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Monitoring Health of the Structures by Sensor Nodes using IoT Technology

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Abstract: ***The advancement of modern technology, structures like buildings, bridges, etc. are getting structurally complicated, and safety has become an issue. Structural Health Monitoring (SHM) with Internet of Things (IoT) can help improving health and safety of structures. In Monitoring health of the structures by sensor nodes using IoT technology, an idea of continuously observing the health of the structures using Internet of things technology. IoT is used for Sending information to cloud about structure health sensed by the sensors. The sensors installed on various parts of the structure, sensors monitor the vibrations, dampness, temperature and tilts of structure's wall. The complete parameters of the structure are measured by sensor nodes. Large number of heterogeneous Sensor nodes spread over a large field. IoT is a combination of different technologies like Wireless Sensor Network, Data networking and Cloud computing. IoT provides a bridge between the real physical world and virtual world. It encompasses damage detection in structures from natural disasters like earth quake and rain. The work is mainly proposed for three segments. First segment constitutes recognizing and alerting of abnormal vibration of the structure due to natural disaster like an earth quake. Second segment predict the moisture content in wall bricks in structures after heavy rain. Third segment presents the smartness that is the temperature sensor predict the temperature inside the structures like auditorium or smart home which is used to reduce the power consumption. The temperature, dampness and accelerometer sensors sense any variations and sent information to central board, here data is processing. The gateway helps to converts to the suitable protocols. Then the data sent to the thingspeak cloud. In cloud data stored and analysed. Using the received data in cloud, the statistical reports are made that can see on the dashboard.***

Key words : Structure Health Monitoring, Internet of Things, Cloud, Gateway, Wireless Sensor Network.

I. INTRODUCTION

Web of Things is one of the present best tech popular articulations. Broad organizations regard its market in a huge number of dollars for the exceptional years, investing billions into research and development despite this, nobody seems to surrender to what Internet of Things (IoT) truly is [1]. Primarily people agree, that is defended paying little heed to a lot of money is required. The Internet of Things (IoT) is a convergence of smart devices that generate data through sensors to create new information and knowledge to boost human intelligence, efficacy and productivity to enhance the quality of life. IoT means "Intelligent interactivity between human and things to exchange information and knowledge for new value creation". It is a complex yet complete solution encompassing three main technology components namely connected things with embedded sensors, connectivity and infrastructure, and most importantly analytics and applications. The deployment of the IoT is based on a handful of enabling technologies. Including communications networks and protocols, hardware devices and components such as sensors, wireless technologies and software. Numerous efforts are currently underway to develop standards and protocols that will help to guide future IoT technology development. The association of the IoT relies upon discreet group of engaging advances. These consolidate correspondences works and traditions, hardware contraptions and portions, for instance, sensors, remote charging progressions and programming. Different undertakings are at display in advance to make standards and traditions that will oversee future IoT development headway. The main objective of the work system is to monitor and safety of the structures. Here productivity is more as compared to the conventional systems, this monitoring and safety system may easily adjusted to modern days [4]. Old systems have some challenges like reliability, power consumption, node size, mobility, privacy and security. So in this proposed system has overcome from these challenges.

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II. LITERATURE SURVEY

This section discusses the survey of papers presented on Monitoring health of the structures by sensor nodes using IoT technology. Danilo Ecidir Budoya and Fabricio Guimarães Baptista [1] presents the Structural health monitoring (SHM) systems are scientifically and economically relevant as methods of detecting structural damage to various types of structures, thus increasing safety and reducing maintenance costs. Among the various principles of damage detection, the electromechanical impedance (EMI) method is based on the electrical impedance measurement of piezoelectric transducers attached to the monitored structure. Md Anam Mahmud et al [2] presented the progression of current innovation, structures like structures, spans, and so forth are getting basically convoluted, and security has turned into an issue. Ronnie S. Concepcion et al [3] showed that the Structural wellbeing checking (SHM) is a propelling zone in the field of auxiliary building. Brinda Chanv et al [4] depicted that a Structural Health Monitoring is the showing up field in structural building which offers the potential for ceaseless and intermittent evaluation of the security and trustworthiness of common foundations. William Contreras and Sotirios Ziavras [5] delineated the Structural wellbeing observing (SHM) concerns the advancement of methodologies to evaluate the state of instrumented building structures. Leena Mhatre and Neha Rai [6] showed the proficient of web of Things (IoT) is rising and is modify for remote perception of the encompassing parameters and different stuffs with the use of sensors that familiarize for remote detecting of constant information Ahmed et al [7] proposed a model on Internet of Things (IoT) that has advanced from being a dream for the future to being an expanding market reality. Partha Pratim Ray [8] displayed the Thermal solace, it is one of the imperative climatic elements that conditions human living hood. The current essential techniques for warm solace estimation are lacking to screen the solace level of human body through PC systems, particularly web like foundation. M.Sri Ram Prasad and Dr. Syed Khasim [9] presents some portion of the structure of a structures are discovered all over the place and is checked utilizing remote sensor systems is a standout amongst the most rising advancements for a hazard moderation.

III. METHEDOLOGY

The wireless sensor network is mainly includes smart sensor modules connect together in a network. Sensors modules are connected to the motes, in the Fig 1 shown that how motes are placed in the structure. Smart vibration sensor module perceiving the abnormal vibration due to natural disaster like an earth quake. Hence in the work main principle is vibration analysis.

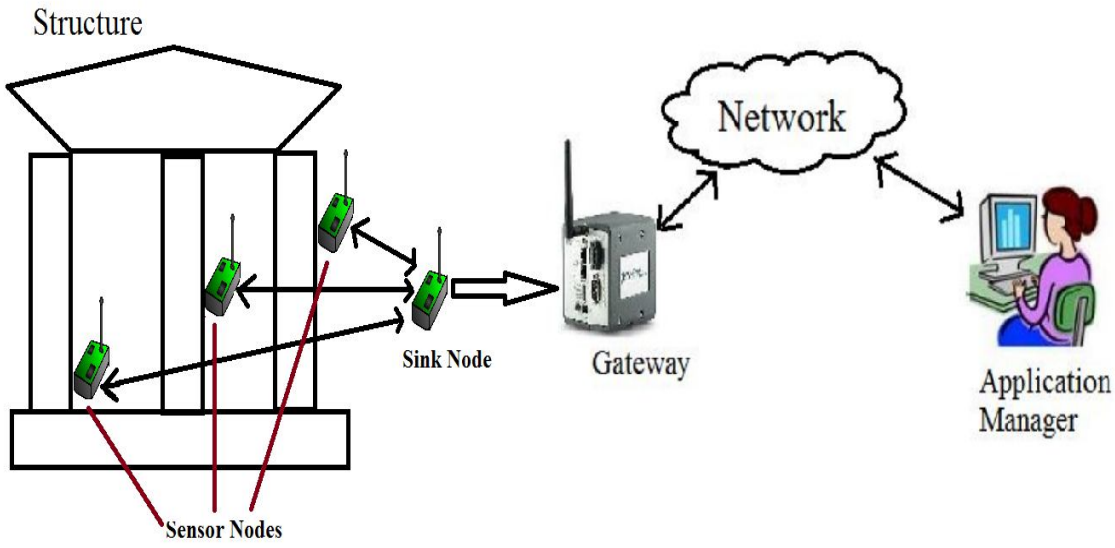


Fig 1: Typical block diagram of Internet of Things

Damage detection includes identification of moisture content in wall bricks in structures. The accelerometer sensor detects orientations of the structure, can be taken x angle and y angle. The temperature sensor LM35 IC is used in the work, temperature sensor used in two ways, for automation purpose and temperature detection purpose [6]. If temperature is more in structure it may automatically switch ON the fans or air conditioners. In another way if any fire incident occurs in structure, temperature is more, then sends data to the related person directly through cloud. Using of these smart sensors reduce the power consumption in any real time structure.

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The sensor modules are connected to Arduino board, the Arduino board receives data and process that data, and then data will sent to the thingspeak cloud [7]. If two or more motes are used in the work all data from motes are collected by the sink node. Gateway is used in the work to establish the linkage between the sink node and cloud. This gateway translates 802.15.4 protocol to 802.3 or 802.11. The gateway will help to connect motes to the internet access through Wi-Fi because ESP8266 Wi-Fi module is used. When measured data from mote is sent to cloud through gateway. Once data reached to the cloud then it is easy task to send data to application manager. The data stored in cloud may reach to the destination as application manager via email, text message or can create mobile applications.

IV. IMPLEMENTATION USING CLOUD

Monitoring health of the structures by sensor nodes using IoT technology is an idea of structure health monitoring is continuously observed and sent information to the cloud, this is by using IoT technology. The smart sensors installed on various parts of the structure, monitors the temperature, vibrations, dampness and tilts. The complete parameters of the building are measured and controlled by sensor nodes. At any point of time if any of the parameters cross their threshold value the communication system informs the application manager. IoT is a combination of different technologies like Wireless Sensor Network, Data networking and Cloud computing. IoT provides a bridge between the real physical world and virtual world. The Fig 2 shows that overview of monitoring health of the structures by sensor nodes using IoT technology. A wireless sensor network is a group of specialized motes with a communications infrastructure for monitoring and recording conditions at various locations in structure. Commonly monitored parameters are monitors the temperature, vibrations, dampness and tilts. Recent advances in IoT technology, low power consumption is achieved and highly integrated circuits are used in the work, this led to the development of micro-sensors. Such sensors are generally equipped with data processing and communication capabilities. The sensing circuitry measures the ambient conditions related to the environment surrounding the sensor and transforms them into an electric signal. Processing such a signal reveals some properties about objects located and/or events happening in the locality of the sensor. The sensor sends such collected data to central Arduino board. Similarly some motes are installed in structure. The sink node collects data from all motes, the data is placed in thingspeak cloud through the gateway.

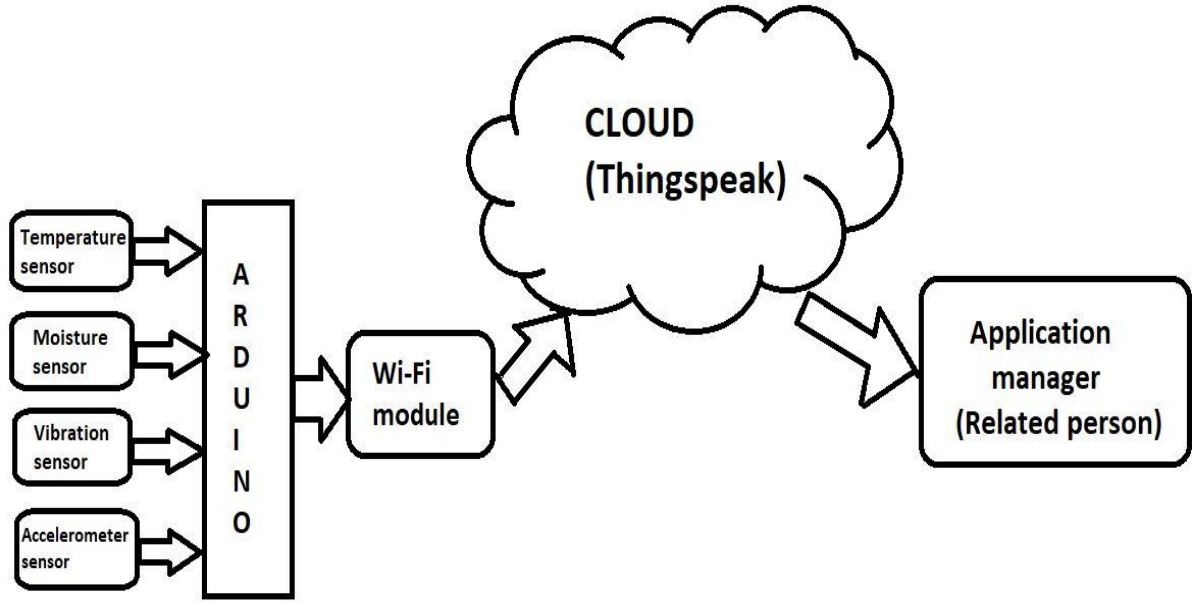


Fig 2: Overview of monitoring health of the structures by sensor nodes using IoT technology

The decrease in the size and cost of sensors, resulting from such technological advances, has fuelled interest in the possible use of large set of disposable unattended sensors. Such interest has motivated intensive research in the past few years addressing the potential of collaboration among sensors in data gathering and processing and the coordination and management of the sensing activity and data flow to the sink.

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A. Thingspeak Cloud

The ThingSpeak cloud is an open source for Internet of Things (IoT) application and API to store and retrieve data from things using the internet. ThingSpeak enables the creation of sensor logging applications, location tracking applications with status updates. ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks, allowing ThingSpeak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks. The main aim is basically collect information from a sensor nodes and sent to the thingspeak cloud using internet access. User anywhere on the planet looking at this information will make decisions by sending remote commands. One of the most important parts of the work is the ThingSpeak cloud, an open IoT platform that will permit to collect, analyse and act on collected data. First sign in to thingspeak website create a new account then create some channels [7]. For every sensors destination channel is assigned and the received data from sensor will placed in assigned channel. Monitoring health of the structures by sensor nodes using IoT technology has many advantages, some of them are as follows: Obtain data in real time, the application of sensing devices in fields will allow a continuous monitoring of the chosen parameters and will offer real time data ensuring an updated status of the field all time in thingspeak cloud database. Robustness/Ability to withstand rough environmental conditions, Because of shrinking size, their ability to communicate through a lot of materials and the possibility to cover the particular nodes in robust cases. Monitoring health of the structures by sensor nodes using IoT technology has the disadvantage as costly at large, the motes and gateways are used in this work are tiny and embedded very closely and operate wirelessly so the cost of the components are high. This work is implemented to whole structure so the first initial install mentation cost becomes high. Lower data rates is another problem. Various applications of monitoring health of the structures by sensor nodes using IoT technology follows. The work can be used for monitoring the health of Infrastructures, this work will continuously observe the strength structure so it will helps to improve the durability of the structure. By using this work can Avoids loss of life. If any accidentally damages are happened to the structure this may effect on life of the people so in the initial stage recognize the defectives and helps to remove the loss of life. This work can be implement anywhere or to any structure like public property can Prevents damage. This work can be implement to the public properties like bridges, buildings, tunnel, dams, airports etc.

V. RESULTS AND DISCUSSIONS

The subsequent monitoring outcomes are obtained by temperature sensor, accelerometer sensor, moisture sensor and vibration sensor. These real times monitoring outcome are recorded on web server. In thingspeak cloud we create the channels for receiving the sensed data from the sensors. Each channel having own API keys for specific destination address. The results are acquired in the form of graphs. The outputs from various sensors stored in thingspeak cloud database are as shown in Fig 3 The moisture sensor gathers information about moisture content. The information is sent to cloud database by means of door by utilizing ESP8266 Wi-Fi module. The cloud database stores the esteem originating from sensor which can be pictured remotely in the cloud dashboard. The information originating from Accelerometer sensor of x angle used to distinguish deviation of the wall. The graph is taken that what date the wall deviates versus deviation value. In the same way the Accelerometer sensor of y angle used to distinguish deviation of the wall. The graph is taken that what date the wall deviates versus deviation value. The temperature sensor gathers information is sent to cloud database using Wi-Fi. The cloud database stores the esteem originating from sensor which can be pictured remotely in the cloud dashboard. Fig 4 demonstrates the graphical form of information in the cloud, sensed by the sensor nodes.

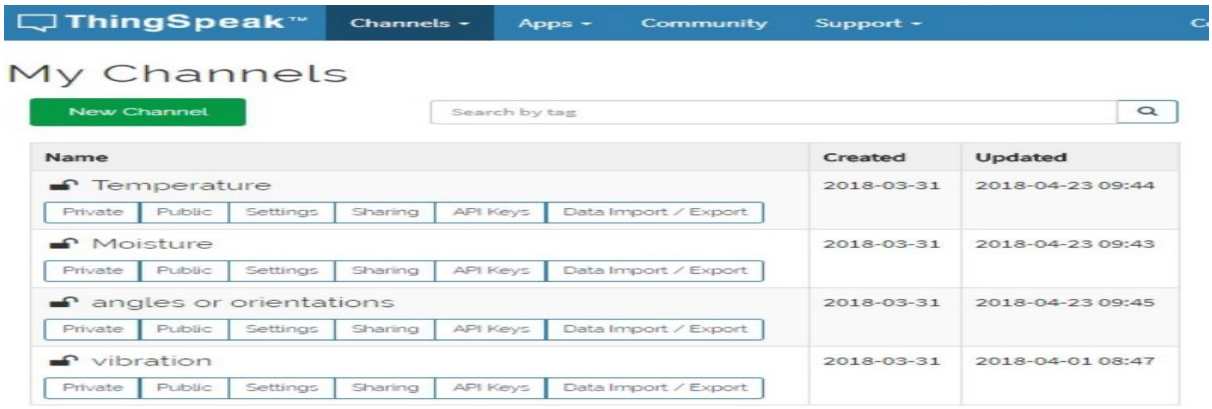


Fig 3: Cannels created in the thingspeak cloud

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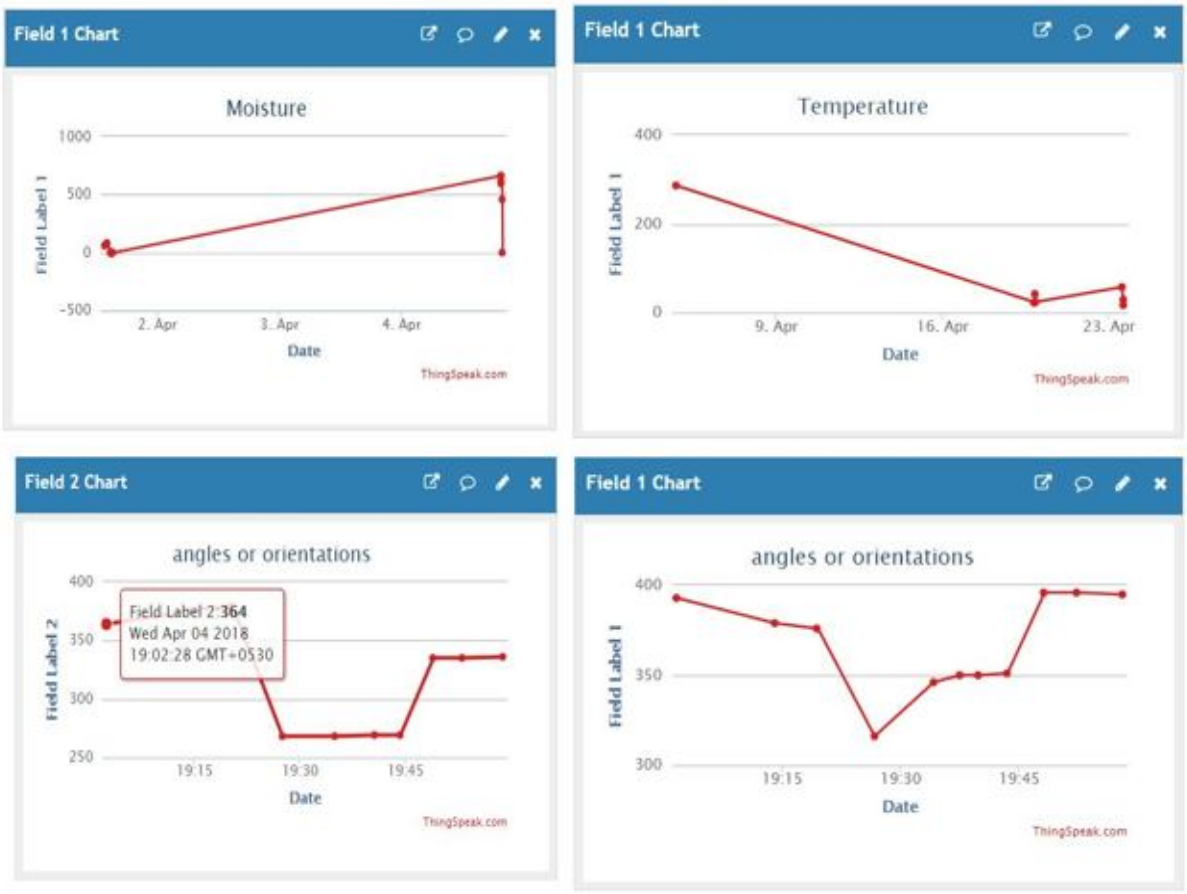


Fig 4: Graphical form of sensors data collected in thingspeak cloud

VI. CONCLUSIONS

Monitoring health of the structures by sensor nodes using IoT technology using Internet of Things advancement has an amazing potential to enhance individual fulfilment in all points of view and is most likely going to be comprehensively used as a piece of the future. The sensed analog data is converted into digital using ADC, the data is sent to main Arduino board. The data is processed, analysed and successfully sent data to the thingspeak cloud. Statistical reports are created using dashboards in clouds, so that can make sense for easy of understanding. The work provides a summary of the research and development in the area of structural monitoring of civil infrastructure by use of the sensors used in Internet of things technology. Consistently sensors sense and produce data, the data sent to the thingspeak cloud hence achieved constant observing the health of the structure.

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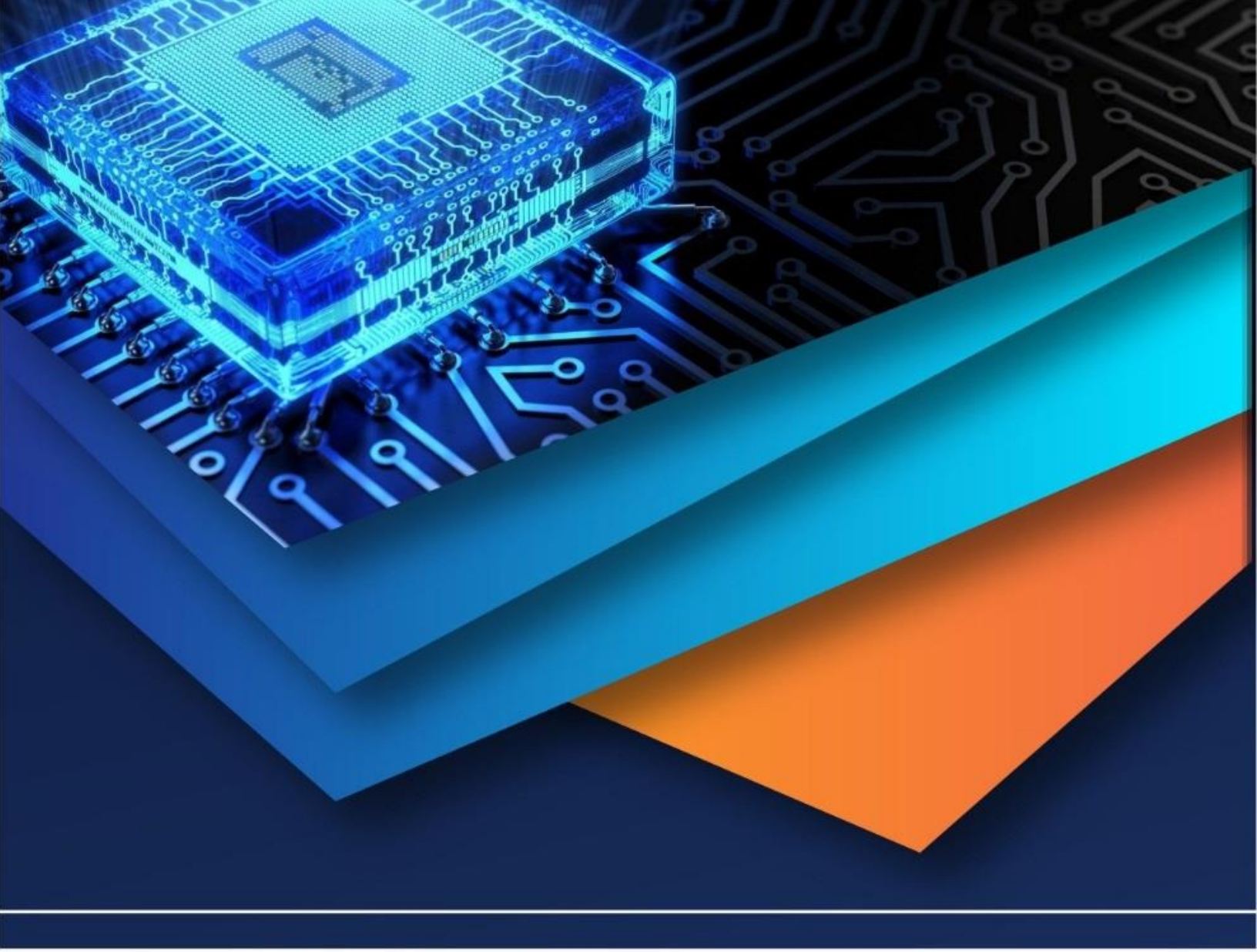
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