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Density Based Traffic Light Control Using IR Sensors and Arduino

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Abstract: ***In now day's traffic congestion consider as a serious issue in all over the world and for the public it become a daily life challenge because they have to face a problem of traffic congestion in their daily life at the time of travelling. In ordinary arrangement traffic problem is solved by traffic police or by the use of automatic traffic light but this arrangements are static and having a fixed time allocation at every side of junction and because of this arrangement they are not capable to perform according to need. And at traffic junction now days we need a dynamic arrangement of traffic lights at the place of static so it can be quickly resolve the problem of traffic if any emergency vehicle is waiting in the queue or as per the need. In this paper we introduced the concept of density based traffic light arrangement which change the colour of traffic light according to density of traffic which is present at a particular side of traffic junction. To know the density of traffic we have to use sensors and IOT technology. In this paper the proposed model is design using IR Sensors and Arduino. IR sensors are used as sensors to detect the density of traffic and Arduino is used as microcontroller. At traffic junction IR sensors are fitted at every side of the junction and sense the number of passing vehicle to each side of junction and interfaced to the arduino. After receiving the input from sensors we know the density of traffic at each side of junction change the traffic light as per the need. So, in this paper we are going to discuss about the density based arrangement of traffic light and the limitation related to it and throw some light related to future work.***

Keywords: IR sensors, Arduino, IOT, Traffic Light

I. INTRODUCTİON

In modern day lifestyle traffic congestion is consider as serious issue because of increasing number of vehicle at road but if we deep analysis this problem so we find only an increasing number of vehicle is not a single cause of traffic congestion some other issue is also responsible for this for example poor infrastructure, static arrangement of traffic lights etc. Vast improvement in road infrastructure is not possible at every location because it's costly and not suitable for narrow roads. So, in this paper we are going to focus on arrangement of traffic light because static arrangement has a fixed time allocation at each junction and it's not able to perform according to density of traffic is available at junction. So density based traffic light control can be consider as a solution to reduce traffic congestion in some possible way at the road. In density based traffic light control sensors and microcontroller play a major role to sense the traffic and transfer the information to the next level for receiving an output. The main objective is to focus on this problem is only to reduce traffic congestion, wastage of fuel, collision due to high number of vehicle at the time of travelling. IOT, Internet of things is a main key technology of this project. IOT empower different devices to share data over the internet with operator, or with other connected devices [2]. The internet of things allow object to be sensed and controlled remotely across present network framework [1].

II. CURRENT ARRANGEMENT OF TRAFFİC SİGNAL

In current scenario road traffic is handling by traffic police and by traffic regulation authorities who are responsible to ensure that public is follow the traffic rule in an appropriate manner. For traffic police it's compulsory to educate public about traffic rules and guide them about those devices which are used in traffic management system. In current situation for traffic management traffic lights play the role of main component with the help of traffic lights at traffic junction regulation of traffic is get easier. But these traffic lights are static in nature and have a fixed time allocation at each junction. But this fixed time allocation has some limitation like if at a one side of junction traffic density is high and at another side density is low so traffic light not change the colour according to density but its change the colour as pre-fixed time. To overcome this problem in this paper we proposed a solution of density based traffic light control. In this arrangement traffic light is change according to density of traffic at each junction. To measure the density we use IR Sensors at each side of junction which is count the passing number of vehicle and forward this data as input to microcontroller which take the decision as per requirement.

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III. ELEMENT USE İN DENSİTY BASED TRAFFİC LİGHT CONTROL

In this proposed model several elements is used for successful completion of this project.

A. Arduino

Arduino is use to create digital appliances and collective items which is work as a sensor and control physical devices. Arduino is a open source project which is help to make microcontroller based kit for digital appliances [4]. The proposed system is based on microcontroller and sensors. This system has several digital and analog input/output pins which are interact with another extension board and circuit to provide desired output. This microcontroller board has serial communication interface and universal system bus to fetch written program from personal computer. The Arduino project provide integrated development environment which supports c and c++ language. Arduino is design to provide easy and low cost platform to design devices which can interact with real world using sensors and actuators [4]. In present time Arduino is used to design IOT and robotics based project.

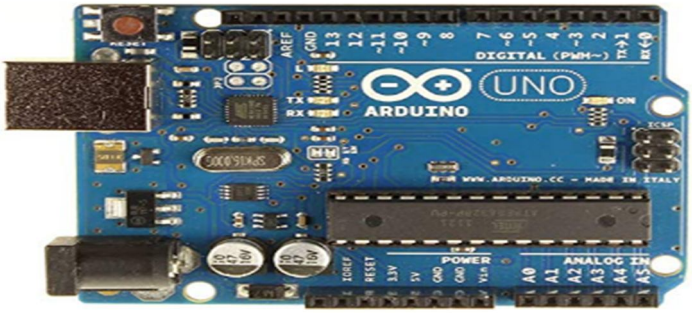

Fig 1:- Image of Arduino Board

B. LED

A Light Emitting Diodes (LED) is a single light display which contain radiant and perform as a single binary point to be switch on and off by programming instruction. LED reside semiconductor material which create p-n junction and in active mode it's emits light. In LED when an electron meets with a hole so it's decrease the energy level and release energy in form of photon. Wavelength of light is emitted and the colour is decided by the band gap energy of semiconductor. The size of standard LED is 5mm diameter domed. LED traditional colours are red, green, orange and yellow but in present time it's available in white and blue colour also.LED are frequently used in battery powered project because consumption of LED are low as compared to lamps. In standard LED wavelength of red LED is trends between 625 to 660nm, for yellow its 590nm, and for green its 565nm.

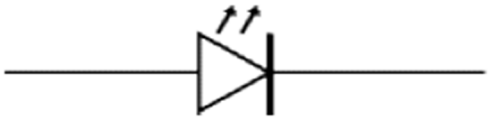

Fig 2:- Symbol of LED

C. LCD

Liquid Crystal Display (LCD) is used for display information. It's taken the information as an input from sensors and microcontroller and display the output result from binary format by generating ascii character.

D. Power Supply

Main function of power supply is to convert high voltage AC into appropriate low voltage for circuit and devices. For electronic devices standard low voltage rate is 5V. Here is a block chain diagram for standard 5V regulated supply.

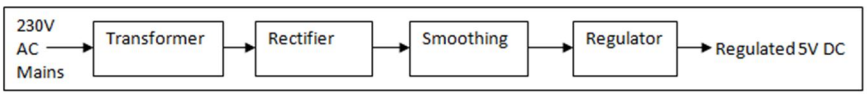

Fig 3:- Block Diagram of Regulated Power Supply System

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Transformer is used to convert AC electricity from one voltage to another voltage. In this process it's lose some power. Transformer works only on AC electricity. This is the reason in this project main electricity is AC. Along with transformer rectifier, smoothing and regulator is used to provide smooth DC output without ripple which is suitable for all electronic circuit.

IV. SENSORS USED IN DENSITY BASED TRAFFIC LIGHT CONTROL

A. IR Sensor

IR Sensor is known as infrared sensor which is used to sense nearby object. IR Sensor is work on different block chain specification.

IR Transmitter

In IR Sensor transmitter is used to change an electrical signal into a visible signal. For IR transmitter most suitable devices are IR LED and IR semiconductor laser diode. Where LED is suitable for low range trade devices and laser diode is suitable for high range trade devices because of its high modulation and bandwidth. For proposed system we use IR sensors which are similar to a LED. IR transmitter release IR rays. IR rays create electromagnetic field with high wavelength to sense an object normally IR rays are not visible to humans it can be only see through camera.

B. IR Light Emitter

IR Light Emitter is used to design discrete infrared transceiver circuit. In general IR emitter has four kind of specification.

1) Measure Increase and Decrease Time
2) Emitter Wavelength
3) Emitter Power
4) Emitter Half Angle

In the proposed system IR LED used has specification QED23 which is 940nm GaAS encapsulated in a T-1 3 package.

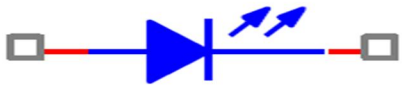

Fig 4:- Symbol of IR Light Emitter

C. IR Light Detector

For detecting the light photodiode data stream is used. A photodiode is allowed light to strike on p-n junction. In the proposed system transparent, black colour silicon based encapsulated PIN photodiode is used which has specification QSE973 and plastic T092 package. Specification of QSE973 is it has daylight filter, having receipting angle is 90 degree and chip size is 2. 712 sq. mm.

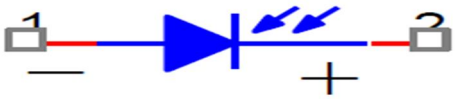

Fig 5:- Symbol of IR Light Detector

D. IR Reflector Circuit

This circuit show reflection on surface. It's has two scenario in the first one when IR LED release IR rays and reflect to white surface so it's accepted by photodiode. And when IR rays is sink on photodiode so it's pass 5V to base of transistor (BC 547). Transistor turns on and passes 5v from receiver to emitter. For reflector circuit output is get zero. The zero is received by microcontroller and microcontroller provides next process as written in program.

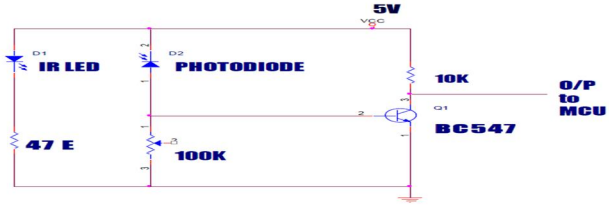

Fig 6:-Circuit Diagram of Reflector Circuit

In the second scenario when IR LED release IR rays and reflect to black surface so photodiode it's not able to recive that rays. Photodiode not get ON and not pass 5V to base of transistor(BC 547). Transistor not get ON. For reflector circuit output remain one. The one is recive by microcontroller and microcontroller provide next process as written in program.

V.BLOCK DİAGRAM OF PROPOSED SYSTEM

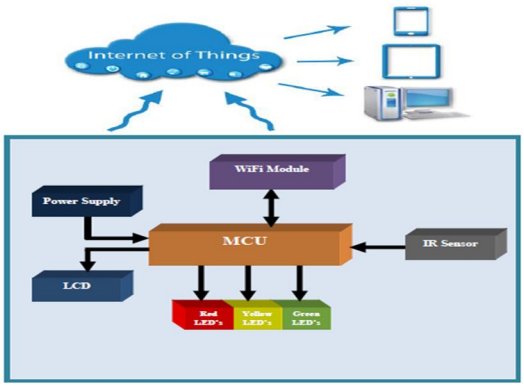

Fig 7:- Block Diagram

As shown in figure 7, Density based traffic light control is operated by microcontroller which is Arduino and all other reciver component which include IR Sensor, LCD connected to microcontroller by analog pin. And LED , wifi module and power supply is connected by digital pin. When on the road traffic is high at that time IR Sensor output become low and and after getting low input from IR Sensor green LED is activate and green signal turns on and on the another side red and yellow signal remain constant. Changing process of signal is depend on the density of traffic.

VI. PREREQUİSİTE AND STİPULATİON SYSTEM

A prerequisite and Stipulation system is desribe behaviour pattern of system. It's describe use cases and interaction of all devices and user with software. Prerequisite and Stipulation system is divided between software and hardware requirment.

A. Units of System

1) User Pannel
2) Login
3) Object detection by IR Sensor
4) Confirmation of an object detection
5) Recieve Output from microcontroller
6) Chage in traffic light as dnsity of traffic

B. Hardware Interfaces

1) Monitor- To recive standard output
2) Microcontroller
3) Software Interfaces
4) Operating System- 7/8/10
5) Random Access Memory- More than 1 GB
6) Wifi Module
7) Power Supply
8) Light Emitting Diodes
9) Liquid Crystal Display
10) Hard Disck
11) IR Sensor

C. Software Interfaces

1) Programming Language- PHP
2) Data Base- My Sql 6.0
3) Connectivity- IR Sensor and TCP/IP

Fig 8:- Composition Pattern of Proposed System

VII. WORKİNG MODEL OF PROPOSED SYSTEM

This proposed model is design to analyze delay at the time of traffic congestion because of static traffic lights which has fixed time allocation. Because of fixed time allocation traffic lights are not able to change colour of traffic signal according to traffic density and it's also a reason of high traffic congestion on road. In this model we proposed a solution to overcome from this problem and this model is work on traffic density. To know the traffic density IR sensor are install at all side of junction which is sense the total number of passing vehicle from that road. IR sensor has IR transmitter, light emitter, light detector and reflector. IR transmitter and IR light detecotor placed on the same side of a road having some short distance when any vehicle pass near sensor, IR sensor sense the vehicle and convey this data as an input to microcontroller. Microcontroller(Arduino) count the number of vehicleof all side of junction and turns green signal of that side of junction which has high density of traffic.

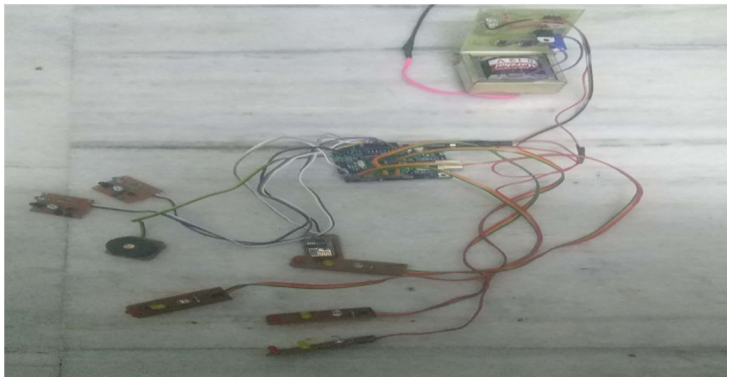

Fig 9:- Image of Working Model

In this model total 4 IR Sensor is used and total numbers of LED are 12 which are connected to microcontroller. Sensor is activated based on the density of traffic.

1) If traffic density is low only one senor will be ON
2) If traffic density is medium two sensor will be ON
3) If traffic density is high three sensor willbe ON

AT the timeof traffic density output voltage is decide by the sensor distance from an object. When high number of vehicles pass neat the sensor so output voltage is high. High and low voltage is decided by the number of vehicle count which is sensed by sensor.

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A. Working Process of Proposed Model

1) Affix adaptor with Arduino Board and connect with the power supply
2) Load the program on Arduino(ATMEGA16UT) microcontroller
3) Install IR Sensor at every side of junction.
4) Connect LED with Arduino via digital pins.
5) Install all 4 IR Sensor and 12 LED as a traffic system and when huge number of vehicle pass near to the specific side of junction so LED of that side will turn green.

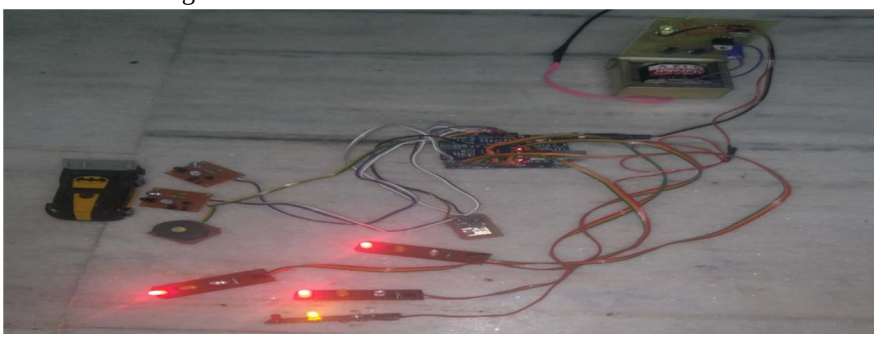

Fig 10: Targeted Signal Led dynamically change the colour when any object pass near to IR sensor

B. Admin Panel to Check the Status of Traffic

In the proposed system admin panel is also required to check the real time data of traffic congestion. This panel can access by authorized team to check real time data and in any scenario if traffic signal cannot change the traffic light as per need because of system failure so authority team will take the decision as per need. This admin panel is compatible to operate on remote server.

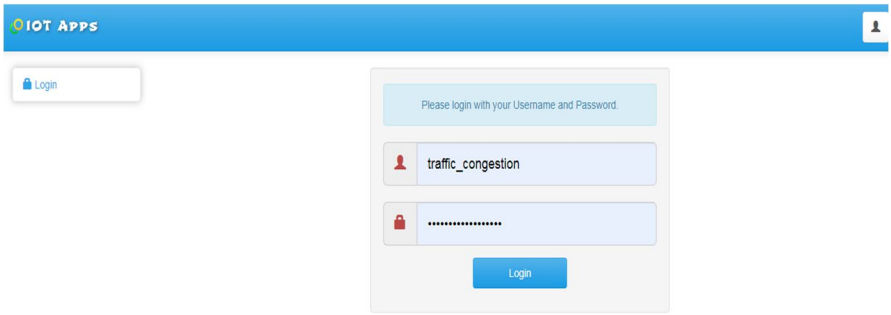

Fig 11:- Login Panel for Authorized Management Team

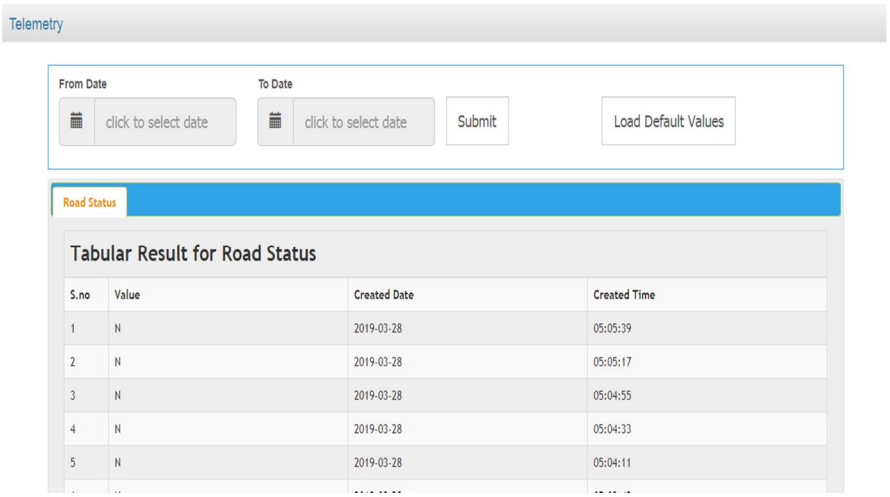

Fig 12: Status of Road Value N is show the No traffic congestion

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VIII. CHALLENGE RELATED TO WORKİNG MODEL

For density based traffic light control in real life model scenario may very as compared to prototype model. Here this model has go through some kind of problems.

1) Low range IR Sensors are not suitable for high range signalling system.
2) Hacking and stealing of data and device failure is also a challenge for this system.
3) In IR Sensors infrared rays are effected by natural objects like sunlight, smoke etc.

IX. CONCLUSİON

Density based traffic light control is a need of present time to avoid unnecessary delay during travel. It's remove fixed time delay allocation barrier and provides solution to reduce travel time at the time of traffic congestion and save fuel and time. This prototype model is successfully work and give an appropriate result as per expectation. But for future reference we can add detection of emergency vehicle feature in this project to provide path to emergency vehicle.

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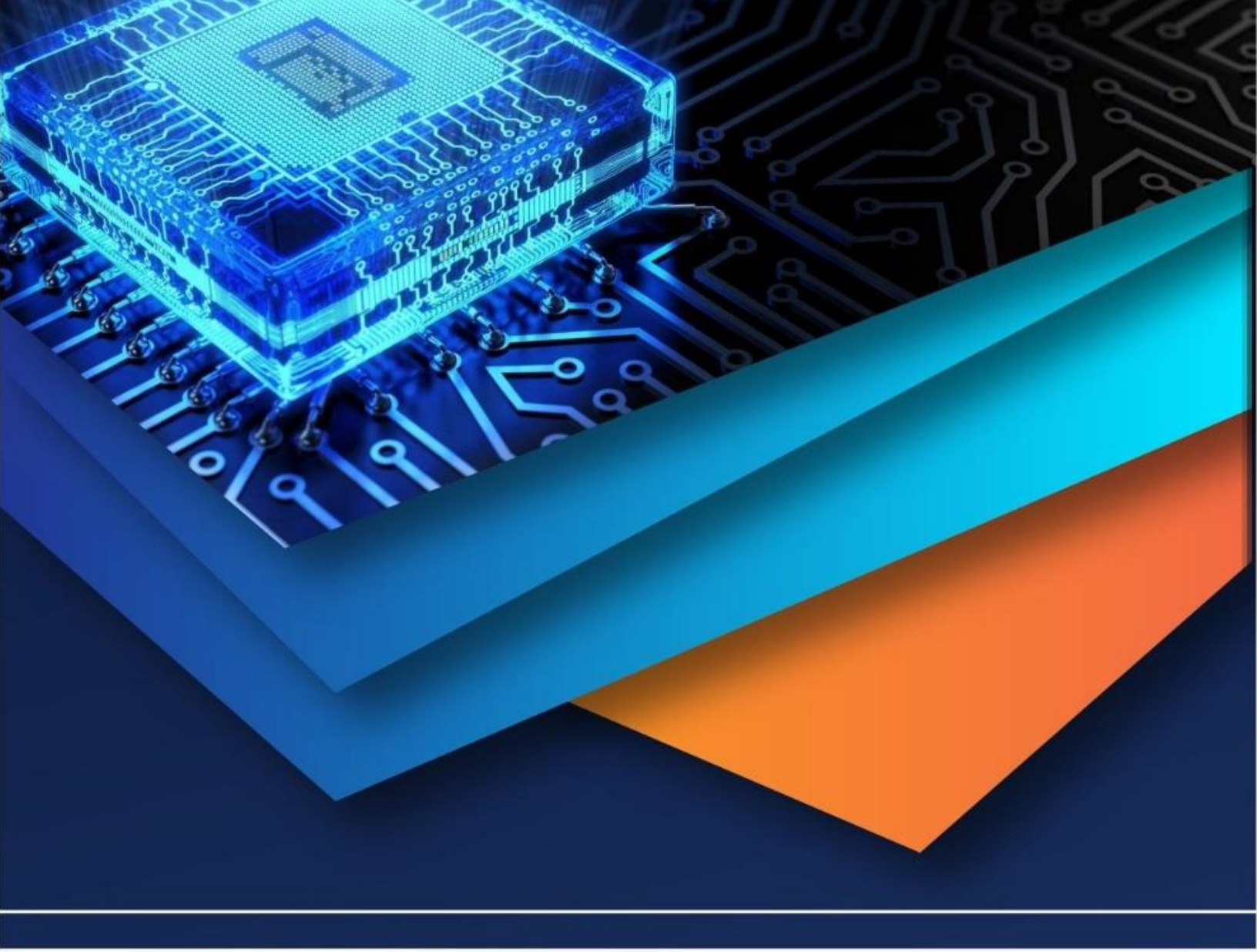

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