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IoT based Employee Wellness Program

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Abstract: ***Owing to globalization, employees spend 60-70% of their time in their offices hence they offer an important venue for influencing dietary behaviour of employees [1, 3]. With the increased technology and usage of sensors, the application of Internet based smart health monitoring has emerged at a greater pace. Internet of Things (IoT) is the new revolution which is the growing research area especially in the health care domain [7]. The current work presents a methodology that links the employee health to risk factors such as diet and physical activity and provides an exclusive diet plan to each employee through IoT enabled devices and network. A portable IoT enabled weighing scale setup was constructed using a Bench scale RSL 601AC Load Cell, Load Cell Amplifier HX711, Node MCU, RF ID and card reader to record the employee data & upload it to cloud. A .NET application was developed to download the data from the cloud and determine the BMI of an employee and the corresponding calories to be consumed and expended in a day. Taking into account the calories to be consumed and the diet preferences, the application then constructs a diet plan and sends it across to the employees and generates weekly statistical data of BMI to guide and monitor the overall fitness of the employees.***

Keywords: Dietary behaviour, BMI, Internet of Things (IoT), Diet plan, Fitness

I. INTRODUCTION

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. According to the World Health Organization, the BMI of a healthy individual ranges between 18.5 and 24.9. Individuals with a BMI of 25 and above are defined as overweight and those with a BMI of 30 or above are categorised as obese [4].

In 2012, people with obesity accounted for 38 million deaths and the number is expected to grow to 52 million by 2030 [1]. By 2040, the prevalence of overweight and obesity will be doubled and tripled respectively among Indian adults. It will reach 30.5% and 9.5% among men, and 27.4% and 13.9% among women, respectively [6]

In developing nations, the rapid globalization and urbanization have redefined the corporate culture and extended working hours and desk-bound lifestyle are the new standards introduced to meet the organizational deadlines. This has resulted in lifestyle and behavioural changes contributing to the risk factors associated with obesity. As the corporate culture continues to become more and more competitive, with employees having time as the biggest obstacle in life, the young individuals employed with the corporates are more at risk for the obesity.

II. PROBLEM AND SOLUTION

During the job hours, sitting for prolonged hours could adversely impact employees' health. The lack of movement slows down the digestion process by reducing the amount of food that is converted to energy and thus promoting fat accumulation resulting into overweight and obesity. An employee with any form of ailment may not be able to contribute productively for the company.

Nutrition impacts overall health at the workplace. An unhealthy diet indirectly promotes the risk for an array of chronic diseases, including heart disease, diabetes, and cancer, as it leads to overweight and obesity [3, 4]. Given the considerable time an employee spends at job, measures should be taken by an organization to understand its employees views on nutrition and wellness activities and therefore becomes a responsibility of the employer to educate and promote healthy regimes.

There has been enormous increase in the usage of IoT devices specifically in the field of health care. IoT enabled devices in a typical health care system, improves the understanding of user behaviour by providing precise and real time health data of individuals such as biomedical variables namely height, weight, temperature, blood pressure, heart rate, oxygen content etc. The provided data helps in individualizing treatment routines for different health conditions such overweight and obesity. The biomedical variable taken into account in the current case is the weight of an employee.

The current work presents a methodology with an objective to prevent obesity in the corporate culture by encouraging the employees to eat right. The proposed methodology links the employee health to risk factors such as diet and physical activity and provides an exclusive diet plan to each employee through IoT enabled platform. The factor that drives the methodology proposed is BMI (Body Mass Index), BMI is a person's weight in kilograms divided by the square of height in meters.

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III. ARCHITECTURE OF SOLUTION

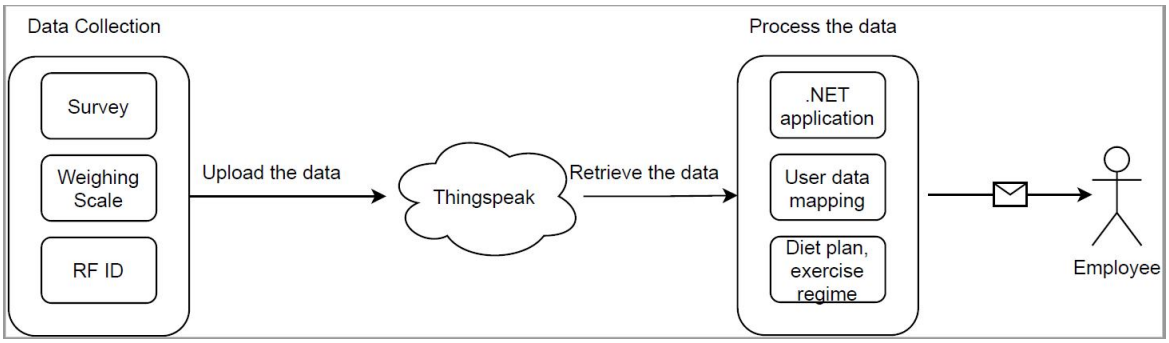


Figure 1: Architecture of solution

As depicted above in Figure 1, the proposed methodology constitutes of four basic steps,

A. Data Collection

A survey was conducted to collect the height, diet preferences, allergies and any chronic ailments of the participants in the case study. The weight of the participants was recorded using the portable weighing scale against a unique RF ID provided to the participants. The recorded weight is the average of the multiple entries from the stored data.

B. Data Transfer to Cloud

The data recorded by the weighing scale along with the RF ID is uploaded to the cloud. Data is appended to existing database in cloud with the uploaded timestamp.

C. Computing and Processing

The collected data is processed in local system within an encrypted database to avoid breach of privacy. Data is downloaded by a .NET application and diet plans and fitness routines are prepared for each employee separately.

D. Action

The application sends the diet and fitness plans through mail to all the employees.

IV. DEVICE CONSTRUCTION AND SETUP

A portable setup was created as shown in Figure 3, using a Bench scale RSL 601AC Load Cell, Amplifier HX711, Node MCU and card reader. The load cell was installed in between two wooden square planks using 6X M6 bolts to determine the employee weight. The weighing scale setup was connected to Node MCU along with a card reader via wires. The Node MCU was connected to Wi-Fi. The setup was powered by a 5V wall adapter. The schematic representation of the portable IoT setup is depicted in Figure 2.

A. Description of devices

1) Wooden block -> To rest the weighing setup on floor & user can stand on block
2) M6 Bolt -> To fix the load cell in between wooden blocks
3) Load cell -> Records the weight of person
4) Jumper Wires -> To connect load cell to amplifier
5) Amplifier -> Converts the analog signal to digital signal
6) Card reader -> Records the ID of the swiped card
7) Node MCU -> Uploads the recorded data to cloud storage via Wi-Fi

Python code was embedded in Node MCU to record the data & upload it to cloud and was thoroughly tested before deploying the setup. The code also contains the address of the cloud database. Once the data is uploaded to cloud, it gets appended to existing database in cloud with the uploaded timestamp.

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The weighing setup was placed on the ground and user can stand on it comfortably. The card reader was attached to the wall at a suitable height for a person to swipe his ID card.

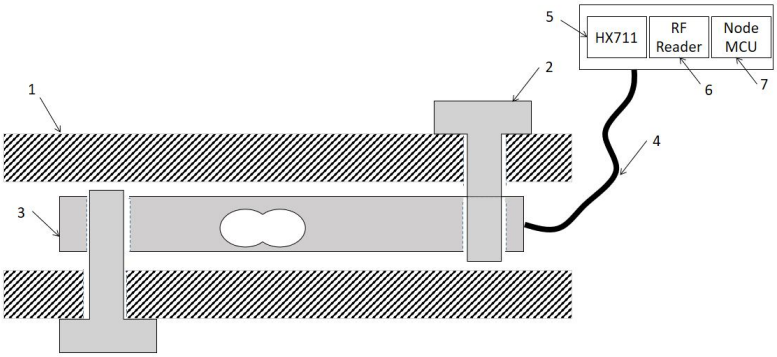


Figure 2: Schematic representation of portable IoT setup

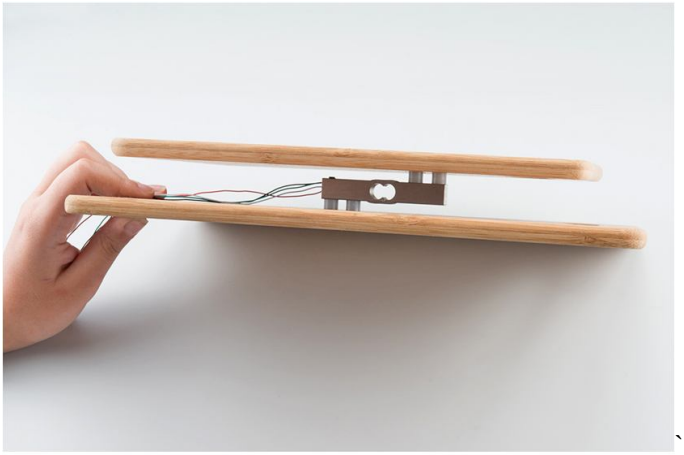


Figure 3: Sample of portable IoT setup

V. IMPLEMENTATION

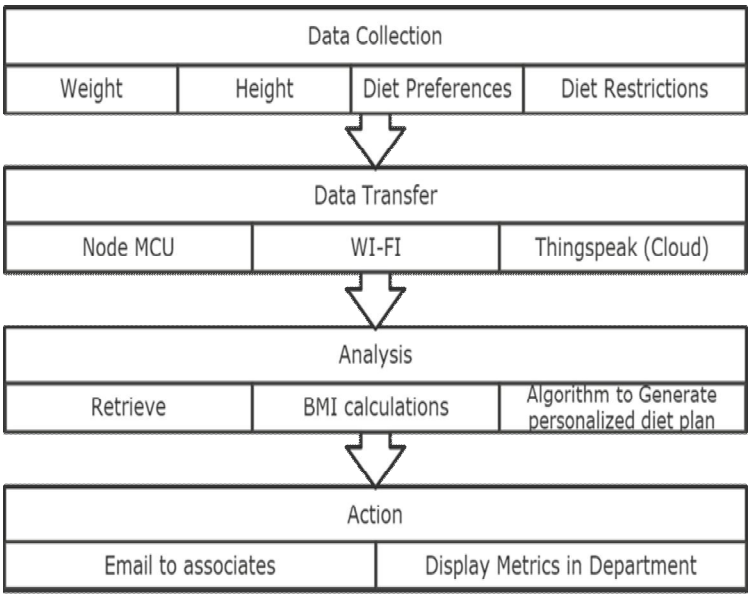


Figure 4: Implementation of the application.

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The pictorial representation of the implementation of the application is depicted in Figure 4. A survey was conducted to collect height, diet preferences and allergies of users participating in the case study. The collected data was stored in encrypted database to avoid breach of privacy. Each user was issued an RF ID card for the study. To use the device, user would stand still on the weighing scale setup and swipe his ID card against RF ID Reader as depicted in Figure 5, 6 and 7. The Node MCU collects the ID via card reader and weight via weighing scale setup and uploads it to cloud storage (Thingspeak). The recorded data is depicted in Figure 6. Each employee would perform this process once a day for a couple of weeks. The process of data collection is depicted in Figure 8.



Figure 5: Employee using the device



Figure 6: Employee standing on the weighing scale

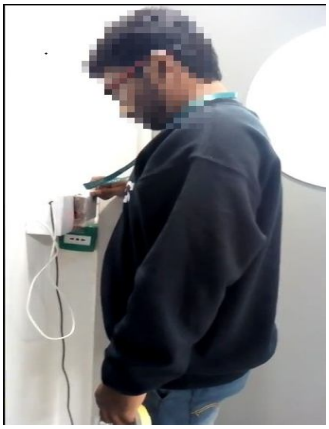


Figure 7: Employee swiping his ID card

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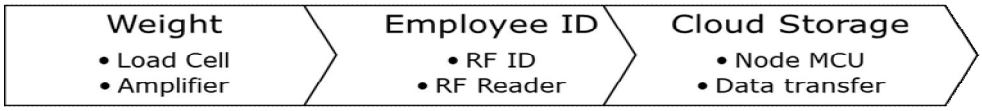


Figure 8: Process of data collection

A	B
Emp ID	Weight(kgs)
1	71.909
2	62.235
3	62.536
4	55.094
5	56.32
6	52.753
7	77.921
8	55.169
9	81.077
10	77.669
11	54.402
12	69.409
13	64.63
14	62.516

Figure 9: Employee data recorded

The data shown in Figure 9 is the average of the multiple entries of a unique employee ID from the stored data.

A. NET Application was Created to Accomplish the Following

1) Download the data from the cloud and calculate the average of the recorded weights against each ID
2) Calculate BMI of the user and come up with number of calories to consume each day.
3) Calculate diet plans and fitness routine for the users based on number of calories.
4) Send the diet plans and fitness routine to the users.
5) To generate weekly statistical data to monitor the overall fitness of the users.

VI. WORKING OF APPLICATION

The pictorial representation of the working of the application is depicted below in Figure 10.

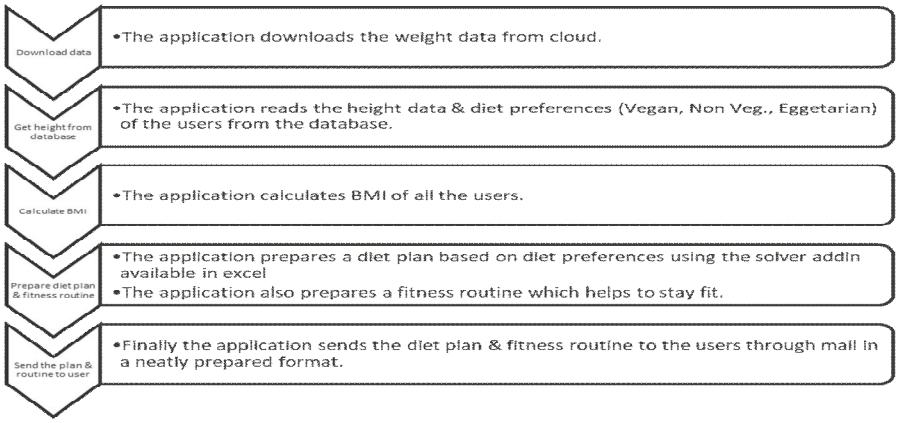


Figure 10: Flowchart depicting working of the application

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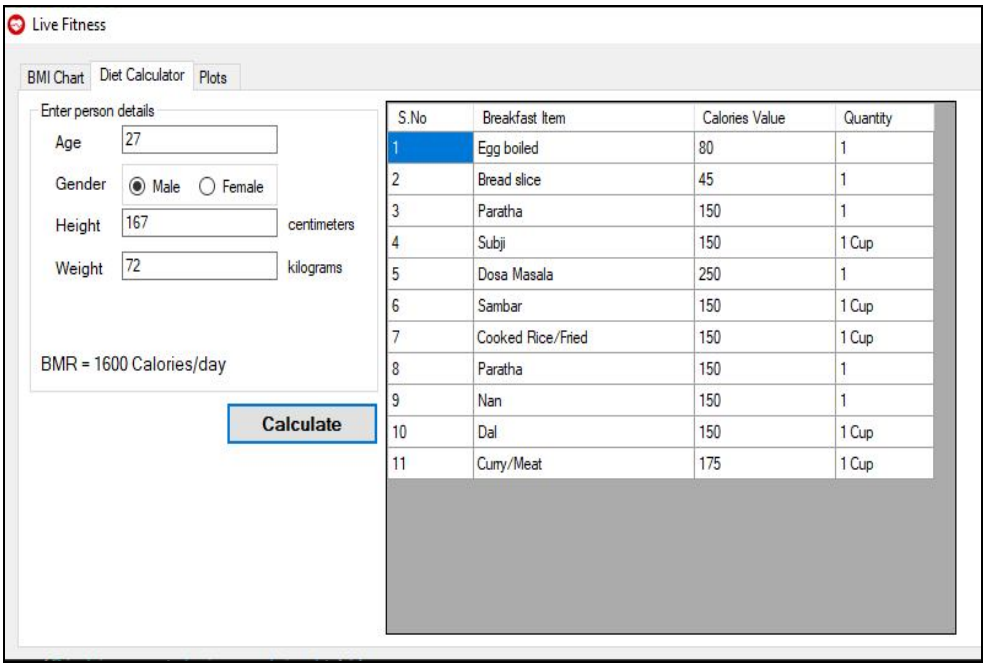


Figure 11: Sample image of the application

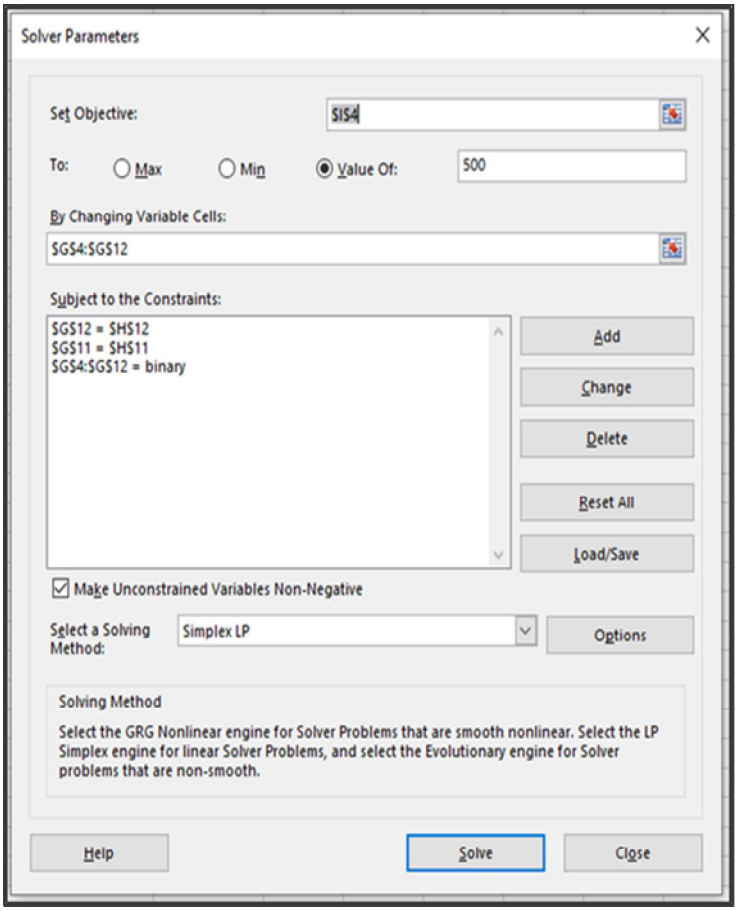
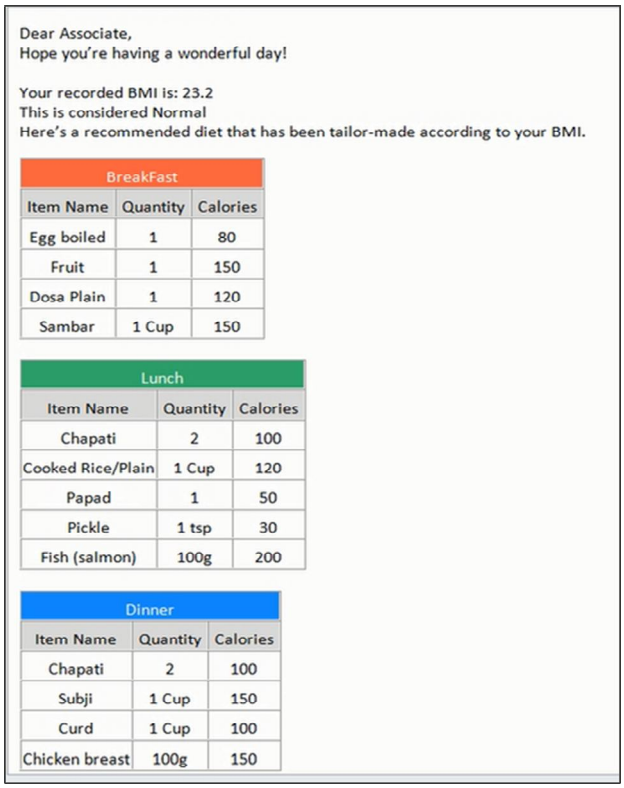


Figure 12: Solver usage

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VII. RESULTS/ACTION TAKEN

The prepared diet plans and fitness routines were shared to the users on weekly basis as shown in Figure 13 and 14 respectively through mail so users could take a print out and follow it. Regular follow up was done to check if the diet plans & routines were followed up by the users and to check if the users have started to see any differences (weight gain or loss) by following the plans.



Dear Associate,
Hope you're having a wonderful day!

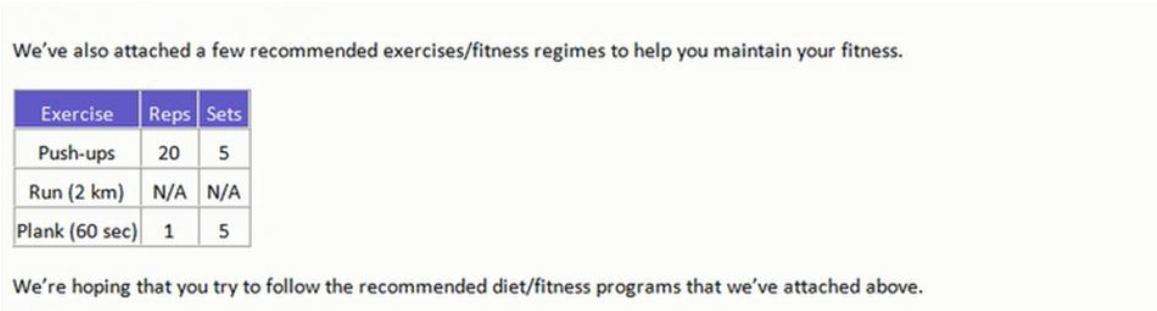
Your recorded BMI is: 23.2
This is considered Normal
Here's a recommended diet that has been tailor-made according to your BMI.

BreakFast		
Item Name	Quantity	Calories
Egg boiled	1	80
Fruit	1	150
Dosa Plain	1	120
Sambar	1 Cup	150

Lunch		
Item Name	Quantity	Calories
Chapati	2	100
Cooked Rice/Plain	1 Cup	120
Papad	1	50
Pickle	1 tsp	30
Fish (salmon)	100g	200

Dinner		
Item Name	Quantity	Calories
Chapati	2	100
Subji	1 Cup	150
Curd	1 Cup	100
Chicken breast	100g	150

Figure 13: Diet plan mailed to the users



We've also attached a few recommended exercises/fitness regimes to help you maintain your fitness.

Exercise	Reps	Sets
Push-ups	20	5
Run (2 km)	N/A	N/A
Plank (60 sec)	1	5

We're hoping that you try to follow the recommended diet/fitness programs that we've attached above.

Figure 14: Fitness plan mailed to the users

VIII. FUTURE SCOPE

In the current scenario, the fabricated portable Weight measurement setup encompasses a standard Bench scale RSL 601AC Load Cell between two wooden square planks, however the load cell can be selected to suit the application and the space requirements. The probability of fabricating a weight sensing platform using a micro load cell or a thin load cell right outside the workplace just like an office doormat should be explored as that eliminates the need of dedicated weight measuring workstation setup in the facility to measure the weight.

Scope of the current application can also be widened to monitor various health parameters such heartbeat, blood pressure, oxygen content, temperature and other body vitals using appropriate sensors to identify early signs of health issues.

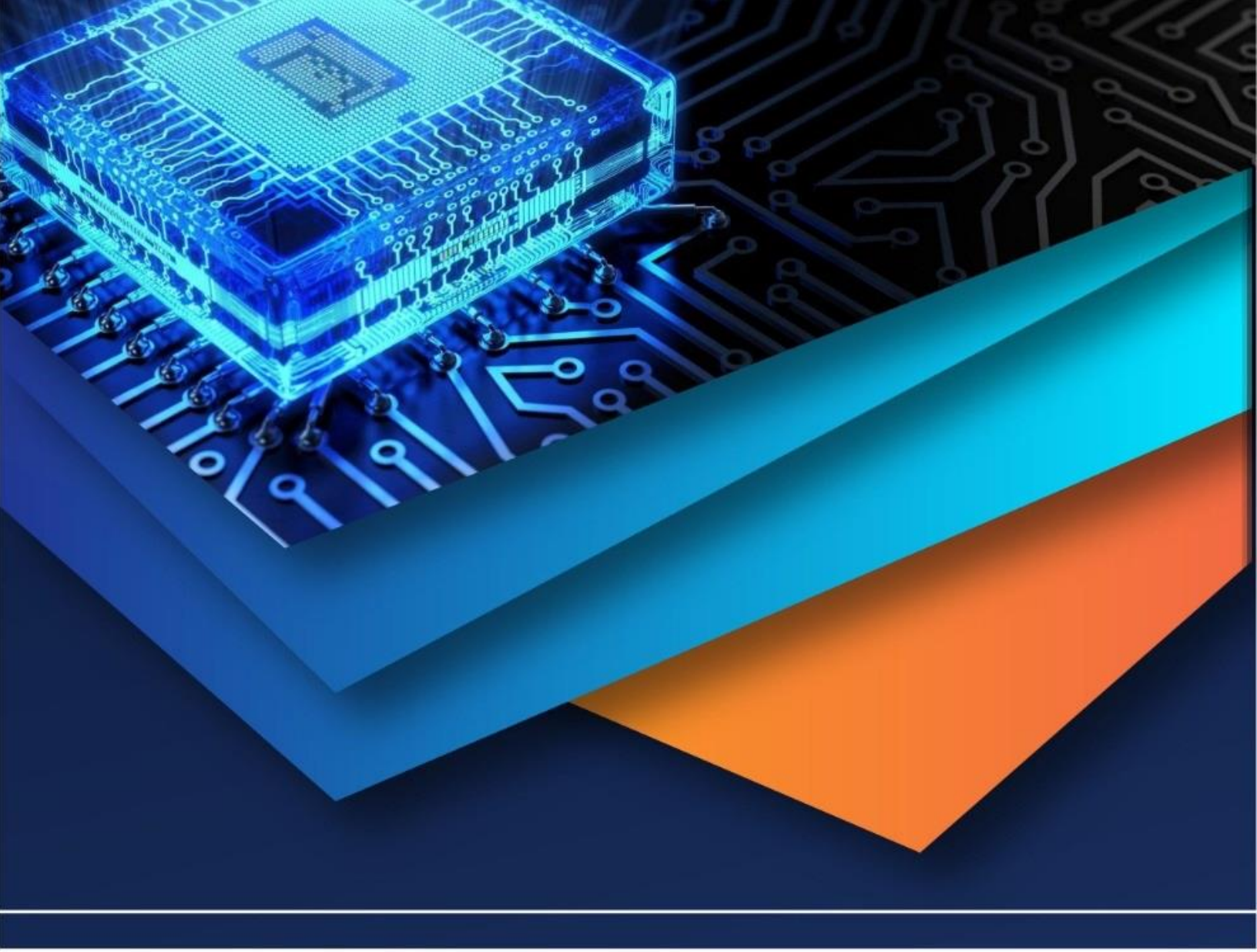
With widespread use of mobile phone or tablets, an Android and iOS application can be developed to push notifications about diet and fitness regimes to employees.

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