonic sensor monitors the level of dust in the trash can and sends signals to the Arduino controller, where they are received. The database, which displays the state of the trash in the trash can on the application of an authorised person mobile, has received, analysed, and processed the data. The relevant authority receives notice that the trash can is full and notifies the person in charge of collecting waste from the specific regions. Garbage is removed from the completely filled dustbin by garbage trucks, who then dispose of it.

The idea of automation as it relates to cleanliness and hygiene and waste management systems. In all developing nations, it is normal practise to dump trash on the ground and in public spaces, which has a negative impact on the environment and leads to various unsanitary problems. In order to address these issues The idea of a "smart dustbin" combines hardware and software technologies, i.e., attaching a Wi-Fi system to a standard trash can, to allow users to access the internet for free for a set amount of time. The technology rewards the user for maintaining a clean environment, which helps to ensure effective waste management in a community. The suggested system will operate on a client-server architecture, ensuring a clean environment, good health, and a society free from pollution.

## II. PROBLEM IDENTIFICATION

The management of the waste that is produced daily is a major issue that practically all cities face. Currently, corporation cars are required to empty the bin on a daily basis along a predetermined path. Occasionally, the bin will be overflowing with waste, which attracts dogs and cattle. These animals will cause the garbage to pour into the road.

Due to overfilled bins, individuals won't approach trash cans to dispose of their waste; as a result, total automation is required so that concerned parties can remotely monitor the trash cans and alert the collection vehicle to empty them when they are full, saving fuel and preventing waste spills.

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Fig.1. Overflow Garbage create pollution

System flaws: The following are the primary issues with the current approach for collecting and managing solid waste:

*1)* Increased processing complexities;
*2)* Several controlling units connected to one another;
*3)* A higher cost of implementation.

## III. OBJECTIVE

*1)* The goal is to comprehend the advantages and disadvantages so that advancements and innovations may be made to effectively and efficiently manage garbage and to preserve a healthy atmosphere in our communities.
*2)* To make the solid waste collection and management system for smart cities more useful.
*3)* Smart trash can deployment based on actual needs.
*4)* To cut costs and optimise resources.
*5)* To boost the quality of the environment.
*6)* To create the embedded smart trash can that is fueled by solar energy.

## IV. LITERATURE SURVEY

Adil Bashir, Shoaib Amin Banday, Ab.Rouf Khan and Mohammad Shafi [1] , “Concept, Design and Implementation of Automatic Waste Management System", In this study, the authors present a Smart Trash System that incorporates a Smart Trash Bin, an electrical device made up of a Radio Frequency (RF) transmitter, a Load sensor, and an IR proximity sensor. To collect, monitor, and manage waste, you need an automated GSM module, load sensor, microcontroller, DC motor, LCD, web camera, and power supply. The implementation of this initiative aids in preventing rubbish overflow from the container in a residential neighbourhood, which was previously either manually filled or assisted by a loader in conventional vehicles. Due to the highly contaminated trash, it lowers the productivity of the vehicles and people used, limiting the risk to the sanitation workers' health.

Chowdhury and M. U. Chowdhury [2], "RFID-based real-time smart waste management system," This study considers "pay as you throw" weight-based charging for residential collection, which may encourage residents to limit their garbage, according to certain smart trash research. The load sensor is employed.

Fachmin F olianto, Y ong Sheng Low and Wai Leong Yeow [3], "Smartbin: Smart Waste Management System", In this study, a system is described that uses an ultrasonic sensor to gather data and a wireless mesh network to transmit that data. Duty cycle technology is also used by the system to minimise power usage and extend operational time. The Smart bin system was put to the test outside. We gathered data through the testbed and used sense-making techniques to learn about trash bin consumption and daily seasonality. Litter bin suppliers and cleaning companies can make better decisions to boost production with the help of this information.

Dr. K. R. Nataraj and Meghana K. C [4], "IOT Based Intelligent Bin for Smart Cities", The suggested strategy focuses on solving the problem of uncleanliness that is harming our environment before reducing it. Two sensors—IR and gas sensors—make up the smart garbage. Toxic gases will be detected by the gas sensor and the IR sensor put inside the trash to measure the level of trash. Alarm sounds when garbage is full.

S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale [5], "IoT Based Smart Garbage and Waste Collection Bin", The concept of a smart garbage can is not new; it has been around for a while, since since the Internet of Things started to influence our daily lives. This is a unique design for a smart trash can that includes a weight sensor, IR sensor, and Wi-Fi module for data transmission. As the rubbish level reaches its peak, this method ensures that dustbins will be cleaned as quickly as possible. A record is forwarded to the higher authority, who can take necessary action against the relevant contractor, if the trash can is not cleaned within a certain period

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of time. This lowers the total number of trips made by the waste collection vehicle and, as a result, lowers the overall cost of rubbish collection.

Gaikwad Prajakta, Jadhav Kalyani, Machale Snehal [6], "Smart Garbage Collection System in Residential Area", Automatic garbage collection and data gathering system built on both a GSM module and image processing. The fundamental idea is that a camera and a load cell sensor at the bottom of each trash can will be positioned at garbage collection points. The trash can will be continuously captured by the camera. The output of the camera and the load sensor are compared at a threshold level. With the aid of a microcontroller, the comparison is carried out. The amount of trash in the can is estimated after image analysis, and the weight of the trash is determined by the load cell sensor. As a result, data is processed to determine whether or not the threshold level has been exceeded.

Vishesh Kumar Kurre [7], "Smart Garbage Collection Bin Overflows Indicator using IOT", Under the trash can in this, there is an infrared sensor/proximity sensor. A mail notification (such an email, tweet, or WhatsApp message) will be sent to the appropriate Municipal / Government authority person when the sensor signal hits the threshold value. We may also view the dustbin's density online on a dashboard. Because it has a GUI (Graphical User Interface), any authenticated individual can quickly and simply assess the dustbin's current state. The collection vehicle can then be sent to pick up the full trash cans or dustbins.

Jeslin Anna Jacob et. al.[8], IoT based smart waste management system, In order to collect waste and monitor its level inside the bin, this article introduces smart waste management using IoT-based waste bins. Two ultrasonic sensors are used in the system, which is controlled by a Node MCU. The level of waste in the bin is detected by one ultrasonic sensor, and the person approaching the bin to dispose of waste is detected by another. This detection aids in the lid's automatic opening and closing. The lid is coupled to a servo motor, which facilitates shutting and opening of the lid. This device will notify the relevant authorities of the amount of rubbish in the trash can. The Blynk app is used to store and keep track of the IoT data. The suggested system is dependable, economical, and The proposed system is reliable, cost effective and can be easily implemented.

Kumar et al. [9] In their research, they developed a structure for an IoT-based incredible waste clean association where sensor systems are used to continuously monitor the waste component of the garbage canisters. In this methodology, the framework accordingly warns the embracing individual by means of GSM/GPRS methods when the trash estimation over the dustbins is identified. The GSM/GPRS system and the sensor are interfaced by the microcontroller used in this construction. Also, an Android application is used to screen and combine the crucial information pertaining to the distinct component of garbage discovered in various zones. With this framework, a different client effectively has the option to select the structure rather than just the manager. Yet, anyone may create a record, and the system also grants unauthorised users access. Setting two holders to autonomously gather dry and wet waste will improve this structure. For this circumstance, the wet waste can also be planned and used for the production of biogas, making it more effective by making it unimportant and financially wise.

Abdullah et al. [10] constructed a sharp reject monitoring system that is used in the continuous assessment of deny level and alerts the appropriate expert by SMS messaging. The framework is desired to monitor the waste holder and provide messages as alerts when it is thought to be full or fully full to aid in its timely evacuation of the compartment. The goal of the structure is to increase the dependability of the executives' ability to handle strong waste. The warning of the storehouses' status, in any case, avoids the area of the holder or its orientation, making it difficult to locate and gather the waste canisters quickly.

Prajakta et al. [11] A garbage storing up framework that is modified to have data gathering structure based on the arrangement of photographs taken and GSM module has been proposed. The system uses a camera that is placed at each location where trash is gathered close to a stack cell sensor organised at the base of the waste holder to achieve this point of confinement. In this instance, the camera will continuously scan the reject holder while the stack cell sensor weighs the reject holder to determine if it is full or not. Moreover, a level edge is set, which is used to divide the weight sensor and camera results. When the edge is really used, the controller sends a message to the appropriate master using GSM module techniques. It makes sense to send the trash archive entire vehicle to collect the denial with a robot tool. The catch is that the camera captures photographs despite ignoring the fact that its goal of constraint is determined to only take into account the most recent to select group. The usage of the camera is unnecessary or senseless given the circumstances.

Chaware, et al. [12] developed a rubbish collection system that was thought to be creative to aid in maintaining clean metropolitan areas. The system operates by keeping an eye on trash cans and using a web application to inform professionals and waste collection vehicles of the portion of trash that has been stored away or held in the refuse holder. Nonetheless, the system makes use of ultrasonic sensors, whose unique precision is susceptible to variations in temperature. Also, it makes use of WiFi, which is a short-range alliance tool by nature. These drawbacks now affect how well the structure will function in its optimum form.

Kalpana, et al. [13] offered a sharp canister the government system that keeps the majority of the data on the trash cans and their location on the server. In this system, it is the clients' responsibility to verify the portion of the loss in the holder and report this information to the server. The proper professionals are able to access the details at the less than appealing end using Internet approaches, and swift action may be initiated to set up the garbage vault. When a client provides the holder's status to the server via an adaptable application, the canister in this structure must be cleaned. The resultant harm is that concerned managers must now keep an eye out for messages rather than continuously monitoring the waste estimation. Similar to this, it suggests that nature will be confirmed with waste when the holder is full if a client is unfit to deliver the message.

MohdHelmyAbdWahab et al. [14] have suggested the possibility of a "Talented Recycle Bin" that uses RFID imprints to identify the personality of the person throwing the item. It is unrealistic to believe that everyone will consistently hand over their RFID cards whenever they need to engineer a particular type of rubbish into a trash can. This applies to RFID-based (or other ID card-based) infrastructure. Additionally, their platform lacks a strategy for delivering the data to the cloud.

C.K.M. Lee and Trevor Wu et. al. [15] have made an effort to comprehend Hong Kong's garbage association system. Their framework makes use of GPRS to transmit sensor data via the cloud to an adaptable application. Again, this is not feasible since it is absurd to think that most trash cans in a city could be fitted with GSM modules and that most canisters could have access to GPRS data.

Reviewing the shortcomings of the aforementioned frameworks, we propose a "IoT based strong waste association structure" with a helper game-plan that provides a quick review of the framework level arrangement, square estimation building, and a convention stack, and that can be implemented and scaled on a city wide estimation without many obstacles.

## V. BLOCK DIAGRAM

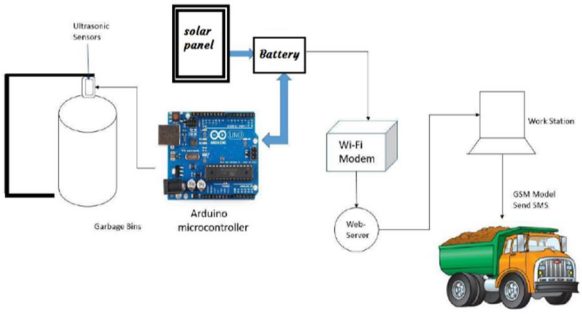



Fig. 2. Project Block Diagram

## VI. WORKING

The IOT Trash Monitoring system is an extremely creative technology that will aid in maintaining clean towns. This system keeps an eye on the trash cans and provides information via a web page about the amount of trash being gathered in the cans. The system measures the rubbish level and compares it to the depth of the bins using ultrasonic sensors that are installed over the bins. The system uses a buzzer, an LCD screen, a Wi-Fi modem for data transmission, and a microcontroller from the Arduino family. A transformer with a 12V output powers the device. The status of the amount of waste collected in the bins is shown on the LCD panel.

## VII. FLOW CHART OF PROJECT

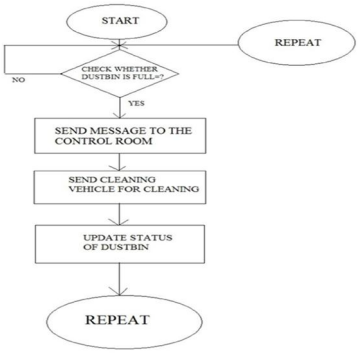



Fig.3. Flow chart of system

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## VIII. COMPONENTS SPECIFICATION

1) Ultrasonic Sensor
2) Arduino Uno Controller
3) LCD display
4) Battery
5) Solar panel
6) Dust Bin
7) Frame
8) Buzzer
9) IOT Module
10) Others

### A. *Arduino Uno*

- Arduino is an accessible hardware and software platform for electronic projects. The innovative RISC design of the ATmega328P, an 8-bit AVR microcontroller with excellent performance and low power consumption, allows it to execute 131 strong instructions in a single clock cycle.
- Several expansion boards (shields) and other circuits can be interfaced with the board's sets of digital and analogue input/output (I/O) pins.




### B. *IOT Module*

The term "Internet of Things" (or "IoT") describes how common things can connect to the Internet and transmit and receive data. The ESP8266 WiFi Module is an integrated TCP/IP protocol stack-equipped self-contained SOC that allows any microcontroller access to your WiFi network. The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application.



### C. *Liquid Crystal Display*

A liquid crystal display, which has replaced many other display types like cathode ray tubes, LED displays, and plasma displays, is a type of display used in digital technology. Liquid crystal displays, also referred to as LCDs, are thin flat panels comprised of many blocks filled with liquid crystals.




### D. *12 v battery*

- A high power battery that can easily fulfil all functions is the 12 V, 8 Amp Battery.
- The main tasks involve obtaining electrical energy from solar panels and supplying it to various components so they can carry out their respective functions.
- A device containing one or more electrochemical cells and provided external connections is an electric battery, which powers electrical gadgets.




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*E. Solar Panels (12v 20w)*

Solar energy can be captured and stored for use at night and during overcast weather. Because constant availability is a crucial necessity for current energy consumption, storage is a significant issue in the development of solar energy. Only when it is daytime is solar energy available. A solar panel, also known as a photovoltaic module or panel, is an interconnected packet of solar cells, often referred to as photovoltaic cells.



## IX. ADVANTAGES

1) Less time and fuel are used because the trucks only travel to the filled containers; there are also fewer trucks on the road, which reduces noise, traffic, and air pollution.
2) Our intelligent operating system provides two-way communication between the service operator and the trash can placed in the city. The collection of the containers' route-based fill level is therefore the only area of concern. Real-time information on the fill level is provided by sensors that have been installed in the containers. The timing and location of collection priority can be determined using this information.
3) In this approach, a system that is optimised results in significant cost savings and less urban pollution, benefiting both service providers and citizens.

## X. APPLICATIONS

This project can also be used in the" SMART CITY". This project is also helpful in the government project of "SWACHH BHARAT ABHIYAN.

## XI. RESULT AND DISCUSSION

It is conceivable to create a system that is more effective than the one that is currently in place by using sensors to monitor the fullness of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human intervention, minimising human time and effort, and producing a healthy and trash-free environment. The system is made to gather data and transmit it via a wireless mesh network. Duty cycle approach is also used by the system to minimise power consumption and extend operational time. The Smart bin system was put to the test outside. Our solution connects the smart trash cans to the internet so that users can access real-time data about the trash cans.

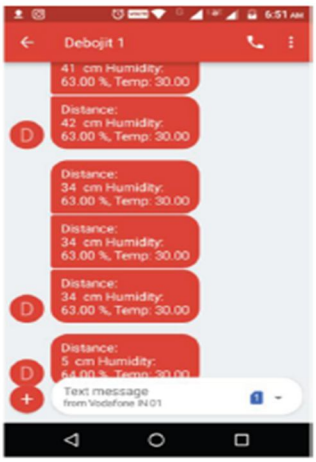



Fig.4. Result obtain on smartphone

The output of this project was supposed to be the distance values, which we were to obtain using IOT data. The sensors on the IoT Module must function flawlessly in order for it to convey data, as seen in the figure, which displays real-time data on the app through WiFi.

We displayed a clear social event waste structure. The IoT recognition model is dependent on the structure. It is in charge of estimating the amount of rubbish in the trash cans and sending that information (over the Internet) to a server for processing at a remote location. This information calculates the updated expert collecting courses. In the future, we'll need to make the structure better for different types of waste, especially strong and fluid waste. By comprehending this task, we may keep a strategic distance from the pollution caused by dustbins and moreover reduce or avoid the shocking stench due to the difficulty before its decomposition.



Fig.5. Project Image

By using sharp dustbins to scan the section of impressive dustbins without paying attention to whether they are full or not, we have implemented a waste association framework. This framework sends the requested information to the person when the garbage is filled. By putting into practise the suggested structure, we may develop the sharp city idea while cutting costs. The advantage may be advanced by the effective use of pointed trash cans. This structure slows down development in the magnificent city with the intention of improving the situation.

## XII. CONCLUSION

By regularly checking on home waste in and around the neighbourhood to prevent harm to the environment and public health, it assists the local corporation in managing waste. It lessens the entire trip made by garbage vehicles and, as a result, lowers the cost. Several types of sensors may be used in the future to produce exact results. This technology is user-friendly because it cuts down on manual labour and time requirements. With this suggested product, an effort is being made to upgrade India's current waste collecting system and create a more environmentally friendly setting. When the garbage level exceeds its saturation level, this proposed method ensures that garbage cans are maintained. As a result, the frequency of inspecting the rubbish collection is minimised, which lowers the overall cost of garbage collection. At the end of the day, it wants to keep society productive and clean. As a result, the waste monitoring and management system improves the effectiveness and efficiency of trash collection.

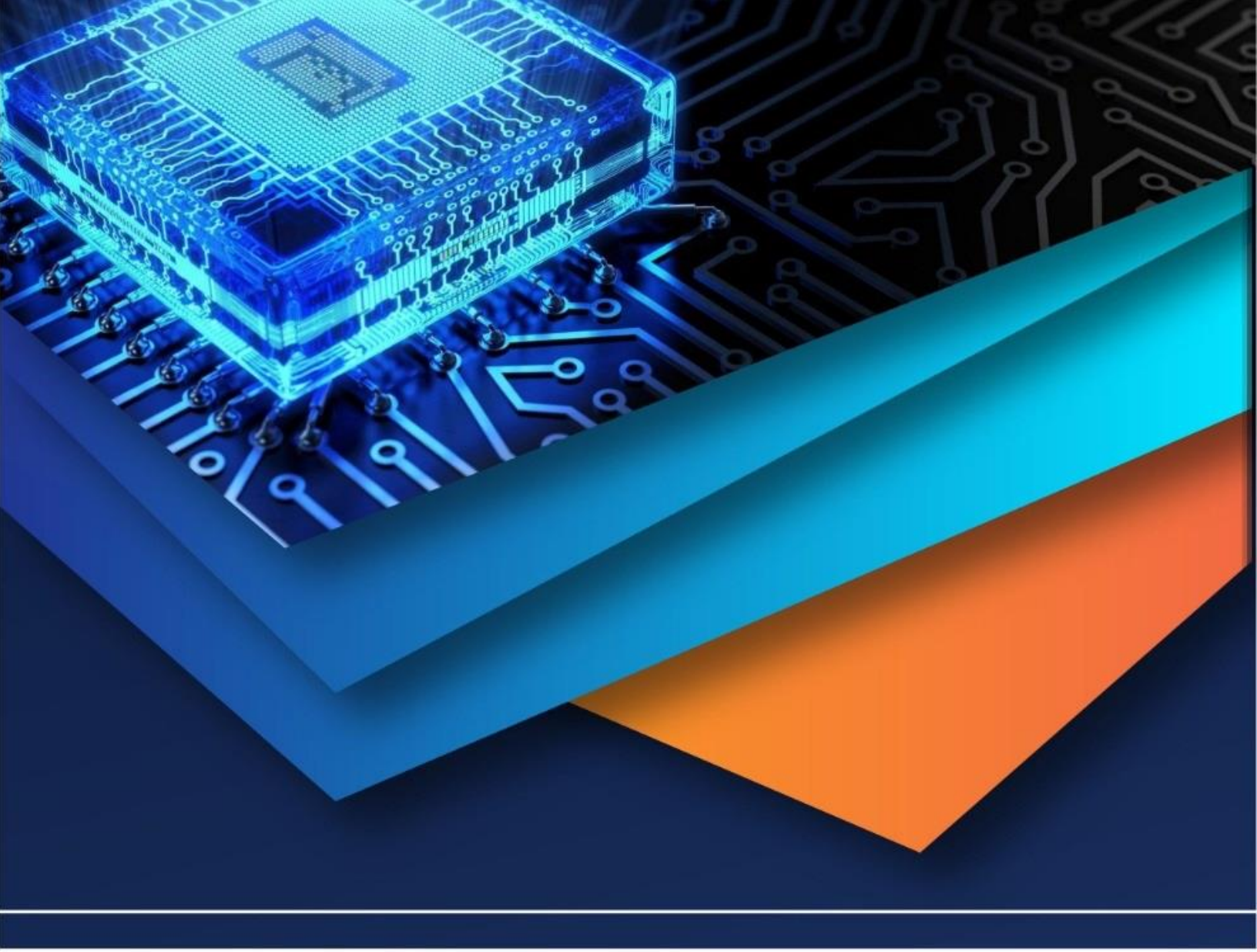
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