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Smart E-Commerce and Facilities Management System Based On I-Button

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Abstract: ***Technological advances in the field of Electronic commerce and facilities management have been overwhelming in the present years, conceding the freedom to consumers for accessing and using these services when and where they wish, at times and places that are convenient to them. The idea of paying for goods and services electronically is not a new one. All around us we see evidence of transactions taking place where at least part of the process is carried on electronically.For ages we have been using computer readable devices for E-commerce and facilities management applications that are based on identification technologies such as Bar codes, Magnetic stripes, Chip cards and RF tags. The range of consumer devices for E-commerce and facilities management access based on these technologies includes Credit card, Debit cards, and Identity cards.In the next step of evolution, the identification technologies are surpassed by silicon media thereby shortening the range of consumer devices to a single device known as iButton. An iButton is a 16mm computer chip housed in a stainless steel casing of a size not greater than a 25- paisa coin. iButton can serve as secure medium forstoring E-Money and user credentials, and are designed as an appropriate system which would handle E-Money transactions, through vending machines, park-meters, bus, trains, and across the ever expanding World Wide. The aim of the paper is to design and implement a system using iButton that fulfills the demands of E-commerce and facilities management applications. These applications include cashless or electronic transactions at transit tax system, gas station. It also aims at providing digital user authentication for authorized access to certain area and services. The applications mentioned above achieves several goals: 1-wire network interrogation, data processing, implementation of several control functions of identification and authorizing type. The solutions given have advantage of the hardware simplicity, which is specific to the 1-wire technology.***

Keyword: I button, Intelligent E-commerce and Facilities management system (IEFMS), ARM7 (Advance Risk machine),

I. INTRODUCTION

The widespread use of technology in the field of e-commerce and facilities management has made the world a globalised market. Every day throughout the world, countless financial transactions take place through electrical fund transfers and conventional currency. Through a process of electrical money transactions, known as E-Money. In day to day to life we need to carry different cards that serve the purpose of identification for accessing different services. These cards provide access to E-commerce facilities, authentication to access authorized areas in industries, issuing of books in college library, etc. For every different purpose we have designed a particular card like for driving a vehicle we need driving license that is based on chip card technology, for college or office purpose we need an identity card based on either bar codes or RFID technology and for e-commerce we need credit or debit cards based on magnetic stripes. Apart from these we also need to carry the conventional paper currency and most frustrating loose change for payment of purchased goods and services. However the iButton is set to change all this. Instead of using cash for purchasing goods and services or for identification purpose, all you need is a computer chip enclosed in a 16mm thick stainless steel can called as an iButton. Because of this unique and durable container, up-to-date information can travel with a person or object anywhere they go. The steel iButton can be mounted virtually anywhere because it is rugged enough to withstand harsh environments, indoors or outdoors. It is small and portable enough to attach to a key fob, ring, watch, or other personal items and thus facilitates transfer of e-cash (or any other form information) directly from one iButton to another. All we need is an inexpensive iButton reader attached to the serial or parallel port of a personal computer or a specifically designed hardware. In contrast to plastic smart cards, the iButton is virtually indestructible. An iButton can be dropped, stepped on and submerged in water without affecting its functionality. It also has an exceptional life expectancy. For these reasons alone, it has already been deployed in a variety of applications that demand extreme durability. Another major advantage is that the iButton offers superior privacy over conventional technologies.

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II. LITERATURE SURVEY

A systematic review of the research is done in the area related to Intelligent E-commerce and Facilities management system (IEFMS) and its essential components. The demand-supply and pricing strategies for different goods and services like transit tax, petrol & diesel prices provides general information of the effectiveness and acceptability of the varying pricing. Many different system designs and evaluations were reviewed to identify pros and cons of the various approaches and technologies used for E-commerce and Facilities management and to identify their potential applicability. Eventually iButton was considered as a key element in designing and implementing the desired system.A novel electronic system for stock control and container tracking in a storage warehouse environment was developed by Kai-Xin Tee Moi-Tin Chew and Serge Demidenko[1]. The system was based on the use of advanced electronic identification tags and 1-Wire communication tools. They proposed one more potentially very beneficial solution, where iButton electronic ID technology and 1-Wire communication protocol are employed for storage space allocation and container/load tracking.The work done by EugenDiaconescu and CristianSpirleanu[2] refers the use of iButton devices as addressable switches and also temperature sensors devices. The iButton devices were found ideal for applications where the information is transported by a person or an object. The research considered cases of the building access, vehicle, equipment or even PC computer. The device can be easily attached to another mobile piece. Some variant of iButton may be used as payment tools for parking, automatons for consumer products, transit or small volume acquisition systems.The application note obtained from MAXIM database [3] provides useful information regarding the electrical aspect of the 1-Wire protocol for new and legacy devices. A special section explains how to determine appropriate timing parameters for a network comprised of both old and new 1-Wire slaves. The 1-Wire Master Concepts section provides references to other documents that discuss 1-Wire masters in detail and to the related software. Currently the most popular form of monetary transaction and commerce for people today is the use of physical currency. Paper money and metal coins have been evolving throughout the centuries, since its first introduction in China about 700AD. It has evolved into present day form of plastic, to avoid counterfeiting and fraud. Paper money has arrived late in civilization's history. Before paper money people exchanged all sorts of material including leather, parchment, and clay tablets. However, no matter how much paper money has advance, it cannot perform transactions across the world and the Internet in less than a few seconds.

Electronic Commerce (also known as E-commerce) is one of the most important aspects of the Internet. It allows people to exchange goods and services immediately and with no barriers of time or distance. Any time of the day or night, you can go on-line and buy almost anything you want. Today, credit cards are by far the most popular form of e-commerce transactions across the Internet, since they are the only items currently in circulation that are able to adapt to the technological world of today. They use a form of magnetic strip that holds identification number that links itself to a bank account. However, for payments across the Internet, consumers must type in their credit card number onto a web page to buy an item.



Figure 1: VISA smart card.

A. iButtons

iButton as an e-commerce device would be the best solution to avoid the problems and limitations of the past. iButtons have the ability to be embedded in rings, wallets, watches and a number of other personal accessories. While most smart cards and credit cards are stored by people in their wallets or hand bags, and therefore become a very potential targets for thieves. But not so for iButtons, as they can be stored in places, or in any device that a person wishes.



Figure 2: Picture of iButton along with key fob attachment.

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iButtons use the same virtual java machine as with smart cards, and have the ability to store large amounts of data. They are also encrypted to get an even higher level of protection. iButtons are durable, light, inexpensive, and have a long life span. iButton has its advantages and disadvantages compared to Smart cards. Currently iButtons are used in Turkey as an e-purse for the mass transit system, in Argentina and Brazil for parking meters and in the United States as Blue Mailbox attachments.

B. Other Application Using iButtons

1) Vending machines in Canada,
2) Parking meters in Brazil,
3) Gas meters in Moscow and
4) Bus passes in China.

III. SYSTEM DESCRIPTION

A. Overview of system

The Intelligent E-commerce and Facilities management system (IEFMS) is designed taking into consideration different components such as the ARM processor, iButton, DC motor, real time LCD display, iButton interface, memory unit, keypad required for E-filling and entering password along with their associated drivers and protocols as depicted in block diagram.

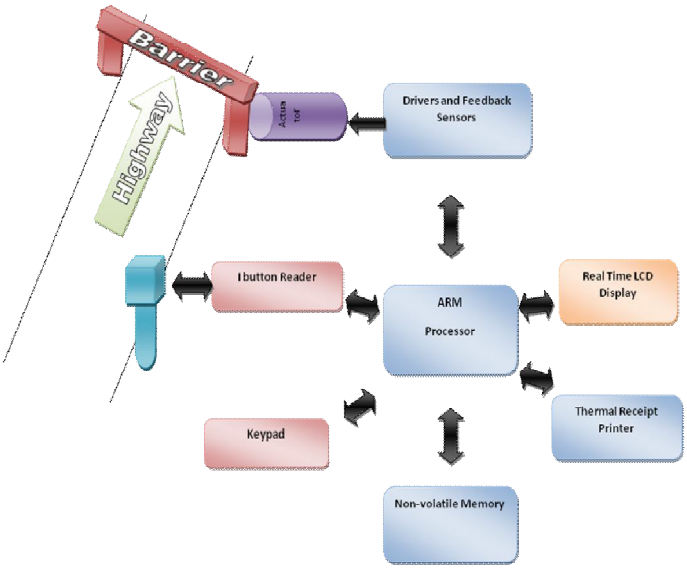


Figure 3: Block diagram of Intelligent E-commerce and Facilities Management System (IEFMS)

The benefits achieved by IEFMS can be broadly divided into three categories: toll agency benefits, user benefits, and social benefits. The toll agency benefits include reduction in operating cost, reduction in man labor, reduction in maintenance cost, and enhanced cash handling. The user benefits include time saving due to the elimination of the hassle of digging for change. In addition, there is time saving due to the reduced toll transaction time and average waiting time. The social benefits include the reduction in mobile emissions that impact the nearby areas where IEFMS is deployed. A similar approach is to be followed for achieving other application as mentioned before.

B. Hardware

The hardware required for this system is broken down into two types, the iButton itself and a specially designed Hardware circuit based on ARM 7 and other associated components that is used to fulfill the purposed tasks.

C. Type of iButton

Currently, there are many different types of iButtons, which are specifically design for different areas and each, having their own unique properties. Therefore, choosing the right one is essential. There are two main types of iButtons designed specifically for E-Money transaction. They are the DS1992/DS1993iButtons. Both are very similar to one another except the memory capacity they

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posses and each has their own unique advantages. For more information on why DS1993 iButton was selected over the DS1992 iButton, see references.

DS 1993 special features include;

1) 4096 bits of Read/Write Nonvolatile Memory.
2) 256-bit Scratchpad Ensures Integrity of Data Transfer.
3) Memory Partitioned into 256-bit Pages for Packetizing Data.
4) Data Integrity Assured with Strict Read/Write Protocols.
5) Operating Temperature Range from -40°C to +70°C.

D. ARM 7

The ARM 7 family of microcontrollers includes various cores and thus it is very essential to select the best suited version of ARM for the project. After evaluating different version we decided to selected LPC 2148 ARM 7 microcontroller.The LPC2148 microcontrollers are based on a 32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, which combine the microcontroller with embedded high-speed flash memory of 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 40 kB, make these devices very well suited for different applications.

Its key features include;

1) 32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
2) 40 kB of on-chip static RAM and 512 kB of on-chip flash memory. 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
3) In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms.
4) Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.
5) USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAM. In addition, the LPC2148 provides 8 kB of on-chip RAM accessible to USB by DMA.
6) Two 10-bit ADCs provide a total of 14 analog inputs, with conversion times as low as 2.44 Micro sec per channel.
7) Single 10-bit DAC provides variable analog output.
8) Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
9) Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
10) CPU operating voltage range of 3.0 V to 3.6 V (3.3 V $\pm$10 %) with 5 V tolerant I/O pads.

E. Others components

IEFMS also includes certain devices providing user feasibility in accessing the system. For e.g. a thermal printer can provides a printed receipt for the transactions done between the consumer and the facility serving authority. Similarly a 20x4 LCD display is incorporated of user friendly view of system operation. A 4x3 keypad is installed for entering amount or conveying any other required information to IEFMS. For automated operation of the system feedback sensors like limit switch, IR LED, etc and motor drivers can be used.

F. Software

The system software will be implemented in C language using the Keil µvision software along with flash magic. The C programming language is perhaps the most popular programming language for programming embedded systems. C remains a very popular language for micro-controller developers due to the code efficiency and reduced overhead and development time. C offers low-level control and is considered more readable than assembly. Many free C compilers are available for a wide variety of development platforms. Additionally, using C increases portability, since C code can be compiled for different types of processors. All software development tasks including editing, compiling and debugging can be accomplished using the above mentioned software's.The circuit designing and PCB layout for ARM board shown in figure 3.2 and 3.3 is prepared using the Proteus design

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suite. The Advanced Routing and Editing Software (ARES) form the PCB layout module for Proteus design suite and offers net list based complete PCB design.

IV. SYSTEM WORKING

The system working could be well explained with the help flowchart shown for the individual application. The system operation start with the initialization of all the peripherals connected in the system. The system offers a selection menu option to the user for selecting a particular module or application that needs to be operated. These applications are listed as;

1) Transit Tax
2) Fuel Refill
3) Banking
4) Identification
5) Vehicle Access

With the selection of 1st option, the system starts executing the transit tax module. At the initial stage, the system keeps on tracking for a valid iButton until and unless the user inserts the iButton into the iButton reader or green dot receptor. On the presence of iButton, the prime task of the system is to read the 64-Bit unique ID of that iButton and check for the available balance amount in that iButton. Now as per the fixed amount of transit tax for different vehicles, the user is required to select the type of vehicle. As per selection made by the user, the required amount is debited from the iButton while issuing the commands to open the gate for passing the vehicle for a predefined time. The payment of transit tax is represented in a form of receipt generated with the help of thermal printer. This module provides an advantage over the traditional method of paying the transit tax, where either the vehicle owner or highway authority has to look for loose change. With this automated operation a better transparency and accuracy in transit tax payment and its log maintenance could be maintained which would quite beneficial for highway maintaining authority.

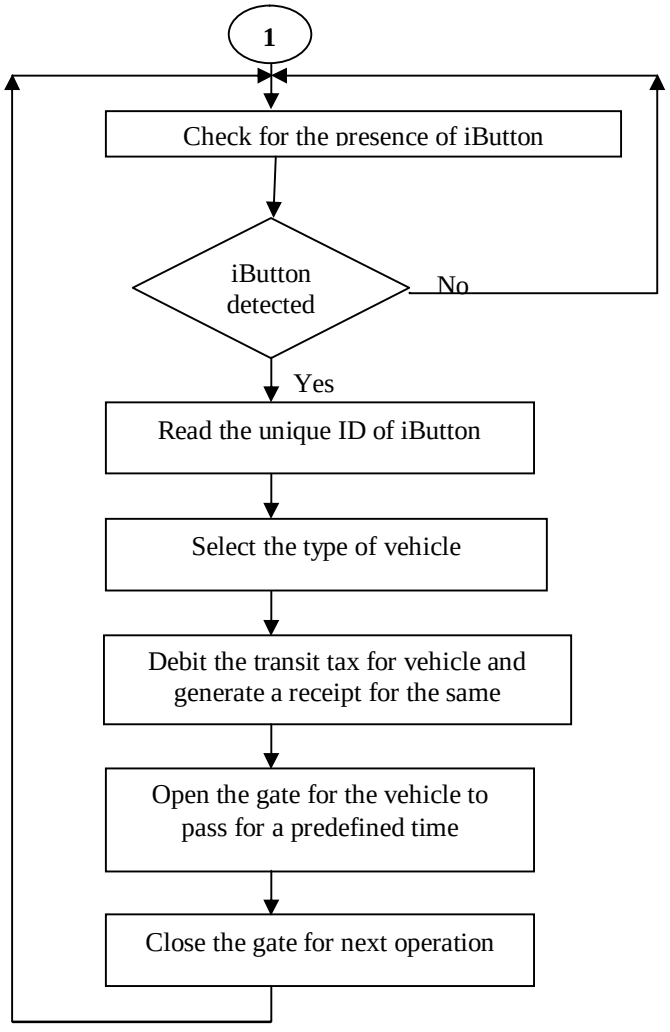


Figure 4: Flowchart for Transit Tax Module

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After the complete execution of first (transit tax) module, the system retrieves back to the Module selection menu. With the selection of second module i.e. Fuel refill module, the system again tracks for a valid iButton inserted by the user. On the presence of a valid iButton, the user is offered to enter the quantity of fuel required. The fuel price is fixed in terms of amount per liter. With the help of these two quantities, the calculated amount is debited from the user iButton. A receipt is generated indicating the debited amount and available balance in user account.

V. SYSTEM TESTING AND RESULTS

To be able to judge how successful the iButton can perform for the specified applications, trials were setup to judge the speed, performances and accuracy of the system. Performance was judged on how well the project was able to do a task and the amount of errors encountered during project operation. Since there was only a single client operational at a time, it would be essential to evaluate the system behavior serving multiple clients simultaneously.

Major error that was discovered during the testing was writing data to the iButton which would sometime cause the designed system to write junk to the iButton. The problem was narrowed down to the programming code that is used to write data to the iButtons. However, for this project to be implemented in a real system, the entire project needs to be tested on different types of controller and processors. The speed of the system is judged upon on how long it takes to perform a certain task. From the first time it started and till the execution of a particular application, the time consumed was measured and compared with the existing systems. All the tests that were setup and performed were all successful and didn't produce any errors or increase the transaction times.

Apart from these testing, a general survey was made examining people's opinions and views on the iButton transactions used for these applications. The survey targeted a wide range of people of varying ages. The results from the survey indicated most people found the system quite appealing and friendly. Most of the people that were surveyed, had issues and question about the security of the iButton when asked to comment about implementing a system like this project into reality.

VI. CONCLUSION AND FUTURE SCOPE

The developed system based on iButton represents a simple solution for electronic transaction at transit tax operation, gas station, to provide user authentication for authorized area and service access and providing user identity information. Although scored by a relatively high grade, the system definitely requires improvements. They primarily refer to increasing the reliability of the end system with respect to prototype. For non-cash transaction, a solution which meets critical success factors such as Mass reach, Security, Convenient and easy, low setup cost and time, requirement of little additional infrastructure, competitive pricing, has the potential for succeeding as an effective mobile payment instrument.Choosing the iButton over other hardware token devices for system implementation is dependent on the customer's specific needs. The iButton is definitely the most robust of the existing hardware token devices. The tamper detection and security features of both the Touch Memory iButton make them useful for implementations where physical attack may be commonplace.As the project implementation is done on a standalone system, forming a network of such system with the help of GPRS, GSM and LAN will increase the utility of the system to a greater extent providing it a global connectivity. This may incorporate many useful features such as acknowledgement of transaction using SMS, centralized monitoring of different events, etc. It is expected that the very encouraging outcome of the system would encourage further development in this promising area, thus leading to efficient commercial as well as industrial application.

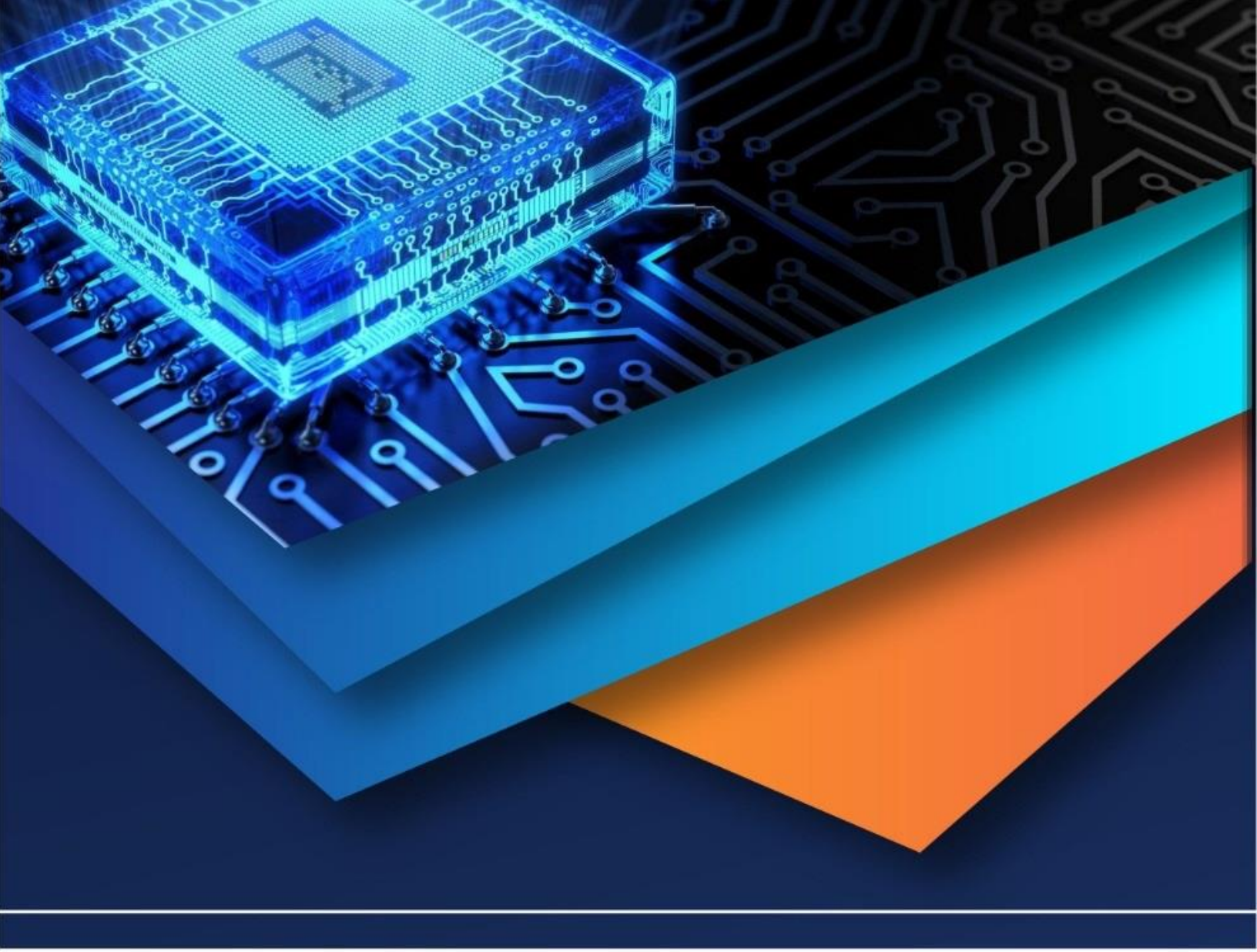
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