OPRA HEALTH: An Obesity Prediction System With Real-World Adoption And Adolescent Interaction

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***Abstract*—Obesity among adolescents is a growing health problem that continues to increase due to unhealthy food habits, stress, and lifestyle changes. Adolescent health is an important part of human life as it helps prevent long-term diseases and improves overall quality of life. Today, many teenagers are not aware of their daily food intake, mental health condition, and physical activity levels, which increases the risk of obesity. To overcome this, we introduced a system called OPRA HEALTH. It is an AI-based obesity prediction and management system designed for adolescents. Obesity prediction is performed using the Random Forest algorithm. An AI food scanner uses a YOLOv8 model trained on an Indian food dataset to detect food items, while activity-related categorical inputs are converted using Label Encoder. Sentiment and behavioral patterns are analyzed using PyTorch-based transformer models, with chatbot support to promote healthy lifestyle habits.**

Index Terms—Random Forest algorithm, Label encoder, *YOLOv8* model, PyTorch-based transformer models.

I. INTRODUCTION

Human health has always been influenced by a complex mix of biological, social, and environmental factors. In the modern era, rapid urbanization, changing food cultures, and the widespread use of digital technologies have reshaped how people live and interact with their surroundings. Adolescents are growing in an environment where convenience often outweighs nutrition, where long hours of study or work reduce opportunities for physical activity, and where stress and screen time have become everyday companions. These shifts have created new challenges for healthcare systems worldwide, demanding innovative solutions that go beyond traditional medical approaches. Among the many health concerns that arise from these lifestyle changes, obesity has become one of the most pressing global issues. It is not only a medical condition but also a social and psychological challenge, affecting confidence, relationships, and long-term wellbeing. The World Health Organization has repeatedly emphasized that childhood and adolescent obesity is a predictor of adult health complications, including diabetes, cardiovascular disease, and mental health disorders. Early detection and timely intervention are therefore critical, as habits formed during adolescence often persist in adulthood. Addressing obesity at this stage can reduce future health risks, lower healthcare costs, and improve overall quality of life. -term well-being. The World Health Organization has repeatedly emphasized that childhood and adolescent obesity is a predictor of adult health complications, including diabetes, cardiovascular disease, and mental health disorders. Early detection and timely intervention are therefore critical, as habits formed during adolescence often persist into adulthood. Addressing obesity at this stage can reduce future health risks, lower healthcare costs, and improve overall

Technology has become a powerful partner in addressing modern health challenges. Advances in artificial intelligence, mobile applications, and wearable devices now enable monitoring, prediction, and guidance of health behaviors in ways that go beyond traditional physical measurements. By integrating psychological, behavioral, and nutritional data, these platforms provide a holistic view of adolescent health and engage users through interactive, supportive tools. AI-driven solutions have shown

promise in combating obesity by identifying risks early, recommending tailored interventions, and motivating healthier routines through gamified approaches. Machine learning models can track lifestyle patterns such as diet, exercise, and screen time, while apps and wearables deliver realtime feedback that encourages better choices. Together, these technologies are shifting obesity management from a reactive medical issue to a proactive and sustainable process for the younger generation.

II. PROBLEM DEFINITION

Adolescent obesity has become a serious and growing public health issue worldwide. It is influenced largely by unhealthy eating habits, less physical activity, too much screen time, and increasing psychological stress. Traditional obesity prediction systems rely mostly on basic physical measures, such as Body Mass Index (BMI), height, and weight. However, these methods overlook key behavioral and emotional factors, such as mood, stress levels, and lifestyle patterns. As a result, these systems offer limited insights and often do not accurately reflect the complex nature of obesity in adolescents. Additionally, many existing models face problems related to data quality, scope, and flexibility. Most systems are created using small or local datasets, limiting their ability to apply to different populations. They also often deal with issues like missing or inconsistent data, lack of consideration for psychological and genetic factors, and no real-time monitoring. Current solutions usually give static predictions without ongoing feedback or user interaction, making them less effective for encouraging long-term behavior changes. The absence of engaging features and personalized guidance further lowers user motivation, especially for adolescents who need interactive and supportive environments.

Thus, there is a strong need for a smart, dynamic, and user-friendly system that goes beyond traditional prediction methods. This system should combine physical, behavioral, and psychological data to offer more precise and complete obesity predictions. It should provide real-time feedback, personalized recommendations, and engaging features to encourage healthy lifestyle changes. Addressing issues like data privacy, user control, and accessibility is also important to build trust and encourage use. The proposed system aims to fill these gaps by creating an interactive and secure platform that not only predicts obesity risk but also actively helps adolescents maintain a healthy lifestyle.

III. EXISTING SYSTEM

The majority of obesity monitoring systems currently in use primarily rely on fundamental physical characteristics like age, height, weight, and BMI. These systems frequently only offer a broad classification of obesity and fail to take into account significant real-world variables like screen time, stress, mood swings, mental health, and everyday behavioral patterns. Additionally, a lot of conventional systems lack interaction, provide little personalization, and don't inspire teenagers to improve their long-term health.

IV. RELATED WORKS

Recent advancements in machine learning and digital health technologies have enabled the development of intelligent systems for obesity prediction and health monitoring. Several studies have explored the use of behavioral, physical, and lifestyle data to predict obesity risk. This section reviews two closely related works and highlights their limitations, which motivate the design of the proposed OPRA Health system.

A. DeepHealthNet: Adolescent Obesity Prediction System Based on a Deep Learning Framework

DeepHealthNet introduced a deep learning-based obesity prediction system for adolescents aged 10 to 12 years. The system gathered health data using a smartwatch and a mobile app. This data included step count, sleep duration, calorie intake, calories burned, height, and weight. A deep neural network was used to model health patterns over time and predict obesity trends.

The framework showed better predictive accuracy compared to traditional machine learning models. It also emphasized the importance of long-term health data. However, DeepHealthNet was limited to a specific age group and did not consider important factors like psychological state, dietary quality, emotional well-being, or social interaction. Moreover, the system was mostly experimental and lacked features like user-controlled privacy, real-time engagement, and personalized motivation.

B. Predictive Performance of Machine Learning Algorithms Regarding Obesity Levels Based on Physical Activity and Nutritional Habits

Lucena et al. proposed a machine learning framework to predict obesity levels based on physical activity and eating habits. The study used a structured dataset that included details such as age, height, weight, dietary behavior, how often people exercise, water intake, alcohol consumption, and screen time. The researchers evaluated multiple classification algorithms, including J48, Naive Bayes, K-Nearest Neighbors, Multilayer Perceptron, and ensemble-based models, using k-fold cross-validation to ensure reliable performance.

The results showed that supervised machine learning algorithms can effectively classify individuals into different obesity categories according to BMI standards. However, the system relied solely on static, self-reported survey data and did not offer real-time health monitoring. It also did not take into account psychological, emotional, and social factors that influence obesity. Additionally, the system lacked features for providing feedback or engaging users. These limitations make it less applicable for ongoing obesity management and interactions with adolescents in real life.

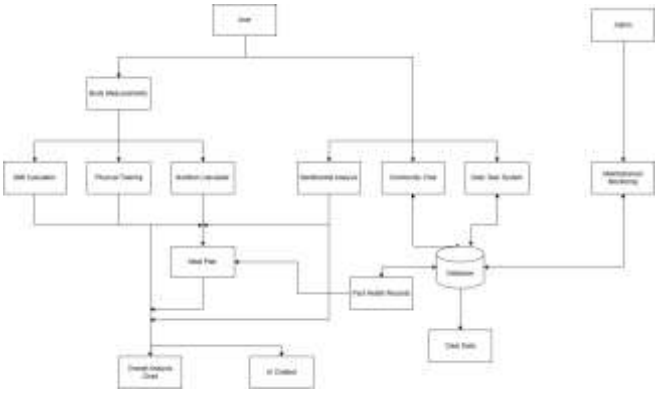
C. Systematic Review of Machine Learning Applied to the Prediction of Obesity and Overweight

This paper provides a review of machine learning and deep learning techniques used to predict obesity and overweight conditions. The authors followed the PRISMA framework to ensure a clear and organized review process and analyzed 17 peer-reviewed studies involving children, adolescents, and adults. The review divided existing approaches into traditional machine learning models, such as Support Vector Machines, Random Forests, and Decision Trees, and deep learning models, including Artificial Neural Networks and Long Short-Term Memory networks.

The findings show that traditional machine learning algorithms often perform better than deep learning models when applied to small or moderately sized structured datasets. While deep learning methods have potential for capturing complex relationships, their use is limited because of high computational needs and the requirement for large, high-quality datasets. The study also highlights that the quality of data, preprocessing, and feature selection significantly affect prediction performance, often more so than the complexity of the model itself. Additionally, the review points out a gap in research regarding the limited use of psychological, behavioral, and unstructured data, indicating a need for more comprehensive obesity prediction systems.

V. PROPOSED SYSTEM

OPRA HEALTH is a comprehensive and intelligent digital health platform designed to predict, monitor, and manage adolescent obesity by integrating artificial intelligence with behavioral analysis. The system addresses the growing need for early identification and personalized intervention by combining psychological, nutritional, and lifestyle factors into a unified framework. Unlike conventional health monitoring systems that focus mainly on physical indicators such as weight and BMI, OPRA HEALTH incorporates emotional and behavioral parameters including mood, stress levels, dietary habits, physical activity, and screen time. By continuously collecting and analyzing real-time data using advanced machine learning algorithms, the platform assesses obesity risk and generates personalized health insights, preventive recommendations, and motivational guidance to support healthier lifestyle choices.



The above diagram illustrates the overall system architecture and data flow of the OPRA HEALTH platform, highlighting the interaction between users, system modules, and administrative components within a unified ecosystem. The process begins with the user, who provides essential inputs such as body measurements, dietary information, physical activity data, and emotional indicators. These inputs are processed through dedicated modules including the BMI Calculator, Physical Training, and Nutrition Calculator, which together evaluate the user's physical health status. The outputs from these modules contribute to personalized meal planning and fitness recommendations aligned with individual health goals.

In parallel, behavioral and emotional data are analyzed through the Sentimental Analysis module to assess mood and stress levels, supporting mental and emotional well-being. Engagement-driven components such as the Daily Task System and Community Chat encourage consistency and motivation by promoting healthy routines and peer interaction. All generated data, including current inputs, daily activities, and past health records, are securely stored in a centralized database, enabling long-term tracking, trend analysis, and adaptive learning.

The system further enhances user understanding and engagement through the Overall Analysis Chart, which visually presents health progress in an easy-to-interpret format. The AI Chatbot serves as an interactive virtual assistant, offering real-time guidance, answering user queries, reinforcing positive behaviors, and providing emotional encouragement when needed. On the administrative side, the Admin module supports system maintenance, monitoring, performance optimization, and

compliance with data security standards. Users are given full control over their personal information through privacy settings and data-clearing options, reinforcing transparency and trust.

Overall, the system architecture represents a seamless and intelligent workflow that integrates physical, nutritional, and emotional health components. By combining AI-driven insights with interactive design and secure data management, OPRA HEALTH functions as a scalable, ethical, and user-centric solution that promotes sustainable lifestyle changes and long-term physical, mental, and emotional well-being among adolescents.

VII. Conclusion

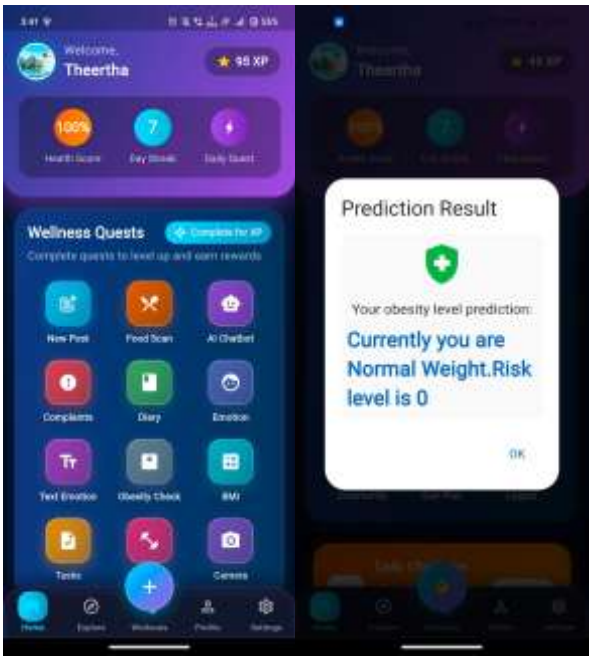
The growing prevalence of adolescent obesity highlights the urgent need for innovative solutions that combine medical accuracy with userfriendly design. OPRA HEALTH addresses this challenge by offering a smart, interactive platform that integrates psychological, behavioral, and nutritional factors to provide a complete view of adolescent health. Unlike traditional approaches that rely only on physical measurements, the system incorporates mood, stress, diet, and screen time, ensuring that both physical and emotional aspects of wellbeing are considered.

Through features such as an AIpowered food scanner, personalized chatbot, gamified health education, and secure community support, OPRA HEALTH transforms obesity management into an engaging and proactive process. By emphasizing privacy, adaptability, and empathy, the system empowers teenagers to take control of their health, build sustainable habits, and reduce longterm risks. Considering the limitations of this study and future research directions, we plan to further improve the generalizability of the model by using specific data like residential area and include wearable devices and assessing its performance over extended periods. Ultimately, this project demonstrates how technology can move beyond simple monitoring to become a true partner in shaping healthier futures for the younger generation.

VIII. RESULT AND DISCUSSION

The OPRA HEALTH system showed promising performance in predicting obesity risk among adolescents by looking beyond just physical measurements and considering everyday habits and emotions. By analyzing factors such as food intake, physical activity, mood, stress, and screen time, the system was able to provide more personalized and meaningful health insights. The AI-based food scanner made it easier for users to track their diet by estimating calorie intake from food images, reducing the effort of manual entry. At the same time, the chatbot created a more interactive experience by offering real-time suggestions and encouragement. Overall, the system responded quickly and handled multiple user interactions smoothly, making it practical for real-life use.

These observations highlight the importance of taking a more holistic and user-friendly approach when dealing with adolescent health. Including emotional and behavioral factors helped in making the predictions more realistic, since lifestyle habits are often influenced by stress and mood. Features like gamified tracking and community interaction also played a key role in keeping users motivated and engaged over time.



However, there are still some challenges, such as relying on users to provide accurate data, occasional errors in food image recognition, and the need for larger datasets to further improve accuracy. Even with these limitations, the system shows strong potential as a scalable solution that can be used in schools and healthcare settings to support early intervention and encourage healthier lifestyles among adolescents.

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