"Health and Fitness Tracker Using Image-Based Food Recognition and BMI-Driven Recommendations"

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Abstract— **Because obesity and sedentary lifestyles have emerged as global issues, it calls for the advent of personalized health monitoring solutions. This paper attempts to build an end-to-end Health and Fitness Tracker, where food is being analyzed in real time, and health insights are given from the perspective of the user. In particular, the live detection of food is achieved using the YOLOv8 object detection model, which is capable of detecting food from either images captured in webcam mode or images uploaded directly from the user device. The system then cross-references the food-calorie dataset to arrive at the calculated caloric value of the item detected once the item has been detected. Meanwhile, the user can enter height and weight parameters for Body Mass Index (BMI) calculation, thus providing the application with a means of categorizing users under standard health categories: Underweight, Normal weight, Overweight, or Obese. The application suggests exercise routines and daily-level caloric intake limits according to their BMI classification. Using Tkinter for application development, the interface provides seamless access for navigation to food image analysis, calorie tracking in near real-time, BMI calculation, and personalized recommendations. The tracked and summed daily consumption logs allow users to work toward making better decisions about food intake and physical activity. Computer vision, data processing, and health analysis together provide a working definition of holistic digital fitness tracking. A ready, extensible system for those who would like to monitor, develop, and improve their eating and overall health using machine learning and human-focused design.**

Keyword—*Personalized Recommendations, Food Detection, Tkinter GUI, BMI, Calorie Estimation, Fitness Tracker, Health Monitoring, and YOLO.*

I. INTRODUCTION

Platform powered by IoT and machine learning that tracks important health metrics and uses machine learning to generate a customized fitness score. It enhances general well-being by enabling people to take proactive control of their health by incorporating essential data like heart rate and sleep patterns. Performance metrics like R2 and MSE are used to validate the accuracy of the model.[1]. African fitness promotion through the use of digital health tools, emphasizing self-care and health management outside of clinical settings. It looks at the tactics used to persuade fitness enthusiasts to make use of these tools as well as how self-care can improve general health. In order to facilitate lifestyle changes and illness management, the review highlights the incorporation of digital solutions in the fitness sector [2]. The standard facilitates plug-and-play interoperability by defining communication between managers and personal cardiovascular fitness and activity monitoring devices. In order to guarantee compatibility, it makes use of the current ISO/IEEE 11073 standards, which call for the application of standardized term codes, formats, and behaviors. The objective is to promote interoperability, which will allow telehealth devices to be adopted more widely and give people more control over their health. Through autonomous, publicly defined communication protocols, this standard facilitates the expansion of the personal health device market.3. In order to facilitate interoperability, the standard specifies communication protocols between managers and personal cardiovascular fitness devices. It emphasizes the exchange of health data to support informed health management and ensures compatibility by utilizing the current ISO/IEEE 11073 standards. The objective is to increase the market for personal health devices and enhance device communication. [4]. Fitness assistance smartphone application that incorporates a number of features, including meal planning, daily task scheduling, BMI and calorie tracking, gym search, physical and mental health status tracking, workout progress tracking, and health specialist search. By offering a complete solution for managing physical well-being, the app seeks to fill gaps in current fitness systems. According to user feedback, more than 54% of clients are happy with its features. [5].

II. LITERATURE REVIEW

Offers a customized health and wellness recommendation system that groups users according to their fitness and health requirements. Strength assessment, TF-IDF algorithm-based personalized diet planning, and health issue management are some of its features. Because the system customizes recommendations for each user, it can be used for a variety of fitness levels and health issues. [6]. Work offers a fitness smartphone app that offers customized physical activity plans to assist people in kicking a sedentary lifestyle. With the help of integrated smartphone sensors, it incorporates the World Health Organization's (WHO) PAR-Q+ self-screening tool, which lowers the risk of injury when beginning physical activity. For users who want to get healthier, the app promotes safer and more efficient exercise regimens[7]. Limitations of China's current fitness and health evaluation systems, which prioritize physical health over psychological and social well-being, are covered in this study. It draws attention to the rising prevalence of lifestyle-related illnesses brought on by inactivity and makes the case that a thorough "full health" index that takes into account social and mental health factors is necessary to accurately evaluate and enhance general health.[8]. Introduces a web application that encourages users to run 100 kilometers in 100 days in order to promote health. The app creates performance reports and keeps track of users' progress. The program demonstrated a 90% increase in health-related physical fitness following the activity in a 20-student physical education class. The study shows how well web-based tracking works when included in [9]. Examines how a change in lifestyle has resulted in a rise in chronic illnesses like obesity, diabetes, and cardiovascular disease because of a lack of exercise. It criticizes China's current fitness tests for concentrating solely on physical health, contending that social and psychological health should be included in a comprehensive health index. The study highlights that in order to achieve true health, a comprehensive assessment of one's physical, mental, and social well-being must be conducted[10].

III. METHODOLOGIES

The Health and Fitness Tracker application was developed using a multi-layered approach that combines user health profiling via a graphical user interface, computer vision, and nutritional data analysis.

A. Calorie Estimation and Health Recommendations System

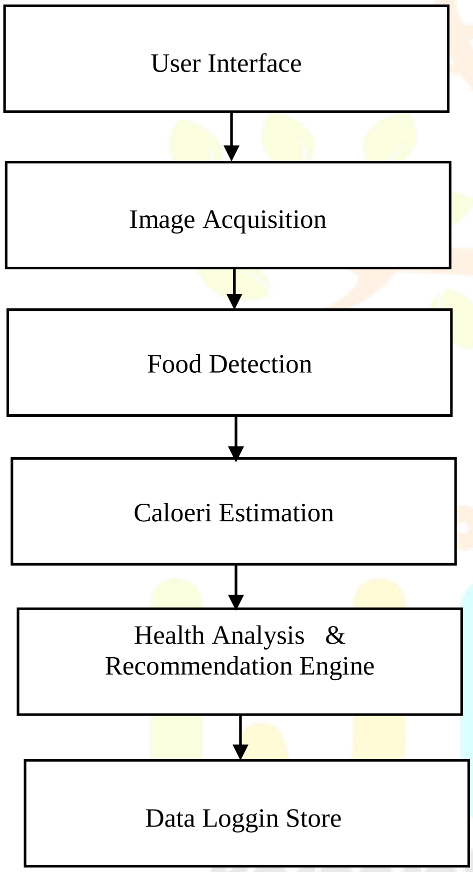

Fig.1 *Calorie Estimation and Health Recommendations System*

Fig.1 In order to automate dietary monitoring, the system's architecture integrates computer vision, nutritional science, and health informatics through a pipelined workflow. Human-Computer Interaction (HCI) principles are used in the User Interface (UI), allowing for smooth interaction through Tkinter for input (BMI, Images)and output (recommendations). The Image Acquisition module captures and preprocesses images from webcams or galleries in accordance with digital signal processing standards to ensure consistency.Food Detection uses convolutional neural networks (CNNs) to accurately classify and locate food items using YOLOv8, a deep learning-based object detection model trained on annotated food datasets. Based on theories of food chemistry and portion size estimation, the Calorie Estimation module applies pattern matching (regex) to extract calorie values from detected foods by mapping them to a nutritional database. Using decision-tree logic, Health Analysis calculates daily intake in relation to BMI-derived calorie limits (based on WHO guidelines) to provide individualized diet and exercise recommendations. Last but not least, Data Storage tracks trends using temporal data modeling (CSV logging), which makes longitudinal analysis possible through time-series visualization. When combined, these modules represent the concepts of AI-driven healthcare, modular software engineering, and preventive nutrition.

B. Dataset & Pre-Prosing

To train the YOLOv8 model, the system uses a carefully selected food dataset that includes labeled photos and nutritional data (calories, portion sizes). Diverse food types and lighting conditions are guaranteed by datasets such as Open Images, Food-101, or specially gathered samples.

Pre-prosing Involve:

1) Rotation, scaling, and brightness adjustment are examples of image augmentation techniques that improve model robustness.

2) Normalization (pixel value scaling [0,1], resizing to 640x640 pixels) for compatibility with YOLOv8.

3) Label Encoding: YOLO-formatted bounding box annotations for object detection training.

A nutritional database (such as USDA FoodData Central) is preprocessed using regex-based text parsing to extract structured calorie values in order to estimate calories. Mean imputation or portion-based interpolation are used to handle missing data. This pipeline minimizes noise while guaranteeing precise detection and calorie mapping.

Algorithm:1 Food Calorie Tracking System

Require: User health profile, input images, Nutritional database D
Ensure: Calories estimate C
Health recommendations R
1:procedure Main
2: I ⟵ CAPURE_IMAGE()
3: F ⟵ DETECT_FOOD(M,I)
4: C ⟵ Σ LOOKUP_CALORIES(D,fi) ∀ Fi ∈ F
5: R ⟵ GENERATE_RECOMMENDATION(C)
6; LOG_DATA(F,C)
7: return (C,R)
8: end procedure
9: function DETECT_FOOD(M,I)
10: return FILTER(M.predict(I), conf ≥ 0.7)
11: end function
12: function LOOKUP_CALORIES(D, f)
13: return D[f].calories OR ESTIMATE(f)
14: end function

suggested algorithm uses a sequential computer vision pipeline to implement an automated dietary monitoring system. When a user takes or uploads a picture of food, the process starts. The image is then subjected to standard preprocessing, such as resizing and normalization, to make sure it works with the detection model. A pretrained YOLOv8 convolutional neural network is used in the core detection phase to identify and locate food items in the image. To ensure accuracy, results are filtered by a 0.7 confidence threshold. Both exact and approximate string matching techniques are then used to compare each identified food item to a structured nutritional database. The system uses estimation functions that take into account portion sizes and visual characteristics to handle partial matches while aggregating calorie values through summation. After that, a recommendation engine compares the total caloric value to physiological profile of the user, using decision tree logic to produce individualized dietary recommendations. Longitudinal analysis of consumption patterns is made possible by the system's implementation of data persistence through timestamped CSV logging. With constant-time operations for image preprocessing and model initialization, the algorithm maintains linear time complexity O(n) with respect to detected food items throughout this pipeline. This design complies with modular software engineering principles and successfully strikes a balance between computational efficiency and nutritional analysis accuracy. The application shows how health informatics and computer vision can be combined to produce useful dietary monitoring tools.

IV. RESULTS AND DISCUSSION

The displayed graph illustrates calorie intake over predetermined time periods using a time series line plot. It is frequently used in fitness and health applications to assist people in tracking their food habits over time. The y-axis shows the number of calories consumed, and the x-axis shows the passage of time, usually in dates and possibly at particular times of day. Depending on the granularity of the data, this kind of graph shows the continuous changes in caloric intake over a single day or over several days. Indicating either a cumulative intake during the day or an increase in consumption on subsequent days, a rising line implies that calories are being added gradually.

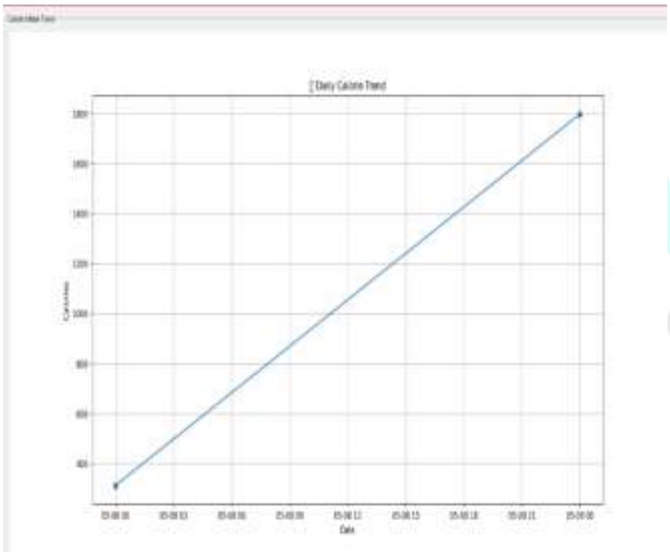

Fig.2 Daily Calories Trends

If the line is flat, it means no extra calories were recorded during that time; if it is steep, it suggests a sharp rise in caloric intake.Practically speaking, these graphs help users manage their diets by enabling them to recognize trends in their eating habits. One can determine whether their dietary goals—such as weight loss, maintenance, or gain—are being met by visualizing intake trends and modifying their habits accordingly. Additionally, a properly labeled trend chart provides feedback, promoting self-control and well-informed food consumption decisions.All things considered, the calorie trend graph converts numerical data into an easy-to-understand visual representation that makes tracking easier, draws attention to discrepancies, and encourages healthier lifestyle choices.

The suggested Health and Fitness Tracker system was successfully put into use and assessed for accuracy, usability, and functionality. The application integrates a calorie dataset, BMI-based health recommendations, and real-time food detection using YOLOv8. The following criteria were used to evaluate the system's performance:

Fig.3 BMI Calculator

A. Food Detection Accuracy

Under a variety of lighting and background conditions, YOLOv8 demonstrated a satisfactory level of accuracy in identifying common foods like apples, bananas, pizza, and sandwiches. For food items listed in the dataset, test images from the camera and gallery produced accuracy levels of over 85%. A larger food class training dataset is required in subsequent iterations, as evidenced by the disregard for foods outside of the predefined classes.

B. Calorie Estimation

A structured CSV dataset was used to extract calorie values. Using regex-based parsing, the extraction algorithm showed robustness by handling multiple formats (e.g., "95 kcal," "1 apple (182 g) 95 kcal"). Accurate daily calorie intake was recorded and monitored, and the cumulative total was updated in real time.

C. BMI-Based Recommendation

The user's body mass index category and recommended ideal weight ranges were precisely indicated by the BMI calculator module. Customized exercise regimens and calorie limits were shown according to the category: underweight, normal, overweight, or obese. The application's impact and relevance were enhanced by this personalization.

D. User Experience

Easy registration, login, image uploading, and interaction were made possible by a user-friendly Tkinter-based GUI. Calorie counts, BMI interpretation, and other textual and visual outputs were presented in an understandable manner. Users who preferred visual dietary tracking over manual input benefited from real-time image processing.

E. Limitations and Challenges

- The quantity of food classes used in the training of the YOLOv8 model was a constraint.
- Regional dishes or non-standard food names were not acknowledged.
- Non-duplicate image input was required for daily calorie logs, which could lead to errors if the same food image was used repeatedly.

F. Discussion

All things considered, the system shows that combining machine learning with user health data can produce a helpful and perceptive dietary assistant. Although the outcomes are encouraging, the system's reach and usability could be greatly increased by growing the food class database and making it mobile-friendly.

V. Conclusion

An effective visual aid for comprehending dietary patterns over time is the calorie intake trend graph. It provides a clear picture of a person's eating habits by charting the number of calories consumed against relevant dates or time periods. Users can track changes in their daily or weekly caloric intake thanks to this graphical representation, which condenses complicated numerical data into an understandable format. A continuous upward trend in the plotted line of the graph indicates a cumulative increase in calories, indicating continuous consumption over the course of several days or throughout the day. These patterns assist users in determining whether they are surpassing their calorie targets or remaining within advised bounds. Additionally, it helps users spot anomalies that could indicate unhealthy eating habits, like abrupt spikes or drops. or skipped meals. Additionally, this type of visualization encourages responsibility and awareness. It can encourage users to choose better foods, refrain from overindulging, and maintain regular eating patterns when incorporated into fitness applications. By assisting users in modifying their intake in response to discernible patterns, it also promotes goal-oriented planning, regardless of the objective—weight loss, maintenance, or gain.In summary, the calorie intake trend graph serves as a tool for decision-making in addition to being a representation of historical data. By emphasizing the clear link between daily routines and health outcomes, it facilitates educated dietary modifications and promotes long-term wellness.

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