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Design and Development of Automated Office Management System Using Zigbee & GSM

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Abstract: In today's fast paced world, office management system still lacks quality and proper facilities to carry out day-to-day activities with the changing socio-economic impact on industry firm. Hence an efficient system for an office/firm, with the following salient features– (a) Wireless fingerprint attendance system based on Zig bee and GSM technology (b) Energy management with minimizing power consumption and (c) Creation of an eco-friendly environment in the office, is developed.
The system includes fingerprint acquisition module and attendance management module through computer. It can realize automatically such functions as information acquisition of fingerprint, processing, wireless transmission, fingerprint matching, and attendance management. The system is also based on building automation involving a prototype to minimize energy power consumption and creation of an eco-friendly environment in office using sensors and interfacing it with a microcontroller.
Keywords: Attendance System, Fingerprint identification, Wireless communication, Zig Bee technology.

I. INTRODUCTION

Attendance is usually the top priority of any institution be it an industrial firm or educational institution. It is a high weight metric to evaluate any individual. So there is a need of a powerful and accurate biometric system to automate the attendance procedure. Today there are many such systems that satisfy this criterion but most of these are wired. This creates a room for a system that uses a powerful biometric for individual recognition and an inexpensive protocol for data transfer.

The modern era beckons to solve the energy crisis along with increasing energy consumption day by day which is creating problem everywhere. Particularly in city area with huge offices and industries has become a big part of energy consumption. Thus, the role of automated control systems in helping to reduce the energy consumption and provide production safety with ecological balance preservation is significantly important.

The prototype developed aimed to solve the above mentioned problems. The main purpose of this work was used to develop (a) A low cost and high performance office automation system with wireless finger print attendance system by using Zigbee and GSM technology and (b) A system for energy management and setting up eco-friendly premises.

II. SYSTEM STRUCTURE AND FUNCTIONING

The system consists of two components. The primary component comprises of fingerprint scanner module, Transmission and receiving module for data, and attendance Management application and database server as shown in Fig 1 and Fig2.

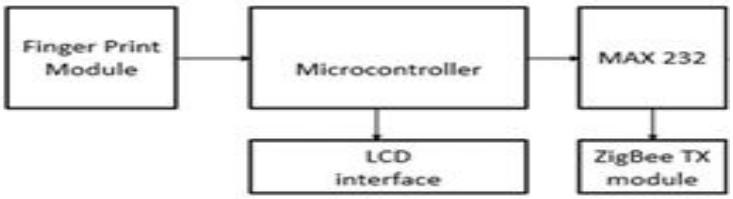

Fig 1. User Unit part.

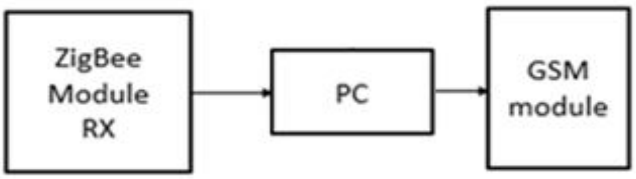

Fig 2. Central Control Unit

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Fingerprint acquisition module is used to realize fingerprint matching and collection. Zig Bee module is used for transmission and reception of corresponding fingerprint address to computer. Attendance management workstation (PC) is used to realize fingerprint address extraction and store result in order to realize attendance function and database. If the finger prints image template and recorded sample in the database matches, attendance is granted. GSM module connected to computer will acquire the attendance status from the database and will send messages to the concerned mobile phone over the GSM network.

The secondary component which handles Energy Management System has PIR sensors which will sense the presence of a person thereby sending signals to the microcontroller which controls the lights and fan/ac. Smoke sensor will detect the increased CO2 level content. It will send signal to microcontroller which will trigger sound alerts thereby helping to have a smoke free environment. The cabin control unit is shown in Fig3.

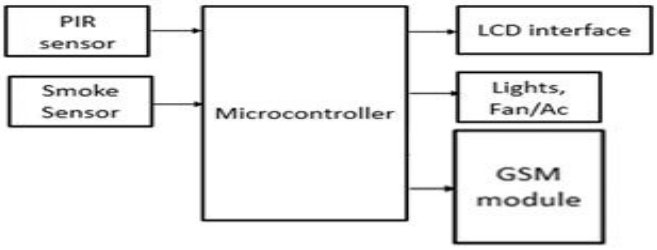

Fig 3. Cabin Control Unit

The finger print module in the User unit captures the data which is a person's fingerprint. The sensor forms the core part of the fingerprint module. This in turn is connected to a microcontroller using RS232. The microcontroller stores the captured data and identifies a unique ID for the data. The unique id of the captured data is sent through the ZigBee transmitter module for further processing.

The unique id of the captured data is received by the Zig bee receiver module and is forwarded to a PC .The database of the employees details stored in PC is compared with the unique id. If they match then attendance is indicated in the application and stored in database. The PC also sends the information to the concerned person through the GSM module as an SMS.

The PIR sensor and smoke sensor are connected to microcontroller and according to the threshold set the output devices are controlled.

The control flow of the system can be represented by following flow charts as shown in Fig 4 and Fig 5.

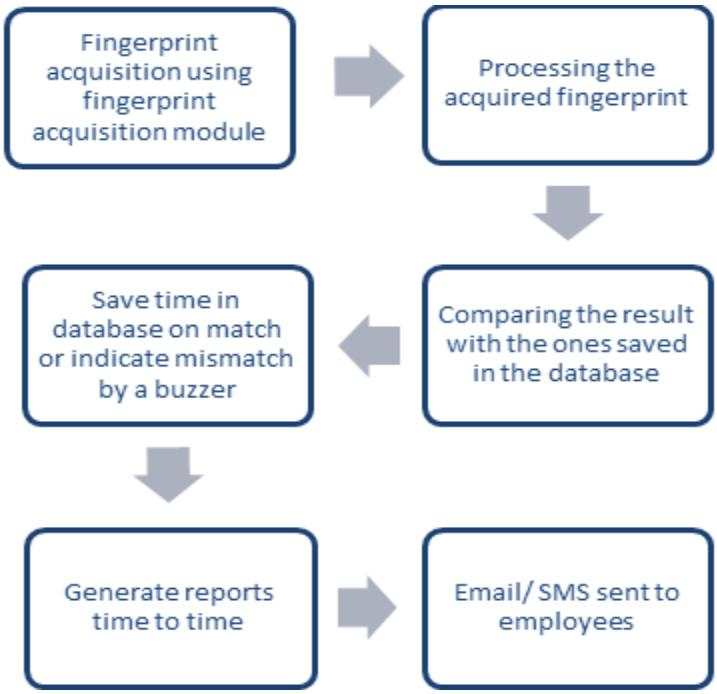

Fig 4. Flowchart explaining working of user and central control units.

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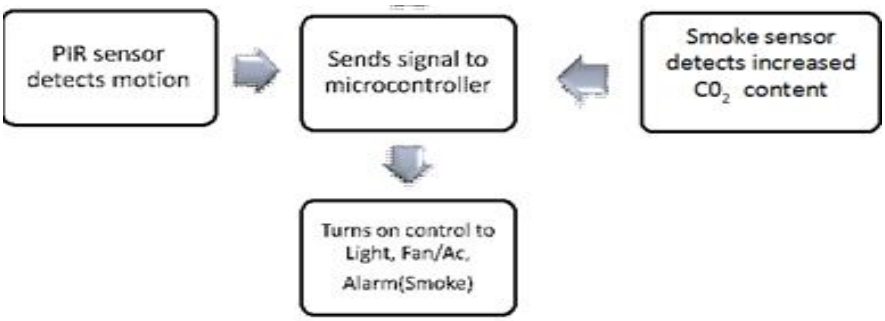

FIG 5. Flowchart explaining working of cabin control unit

III. SYSTEM DESIGN

The system hardware includes: fingerprint scanner module (R305), GSM modem(SIM 900), microcontrollers - ARM7 LPC2148 and Arduino-Uno, Zig bee Transceiver, PIR and smoke sensors. The system software includes programming the microcontrollers and developing an application for registering and verifying finger print.

A. Fingerprint Acquisition Module

Fingerprint processing includes two parts: fingerprint enrolment and fingerprint matching (the matching can be 1:1 or 1: N). When enrolling, user needs to enter the finger two times through optical sensor. The system will process the two time finger images, generate a template of the finger based on processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library previously created. For 1:1 matching, system will compare the live finger with specific template designated in the module and for 1: N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result as either success or failure.

B. ZigBee

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range.

This module is responsible for transmission of information from the microcontroller to the workstation(PC) that is running the Attendance Management Application. Zigbee module doesn't perform any computation over this data, it only forwards to it to the Zigbee receiver. Zigbee receiver forwards it to the Application.

C. GSM module

This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. The communication with the microcontrollers takes place via RS232 serial port. The GSM modem helps in not only sending the attendance status but also to inform about breaching if taken place. It also updates the status of the electrical appliances in the cabin/ cubicle of the employee through an SMS.

D. Microcontrollers

The LPC2148 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. This module is used to receive input from the Fingerprint Processing system.

The Arduino is used to get sensors data and control the output devices and also send SMS alerts to the user through the GSM modem.

E. Senors

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are used here to detect the presence of an employee in his cabin/cubicle.

A carbon dioxide sensor or CO_2 sensor is used for the measurement of carbon dioxide gas or smoke detection. Measuring of carbon dioxide is important in monitoring indoor air quality.

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F. Visual Studio C#.NET

The .NET Framework introduces a completely new model for the programming and deployment of applications. .NET is Microsoft's vision of "software as a service", a development environment in which user can build, create, and deploy his own applications and the next generation of components. Here the application designed is connected with SQL server database management for data storage and acquiring data from server to application end to display report.

G. SQL Server

A database management, or DBMS, gives the user access to their data and helps them transform the data into information. Such database management systems include dBase, paradox, IMS, SQL Server and SQL Server. These systems allow users to create, update and extract information from their database.

A database is a structured collection of data. Data refers to the characteristics of people, things and events. SQL Server stores each data item in its own fields. In SQL Server, the fields relating to a particular person, thing or event are bundled together to form a single complete unit of data, called a record. Each record is made up of a number of fields. No two fields in a record can have the same field name.

IV. RESULT

The prototype designed are shown in Fig 6 and Fig7. This prototype takes the attendance of the employee and sends this attendance to their mobile through GSM.

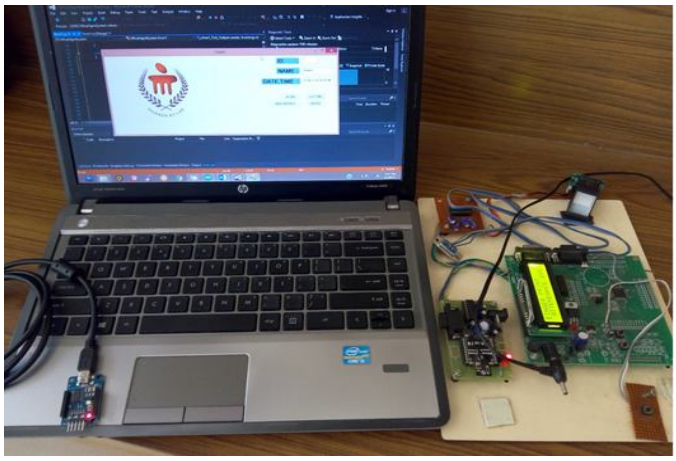

Fig 6. Experimental setup of User unit and Central control unit

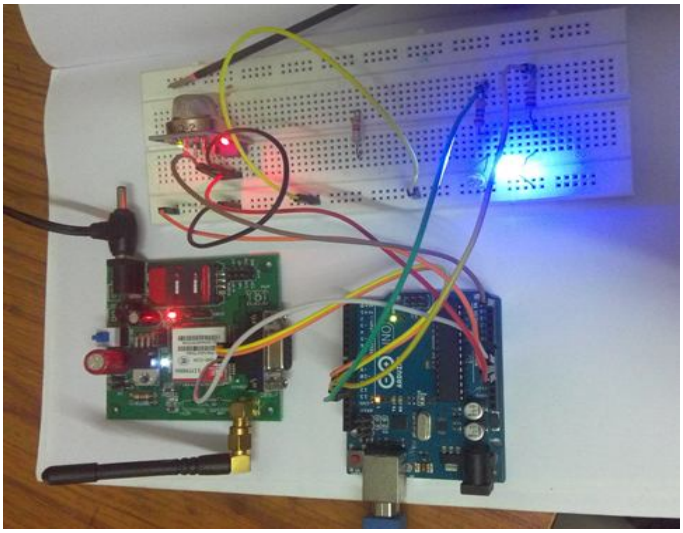

Fig 7. Experimental setup of Cabin control unit

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Fig 8 shows the application developed for attendance management system using Visual Studio C#.NET and SQL Server.

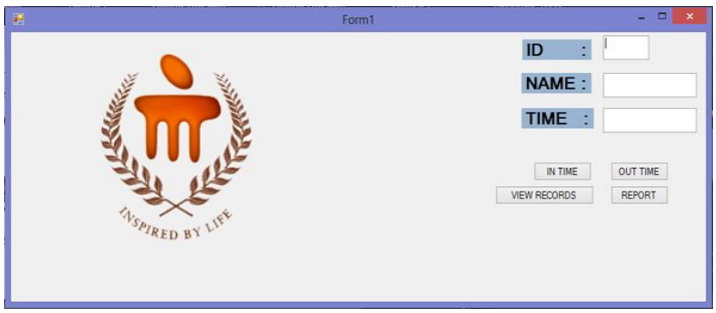

Fig. 8. Application developed for attendance management system

Fig 9 shows the application where th finger print is displayed.

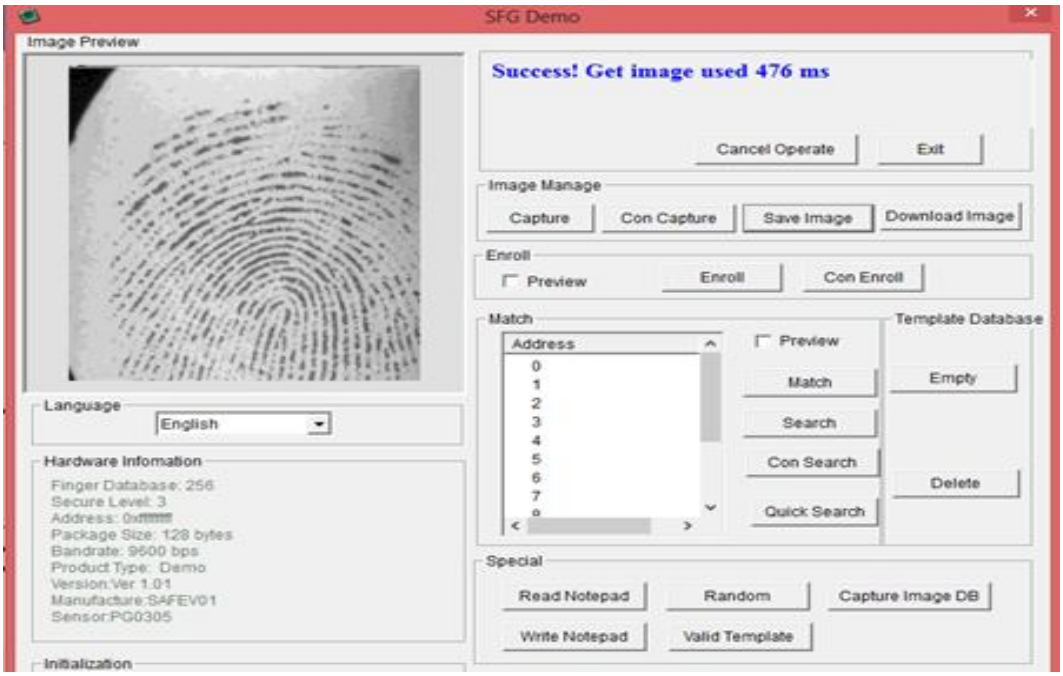

Fig 9. Application with the finger print displayed.

Fig 10 shows the employee attendance report generated.

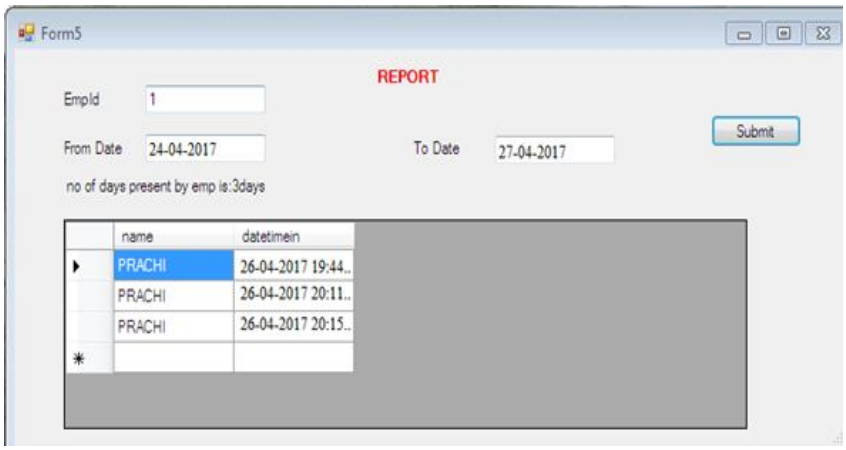

Fig 10. Employee attendance report

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Fig 11 shows the screenshot of serial monitor of Arduino checking various sensors and sending alerts.

Fig 11. Serial Monitor od Arduino

V. CONCLUSION

The developed prototypes realized as a low-cost and high-performance wireless fingerprint attendance management system. It also supports real time monitoring for energy conservation and to set up an eco-friendly environment.

The feasibility of the prototype was analysed so that it can be brought out as a commercial product with minor up gradations as per the requirements of the customers. The prototype seemed to be economically and technically feasible.

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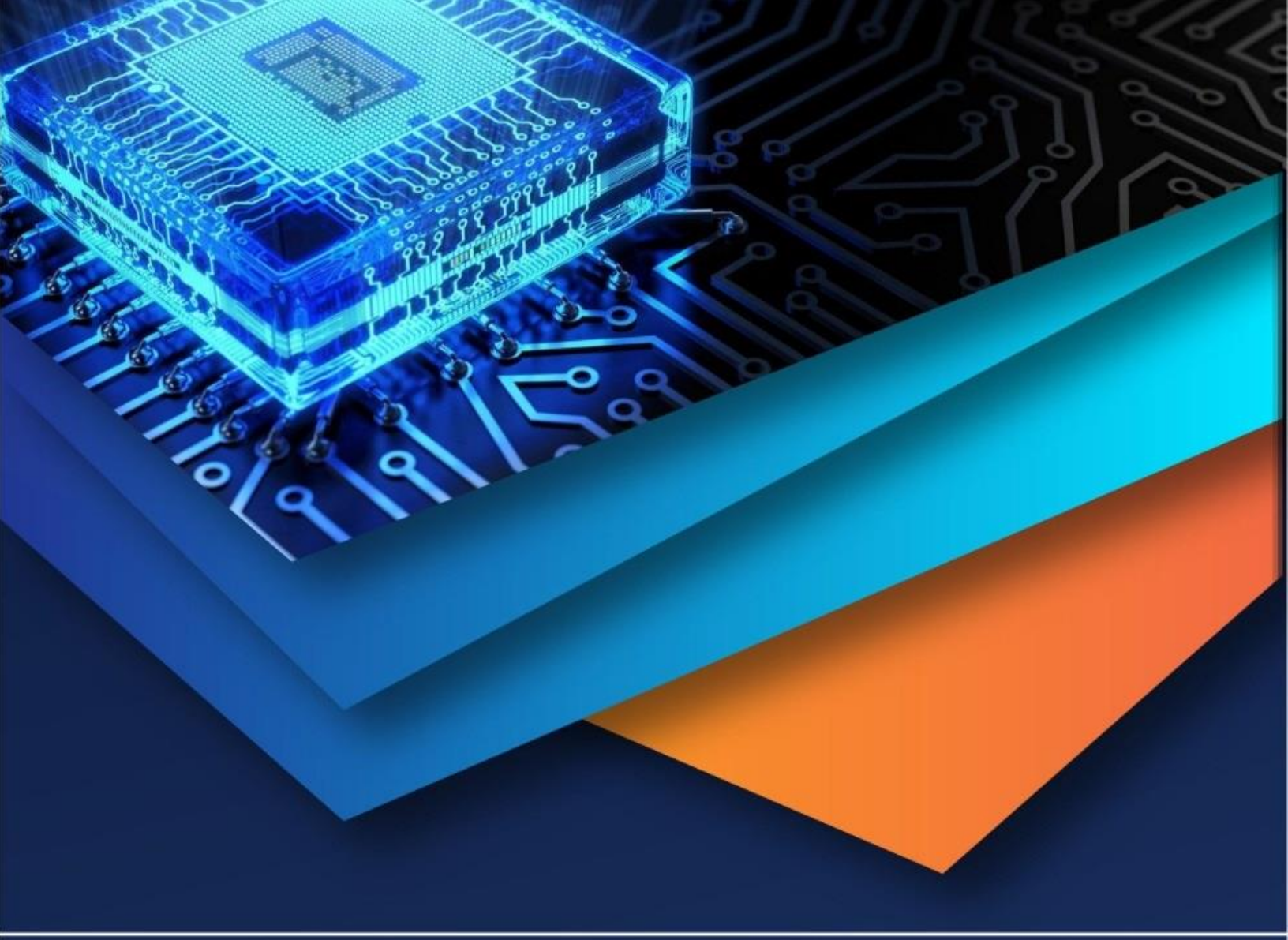

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