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Home Automation Using IoT with Raspberry Pi

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Abstract--This paper presents a Smart Home system based empowered by networking technology, single board computer Raspberry Pi and Android Powered Devices. The proposed Smart Home system is restricted do image transmission for home surveillance. Image from camera is collected by the dropbox server is send wirelessly. The Android Phone will transmit data using WLAN. Home automation provides the automatic control of home appliances also monitor home to provide safety from intruder. Raspberry Pi is used as main part of Smart Home system. Raspberry Pi support various languages i.e. C, C++, python etc. python is the default language of Raspberry Pi. Python language programming integrated with HTML language. This will enable smartphone access the Raspberry Pi through web browser application. Remote communication from user is carried out trough cloud storage server. The cloud storage (Dropbox) has been synchronizing with the data base in Raspberry Pi. The image transfer successfully done for home surveillance application.

Keywords--Internet of Things, Raspberry Pi, Pubnub, Dropbox, Raspberry Pi, Home Automation, Display, Sensors, Relay

I. INTRODUCTION

In today's world people are so busy in their life that they prefer automatic systems over manual system. [1]Wireless home automation using IoT is a system that uses computer or mobile devices to control basic home function and feature automatically through internet from anywhere around the world. It save energy and time also helps to old age peoples and disable persons by providing remote control of home appliances. Raspberry pi is used as main part of project; as events are occurred some specified functions are performed accordingly i.e. turn on or off light. Also sense the presence of person and click some picture uploaded it to cloud storage from where we can collect these. Programming is done using python and HTML.[2]

II. PROPOSED SYSTEM

In this project we are using mainly three modules i.e. Relay board, Camera Module and Temperature and Humidity Sensor. The core of this project is Rapsberry Pi that is a minicomputer which runs the backend process of home automation all the backend programs are running on the raspberry pi. All the programs that we run are coded in python.[3]

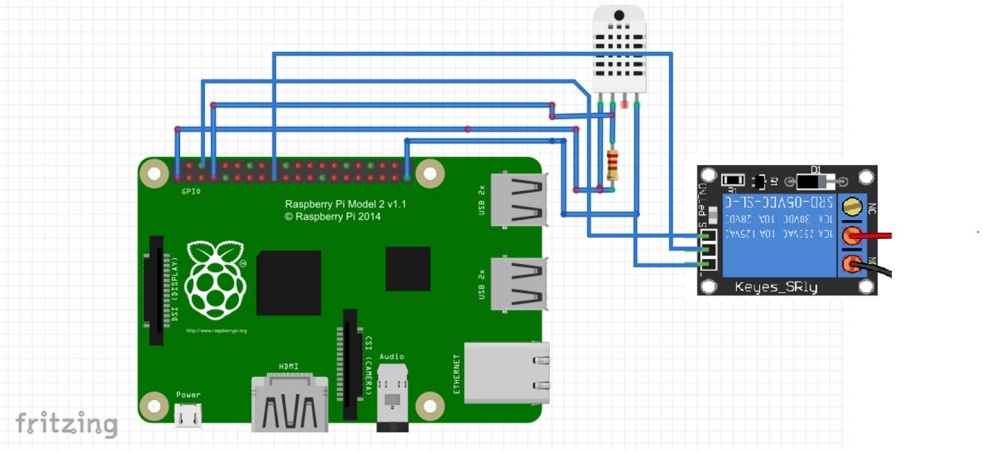

Figure 3.1: proposed circuit

The proposed system for security purpose and monitoring the home basically consists of Raspberry Pi 2 hardware, webcam, modem, sensors and modules. Raspberry Pi 2 has been chosen as the processing unit for the system because of its user friendly features and economic benefits. Further, python coded algorithm has been fed into the Raspberry-Pi and is connected to the internet through Modem interface to access and send data to web.[4] The Devices to be controlled have been interfaced with Raspberry-Pi using relay driver circuit due to different power ratings of devices and Raspberry-Pi. The sensor data are fed into web via integrated web

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server on Raspberry-Pi.

III. WORKING

A. Light control

The lights in the smart home can be controlled from anywhere in the world by means of internet. Here we use raspberry pi as our minicomputer that executes our back end program, the backend program is written in python and the front end program i.e. the user interface is build using HTML and designed using CSS language. There is totally 4 pair of buttons in the user interface and an extra button that directs the user to the temperature and humidity monitoring web page. Each button has its own function and event is generated whenever the button is pressed, whenever the event occurs the class calls the function of that particular event and hence by which a predefined message is being send to our specified channel.[5-6][21]

Here the channel used is that of Pubnub, each and every channel created in the Pubnub has a unique channel name a unique publishing key and subscription key using which the user will be able to access the channel. Whenever a button is pressed the a particular message is published into the Pubnub channel using the already obtained publishing key. The raspberry pi has subscribed to same channel using the subscription key. The raspberry pi monitors the Pubnub channel in the real time environment. The if conditions checks each and every message that is being received in the channel and if the condition seems to be true the raspberry pi makes the corresponding GPIO Pin HIGH and there by which the relay is triggered and the light goes on.

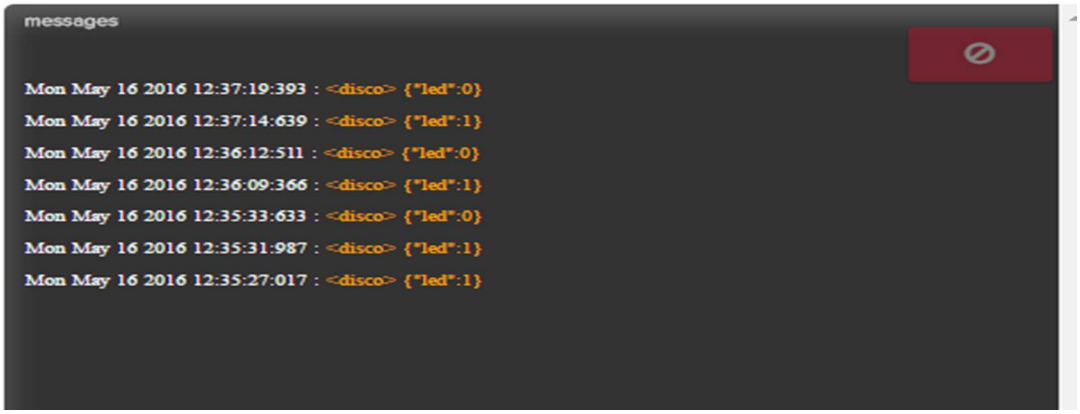

Figure 4.1: Console window of pubnub server to display led messages

B. Temperature and Humidity Monitoring

In order to monitor the temperature and humidity of the smart home we use the DHT11 sensor .This sensor monitors both the temperature and humidity in the room and send the real time data to the user. This real time data is received by the web user interface and by using the eon real time data monitoring and chart creation application the real time temperature and humidity is embedded to the web UI.[7] The DHT11 sensor has 4 pins pin 1 is the Vcc and the pin 2 is connected to GPIO 4 through a pull up resistor. The pin 3 of the DHT11 module is left free and the pin 4 of the DHT11 module is connected to the Physical Pin 39 of Raspberry Pi. The python program for temperature and humidity sensing is made to run in the raspberry pi and the data collected by the sensor is being published to the channel in Pubnub in the case the channel climate is used for the same. Now in order to publish real time data to the eon the storage and playback option in the Pubnub console is enabled that the Pubnub can generate history in the console. The eon script included in the HTML file receives the temperature and humidity value from the history block in the Pubnub console, it also collects the current time and then generates the real time graph based on that.

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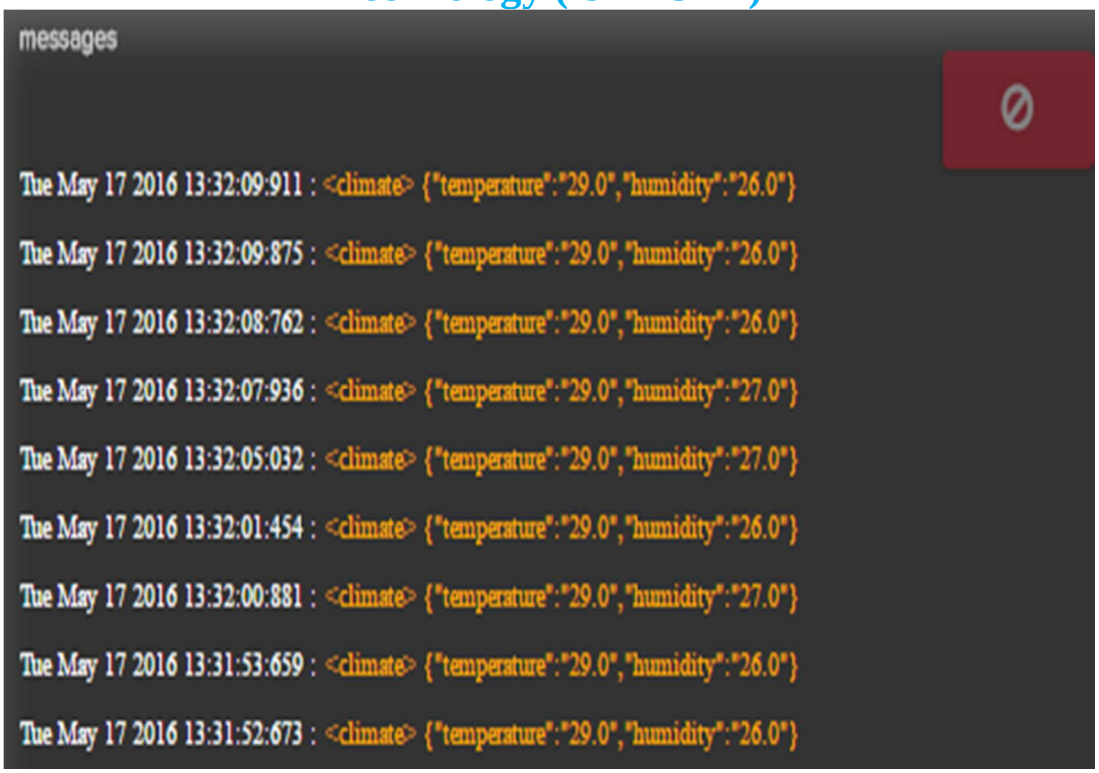

Figure 4.2: Console window of pubnub server to display temperature and humidity messages

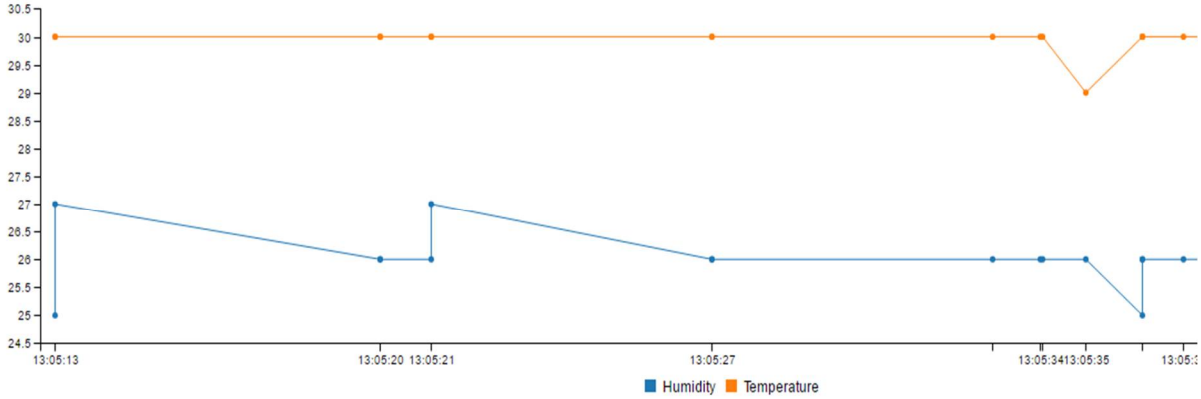

Figure 4.3: Temperature and humidity graph

C. Intrusion Detection and Security System

The intrusion detection system monitors the home via pi camera and if any motion is detected it clicks the photo of the intruder and uploads it to the dropbox so that the user can identify the intruder. For this we use Andrea Fabrizi's excellent Dropbox Uploader shell script. This script can run from a Pi or any other Linux/Unix machine and send data to Dropbox with a simple command. By configuring the motion software to call Dropbox Uploader you'll have a camera uploading images to Dropbox with almost no work. Dropbox is one of many popular consumer cloud storage services. By sending the Pi images to Dropbox you can easily view them from any computer using Dropbox's sync client or its web interface. [8][9]

To detect motion with the Pi camera we can use the excellent motion software package. This program will turn the Pi into a dedicated security camera that can monitor a connected camera to look for motion or periodically capture images. In order to use the motion package you'll need to load a special kernel module that will make it work with the Pi camera. Normally the Pi camera talks directly to the Pi's GPU so programs have to be written to specifically use the Pi camera--i.e. the camera doesn't appear like a webcam or other video source. However the Pi foundation created a special kernel module to make the Pi camera work with Linux's

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Video4Linux 2 API and look like a normal video source.[10][11] Using the Pi camera V4L2 module you can use the Pi camera with motion and most other Linux video programs. The camera module scans the pixels of the image and if there is any change in the pixel formation of the image there occurs an event and the photo captured is being uploaded into the dropbox account so that that the user can access the photos from anywhere.

IV. DISCUSSION OF RESULT

The Final Setup of the Project shown in Figure 4

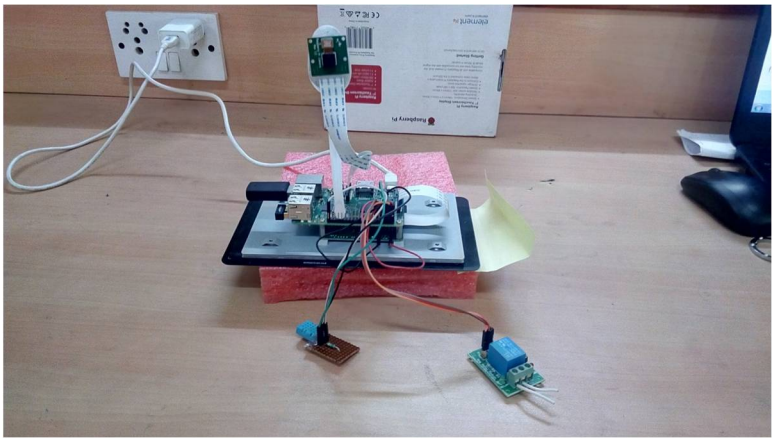

Figure 5.1: Final Setup of proposed project

First, I created a web page to control the home appliances over the local Network and done using HTML and JavaScript linked with Python script. Then prove a real time communication between UI and raspberry pi using Pubnub. UI contains four pair of button to turn light ON and OFF, and also one button to monitor temperature and humidity.[12][13]

Figure 5.2: Final Setup of proposed project

Then, monitor Temperature and Humidity over the Air and visualizing it. This Dashboard shows the Logs.

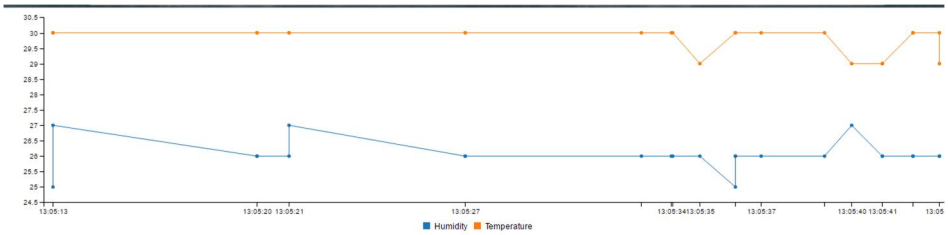

Figure 5.3: Temperature and Humidity Visualization

Then, program a alert system when motion detects sends the image taken by the webcam connected to Raspberry Pi and store to dropbox server.

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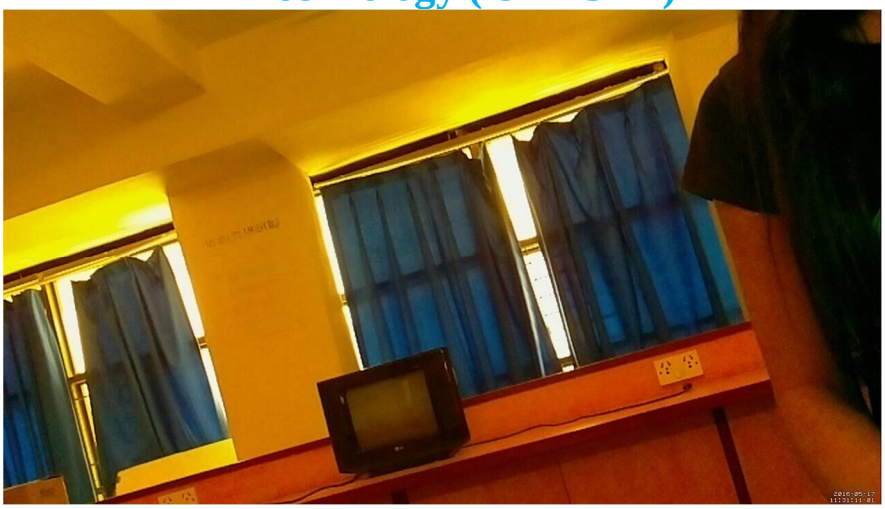

Figure 5.4: Motion Capture by Webcam

V. CONCLUSIONS AND FUTURE SCOPE

In today generation everything is dependent on computation and information either directly or indirectly. The project has two part hardware and software. Software part defines the algorithm for intruder detection, light control and temperature and humidity monitoring. Hardware part describes how the system was built, what module does it uses. The system is designed for light control, temperature and humidity monitoring, and intruder detection. The proposed system provides minicomputer based home security system by use of very advanced low cost stable operating system. In future works, it is planed the development of new modules to reduce the energy necessary for surveillance cameras. By adding a solar energy panel, the camera will be capable of harvesting the solar energy and be wireless. With a very low power Wi-Fi module, it will be able to upload the recorded videos to a server. In addition, to control all the modules, in order to keep the performance and control the energy usage through periods of little or no solar energy supplied, there will be a control module.

VI. ACKNOWLEDGEMENT

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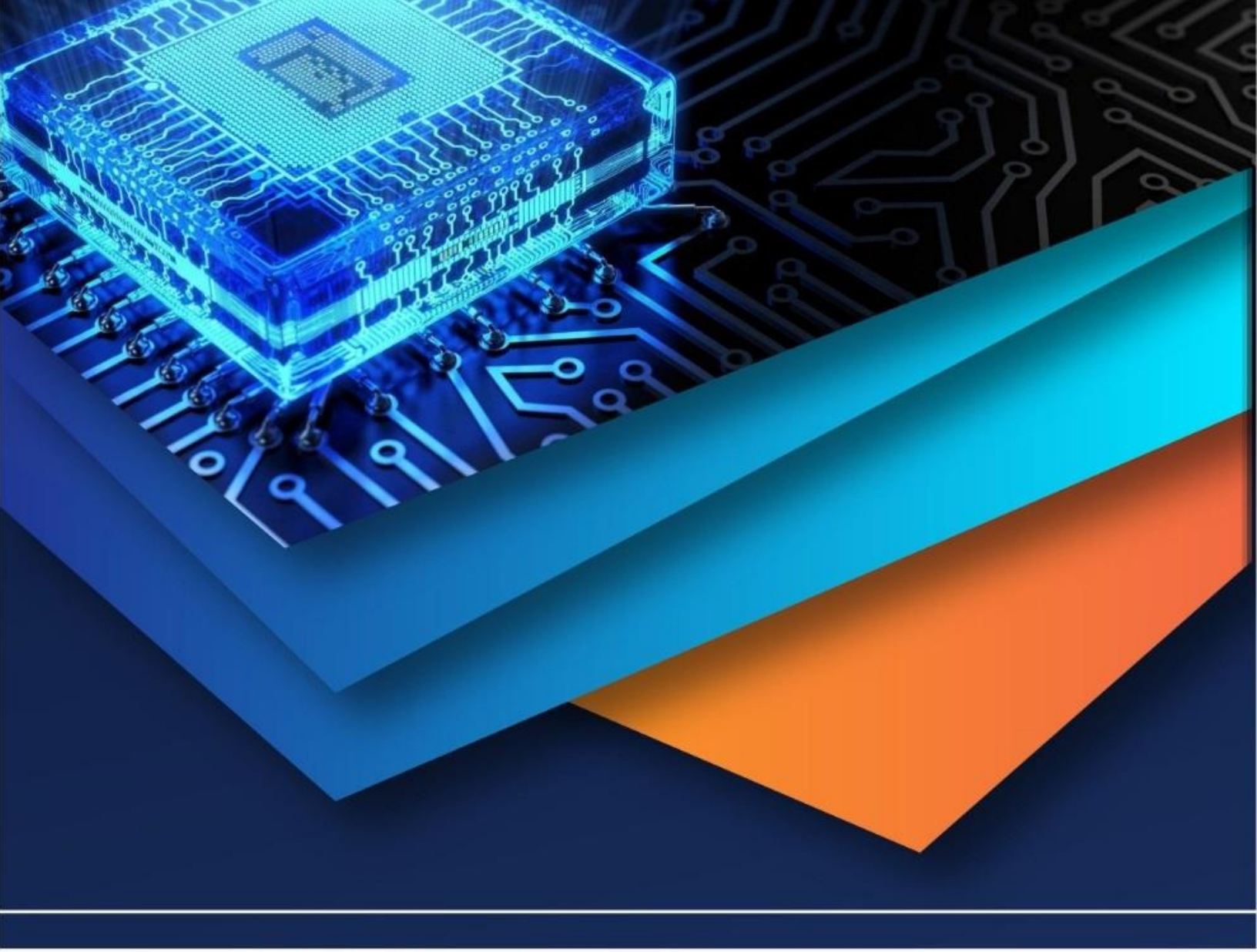

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