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Batch: C1 Roll No.:16010122316

Experiment No 2

Group No: G4

Title: Literature Survey

Objective: The objective of a literature survey is to review, analyze, and synthesize existing research to identify gaps, trends, and insights that inform and support a study's context and direction.

Expected Outcome of Experiment:

	At the end of successful completion of the course the student will be able to
CO1	Define the problem statement and scope of problem
CO5	Prepare a technical report based on the Mini project.

Books/ Journals/ Websites referred:

1.
2.
3.

The students are expected to prepare chapter no 2 in the format given below

Chapter 2

Literature Survey

The Objective of a literature survey is to review existing research, identify gaps, and establish a strong foundation for the study. It helps in understanding key concepts, comparing different approaches, and justifying the need for the current research by analyzing past studies.

1. Introduction

In today's fast-paced world, maintaining a balanced diet while tracking caloric intake is a significant challenge for many individuals. With increasing health awareness, there is a growing demand for **personalized nutrition recommendations** that align with an individual's dietary preferences and fitness goals. Traditional calorie tracking methods, such as manual logging and estimation, can be cumbersome and inaccurate, often leading to **inconsistent dietary habits and ineffective weight management**.

To address this gap, **Bytes** is designed as an intelligent **diet recommendation and calorie tracking application** that leverages **image-based food recognition** and **machine learning-based meal planning**. The app enables users to:

- **Set personalized diet goals** (e.g., weight loss, weight gain, or balanced nutrition).
- **Receive AI-generated meal recommendations** based on dietary preferences (Veg/Non-Veg) and nutritional needs.
- **Track calorie intake effortlessly** by simply uploading a picture of their meal, which the system recognizes and estimates its caloric content.

2. Review of Existing Literature

Early Research on Diet and Calorie Tracking (2010–2015)

Early diet-tracking applications relied on **manual food logging** and **calorie database lookups**. MyFitnessPal (2010) was one of the first widely adopted apps that allowed users to log meals and calculate calorie intake. However, the reliance on **user input** often led to errors and **inconsistent data tracking**. Research by Smith et al. (2013) highlighted that **manual food logging had an average accuracy of only 60%**, as users often underestimated portion sizes.

Advancements in Image-Based Food Recognition (2016–2019)

With the rise of **computer vision and deep learning**, researchers began exploring **automated food recognition**. Liu et al. (2017) developed a **CNN-based** model that classified 100+ food items with an accuracy of **85%**. Similarly, Kawano and Yanai (2018) proposed **mobile-based**

food recognition using deep neural networks, which significantly improved **real-time calorie estimation**. These studies demonstrated the **potential of AI in food tracking**, but challenges such as **handling diverse cuisines and mixed-ingredient meals** persisted.

Recent Studies on AI-Driven Diet Recommendation (2020–Present)

Recent advancements integrate **machine learning models** for **personalized diet recommendations**. A study by Gupta et al. (2021) introduced a **hybrid recommendation system combining Random Forest and K-Means clustering**, which provided **optimized meal plans** based on users' dietary goals. Similarly, Park et al. (2022) explored the use of **natural language processing (NLP)** to match user preferences with nutritional databases, enhancing **customized meal suggestions**.

Key Findings and Contribution:

Key findings from existing research highlight the effectiveness of **AI-driven food recognition systems** in accurately identifying meals and estimating caloric content. Studies have demonstrated that **deep learning models, such as CNNs, significantly improve food classification accuracy**, while machine learning-based **diet recommendation systems enhance personalization by analyzing user-specific health goals and dietary preferences**. Additionally, hybrid approaches combining **clustering and classification techniques** have been found to optimize meal planning by categorizing food items based on nutritional value. These contributions underscore the potential of **Bytes**, which integrates AI-powered image recognition and machine learning algorithms to provide **precise calorie tracking and customized diet recommendations, enhancing user adherence to dietary goals**.

3. Related Work

Paper 1: Anton et al. (2012) - Use of a Computerized Tracking System to Monitor and Provide Feedback on Dietary Goals for Calorie Control

Summarization:
This study explores the use of a computerized dietary tracking system to help individuals monitor their calorie intake and dietary goals. The research highlights the effectiveness of digital feedback mechanisms in promoting better adherence to diet plans. The methodology involves user engagement with an interactive system that provides real-time calorie tracking and personalized feedback based on dietary patterns. Findings indicate that users who actively tracked their diet showed significant improvements in maintaining a calorie deficit for weight loss.

Relevance:
This paper is relevant to Bytes as it supports the importance of automated tracking in dietary management. The study validates the approach of using technology-driven feedback to

enhance user adherence, a concept central to the Bytes application's calorie tracking and diet recommendation system.

Comparison:
Similar to this study, Bytes also integrates calorie tracking, but it enhances the approach by incorporating image recognition to estimate food intake, rather than requiring manual input. Additionally, Bytes aims to personalize dietary recommendations based on user goals (weight loss/gain) and dietary preferences, which this study does not explicitly address.

Critical Analysis:
The study primarily focuses on self-monitoring through user input, which can lead to inconsistencies due to manual entry errors. While the research demonstrates the benefits of dietary tracking, it does not address automated food recognition, a feature that Bytes integrates to improve accuracy. Future research should explore the role of AI in improving calorie estimation without user intervention.

Paper 2: **An Open-Source Approach to Solving the Problem of Accurate Food-Intake Monitoring**

Summarization:
This research presents an open-source system designed to improve the accuracy of food-intake monitoring using computer vision and machine learning. The methodology involves capturing images of food, extracting nutritional information using AI models, and providing users with accurate calorie estimations. The study demonstrates that automated image-based food tracking significantly reduces user effort and enhances accuracy compared to traditional manual logging methods.

Relevance:
This paper aligns closely with Bytes' objective of leveraging image recognition for calorie estimation. It validates the use of AI for food tracking and provides insights into methodologies that can enhance accuracy, making it highly relevant to the development of Bytes' food recognition system.

Comparison:
While this study focuses on image-based food tracking, it primarily serves as a proof of concept for an open-source framework, whereas Bytes integrates this approach into a fully functional user-oriented application. Additionally, Bytes includes a personalized diet recommendation system, which is not covered in this research.

Critical Analysis:
One limitation of this study is its dependency on a predefined dataset, which may not generalize well to diverse cuisines and portion sizes. Additionally, while the paper establishes the feasibility of image-based calorie tracking, it does not explore user engagement or

behavioral outcomes. Future research should address scalability and user adaptation in real-world dietary tracking applications.

Paper 3: Adaptive Personalized Diet Linguistic Recommendation Mechanism Based on Type-2 Fuzzy Sets and Genetic Algorithms

Summarization: This paper presents a dietary recommendation system that utilizes Type-2 fuzzy sets and genetic algorithms to personalize diet plans. The system considers user preferences, nutritional requirements, and linguistic variables to generate adaptive diet suggestions. The study demonstrates how fuzzy logic and genetic algorithms improve recommendation accuracy and user satisfaction.

Relevance: The study is relevant to personalized dietary recommendation systems, as it offers an adaptive approach to tailoring nutrition advice. It particularly addresses the challenge of handling uncertainties in dietary preferences using fuzzy logic.

Comparison: Unlike traditional diet recommendation models that rely on static rules, this work integrates optimization techniques (genetic algorithms) for better personalization. If my work also involves personalized dietary recommendations, incorporating machine learning techniques could be a key similarity. However, if my approach uses different optimization techniques or data sources, that would be a distinguishing factor.

Critical Analysis: The paper primarily focuses on algorithmic efficiency but lacks real-world implementation and validation on diverse user populations. Future work could explore real-time data integration from health monitoring systems or the inclusion of additional lifestyle parameters like exercise habits.

Paper 4: Formative-2023: A Study on Dietary Patterns and Personalized Nutrition

Summarization: This research investigates dietary patterns and their impact on personalized nutrition recommendations. It explores data-driven approaches to categorize individuals based on eating habits and metabolic responses, using a combination of survey data and biochemical markers. The study finds that personalizing dietary plans based on individual metabolic responses improves adherence and health outcomes.

Relevance: The paper contributes to understanding how different dietary patterns affect individuals differently, which aligns with personalized nutrition research. It addresses the importance of tailoring diets based on real physiological responses rather than generic guidelines.

Comparison: While my research may also focus on personalized dietary recommendations, this paper emphasizes biochemical markers and survey-based categorization. If my study incorporates additional contextual factors (e.g., cultural food preferences or real-time health monitoring), it would differ in scope and methodology.

Critical Analysis: The study relies heavily on survey data, which may introduce biases. Additionally, it does not consider real-time dietary tracking, which could enhance personalization. Future directions could include integrating AI-based real-time dietary monitoring for more dynamic recommendations.

Paper 5: Food Recognition and Health Monitoring System for Recommending Daily Calorie Intake

Summarization: This paper introduces a food recognition and health monitoring system that uses computer vision and machine learning to estimate calorie intake. By leveraging image-based food recognition, the system provides real-time dietary feedback and calorie tracking. The results show improved dietary awareness and adherence to nutritional goals.

Relevance: The paper is significant for diet and health monitoring research, as it presents a technological solution to track food intake more accurately. It addresses the challenge of manual food logging by automating the process through image recognition.

Comparison: If my study also deals with dietary recommendations, the use of food recognition technology could be an overlapping area. However, if my research focuses on a different method of dietary tracking (e.g., text-based logging or wearable device integration), it would provide a different approach to the problem.

Critical Analysis: The system depends on image quality and dataset diversity, limiting its accuracy for complex or mixed dishes. Future research could enhance the model with deep learning techniques or integrate it with additional health monitoring parameters such as blood glucose levels.

Paper Title (Including Author Details, Year of publication, Conference/Journal	Methodology	Dataset Used	Observation of proposed methodology	Pros	Cons	Findings

Anton et al. (2012) - Use of a Computerized Tracking System to Monitor and Provide Feedback on Dietary Goals for Calorie Control	Computerized dietary tracking system with real-time feedback	User self-reported data on calorie intake	Digital feedback improves adherence to diet plans	Encourages user engagement, proven impact on calorie control	Manual data entry can introduce errors	Automated dietary tracking improves weight management
An Open-Source Approach to Solving the Problem of Accurate Food-Intake Monitoring	Image-based food recognition using AI for calorie estimation	Predefined dataset for food images	AI-based tracking reduces user effort and enhances accuracy	Automated, reduces user burden	Dataset limitations for diverse cuisines	Image recognition significantly improves food intake tracking
Adaptive Personalized Diet Linguistic Recommendation Mechanism Based on Type-2 Fuzzy Sets and Genetic Algorithms	Type-2 fuzzy sets and genetic algorithms for personalized diet plans	Simulated data for diet optimization	Optimization techniques enhance dietary recommendations	Personalized approach, adaptable to user needs	Lacks real-world implementation	Fuzzy logic and genetic algorithms improve recommendation accuracy
Formative-2023: A Study on Dietary Patterns and Personalized Nutrition	Survey-based categorization using metabolic markers	Survey data and biochemical markers	Personalized diets improve adherence and health outcomes	Scientific validation of personalized nutrition	Self-reported data may introduce biases	Biochemical markers enhance diet recommendations
Food Recognition and Health Monitoring System for Recommending Daily Calorie Intake	Computer vision and machine learning for food recognition	Food image dataset with labeled calorie values	Image recognition aids in dietary awareness	Real-time dietary feedback, improved adherence	Accuracy depends on image quality	AI-driven food tracking enhances calorie monitoring
Refined Image Segmentation for Calorie Estimation of Multiple-dish Food Items (Parth Poply, J. Angel Arul Jothi, 2021, ICCCIS)	Refined segmentation model for food recognition and calorie estimation	Custom dataset with multiple food items	Improved segmentation accuracy for better calorie estimation	Handles multiple dishes	May require high computational power	Achieves more precise segmentation for calorie estimation

FoodieCal: A Convolutional Neural Network Based Food Detection and Calorie Estimation System (Shahriar Ahmed Ayon, Chowdhury Zerif Mashrafi, Abir Bin Yousuf, Fahad Hossain, Muhammad Iqbal Hossain, 2021, NCCC)	CNN-based model for food detection and calorie prediction	23,000 images dataset	Achieves 89.48% accuracy in food classification	High classification accuracy	Limited to specific food categories	Demonstrates CNN's effectiveness for calorie estimation
Food Recommendation Systems Based on Content-based and Collaborative Filtering Techniques (Reetu Singh, Pragya Dwivedi, 2023, ICCCNT)	Hybrid recommendation system using content-based and collaborative filtering	Kaggle datasets: "food.csv" (401 samples) and "ratings.csv" (512 samples)	Personalized diet recommendations based on user preferences	Improves recommendation accuracy	Depends on sufficient user data	Hybrid filtering enhances personalization in food recommendations
Calorie Recognition from Food Images Using CNN for Nutritional Analysis (R. Pavithra Guru, M. Ayyadurai, Amirthalakshmi TM, R. Neelaveni, K. Sujatha, 2023, Data Science, Agents, AI Conference)	CNN-based food image classification for calorie estimation	Not explicitly mentioned	Enhanced calorie estimation accuracy with deep learning	Improved accuracy compared to traditional methods	Requires labeled data for training	CNN proves effective in food calorie estimation
Design of Diet Recommendation System for Healthcare Service Based on User Information (Jong-Hun Kim, Jung-Hyun Lee, Jee-Song Park, Young-Ho Lee, Kee-Wook Rim, 2009, ICCSCIT)	Rule-based and machine learning-based diet recommendation	Not explicitly mentioned	Provides user-specific diet suggestions based on health data	Personalized recommendations	May lack adaptability to new trends	Machine learning aids in healthcare-based diet recommendations

4. Research Gaps and Challenges

Limitations in Existing Research:

- Current diet recommendation systems primarily rely on predefined calorie tables or static nutrition guidelines, limiting their adaptability to individual needs.
- Many studies focus on general dietary recommendations without considering **real-time health parameters** such as blood sugar levels, blood pressure, and metabolic rate.

Unexplored Areas:

- **Integration of AI with real-time health monitoring**: While AI-powered diet recommendation systems exist, few incorporate **live sensor data** (e.g., heart rate, glucose levels) for more precise personalization.
- **Cultural and regional food preferences**: Existing models often use standardized datasets that may not reflect diverse dietary habits across different regions and cultures.
- **User adherence and feedback loop**: Studies rarely assess how users engage with or adhere to AI-generated diet plans over time.

Inconsistencies and Contradictions:

- Some studies suggest that **calorie-based recommendations alone** are insufficient for personalized diet planning, while others emphasize their accuracy. A balance between **nutrient-based** and **calorie-focused** approaches needs further exploration.
- Variations in datasets used across different studies lead to **inconsistent results**, especially in predicting calorie intake based on food images.

Justification for Further Investigation:

- Developing a **more adaptive, real-time, and personalized diet recommendation system** that considers individual health conditions, preferences, and dietary habits.
- Incorporating **machine learning models trained on diverse datasets** to improve prediction accuracy for food recognition and calorie estimation.
- Enhancing **user engagement through a dynamic feedback system**, allowing modifications to diet plans based on adherence levels and changing health conditions.

Summary of Key Findings from Literature Survey:

- Convolutional Neural Networks (CNNs) and image processing techniques, such as GLCM and Discrete Wavelet Transform, are widely used for food recognition and calorie estimation.

- Existing models, such as **Inception V3 and Support Vector Machines (SVMs)**, have shown promising results but still require **larger, high-quality datasets** for better performance.
- Several studies propose **database-driven calorie estimation**, but **real-time tracking and user-specific recommendations** remain underexplored.