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Energy and Depression Management System

Gaurav Soni[1], Navami B G[2], Ridhi M Jain[3], Vivek Gupta[4], Dr. Nirmala C R[5]
[1, 2, 3, 4, 5]*Computer Science and Engineering Department, BIET, VTU University*

Abstract: ***The aim of the Internet of things (IoT) is to bring every object online. These different objects generate huge data which consequently lead to the need of requirements of efficient storage and processing. Cloud computing is an emerging technology to overcome this problem. The pandemic due to COVID-19 has caused great impact on people's approach to have proper lifestyle. People these days are found inactive, unhappy and less energetic, because of their busy routine and continual ignorance of overall health. By keeping a track of their mental and physical health, one could achieve better response and hence expected lifestyle. Our solution is to detect, analyze and deliver a solution to treat depression and assist people with fulfilling their daily energy requirement for being more active and enthusiastic. Our solution is a Soft-Ui Web Application that gives smooth UI/UX experience to users showcasing fluctuations in energy and playing games to get cognitive features' result. The hardware is a wearable wrist band made with NodeMCU embedded with accelerometer and heart rate sensors. An analytical report is generated and updated in real time and user could download as per their convenience.***

Keywords: IoT, Machine Learning, Cloud computing, Depression, BPM, Energy, Accelerometer, SoftUI, Energy Fluctuations, Heart rate, Game Analytics, Cognitive features, Statistical approach.

I. INTRODUCTION

According to the recent survey conducted during the pandemic due to COVID-19, it is found that about 1 out of 4 people in the country need counselling psychologically and psychiatrically. There's a need to deal with the prevalence of stress, anxiety, depression among the general population which in turn does affects their physical health. Due to lack of awareness about the energy content required and the continual ignorance of the disruption caused, there is no proper on-time help provided for the people suffering from depression. People usually get so carried away with their busy routine that, the appropriate required amount of energy is compromised which effects the overall health on a long-term basis.

A combination of IoT-SOFTWARE application to maintain conventional energy levels and detect, assess and treat depression by maintaining the track of their online activities through application installed on device. Activities of Daily Living (ADL) and Physical Activity Level (PAL) are calculated through IoT model embedded with sensors like accelerometer, heart rate sensors, etc to collect real time data and perform analysis. Cognitive features, beats per minute, calories burnt are considered to showcase the continual energy-level fluctuations and generate a report based on predictions made by the collected data. The digital features correlating with the cognitive function based on device's built-in sensors are used to keep track on user's typical behavioural pattern. The obtained analytical data is analyzed for early detection of depression.

II. LITERATURE SURVEY

There is growing body of literature that analyses the properties of depression. Choudhury et al. argue that depression constitutes a genuine test in individual and general wellbeing. Considerable number of individuals experiences the ill-effects of despondency and just a division gets sufficient treatment every year. They also investigated the possibility to utilize online networking to identify and analyze any sign of significant depression issue in people. Through their web-based social networking postings, they quantified behavioral credits identifying with social engagement, feeling, dialect and semantic styles, sense of the self-system, and notices of antidepressant medications.

Choudhury et al. considered online networking as a promising instrument for public health, concentrating on the utilization of Twitter presents on fabricating predictive models about the forthcoming impact of childbirth on the conduct and disposition of new mothers. Utilizing Twitter posts, they measured postpartum changes in 376 mothers along measurements of social engagement, feeling, informal community, and phonetic style.

O'Dea et al. examined that Twitter is progressively researched as methods for recognizing psychological well-being status, including depression and death rate in the population. Their investigation revealed that it is conceivable to recognize the level of worry among suicide related tweets, utilizing both human coders and a programmed machine classifier.

Zhang et al. have shown that if individuals with a high danger of suicide can be recognized through online networking like microblog, it is conceivable to actualize a dynamic intervention system to save their lives.

Many researchers have demonstrated that utilizing user-created content (UGC) accurately may help decide individuals' psychological wellness levels. For instance, AL Darwish and Ahmad examined that the utilization of Social Network Sites (SNS) is expanding these days, particularly by the more youthful eras. Because the accessibility of SNS enables clients to express their interests, sentiments and offer day by day schedule.

Nguyen et al. utilized machine learning and statistical strategies to separate online messages amongst depression and control groups utilizing temperament, psycholinguistic procedures and substance subjects removed from the posts created by individuals from these groups.

Park et al. investigated states of mind and practices toward online web-based social networking in view of whether one is discouraged or not. They directed semi-organized up close and personal meetings with 14 dynamic Twitter users, half of whom were discouraged and the other half non-discouraged. Other than they examined a few plan implications for future social networks that could better suit users with depression and give bits of knowledge towards helping discouraged users address their issues through online web-based social net-working.

Bachrach et al. studied how user's activity on Facebook identifies with their identity, as measured by the standard Five Factor Model. They analyzed relationships between user's identity and the properties of their Facebook profiles. For instance, the size and thickness of their friendship network, number of transferred photographs, and number of occasions went to, number of gathering enrolment's, and number of times the user has been tagged in photographs.

Ortigosa et al. have exhibited a new strategy for sentiment examine in Facebook that suggests that starting from messages composed by users, as to extract data about the users' assessment extremity (positive, unbiased or negative), as transmitted in the messages they write; and to show the users' standard conclusion extremity and to distinguish huge passionate changes.

Case Study: A study was conducted for 10 people, who were asked to play the games like Tower Blocks, Bounce, Kill the Birds and Snake during different states of mind (to derive cognitive features). A statistical approach is used by considering weighted functions and an approximation formula was derived based on the scores attained by the person in the above-mentioned games to get the game analytics for the cognitive features like Perception, Attention and Learning. Dictionary of Psychology and Diagnostic and Statistical Manual of Mental Disorders were referred to arrive at an approximation formula.

III. METHODOLOGY

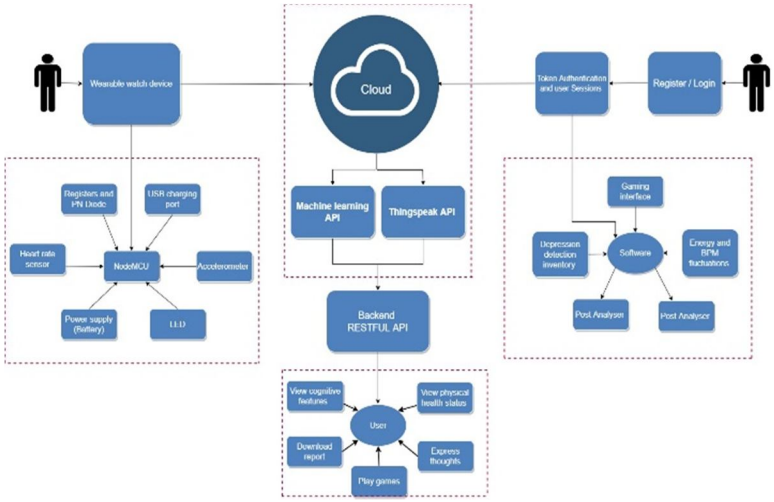

Fig. 1: Methodology Diagram

Our solution comprises of two units namely, Software and Hardware which are linked through the cloud and integrated via APIs.

Software : The Software application provides user with an interface to play games correlating neuropsychological cognitive features. User can share thoughts through the depression inventory and severity of depression is analyzed. Further energy and BPM fluctuation values are showcased to the user, wherein calories burnt is calculated. An overall health analytical report is generated.

Hardware: A wearable device is designed for a user. It's a NodeMCU board embedded with heart rate sensor and accelerometer sensor which aids in showcasing calorie burnt and heart condition to generate recommendations accordingly.

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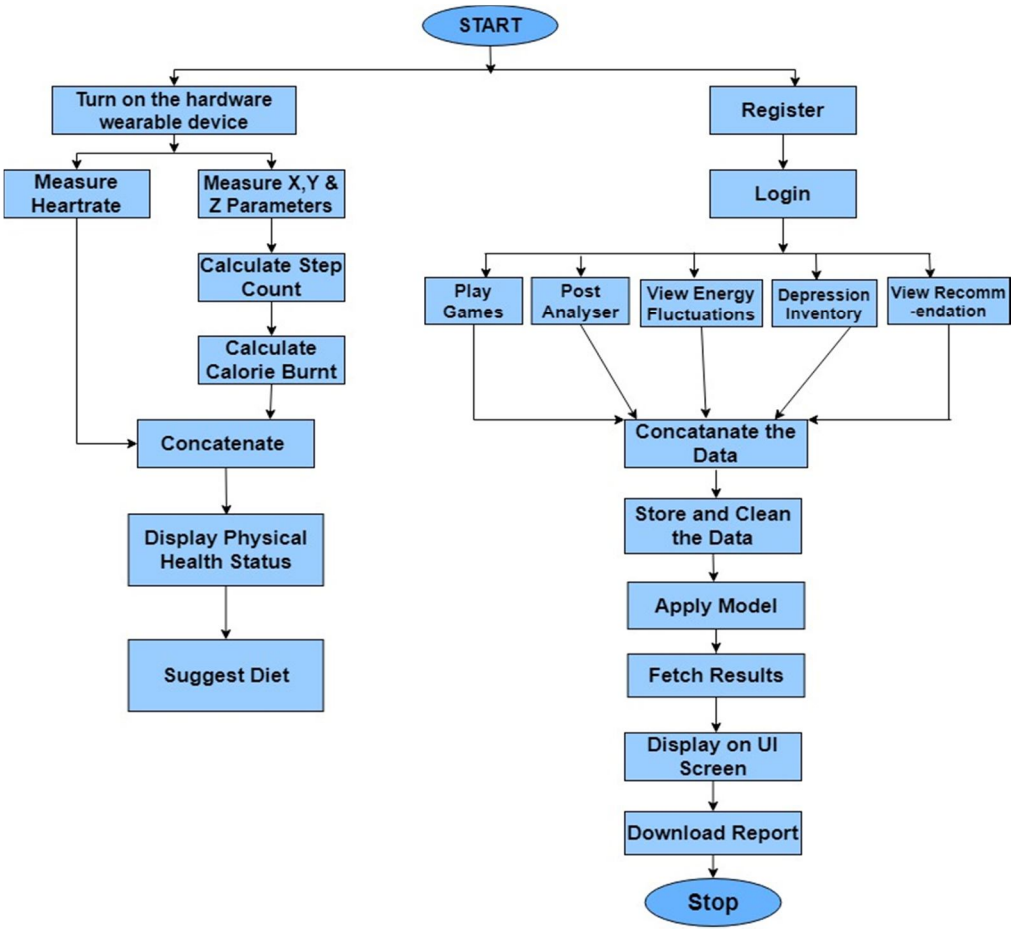


Fig. 2: Flow Diagram

As depicted in the above diagram, first the hardware wearable device containing the sensors like heart rate sensor and accelerometer should be turned on. Heart rate is measured and the measured parameters X, Y and Z must be operated to calculate the step count and hence the calorie burnt. Both the readings shall be concatenated to display the physical health status and hence can suggest a diet to the user.

The user has to register and login using the user interface and can play games and hence a statistical approach is used by considering weighted functions and an approximation formula was derived based on the scores attained by the person in the above-mentioned games to get the game analytics for the cognitive features like Perception, Attention and Learning. Also, a tab is provided to view energy levels and view recommendations. The data generated as a result of the user performing all these activities shall be concatenated and stored. Further a model is applied to this data to fetch the results which shall be displayed on the UI screen and the user is also provided the option to download the report.

Formulae used:

content['perception_percent'] = round(23.33*tbn + 10*kbn)

content['attention_percent'] = round(20*sn + 13.33*bn)

content['learning_percent'] = round(33.33*sn)

Legend:

tbn : tower blocks game numeric score factor

bn : bounce game numeric score factor

kbn : kill birds game numeric score factor

sn : snake game numeric score factor

IV. MODEL DESIGN

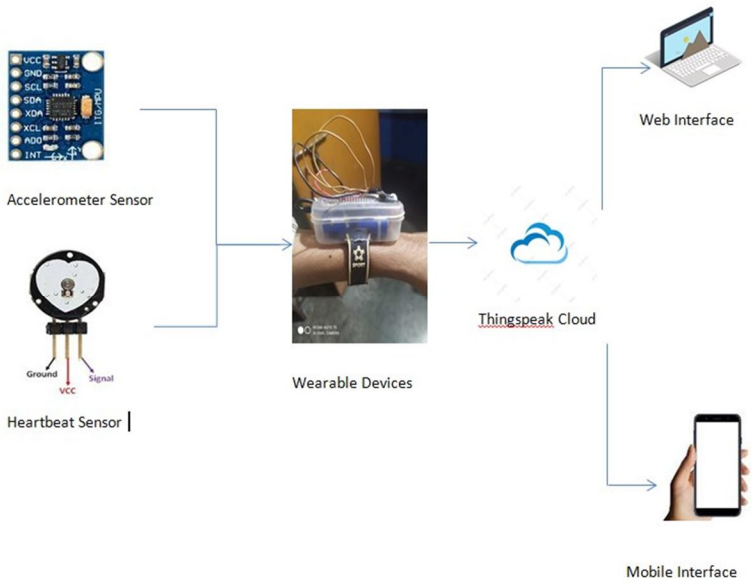


Fig. 3 :Model Design

1) *Accelerometer Sensor:* An accelerometer is an electronic sensor that measures the acceleration forces acting on an object, in order to determine the object's position in space and monitor the object's movement. Acceleration, which is a vector quantity, is the rate of change of an object's velocity (velocity being the displacement of the object divided by the change in time).
2) *Heartbeat Sensor:* Heartbeat senor or Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart- rate data into their projects.
3) *Wearable Device:* The above-mentioned sensors – accelerometer and heartrate sensors are embedded to a wearable device made with NodeMCU as shown in the above picture. This wearable device produces the required reading.
4) *Thingspeak Cloud:* ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak.

The analyzed live data is then presented to the web interface and the mobile interface.

V. RESULTS

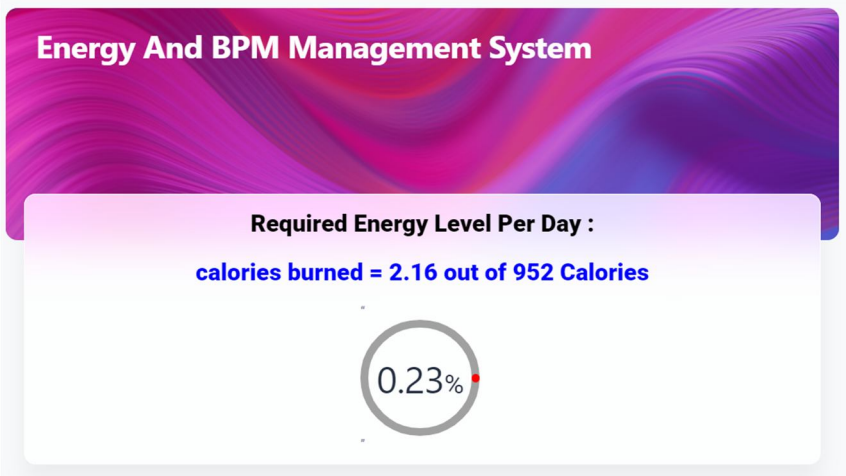


Fig. 4: Energy and BPM management system

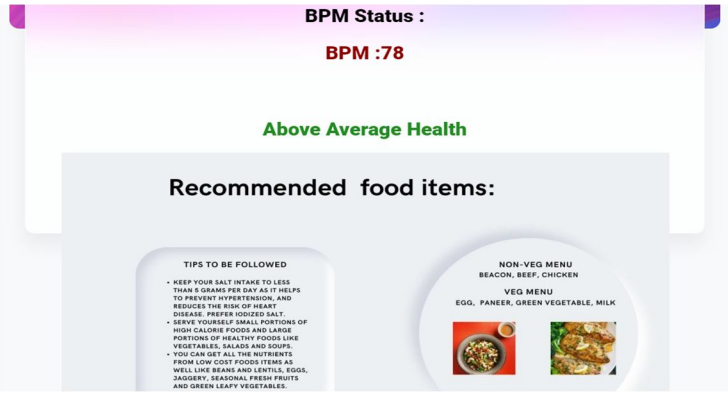


Fig. 5. BPM status and Recommendation

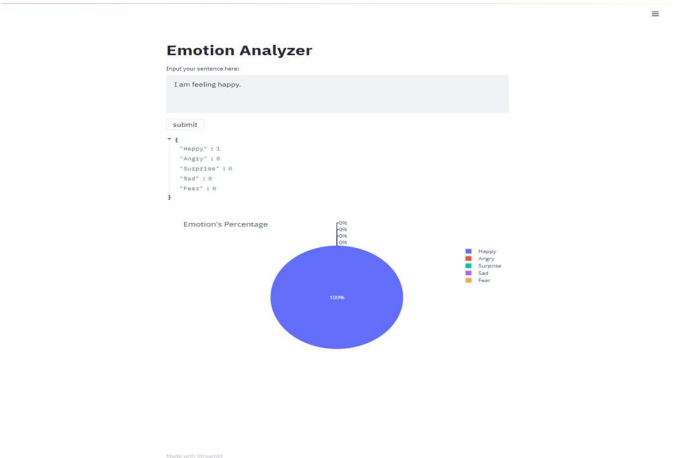


Fig. 6 : Emotion Analyzer

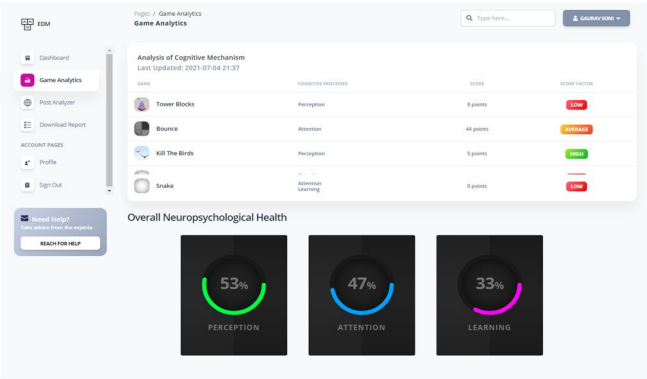
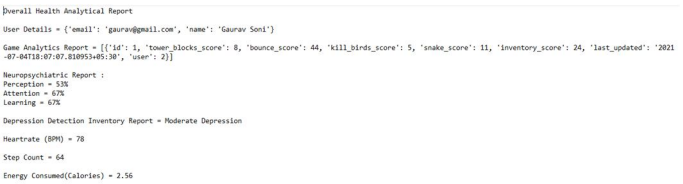


Fig. 7 :Game Analyzer


Overall Health Analytical Report

User Details = {'email': 'gaurav@gmail.com', 'name': 'Gaurav Soni'}

Game Analytics Report = [{'id': 1, 'tower_blocks_score': 8, 'bounce_score': 44, 'kill_birds_score': 5, 'snake_score': 11, 'inventory_score': 24, 'last_updated': '2021-07-04T18:07:07.810953+05:30', 'user': 2}]

Neuropsychiatric Report :
Perception = 53%
Attention = 67%
Learning = 67%

Depression Detection Inventory Report = Moderate Depression

Heartrate (BPM) = 78

Step Count = 64

Energy Consumed(Calories) = 2.56

Fig. 7: Overall Health Analytical Report

VI. CONCLUSION

The project intents to signify the importance of one's physical and mental well-being which is an essential requirement especially in the recent times when lives of many has been affected due to the COVID-19 pandemic. A literature review was carried out to understand the drawbacks and shortcomings of the existing energy and depression management systems. The system keeps tracks of daily physical activities to provide physical health status and performs several psychological assessments to evaluate the symptoms and signs of various depression levels. Based on the objectives the project is implemented successfully.

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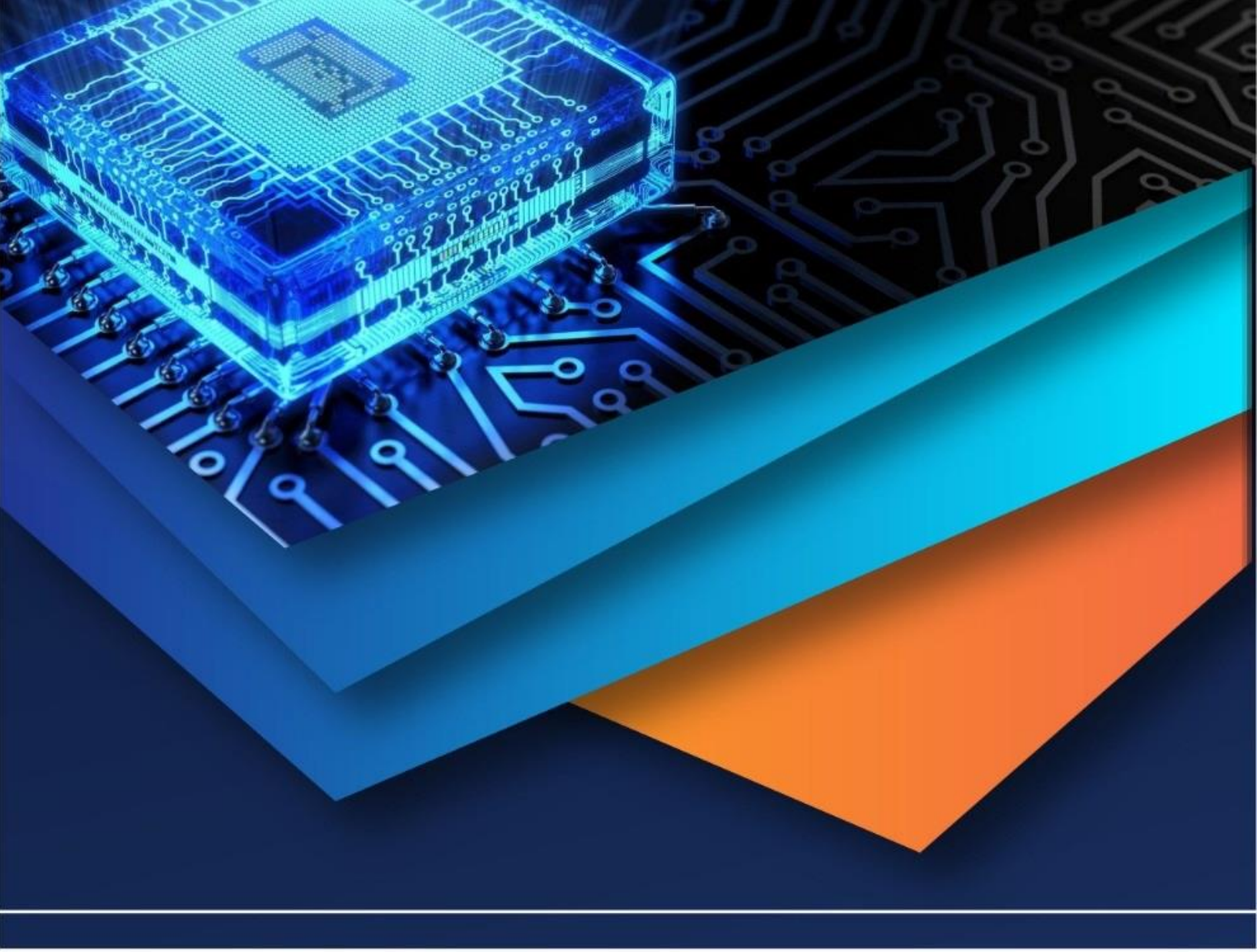

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