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Fingerprint Biometric Technology as an Appropriate Tool for Students Authentication Problem in Tertiary Learning Institutions in Tanzania

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Abstract: ***The use of Information and Communications Technology (ICT) in Tertiary Learning Institutions (TLI) in Tanzania has brought many advantages in day-to-day institutional activities; this is due to high demands of security, efficiency, effectiveness and time management in service provision. However, despite the good ICT infrastructure TLI institutions have, still managements and service providers are challenged by improper identification and verification of students during meals, gate passing and examination. They use plastic card identification with barcode technology, lead to high running costs for they are easily damaged/scratched, forged. Additionally, leading to inaccurate record keeping especially during the use of temporary identification cards (paper based), time wastage on queue for getting identified, moreover, leading to nasty dialogue with students once identification or verification problems occurs. Nevertheless, students get challenged by reproduction costs in case of ID card lost or damage, late of issuing of ID cards after renewal payments, as well as experiencing disturbances from management and service providers for the ID problems.***

To address and solve the plight, this research applied literature review, observation, documentation and quantitative research methods to collect data. It was revealed that, most of students and the management do not satisfied with the use of plastic ID cards and they highly recommends the use of biometric technology. Additionally, they showed that are aware of various biometric identification and verification methods. Moreover, they highly recommended among other methods, the use of fingerprint-based identification and verification method.

Finally, the study developed an application as a prototype that use finger-print to identify and verify students during the time of taking their meals in Tertiary Learning Institutions in Tanzania. The prototype of the application developed using C#, ASP.NET, HTML, Java Scripts and MySQL. The application developed replaces the plastic-based ID cards to identify and verify students during taking their meals in Tertiary Learning Institutions in Tanzania.

Keywords: Identification, Verification, Biometric, Fingerprint, Tanzania Tertiary Learning Institutions

I. INTRODUCTION

In Tanzanian context, Tertiary Learning Institutions are referred to as the institutions that offer training in technician, semi-professional and professional levels leading to certificate, diploma or other related awards [1]. Students in these institutions are either admitted as government sponsored–those who are selected direct by the government from form four examination or Ordinary Level selection (after passing Ordinary Level education examination) or those admitted as private sponsored students–these apply direct to the institutions and fulfil admission requirements.

All government sponsored students are provided with a meals service by the government as part of sponsorship, whereas private students who need the meal service within a campus are required to pay for it the same rate charged to students sponsored by government. To distinguish students who qualify for meals service from those who do not needs, a proper identification process is required. The number of students enrolled in Tertiary Learning Institutions is on an increase; this is due to the pivotal and compulsory role of science and technology in the implementation of the strategy to uplift Tanzanian economy to a middle-income[2][3]. This escalation consequently leads to the long queues of students when taking their meals. For instance, students are staying on queue waiting to get meal service. Indeed, they lost a lot of time which they could spend in other core activities of, the

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learning such as conducting discussions, doing assignments or private studies. Additionally, the increase of number of students, consequently intensifies the challenge of identification and verification process as it will require conducting it quickly and properly in order to timely provide the service to the beneficiaries only.

Based on the aforementioned challenges regarding to the other than fingerprint method of identification and verification, this research presents a fingerprint based biometric method for students' identification and verification during taking their meals in Tertiary Learning Institutions in Tanzania.

II. RELATED WORK

Several approaches have been used in order to improve personal identification and verification. This involves methods or technologies from scholars that describes a need of proper identification and verification methods in educational sector for students and other institutions stakeholders.

A research by M. Akshatha, in [4] presented a Student Authentication and Verification System using Barcode Scanner as an alternative method for students identification and verification. The use of bar-coded smart card helped students to perform multiple functions; like canteen bills, library fines and others after recharge instead of dealing with cash money and the automation operation technology adoption. On the other side, barcode technology suffers from line of sight operation with the barcode scanner, environmental effects (natural wear and tear), limitation of data storage and static data updates [5]

Despite of the good performance, fast readability and large storage capacity of information offered by QR code compared to barcodes in identification and verification of a personal, QR code technology requires devices like smartphone and QR code software to operate, that could be an obstacle for students to purchase smart phone basing on poor financial backgrounds of parents. [6][7].

Furthermore, a research work by M, B, and Kharade [8], present an Advanced Student Identification System Using Radio Frequency Identification technology (RFID technology). The technology provides automatic contact less student identification. Though RFID technology provides advanced featured regarding to security and identification and verification compared to barcode identification and verification, still costs, agreement on standardization regarding communication protocols, signal modulation types, data transmission rates, data encoding and frames and collision handling are among of the challenging issues[9][10].

Moreover, a research works by Issue[11] presents the use of smart-cards identification and verification technology that involves chip technology, which is capable of providing an extremely secure operational framework in terms of user and application provider authenticity, management of access privileges, data integrity and confidentiality. Despite of the good features, smartcards possess the following shortfalls; high costs of production, environmental affects (can easily damage, lost), skimming and can be involved in information theft via internet [12][13].

The above research findings, reveals that the use of plastic ID card regardless of the technology used can still be an obstacle for implementation in TLS. This is due to the fact that plastic ID cards are easily lost, stolen and are easily affected by environments when are not kept properly.

A. Meal Service in Tertiary Learning Institutions.

In Tertiary Learning Institutions, meal service is provided under government and private sponsorship bases. Upon completion of registration, all government sponsored students are added to the meal system for service, while all private sponsored students have to pay for costs for meal service at the campus. The government provide meal service to government sponsored students in order to encourage young Tanzanian to study science especially technical studies [3].

B. Biometric System

A biometric system is a technology which takes an individual's physiological, behavioral, or both traits as input, analyzes it, and identifies the individual as a genuine or malicious user [4].

A biometric system can be either for verification or identification. Verification is the process that compares a person's presented biometric data to a biometric data for the person he/she claims to be, that is already saved in the system. On the other hand, identification is the process that checks if a person's presented biometric data matches to any biometric pattern in a database [5].

Some of the examples of biometric systems are fingerprint recognition, iris recognition, voice recognition, signature recognition and gait recognition [6].

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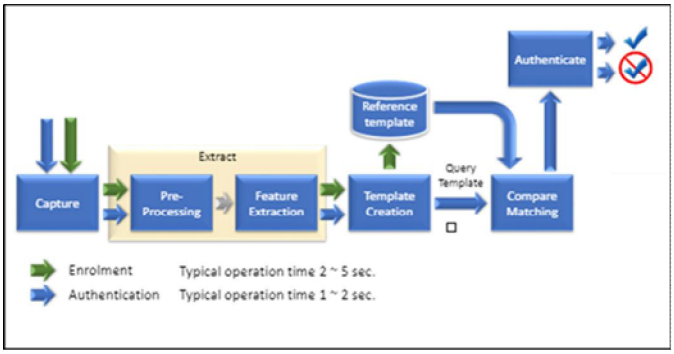


Figure 1: Biometric System

C. Fingerprint Biometric Method/Technology

Fingerprint is among of biometric technology that uses human finger patterns to identify people. It is the most accepted biometric technology and widely used compared to other technologies due to factors like ease of use, ease to adopt, low implementation cost and high universality. Fig. 2 below shows the acceptance of various biometric types. Basing on this figure, fingerprint biometric score higher market shares of 65% compared to other biometrics. This is an indication that fingerprint is the most applicable biometric type in worldwide among from other biometric types. Also, according to Saini & Narinder[14] distinctiveness and universal are among the key factors that distinguish fingerprint with other biometrics.

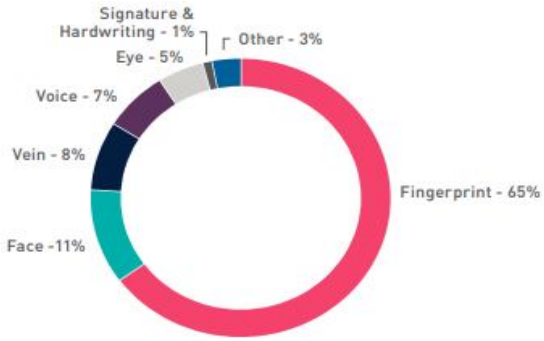


Figure 2: Biometric Technologies

D. Fingerprint Identification and Verification Processes

Like any other biometric technology, a fingerprint identification and verification involve fingerprint enrolment, image processing, storage, verification and identification processes. In enrolment, a fingerprint is captures via fingerprint sensor and extracted to obtain genuine features for a personal identification. The extracted image is then stored to the database for performing image comparison with a live fingerprint image from the scanner during personal identification and verification. The matching operation then is used to decide whether the authentication has been granted or not.

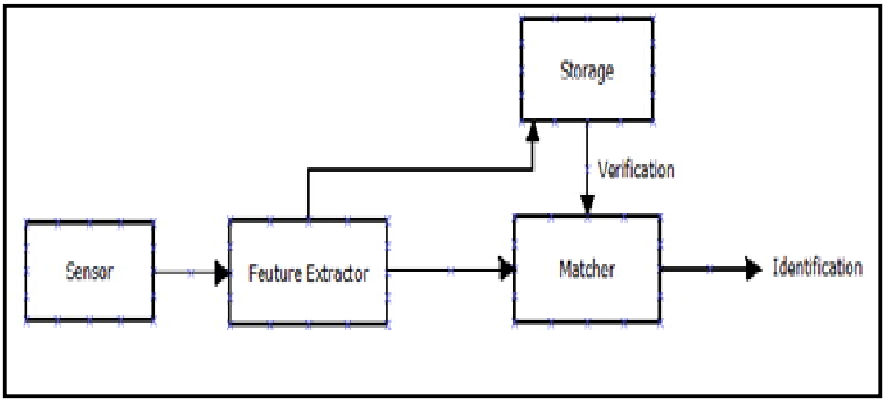


Figure 3: Finger print recognition process

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III. RESEARCH DESIGN

This study involved four (4) Tertiary Learning Institutions allocated in three regions in Tanzania; Dar Es Salaam, Mbeya and Arusha. All these institutions are government based which provide tertiary education. The research was conducted in April and May, 2018 and it involved students and institutional management only. Questionnaires, observations, documentation and literature review methods were used for gathering information for the study.

A. Population and Sampling Technique

The study population involved students and institutional management. A total number of 200 responded, of which 183 were students, 17 and were institution management. Purposive sampling method was used to get the said sample from four (4) mentioned institutions. Just few representatives were obtained from all groups int NTA levels (4-6).

B. Data Analysis

To analyse the collected data, the research used pandas (python) data package tool.

C. Research Results

The study conducted showed that, both students and institutional management faces challenges on the use of plastic ID cards for students' identification and verification. Forgery, easily lost/damage, transferability and reproduction costs are among of the challenges mentioned. Regarding to awareness of biometric methodologies, both students and institutional management are aware of biometric identification and verification, by 77% and 82.4% respectively. On the other side, the study aimed to know how much students and Institutional management knows about fingerprint methodology for verification and identification. The results showed that 60.7% of students and 77% Institutional management knows about fingerprint biometric methodology. Also, on recommending the use of fingerprint methodology for student identification and verification in TLIs in Tanzania, most of students and institutional management strongly recommends for the adoption of the fingerprint methodology as an alternative to plastic ID cards.

IV. PROPOSED SYSTEM

The developed system includes two main functional parts, one for student registration and the other part is authentication part. In registration/enrolment part, student's particulars are captured to the system and stored to the server for future use.

During the time of taking meal a student must scan one of the registered fingers through an input sensor device connected to the computer. The live captured image sample is again processed to get a genuine sample that is then compared with the saved samples from the database.

The authentication process involves verification and identification processes. Verification process involves 1:M (one to many) matching, a captured sample is compared to find if there is any sample that match with among the saved samples.

On the other side, identification process involves 1:1 (one to one) matching, the captured sample is matched with the exactly saved sample.

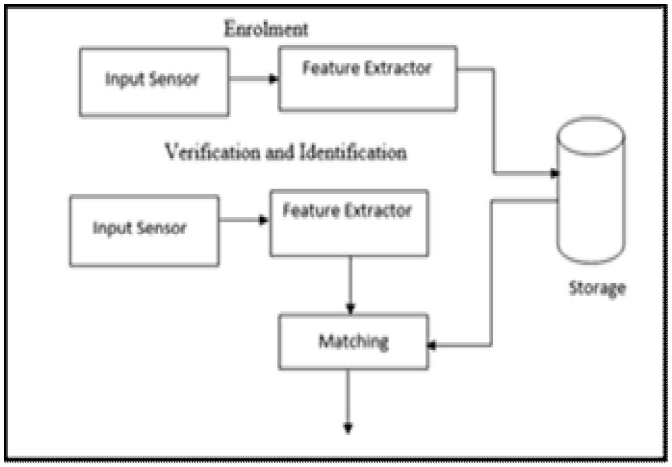


Figure 4: General architecture of a fingerprint biometric system

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A. *Conceptual Diagram of the System*

The system has three main system users which are administrator (institutional management personnel), a caterer and students. The system administrator registers all other users to the system while students are responsible for scanning fingerprints during registration on commerce of semester and are responsible for scanning their fingers each time they attend to the cafeteria or dining hall for getting a particular meal.

On the other side, a caterer or meal service provider, is responsible for setting or specifying a type of meal to be taken by students whether is a breakfast, lunch or dinner. Also, a caterer is responsible for monitoring the scanning process through computers connected with the fingerprint scanner. The monitoring process aimed to avoid none authenticated students to get a meal. This monitoring is due to lacky of automation of some of the facilities like biometric gates. In some cases, like dirty fingers or too much wet fingers can cause reading problem that can cause rejection of students during fingerprint scanning. To login to the system administrator and a service provider can use passwords credentials or fingerprints.

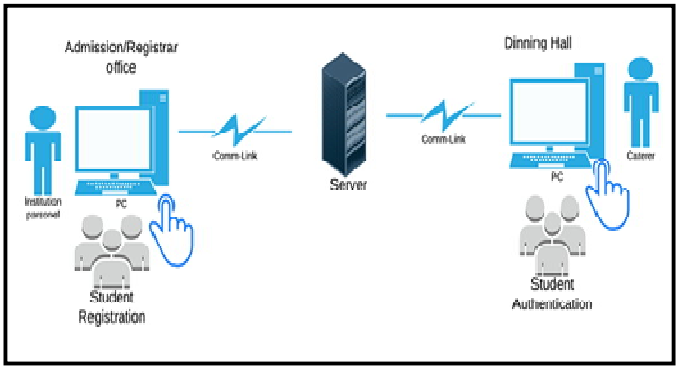


Figure 5: The conceptual diagram of fingerprint biometric cafeteria management system.

V. SYSTEM DEVELOPMENT

The development of the system adopted Rapid Application Development model (RAD) which is among of the system development models that provide interactive, fast and cost-effective development solutions to system development[15].

VI. LOGIN MODULE

The interface allows system users to login to the system. To login to the system a user can use either a fingerprint or a username and password credentials.

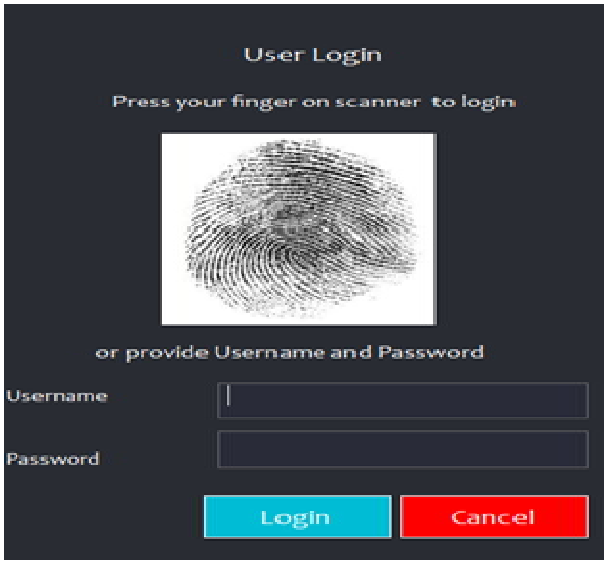


Figure 6: User login Interface

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VII.REGISTRATION MODULE

The registration module adds students and system users to the system. The module involves adding a student's personal particulars and fingerprints captured from the biometric sensor.

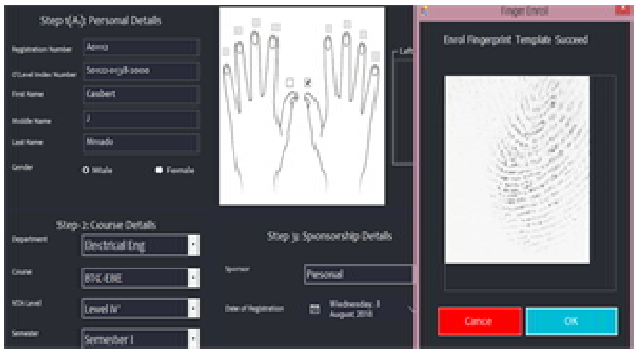


Figure 7: System Registration Interface

VIII. SET MEAL MODULE

This interface allows a caterer or meal service provider, is responsible for setting or specifying a type of meal to be taken by students whether is a breakfast, lunch or dinner



Figure 8: An interface for setting a particular meal

IX. FINGER SCAN MODULE

The Module represents an interface used to allow student to scan their fingerprints for authentication. In this part, a student is allowed to scan a finger that was used during registration.

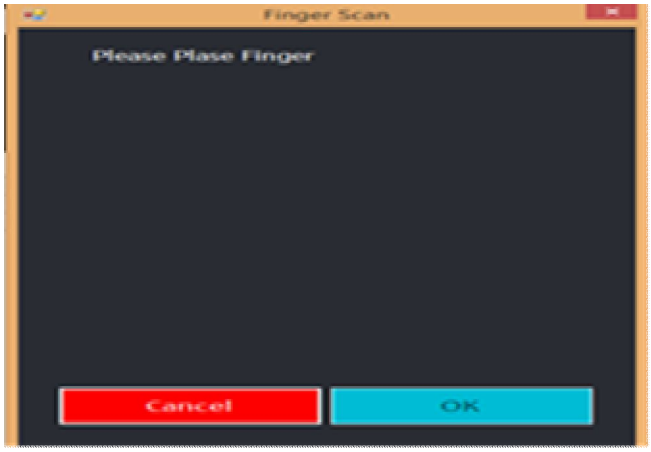


Figure 9: Finger scan interface

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X. FINGERPRINT IMAGE INTERFACE.

This interface shows the image of a student's fingerprint captured by a scanner.

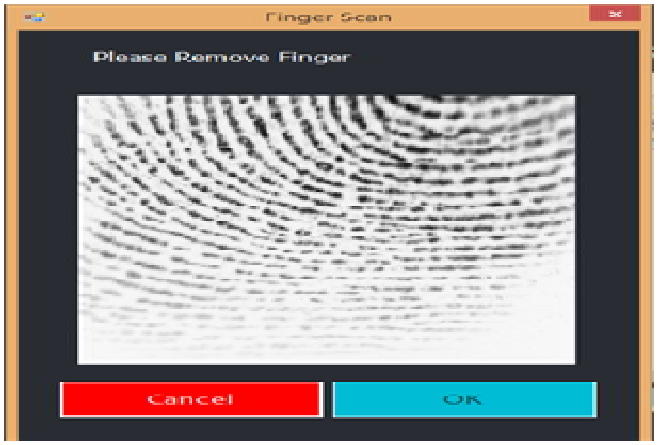


Figure 10: Fingerprint image interface

XI. REPORT MODULES

This part provides various reports that can be generated from the system. Figure 10 and Figure 11 represent reports for registered students and a list of students attended a breakfast meal for a particular day respectively.



Figure 11: List of registered Students

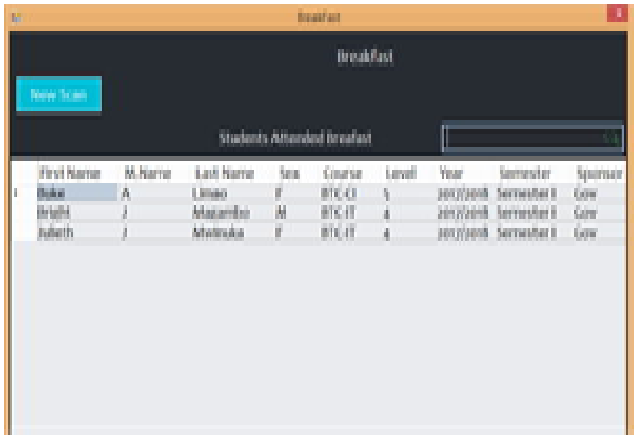


Figure 12: A list of students attended breakfast meal

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XII. CONCLUSION

Fingerprint technology is by far the most suitable and reliable approach for personal identification, as it basically takes care of security and prevents impersonation among students. Furthermore, it is less prone to forgery compared to the existing method on the ground, and hence can be deployed to solve the problem of students' identification and verification during meals in Tertiary Learning Institutions. All the modules of the developed system were tested and positive results were achieved. It is about time that traditional serving meal cards give way to fingerprint biometric identification and verification for security, cost affordable, fast and reliable records.

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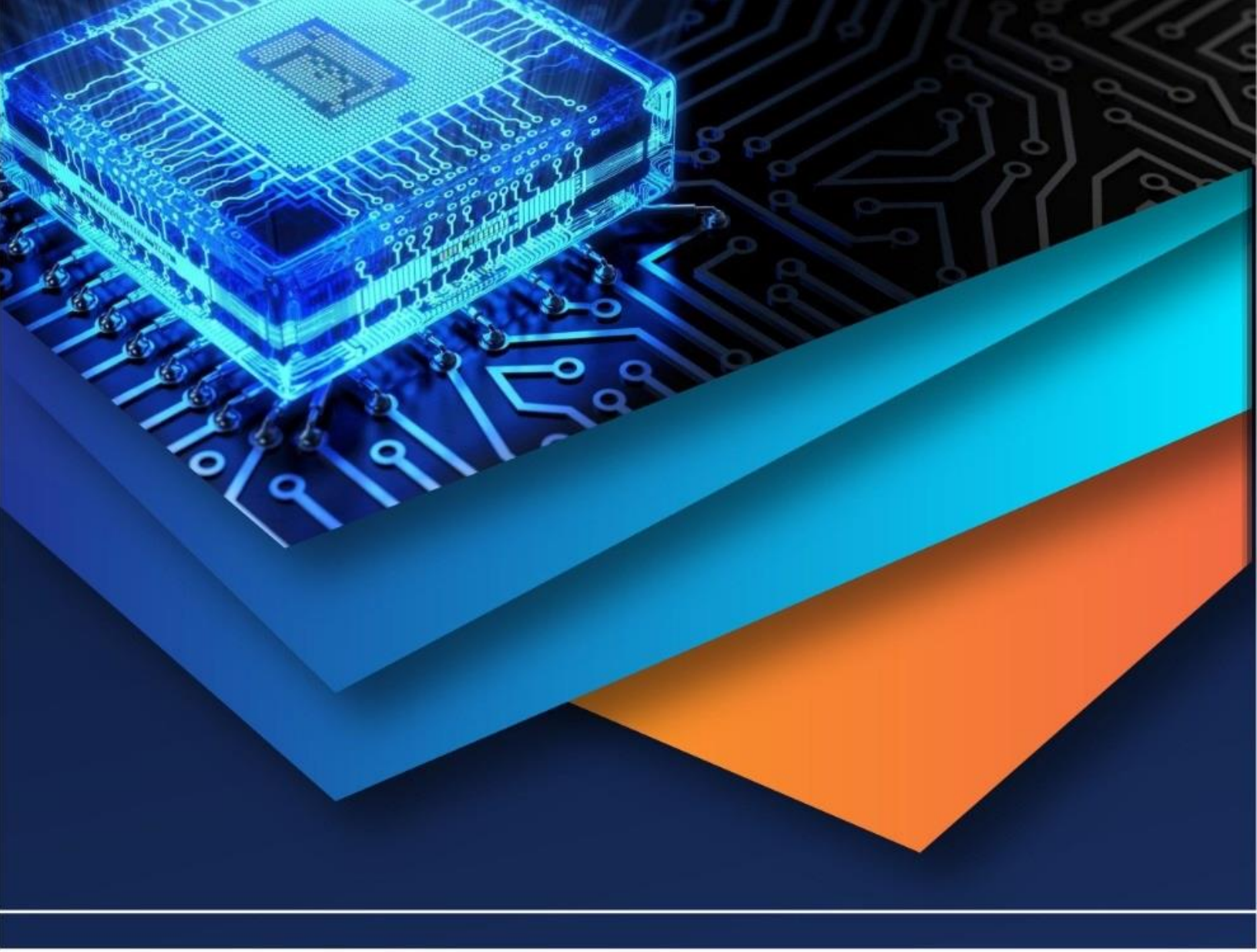


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