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Personalized Mobile Patient Guidance System for Early Detection and Management of Metabolic Syndrome

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***Abstract* - AI-based health recommendation systems can help reduce the risk of delayed or ineffective treatment due to metabolic syndromes by providing tailored advice based on a person's medical history, lifestyle, and other health-related data. AI systems can be used to provide individualized advice, diet plans, customized food, and physical activity advice, daily reminders, risk prediction algorithms, motivational messages, specialized guidance for fitness Persons, AI-powered analyzers, medication schedules, drug development, and create more precise risk forecasts. The most important detail is that the project aims to make a mobile app for metabolic syndrome health assistance popular among people living in remote areas of Sri Lanka. To do this project, the team must collect patient information, analyze patient data, develop personalized recommendations, monitor, and adjust recommendations, and track and update patient data.**

Keywords: monitor, metabolic syndromes, AI-based, analyzers, recommendation.

I. INTRODUCTION

Metabolic syndrome is a dangerous disease that affects the human body including five main factors. If the person has three diseases of those five diseases, then we can call that person has metabolic syndromes. The five diseases are,

1) Waist measurement to assess abdominal obesity
2) Elevated levels of serum fasting triglycerides
3) Low HDL and high LDL levels
4) High blood pressure
5) Elevated levels of fasting plasma glucose

The risk of major clinical illnesses like cardiovascular disease, cancer, and form type of diabetes might be raised by metabolic syndrome, a collection of illnesses. There have been numerous tips and advice that could help with controlling metabolic syndrome and lowering the possibility of serious consequences. Adopting healthy, balanced food plan rich in fruit and vegetables, whole carbohydrates, and controlling protein and minimal in saturated and trans fats is one key suggestion for controlling metabolic syndrome. Frequent exercise too is crucial since it lowers both cholesterol and blood pressure while enhancing glucose tolerance. Weight loss through a mix of proper diet and higher levels of exercise can help people who are obese enhance their metabolism. Furthermore, crucial are giving up cigarettes and controlling anxiety levels with workouts like relaxation techniques or meditation. A healthcare professional may also recommend drugs to treat excessive blood cholesterol, elevated pressure, and diabetes. Those with diabetes or prediabetes should also constantly review the levels of glucose in their blood. All in all, medical therapies targeted at lowering health conditions and enhancing general health are integrated with dietary modification to maintain metabolic syndrome. To maintain metabolic syndrome and lower the risk of major complications, a customized plan can be created with the assistance of a medical professional.

Metabolic syndrome presents a heightened risk for major clinical maladies, such as cardiovascular disease, cancer, and certain types of diabetes. To effectively manage metabolic syndrome and reduce the potential for severe consequences, various recommendations and strategies have been advocated. One fundamental suggestion is the adoption of a healthy, well-balanced dietary regimen, replete with fruits and vegetables, complex carbohydrates, and prudent protein intake while minimizing saturated and trans fats. Consistent physical activity also plays a pivotal role, as it not only lowers cholesterol and blood pressure but also enhances glucose tolerance. Weight loss, achieved through a combination of proper nutrition and increased physical activity, can significantly improve metabolic function, especially in individuals grappling with obesity. Furthermore, smoking cessation and stress management techniques, such as relaxation exercises or meditation, hold substantial importance. Medical intervention may involve the prescription of medications to address elevated cholesterol, high blood pressure, and diabetes. Those afflicted with diabetes or prediabetes should maintain regular monitoring of their blood

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glucose levels. In essence, medical therapies aimed at ameliorating health conditions and bolstering overall well-being are seamlessly integrated with dietary modifications in the management of metabolic syndrome. A tailored plan can be collaboratively devised with the guidance of healthcare professionals to effectively address metabolic syndrome and reduce the risk of major complications.

II. LITERATURE REVIEW

Health and lifestyle are important factors that affect both good health and disease, disability, and even premature death. The current urban lifestyle is characterized by insufficient physical activity, junk food, and excessive stress levels, all of which undermine people's well-being. Long-term effects of this lifestyle include health issues and diseases like diabetes, high blood pressure, obesity, strokes, and cardiovascular disease. This wellness app can learn about the subject, categorize her or him by analyzing some of her or his unique traits (physical attributes and lifestyle), and provide tailored recommendations to improve her or his well-being. By tracking the evolution of the defined features over time, the application can also provide feedback on their efficacy and act as a motivator for the client to pursue their wellness objectives [9]. Utilizing goals setting tools - This is done to persuade them to choose to change their behavior or to keep it changed. This is accomplished through the employment of a reasoning module, which evaluates the wellness performance indicators and determines what kinds of recommendations are required to guide the user toward the adoption of appropriate behaviors. For instance, if the Time spent per Week on Physical Activity Index is too low for recommendations, the app can advise increasing the amount of time spent engaging in physical activity.

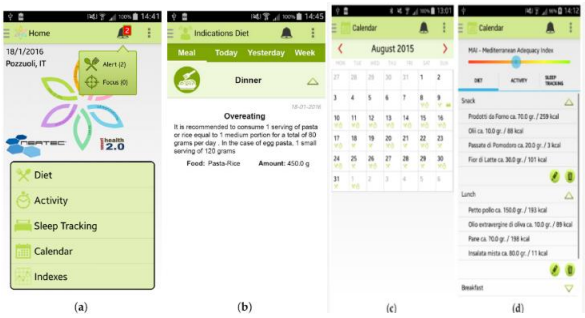

Figure 1: Screenshots of the wellness app (a)dashboard, (b)insert the new meal, (c)calendar, (d)all details [9]

The Wellness App's primary menu is accessible once the user has entered his or her information. By choosing, for instance, the special option "Diet" from the main menu, as seen in Figure 10a, the user can enter details about a new meal. The software offers a straightforward user interface to make interacting with it easier when adding new data is possible. For instance, as seen in Figure 10b, some pre-set quantities have been offered to facilitate the quick inclusion of new meal data. There are a few examples of the types of foods that can be entered into the Wellness App as meals. Based on the entered meals, the Wellness App automatically calculates the Mediterranean Adequacy Index (MAI) every day and every week. Utilizing routinely gathered EHR data, the created artificial intelligence model based on DL demonstrated good exclusionary capabilities for forecasting laboratory studies. The use of DL methods can help patients choose the best laboratory tests, which could enhance patient safety. Further research is advised to determine whether using this model in actual healthcare situations will be an expense [10].

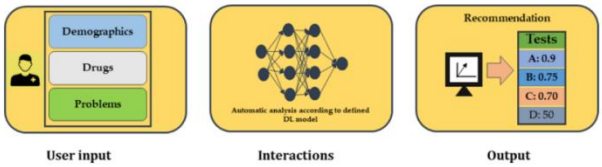

Figure 2: Screenshot of the proposed info graphic recommendation tool using deep learning [10]

The application opens daily step objective is represented by the left circular toolbar, and their daily movement objective is represented by the circular navigation bar. The smooth curves & graphs are generated automatically based on the time of day. The arc shows the mean step objective for each hour, while the graph displays the daily step counting goal for the hours needed. A specific suggestion to the individual user on the pattern inside the prior week has been made using the patient's daily step count that is kept in the Present in significant amounts.

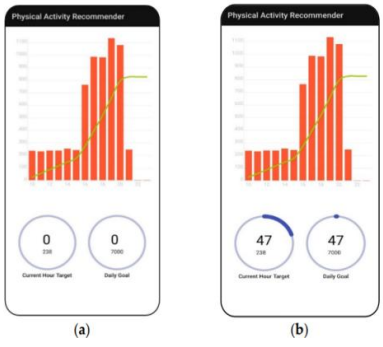

Figure 3: Screenshot of a) suggested exercise schedule, b) progress monitor for steps [8]

Diabetes is on the rise among American Indian (AI) groups, which poses a significant public health risk. With concurrent improvements in excess weight and lower levels of exercise, the rate and frequency of diabetes have massively improved. In this article, they suggest a constructive approach for advising blood sugar level self-care to diabetics via artificial intelligence. Patients are encouraged to maintain a

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healthy routine to combat their blood sugar levels. They select smartphones as the platform to deliver intelligent personal care for AI individual patients to the almost universal usage of smartphones among the majority of AI tribes [1]. The system can provide tailored advice (for example, dietary patterns and regular exercise) according to the specific socioeconomic, social, as well as physiographic condition in general and especially to Artificial intelligence - based clients through embedding the existential resume of the Artificial intelligence-based customers with diagnostic obesity suggestions & recommendations. Mobile apps were used to achieve the proposed methodology.

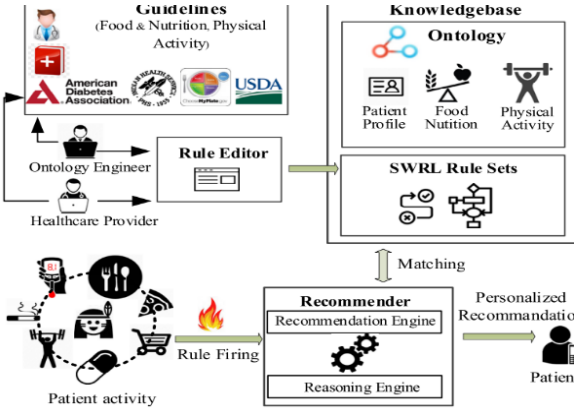

Figure 4: System of Customized Guidelines to Assist AIs' Diabetes Self-Management [1]

III. METHODOLOGY

A) Offering the Highest disease risk profiling through patient-data analytics

Users initiate the process by entering their personal and medical information into the system. This includes details like age, gender, weight, height, medical history, and any existing health conditions. In the initial step of our healthcare system, users actively engage by inputting a comprehensive array of personal and medical information into the system's interface. This encompassing dataset entails fundamental details such as their age, gender, weight, height, and pertinent medical history, including any preexisting health conditions or chronic ailments. By willingly sharing these crucial pieces of information, users lay the foundation for the system's ability to tailor its health recommendations and disease risk assessments with a high degree of precision, ultimately facilitating a more personalized and effective approach to healthcare management. Users can input their health-related reports regularly. These reports may include data on blood pressure, cholesterol levels, fasting glucose, and other relevant medical parameters.

The "Regular Report Input" component of our healthcare system empowers users with the capability to consistently contribute their health-related reports, thereby fostering ongoing monitoring and assessment of their medical status. Users can regularly input crucial data, such as blood pressure measurements, cholesterol levels, fasting glucose readings, and other pertinent medical parameters, ensuring that their health profile remains up-to-date and reflective of any fluctuations or changes over time. This iterative input mechanism serves as a valuable tool for both users and the system, enabling the tracking of health trends, early detection of anomalies, and the dynamic adjustment of personalized health plans to optimize disease prevention and management strategies. It encourages proactive engagement with one's health, facilitating timely interventions and contributing to better health outcomes through informed decision-making. The system ensures the confidentiality and security of the user's bio and medical information. Robust data encryption and security protocols are implemented to safeguard sensitive data. In the realm of secure data storage, our system places paramount importance on safeguarding the utmost confidentiality and security of the user's biographical and medical information.

Formula:

- Metabolic Syndrome Score = Age_Score + BMI_Score + FBS_Score + Thalach_Score + Glucose_Score

- Low Metabolic Syndrome: 0-25%
- Medium Metabolic Syndrome: 25-50%
- High Metabolic Syndrome: 50-100%

- Metabolic Syndrome Percentage = (Metabolic Syndrome Score / Maximum Possible Score) * 100

Using Metabolic Syndrome Percentage, we can predict what is the Metabolic Syndrome status.

- Estimated Blood Pressure = 90 + (0.5 * Age) + (0.2 * Weight in kg) - (0.3 * Height in cm) + (0.1 * fbs)
- High Blood Sugar Risk = (Age + (BMI / 10)) + (Glucose Value / 5)
- Abdominal Obesity Value = BMI + (0.1 * Age)
- Cholesterol = (Age * 0.5) + (thalach * 0.2) + (fbs * 50)
- Triglyceride = (Age * 2) + (BMI * 5)

Using those five disease scores we can predict what is the most affected factor.

B) Offering precision Health recommendations and suggestions based on Metabolic Syndromes

After that, our system will also find the most affected disease weight percentage and whether if it is low, medium, or high.

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Abdominal Obesity

Percentage Rate = ((Age Value / Age Threshold) * Age Weight) + ((Weight Value >= Weight Threshold) * Weight Weight) + ((Height Value >= Height Threshold) * Height Weight)

- low than (-2.5) = low, (-2.5) to (4.0) = medium ,more than (4.0) = high

High triglycerides

Percentage Rate = ((Age Value / Age Threshold) * 100) + ((BMI Value / BMI Threshold) * 100)

- low than 15 = low ,15-25 = medium, more than 25 = high

Cholesterol

Percentage Rate = ((Age Value / Age Threshold) * Age Weight) + ((thalach Value >= thalach Threshold) * thalach Weight) + fbs Value

- low than 15 = low ,15-25 = medium, more than 25 = high

High blood pressure

Percentage Rate = ((Age Value / Age Threshold) * Age Weight) + ((thalach Value >= thalach Threshold) * thalach Weight) + fbs Value

- low than 15 = low ,15-25 = medium, more than 25 = high

High blood Suar

Percentage Rate = ((Age Value / Age Threshold) * Age Weight) + ((Glucose Value >= Glucose Threshold) * Glucose Value)

- low than 15 = low ,15-25 = medium, more than 25 = high

The final system will generate suitable health recommendations and suggestions using the most affected factor to the patient.

Table 1: This is the Recommendation flowable

Age	Disease	Weight	Scalability	plan
10-15 16-35 36-50 >50	Abdominal obesity High Blood Pressure High Blood sugar Cholesterol Triglyceride	It may be 1% 99% 12.3% or any other value	Low or Medium or High	Diet plans Exercise plans

C) Handling Health Profile data and personalizing Health recommendations

Using the above-generated health recommendations and suggestions, the system will customize that meal plan and exercise plan correctly. The system calculates the approximate calorie intake required for breakfast, lunch, and dinner based on the user's age, gender, weight, and activity level. This ensures that the dietary recommendations are precise and aligned with the user's energy needs. The "Caloric Intake Calculation" step in our system is a crucial component that enables us to precisely determine the recommended daily calorie intake for each user's breakfast, lunch, and dinner. This calculation takes into account several key factors, including the user's age, gender, current weight, and level of physical activity. By considering these variables, we can tailor our dietary recommendations to align with the user's unique energy requirements. For instance, an individual with a higher activity level may need more calories to sustain their energy levels throughout the day, while factors like age and gender also play significant roles in determining nutritional needs. This meticulous approach ensures that the dietary guidance provided by our system is finely tuned to each user's specific circumstances, promoting optimal health and well-being.

Derived values from daily calorie intake are also categorized according to different age groups. This customization ensures that recommendations are suitable for users of varying age categories. Age-specific values in our healthcare system refer to the customization of daily calorie intake recommendations based on different age groups.

Age 10 – 15

Male -> 2200cal – 3000cal

Average = 2600cal

Female -> 1800cal – 2400cal

Average = 2100cal

15%-25% of daily calorie intake for the breakfast.

Example 1:

2600cal * 15/100 = 390cal

2600cal * 25/100 = 650cal

For breakfast approximately 390cal-650cal

25%-35% of daily calorie intake for the dinner.

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Example 2:

2600cal * 25/100 = 650cal
2600cal * 35/100 = 910cal
For lunch approximately 650cal-910cal
25%-35% of daily calorie intake for the dinner.

D) Tracking and Monitoring personalized Diet and Exercise Plans for Metabolic Health Optimization

The system continuously tracks and monitors the user's data, creating a dynamic health profile that evolves. The process of Data Tracking and Monitoring within our healthcare system involves the ongoing and meticulous observation of the user's health-related information and parameters. This continuous surveillance allows the system to compile and maintain a constantly evolving health profile that encapsulates the user's medical history, lifestyle choices, and health metrics. As users input data over time, such as blood pressure readings, cholesterol levels, dietary habits, and exercise routines, the system captures these updates and integrates them into the user's profile. This dynamic health profile provides a comprehensive and real-time view of the user's health status, enabling the system to adapt its recommendations and assessments accordingly. It ensures that the user receives personalized guidance that reflects their changing health needs, fostering a proactive approach to disease prevention and management.

1. Food Plan Tracking:

Users can keep track of their diet by taking pictures before and after every meal. They can use this function to visually track their eating decisions and development.

2. Report and Illustration:

Users can access their historical data through our program and view it visually in a variety of graphs and charts. With this function, users may keep tabs on their eating patterns and spot trends over time.

3. Exercise routine each day:

Our smartphone application allows users to start their daily fitness regimens. Users can conveniently plan and adhere to their exercise schedule with this function.

4. User-Friendly Interface with Smart Button:

Users can utilize our system's user-friendly interface to press smart buttons to start and stop their training sessions. This makes it easier to record exercise data.

5. Exercise Alarm:

The system also has an alarm feature that prompts users to end their workouts after the allotted time has passed. This guarantees that consumers don't push themselves excessively when working out.

6. Real-Time Exercise Recognition:

The system can identify and monitor an individual's exercise activities in real-time. This makes it possible to receive immediate feedback and track exercise progress.

7. Calorie Range Tracking:

Using the users' health advisories, our technology continuously tracks and estimates their calorie consumption. For the best calorie control, this feature aids customers in staying inside their suggested calorie range. These capabilities might be added to our mobile application to give our consumers a thorough and convenient way to track their health and fitness.

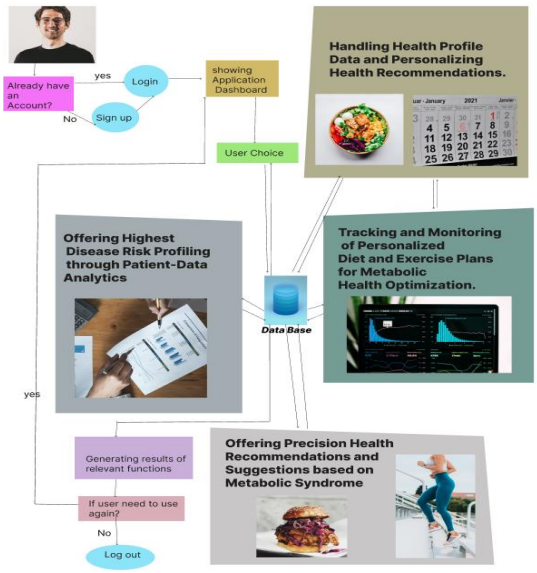

Figure 5: Screenshot of the Entire System Overview

E) Software Solution

We used the Agile software method. The agile methodology places a strong emphasis on accepting change and allowing the production process more freedom. In terms of efficacy, Scrum is better than other agile frameworks. It is a lightweight framework for managing agile projects that can be applied to tackle and address challenging adaptation problems.

IV. RESULT AND DISCUSSION

A big step forward in the promotion of individualized healthcare and preventative actions has been made with the

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effective creation and implementation of the metabolic syndrome mobile application. The main conclusions and ramifications of the application's findings are explored in this discussion. Users provide their necessary health information during the application's initial patient contact phase. Our tailored method is built on this data set, which enables the system to adjust health suggestions based on user preferences. The application ensures a smooth and secure flow of information by keeping patient data in a separate database, enabling fast updates and modifications to the user's health profile.

The application's capability to develop personalized diet regimens and exercise schedules is one of its outstanding results. The application analyzes the patient's input data using machine learning algorithms and produces recommendations that are individualized to meet each person's unique needs. This not only covers the variety of metabolic syndromes but also highlights the significance of individualized care in successfully treating and avoiding these disorders. Machine learning is used in these programs to increase their accuracy over time as the system iteratively improves its suggestions in response to user feedback and changing health patterns. The tracking and monitoring capabilities of the application are crucial components of its functionality. The application promotes a sense of accountability and incentive by routinely tracking the patient's development and adherence to the advised plans. Users are motivated to stay committed to their health journey by receiving regular updates and reminders. This encourages beneficial behavioral adjustments that can reduce the risks related to metabolic disorders. The real-time tracking aspect of the application enables users to see their advancement, generating a constructive feedback cycle that strengthens their will to lead better lifestyles.

Figure 6: Screenshots of final user interfaces

One of the application's most important features is its capability to precisely determine whether users display symptoms of metabolic syndrome. This diagnostic skill acts as an early detection system, enabling people to control their health proactively before the illness worsens. The program offers users actionable strategies to address their particular health concerns with advice that is grounded in evidence-based guidelines. The application serves as a virtual healthcare companion by providing users with thorough information and recommendations, enabling them to make decisions regarding their well-being.

The findings of this study demonstrate how mobile applications could fundamentally alter how we think about metabolic syndromes and other related health issues. The recommendations made by the application are individualized, which is consistent with the move toward precision medicine, where interventions are customized to patient characteristics. There are chances for the features of the application to be improved and expanded as technology develops further. The usefulness and reach of the program could be increased by integrating wearable devices for real-time health data input and investigating partnerships with healthcare experts.

V. CONCLUSION

By utilizing AI in health recommendation systems, it is possible to analyze enormous volumes of data and provide healthcare practitioners with insightful analysis and pertinent recommendations. The technology can help people understand their condition, make essential lifestyle changes, and get the right medical care by utilizing AI algorithms. This gives people the ability to control their risk factors for metabolic syndrome and take preventative action to halt the progression or emergence of connected conditions. There are many advantages to using AI-based health recommendation systems in the Personalized Mobile Patient Guidance System. In the first place, it increases people's knowledge of metabolic syndrome and the hazards it entails. The system aids people in maintaining healthier lifestyles by encouraging positive behavior changes and encouraging daily reminders and motivational messages.

The AI algorithms can also produce personalized suggestions, such as specialized food programs, unique physical activity guidance, individualized drug schedules, and individualized risk prediction algorithms, which can help with the precise control and treatment of metabolic syndrome. Additionally, the system can divide patients into smaller groups according to their objectives and modify advice accordingly. This adaptability guarantees that people receive individualized assistance in line with their unique goals, thereby enhancing the efficiency of the system in combating the metabolic syndrome. The future of AI in this area is very promising. The system can expand further to speed up

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medication development, improve risk predictions, and include new technologies for better oversight and assistance. The system's effectiveness and ability to interface with current healthcare infrastructure will be improved and validated by ongoing study and collaboration with healthcare experts. A considerable improvement in the early detection and management of metabolic syndrome is provided by the development and evaluation of the personalized mobile patient guidance system reported in this research study, which incorporates AI-based health recommendations. By utilizing AI, the system enables people to receive individualized care, adjust their lifestyles, and make informed decisions, thereby lowering the risk of issues connected to metabolic syndrome.

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