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The Autonomous Pill Dispenser with Alarm and Mobile Notifications

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Abstract: Population aging is a global issue and medication adherence is a major problem in health care sector. This paper proposes an autonomous medicine dispenser box that alleviates irregularities in taking prescribed medication at appropriate time. The main purpose of this system is to help patients primarily seniors, other vulnerable group that may need assisted care, and to switch from approaches dependent on human memory to automation with negligible supervision ,hence reducing human efforts and preventing error prone tasks of giving wrong medicines at the wrong time in wrong amount. The system contains a programmable alarm system with an interactive UI and sends notifications about the medicine taken and supply of medicines.
Keywords: Internet of Things, Assistive Technology, Pill Dispenser.

I. INTRODUCTION

As people grow older, they are completely depending upon outside support for health assessment and medical care. The current healthcare infrastructure in recent society is widely considered to be inadequate to meet the needs of an increasingly older population. Most patients have diseases which need to take medications over a long period of time in order to stabilize their conditions. Ensuring that the patients consume the right medication at the appropriate time becomes crucial[2,5]. To overcome this problem proposed system work to ensure that the elderly can live safely and independently in their own homes for as long as possible. Assistive Technology (AT) maintains and improves the individuals functioning and independence, thereby promoting their well-being[1]. But today only 1 from each 10 people in need have access to AT due to high costs and a lack of awareness, availability, personal training, policy and financing [1]. IOT is making strong inroads in the medical industry with the introduction of relevant sensors and devices. Internet of Medical Things (IOMT) is a collection of medical devices connected to health care IT systems for different application [2]. The proposed system deals with the pill time taken for particular patients. Initially, the medication schedule is framed as per the patient's requirement and if necessary can be changed. The system will alert with an alarm at that particular time. To make the system user friendly, the LCD screen shows the timing. After having pills, the system will update the pill no. also check the pill count, when the pills remaining are few, the order for particular pill is sent by the system automatically to medical shop via SMS system.

II. RELATED WOR

There are some research works done on "Autonomous Pill Dispenser" till now. Some key techniques with its advantages and disadvantages are explained in following table respectively;

TITLE OF PAPER	TECHNIQUE	RESULTS	ISSUES
"Smart Medication Dispenser"	Arduino Controlled system	Alarm system reminds the patient to consume the medicine	Pill dispensing is not automated
"Smart medication dispenser: design, architecture & implementation"	Embedded System	New functions can be added without modifying the dispenser control structure	Not portable, cannot be monitored from anywhere around the
"GSM Based Automatic Pill Dispenser"	Global System for Mobile communication	SMS is generated to the caretaker using GSM module	Portability issues, network disruption issues.
"A Smart Pill Box with Remind and Consumption using IOT"	Internet Of Things	Reminder is set to help improve on time medication	Portability issues, application compatibility issues

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"Medi-Kit: Developing a Solution to Improve Attention on Medical Treatment"	Real Time Clock based mechanical dispensing	Prototype used reduces delay in dispensing and consuming pills	No alert system, no fully automated dispensing mechanism, portability issues
"Avion - The Intelligent Medicine Box"	Mobile Application	Tray separation based on the size of the pills	Improper data exchange, lack of reminder system
"Smart Medicine Reminder Box"	Internet Of Things	Sensing capability that can detect the consumption of medicines	Medication cannot be monitored through an application by a family member from anywhere
"Medication Adherence Monitoring Using Modern Technology"	RFID-based systems	proximity sensing-based systems for medication adherence	---

III. SYSTEM ARCHITECTURE

The proposed system overcomes this problem. They deal with the pill taken time for particular patients. Initially the need to set pill timing in the system and it can be change by patient according to his requirement. The system will start alarm at that particular time. To make user friendly system, the LCD screen shows the timing. After having pills, the system will update the pill no. Also the check the pill count, if the box pills remains very few, the order for particular pill is send by system automatically to medical shop through SMS system.

Following are some key tasks that are performed by the proposed system;

1) *Set the time for Pills:* Set the pill time for required medicine by using input system. We can set different time for different pills. If the more than one pill is required at a time, give the box nos. to the system to get required pills. We also set the no. of pills we are inserting in system.
2) *Compare the time Using Real Time Clock:* The real time clock gives continuous time as an output. Monitor the time continuously using Real time clock to identify the pill time. If the system time matches with pill time, the system shows that that it is time to take pill.
3) *Alert the user to take Pills:* It is necessary to alert the user to take pills at particular time. When the system time match with pill time, the buzzer start continuously until the push button is not pressed. When the push button pressed, the buzzer stops and the pills required to take at that time comes out to user to avoid confusion among medicines.

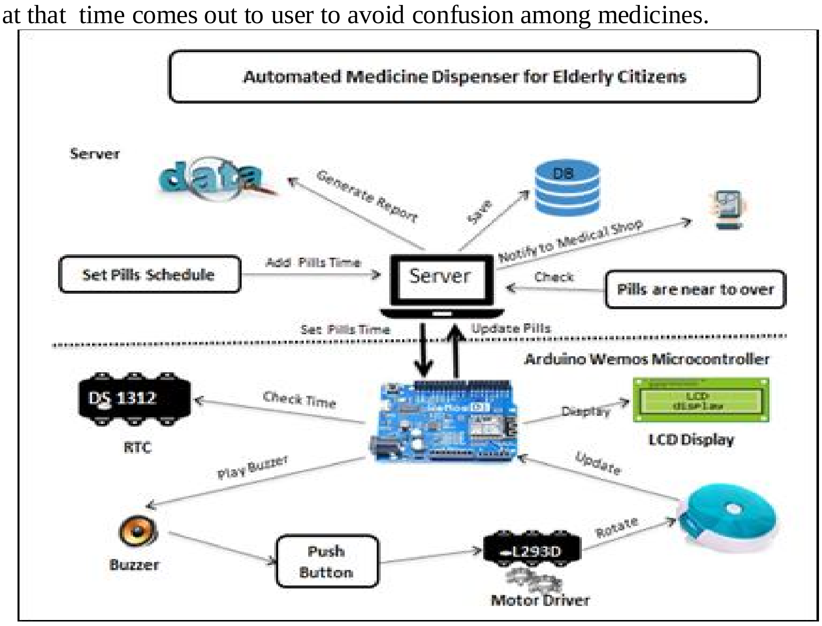

Figure: - Overview of System Architecture

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4) *Get The Feedback About Pills From User:* As pills removed by user, it is necessary to put the no. of pills removed by user. Multiple times a user required more than one pills of same medicine or more than one person are using same system. So it is required that the no. of pills removed by user.
5) *Send Purchase order to Medical Shop:* The system counts no. of pills in the system by using the total no. of pills and the pills used by patient. When the no. of pills remains less, the purchase order sends automatically to medical shop.

A. System Flow (FLOW CHART)

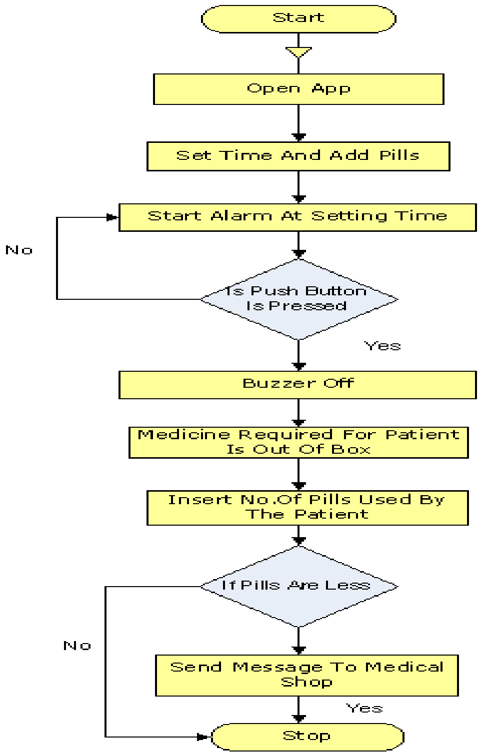

Figure: - System Flow.

B. Major Components Used

1) *LCD:* Liquid-crystal display (LCD) is a flat panel display, electronic visual display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. In our project 16x4 LCD is used to display the information about pillbox such as the number of medicines in each sub-box to be consumed when the alarm rings.

Figure: - 16x4 LCD

2) *Real Time Clock Module:* Real Time Clock (RTC) module uses the DS1307 to keep track of the current year, month, day as well as the current time. It includes small lithium coin cell battery that will run the RTC and can be accessed via the I2C protocol. In our project it used to set a specific time as per the patient required i.e. if the user wants to set 8.00 am as its morning medicine taking time then they can do with the help of this module.

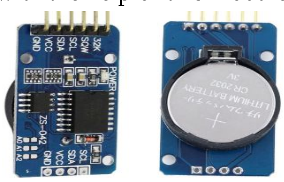

Figure: - Real Time Clock Module (RTC)

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3) *Arduino Wemos:* The "Arduino WeMos" is a micro controller used in the system that can manage the overall functioning of various sensors.

Figure: - Arduino Wemos

4) *Stepper Motor 28BYJ-48:* Is a small stepper motor suitable for a large range of Applications, its rated voltage are 5V, speed variation ratio: 1164, friction torque: 58.84-117.68 mnm, stride angle 5.625°/64.
5) *Buzzer:* The buzzer rings when both timing i.e. pill timing and RTC timing matches.

Figure: - BUZZER

6) *Push button switch.*

C. Algorithms Used

1) *ID 3 ((Iterative Dichotomiser 3) Algorithm:* ID3 builds a decision tree from a fixed set of examples. The resulting tree is used to classify future samples. The leaf nodes of the decision tree contain the class name whereas a non-leaf node is a decision node. The decision node is an attribute test with each branch (to another decision tree) being a possible value of the attribute. ID3 uses information gain to help it decide which attribute goes into a decision node.

Algorithm

a) Establish Classification Attribute (in Table R).
b) Compute Classification Entropy.
c) For each attribute in R, calculate Information Gain using classification attribute.
d) Select Attribute with the highest gain to be the next Node in the tree (starting from the Root node).
e) Remove Node Attribute, creating reduced table RS.
f) Repeat steps 3-5 until all attributes have been used, or the same classification value remains for all rows in the reduced table.

2) *Entropy*

$$H(X) = -\sum_{i=1}^{n} p(x_i)\log_b p(x_i)$$

3) *Information Gain*

$$\textit{For Set } S, \textit{Attribute } A$$
$$\textit{Where } S \textit{ is split into subsets based on values of } A$$
$$\subset_S^A = \text{Subset A of S}$$
$$I_E = \textit{Entropy}, \mathrm{p}(\subset_S^A) = \frac{\mathrm{size}(\subset_S^A)}{\mathrm{size(S)}}$$

$$I_G(S,A) = I_E(S) - \sum^{n} (\mathrm{p}(\subset_S^{A_v}) * I_E(\subset_S^{A_v}))$$

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IV. EXPERIMENTAL SETUP AND RESULT

The system will start alarm at that particular time. To make user friendly system, the LCD screen shows the timing. After having pills, the system will update the pill no.

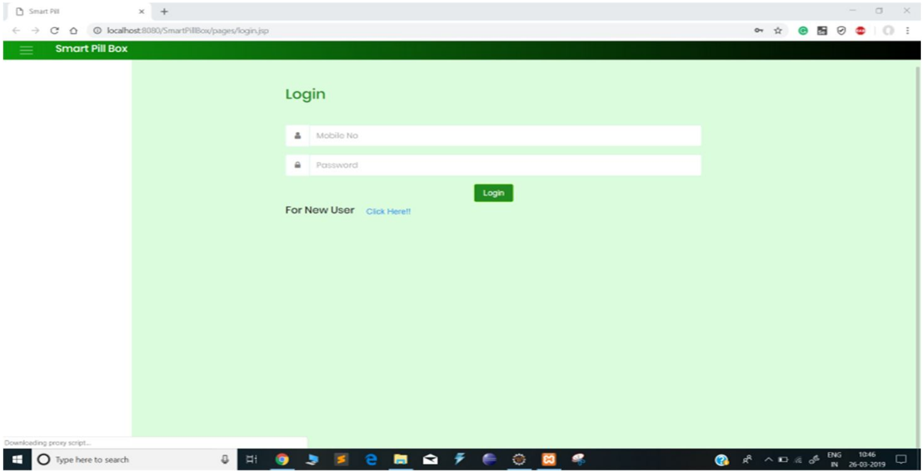

Figure: - Login Form

Above figure is of login form which contains two fields like mobile number and password to login register user.

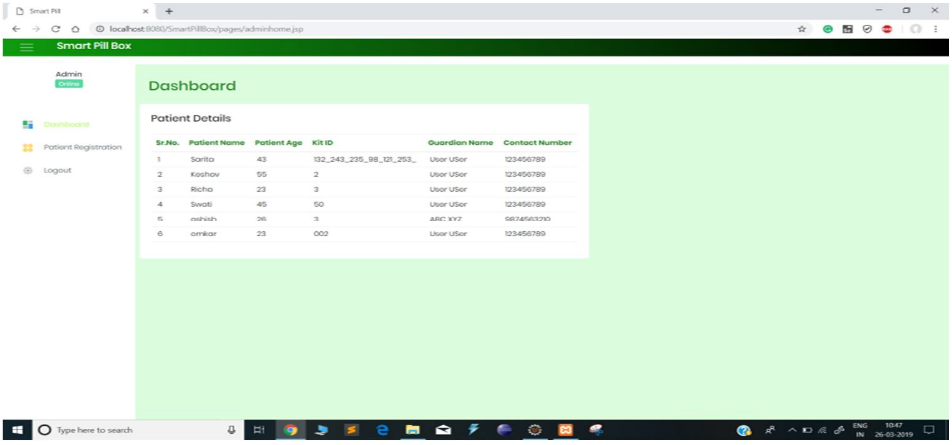

Figure: - Patient Details Table

Patient detail table contain some attributes like patient Age and name, Kit id, Gradient Name and Number these above details are submitted at the time of patient registration.

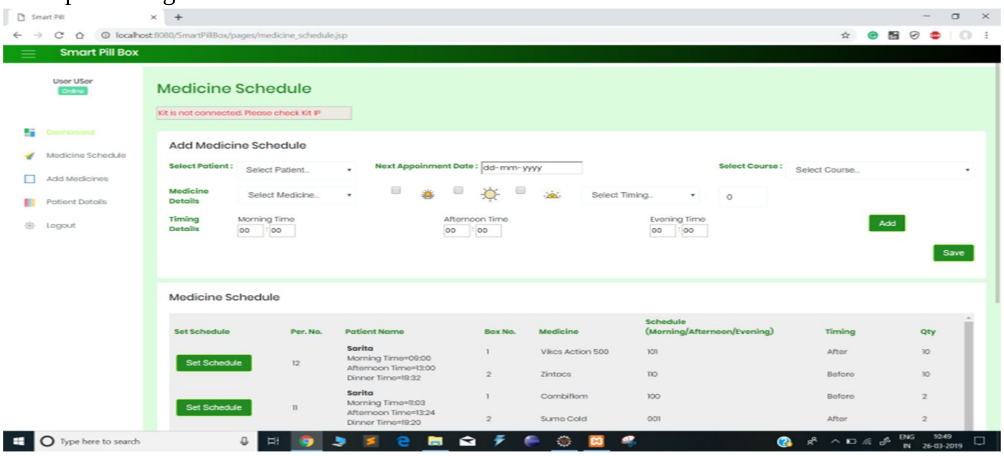

Figure: - Medicine Details and Schedule.

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The medicine schedule contain some attributes like select patient, medicine details, Next Appointment date, Timing details and select course i.e. the quantity to intake the medicines.

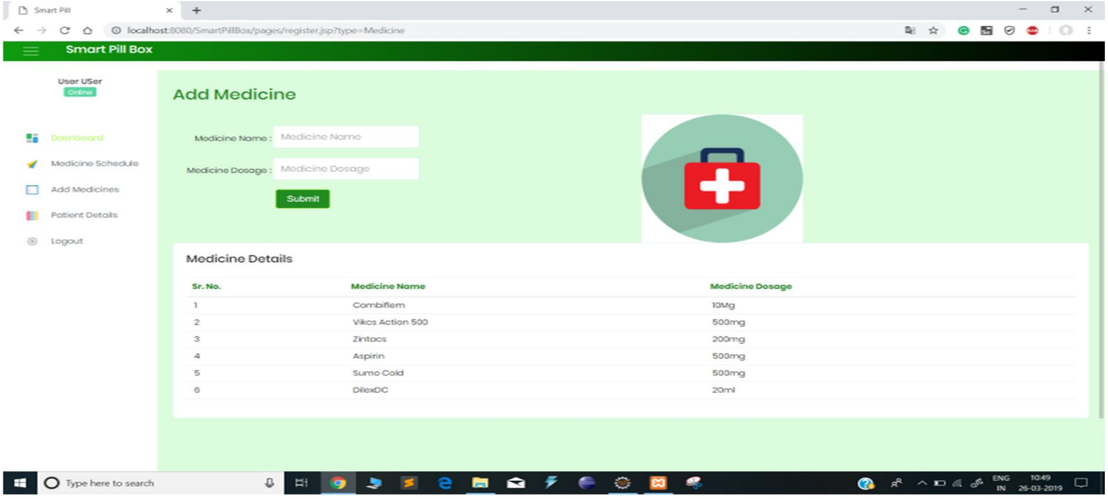

Figure: - Add Medicines

Add the patient medicine and its intake i.e. the dose of it, so that no medicine tablet might skip from the daily dose intake by the student.

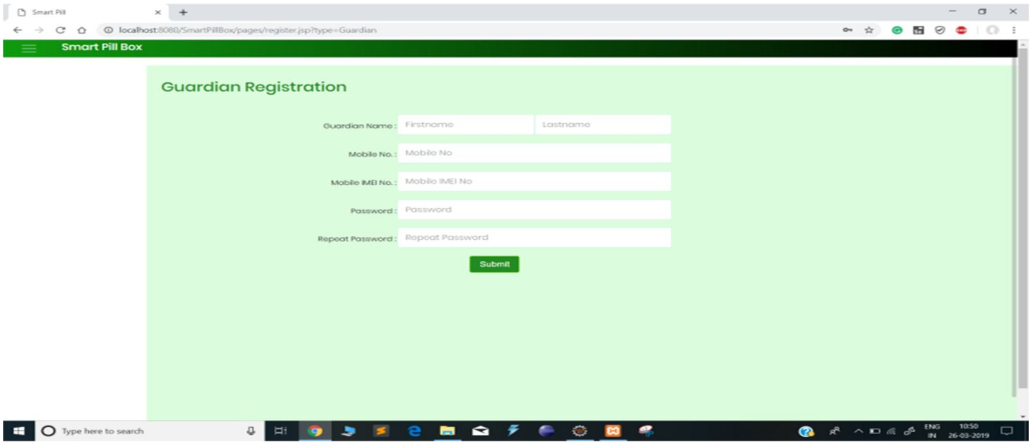

Figure: - Guardian Details

The guardian details like guardian name, contact number and the password in any emergency case

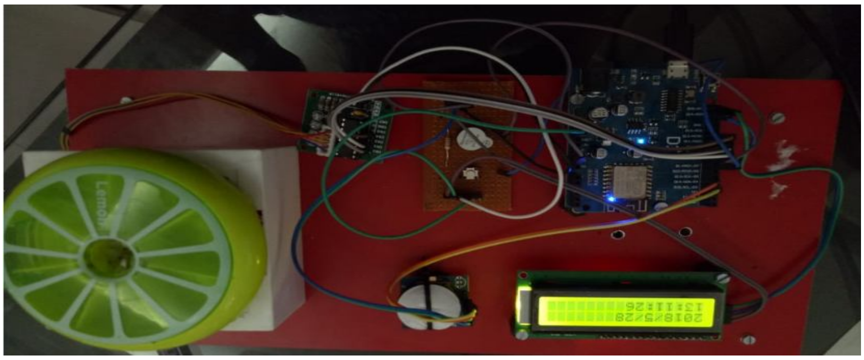

Figure: - Experimental Setup

Also the check the pill count, if the box pills remains very few, the order for particular pill is send by system automatically to medical shop through SMS system.

V. ADVANTAGES

A. To remind specific time to the patient to take his medicines.
B. Avoid the confusion between required medicines to other medicines.

VI. CONCLUSION

The autonomous pill box designed aims at assisting a patient completely with a user friendly manner and reduces human efforts. The circular shape of the box will help in rotating the box and the dispenses the only pill required; the alarm and notification features will help in keeping the record of the medication and will greatly increase the medicine effectiveness.

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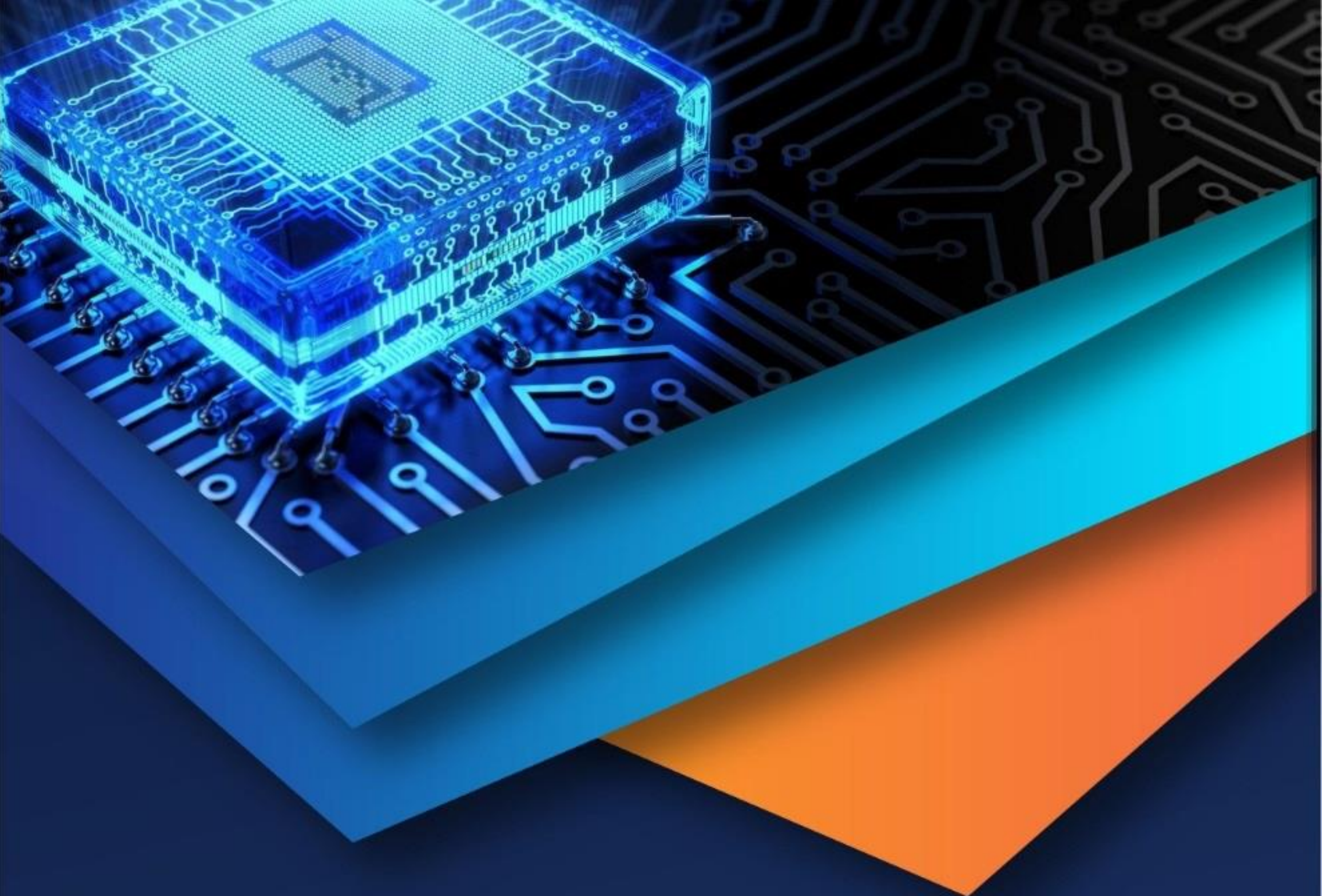

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