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A Technical Report on Radiation Detector

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Abstract: Not only in India but in whole world the nuclear research is going on. After different atomic mishaps in better places individuals are very worried about their wellbeing and wellbeing related issues like disease, tumour and at last demise. To realize how much radio movement is there set up we require a particular gadget like radiation finder. We proposed structure the indicator which has been highlight minimal effort, high exactness, and convenience.

Here, we used gas filled identifier to detect radioactivity additionally estimation of radiation force from portable towers can be recognized in this equivalent gadget. Our radiation finder is a smaller scale controller based, versatile, light weight, and battery worked instrument.

The Geiger Müller counter (GM counter), presented in 1928, is one of the radiation finders generally utilized today. It has basic rule of activity, minimal effort and its general development effortlessness. It is a vaporous ionization locator and utilizations the torrential slide wonders to deliver and effectively perceivable electronic heartbeat from as meagre as a solitary ionizing occasion because of a radiation molecule.

What's more, it is intended to little, advantageous, simple to utilize and remotely interfacing. To make one of these sorts of indicator and can be set up at genuinely ease being normal task in atomic science field. The Geiger-Muller cylinder, or GM tube, is an incredibly valuable and cheap approach to recognize radiation. While the GM cylinder can just recognize the nearness and power of radiation, this is frequently all that is required. Configuration instrument in this task will examine it radiation identifier will quantify radioactive components and portable flag radiation.

Keywords: Nuclear accidents, Radioactivity, Radiation Detector, GM Tube, Alpha, Gamma, Beta, Radio activity

I. INTRODUCTION

These works are intended to structure and development of compact study meter for Radiation portion estimating. The planned framework comprises of 4 primary parts comprising of low voltage control supply, radiation identification, radiation estimation and information show part on LCD.

Improvement of the study meter model is done on Arduino Uno stage. 16-bit Timer1 on the microcontroller is used as outer heartbeat counter to deliver check every second or CPS estimation. Transformation from CPS to portion rate procedure is likewise performed by Arduino to show results in miniaturized scale Sievert every hour (µSvhr-1). Change factor (CF) esteem for transformation of CPM to µSvhr-1 decided from maker information sheet is contrasted and CF acquired from adjustment method. Structure of review meter that comprises of LND7121 GM recognize or with Atmega328P microcontroller. The firmware is created and tried by utilizing Arduino Uno stage.

The plan of the study meter just as Arduino firmware for heartbeat checking will be introduced. Aftereffects of the Arduino based overview meter will be talked about in the Result and Discussion area. The Geiger– Mueller counter (GM counter), presented in 1928, is one of the radiation finders broadly utilized today.

It has basic guideline of activity, minimal effort and its general development straightforwardness. It is a vaporous ionization finder and utilizations the Townsend torrential slide marvel to create an effectively perceivable electronic heartbeat from as meagre as a solitary ionizing occasion because of a radiation molecule

A. Need of System

Need of measurement radiation of alpha (α), beta (β), gamma (γ) for continuous calibration purpose & ensure the safety.

B. Objective

To provide maximum accuracy of radiation measurement
To define a threshold value of radiation intensity
To detect the hazardous level of radiation
To store reading for wireless monitoring by using Things peak API
One device will be common for all radiation detectors

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II. LITERATURE REVIEW

A. Historical Background

The cutting edge comprehension of ionizing radiation got it's begin in 1895 with Wilhelm Rontgen. During the time spent directing different investigations in applying flows to various vacuum tubes, he found that, regardless of covering one of every a screen to square light, there appeared to be beams entering through to respond with a barium arrangement on a screen he did set adjacent. After a few tests, including taking the principal photograph with the new beams, he named them "x-beams" incidentally as an assignment of something obscure, and the name stuck. Despite the fact that it was Henri Becquerel that found the wonder, it was his doctoral understudy, Marie curie, who named it: radioactivity. She would proceed to do much spearheading work with radioactive materials, including the disclosure of extra radioactive components: thorium, polonium, and radium. She was granted the Nobel value twice. She likewise led spearheading work in radiology, creating and conveying portable x-beams machines.

Hans Geiger created his renowned counter to quantify the radioactivity in 1911. Geiger was conceived in Germany and examined material science at the University of Munich. He worked with honourable prize winning scientist Rutherford at his research facility at the University of Manchester.

B. Existing System

Sapna jasrotia and chilisea sadhu published a paper in which a thin end window tube radiation detector has been discussed. Radiation detectors are widely used in industrial applications as well as in research surveys for detecting emission of radioactive radiations. This project discusses the implementation where a large sized, complicated detector is replaced by compact GM tube radiation detector, in order to prepare a small sized, mobile and inexpensive radiation detection device based on low cost PIC microcontroller [1]. Newaz Morshed Remon, Captain Md. Tanjir Hassan, Md. Shamim Hassan and Md. Ghulam Zakir published a paper describes undergraduate project experience and findings on the subject matter. Initially according to project title, they were focused on developing a low cost detector which can detect radiation only. To make one of these kinds of detector doesn't take much and can be prepared at fairly low cost being very common project in nuclear science arena. The Geiger-Muller tube, or GM tube, is an extremely useful and inexpensive way to detect radiation. While the GM tube can only detect the presence and intensity of radiation, this is often all that is needed [2]. Diana Starovoytova, Madara Simiuy Sitati published a paper in which an intelligent-mobile-phone-detector has been described. The system was design by Mbaocha and it was able to detect the presence of GSM-signals emitted from a mobile-phone within the radius of 1.5 meters. A device had a capability to detect calls, SMS and video-transmission even though a mobile-phone is in silent mode. Moreover, a device was able to restrict the detected-mobile-phone from accessing services through jamming which blocks the desired-frequency [3]. W Singseeta, D Thong-aram and S Pencharee published a paper on which detail design and construction of portable survey meter for radiation dose measuring was described. The designed system consists of 4 main parts consisting of low voltage power supply, radiation detection, radiation measurement and data display part on android phone. The test results show that the ripple voltage of low voltage power supply is less than 1%, the maximum integral counts are found to be 104 counts per second and the maximum distance of wireless combination between the server and the client is about 10 meter [4]. Prabhat kumar and Suresh sagadevan published a paper which gives the ides about the beta counting system uses a Geiger-Muller (GM) tube to detect the presence of beta contamination present in filter paper samples or in placket samples. The counting system is enabled with a provision to count the samples at various distances from the detector to the sample position. The efficiency of the counting system is provided by the manufacturer at the time of procurement which is calibrated and tested using the standardized source [5].

III. SYSTEM DEVELOPMENT

The overall system has been developing in to two major domains as radiation detection and radiation measurement.

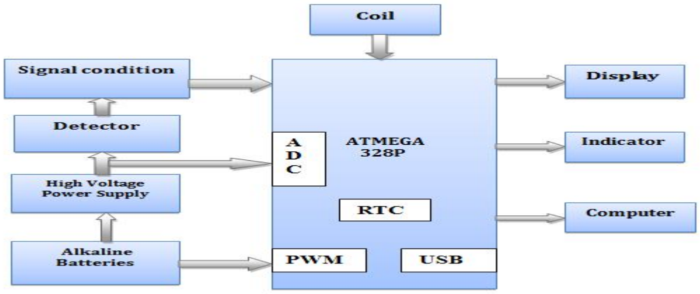

Fig. 1: Block Diagram of Radiation Detector

Radiation detector is a circuit design for detection of radio waves using ATMEGA 328p. The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz. Figure shows the block diagram of implemented system. It consists of signal condition, detector, coil, display and another driver circuits as shown in figure 1

The 16X2 LCD (JHD162A) display is used in the Radiation Survey Meter. The piezo speaker and LED indicator are connected to the adaptation circuit, so the LED started blink with each pulse and the speaker would buzz with each pulse.

A. Flow Chart For Radiation Detection

Figure 2 shows the graphical flow of radiation detection process. In which the system will initialize for detection and in radiation detection the level of radiation will get displayed on display screen. If the system does not detect the radiation it will get back to initialization stage continue the same.

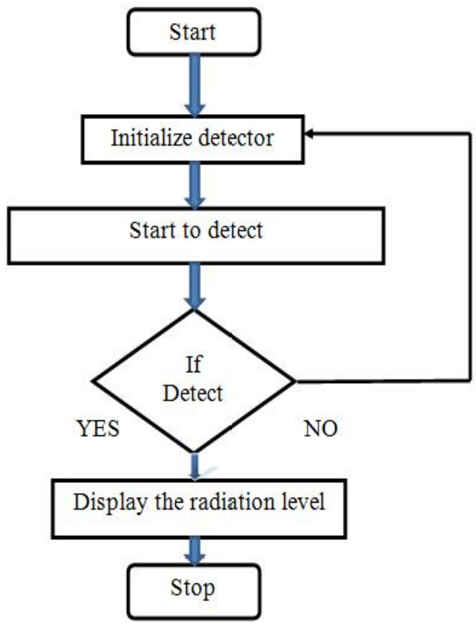

Fig. 2: Flow chart of system

Figure 3 shows the circuit diagram of GM Tube Radiation Detector circuit with display interfacing.

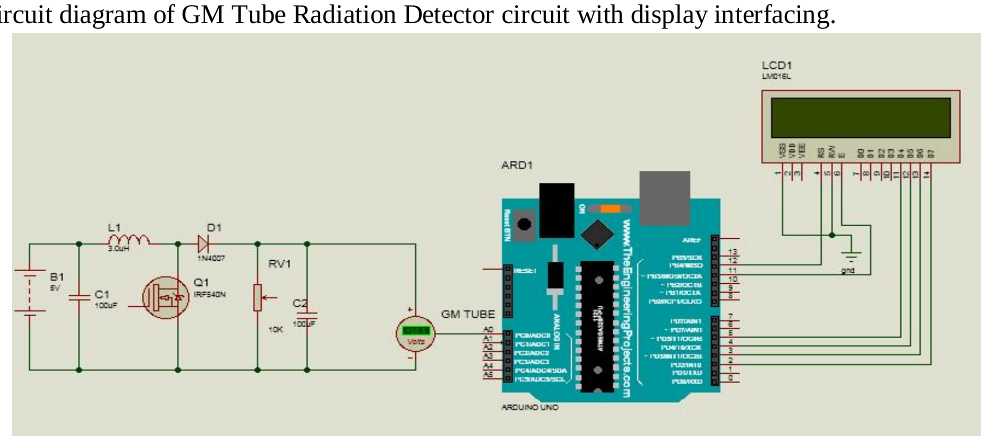

Fig.3: GM Tube Radiation Detector

B. Radiation Detection

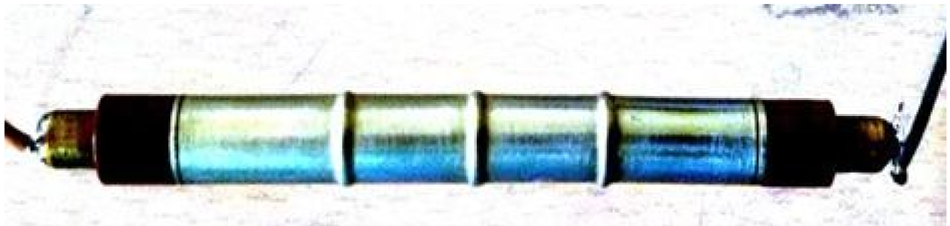

Fig.4: GM Tube Used For Radiation Detector

The LND712 G-M tube that was filled with mixed gas such as Neon and Halogen at low pressure was used to detect the radiation in this work. Its shape is cylindrical end-window tube with 1.5-cm diameter of thin Mica which is called as window plate and 4-cm length with enclose by the grade stainless steel. The high voltage power supply (HV) at 500 volts through RA and RB was applied to its anode for the maximum count rate and lifetime of the tube. The capacitor C was connected by Alternating current (AC) coupling type to AC signals pass through as shown in figure 2. The tube briefly conducts electrical charge when particles or photon of incident radiation makes the gas conductive by ionization. The output signal detected at the anode of the tube on the diagram of the figure 2 by an oscilloscope is the negative trigger pulse. The signal is sharp peak about 550 volts as shown in the Figure 34 This signal will send to a next part to adjust its shape for a data counting.

C. Radiation Measurement

The data processing was established to count the narrow square pulses from the signal conditioning part. An available commercially ATMEGA328P microcontroller board was used as a processing system based on an external interrupt function on D2 port of this board. This function was programmed to count the square pulse and report in counts per second (CPS).

IV. PRACTICAL EXPERIMENTATION

For practical experimentation we have design the boost converted circuit which will convert in the range of 5V- 100 V. The circuit is developed using semiconductor devices such as 1x10k trimmer potentiometer, Diode, Register, Capacitor and GM tube. Figure 5 shows the simulation diagram of Boost Converter circuit and figure 6 shows the experimental setup for the radiation detection. The costing of implementation is around six thousand. The experimentation has been carried out with three different conditions. In first condition we have not taken radioactive source around the GM tube and noted the Radiation intensity in counts per 10 seconds. Similarly the readings have been taken out by keeping radioactive source around the GM tube with different distance between them.

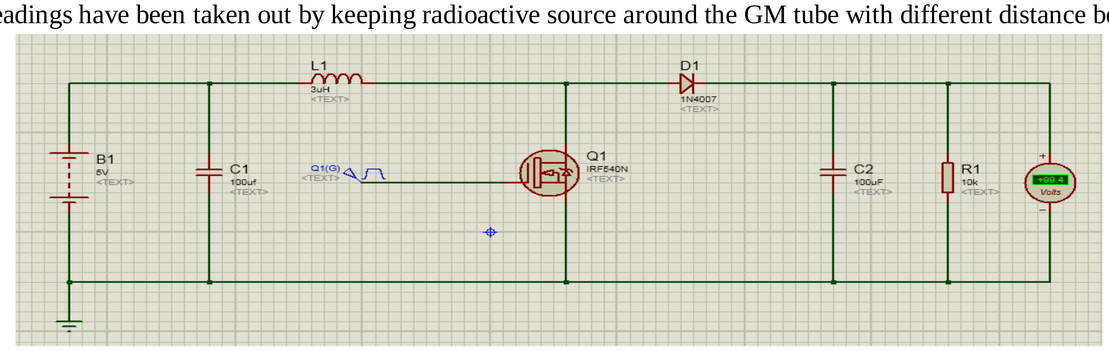

Fig. 5: Boost Converter (5v-100v)

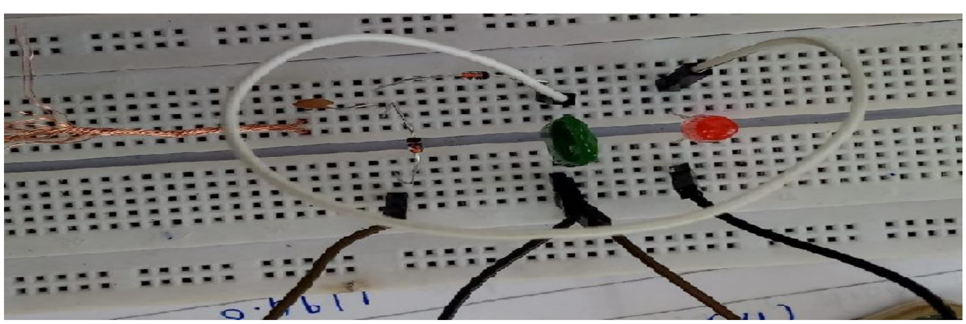

Fig. 6: Boost Converter circuit implemented on Bread Board.

V. PERFORMANCE ANALYSIS

As stated in experimentation we have collected the readings of radiation intensity in three different conditions.

1) *Condition-I:* When there is no radioactive source around.
2) *Condition-II:* When radioactive source is kept around the GM tube at <15cm
3) *Condition-III:* When the radioactive source is kept on the GM tube at <0.5cm

TABLE I
READING OF GM TUBE

Sr. No.	Distance between source and GM tube	Radiation intensity in counts per 10 seconds
1	No nearby source	4 counts/10 sec
2	<15cm	14 counts/10 sec
3	<0.5cm	20 counts/10 sec

Sensitivity=cps/ (mrem/hr))
1 cps= 0.06mrem/hr
Cobalt-17 cps/mR/hr

TABLE III
CONVERSION RATIO

Sr. No.	Distance between source and GM tube	Radiation intensity in counts per 10 sec	Radiation level in standard unit; mrem/hr
1	no source nearby	4 counts /10 sec	0.0235
2	<15cm	14 counts/10 sec	0.0823
3	<0.5cm	20 counts/10 sec	0.1176

The India SAR limit for mobile devices is "1.6 W/kg".

TABLE IIIII MOBILE RADIATION

Distance (from mobile phone antenna)	Peak V/m	Power flux density µw/m2
2cm	8.00 V	169761.27 µw/m2
5cm	6.00 V	95490.71 µw/m2
7cm	5.00 V	66312.99 µw/m2
9cm	3.00 V	23872.6 µw/m2

VI. CONCLUSION

In this paper innovation to distinguish radioactive materials remotely from unobtrusive separations (a few meters) has been talked about. The controller utilized will help in distinguishing the radiation produced by radioactive material and portable pinnacle with least outer equipment prerequisite by holding the proficiency and it is moderate. As India is building atomic power plants, this framework has a more noteworthy extension and opportunity. It very well may be utilized in security and protect of atomic power plant for controlling fissile materials just as in specific military purposes, for example, NBC fighting. In this paper it has been demonstrated that how we can make a minimal effort GM counter which can identify a wide range of radiation.

A. Advantages

Large output signal is produced from tube.
Detect all types of radiation & distinguish them.
High accuracy
Cheap, robust
Portable

B. Applications

1) *Medical Applications*
   a) Particle detection
   b) X-ray and CT-SCAN zone
   c) Personnel protection of doctors
   d) Patient dose measurement
   e) Nuclear medicine
   f) Neutron measurement
2) *Industry Applications*
   a) Nuclear plant safety
   b) National and homeland security
   c) Radon levels in water
   d) Environmental monitoring
   e) At airport
   f) Telecommunication companies

C. Future Work

Now a days GM counter has used many different applications like soil surface radiation pollution detection, Agricultural radiation pollution detection, Ore, building materials radioactive detection, Personal dose monitoring alarm, Industrial X, gamma NDT radiation detection, Radiation medical treatment place radiation detection, Cobalt source, electronic accelerator irradiation place radiation detection. Radioactive radiation laboratory detection, Human do not possesses any sense organ to detect this ionizing radiation, so we need to rely on instrument for the detection and measurement of radiation.

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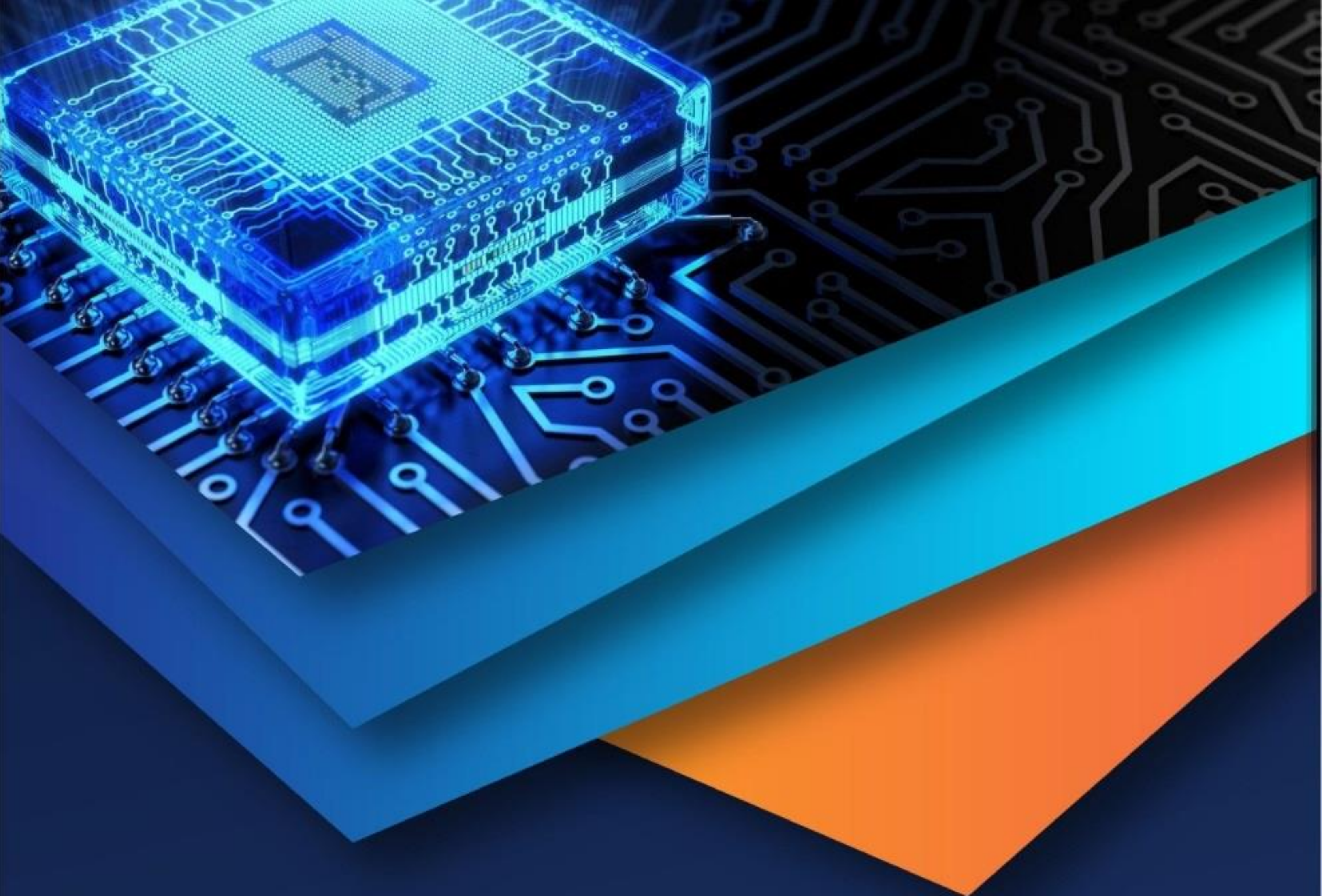

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