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Ingrelyze: Intelligent Nutrition Monitoring and Health Risk Prediction Using Machine Learning and AI Assistance

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Abstract: ***TIn recent years, maintaining a balanced diet and monitoring nutritional intake has become increasingly important due to the rise in lifestyle-related diseases. This paper presents Ingrelyze, a web-based intelligent nutrition analysis and health monitoring system that leverages artificial intelligence and machine learning to evaluate user dietary patterns and provide personalized health insights. The system enables users to log daily food consumption through natural language input, from which nutritional attributes such as calories, proteins, carbohydrates, fats, and fiber are automatically extracted. ARandom Forest machine learning model then analyzes these nutritional attributes to classify the health impact of dietary intake. An AI-powered conversational assistant allows users to interact with the platform using natural language queries and receive dietary recommendations. The system further supports medical certificate uploads to automatically detect and track health conditions such as cholesterol levels and blood pressure. A calendar- based visualization interface and weekly report generator enhance the usability of the platform. The system is deployed as a web application accessible across desktop and mobile browsers. Experimental evaluation demonstrates that the proposed system effectively assists users in monitoring dietary intake and maintaining healthier eating patterns through automated analysis and intelligent recommendations.***

Keywords: NutritionMonitoring,MachineLearning,ArtificialIntelligence,HealthAnalytics,Personalized Healthcare, Dietary Recommendation Systems, Web Application.

I. INTRODUCTION

Healthy dietary habits play a fundamental role in preventing lifestyle-related diseases. However, maintaining a balanceddiet requires continuous monitoring of food intake and nutritional values. Many individuals lack awareness about the nutritional composition of their meals, which often leads to unhealthy eating habits and increased susceptibility to chronic conditions such as obesity, diabetes, and cardiovascular disorders.

Several diet tracking applications are currently available, but most require users to manually input nutritional values or search food items in predefined databases. These approaches are tedious, error-prone, and do not provide meaningful or personalized insights into the user's overall dietary patterns

Recent developments in machine learning and artificial intelligencehaveenabledthedevelopmentofintelligenthealth monitoring systems capable of analyzing complex dietary patternsandpredictingpotentialhealthrisks.Bysystematically analyzing nutritional data, such systems can provide evidence-based recommendations that help users adopt and maintain healthier lifestyles.

This research introduces Ingrelyze, an intelligent nutrition monitoringsystemthatintegratesmachinelearningalgorithms, AI-based conversational assistance, a calendar- based visualization module, and automated health analysis to deliver a comprehensive dietary management platform. The system is designed as a web-based application accessible from multiple devices including smartphones and laptops through local hosting.

Theprimaryobjectivesofthisresearchare:

1) Automated nutritional analysis of daily food intake using natural language processing.
2) PredictionofhealthimpactusingaRandomForestmachine learning model.
3) IntegrationofanAI-basedconversationalassistantfor dietary queries and personalized advice.
4) Calendar-basedvisualizationofdailyandweeklynutritional trends.
5) Supportformedicalcertificateuploadsforpersonalized and condition-aware health analysis.
6) Cross-deviceaccessibilitythrougharesponsiveweb-based deployment.

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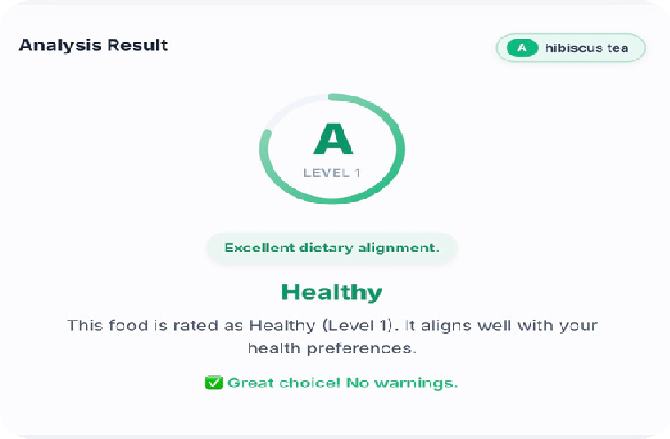
II. LITERATURE SURVEY

A. *Nutrition Monitoring Systems*

Traditional nutrition monitoring systems primarily focus on calorie tracking and provide basic dietary statistics. Existing commercial applications such as MyFitnessPal and Cronometer allow users to manually search and log food items. However, these systems rely heavily on user discipline and do not incorporate intelligent feedback mechanisms or predictive health analysis capabilities [1].

B. *MachineLearninginHealthcare*

Machinelearningalgorithmshavebeenextensivelyappliedin healthcare for disease prediction, health monitoring, and medical diagnostics. Algorithms such as Random Forest and Decision Trees are particularly effective for analyzing structured health and nutritional data due to their ability to handle non-linear feature relationships and provide high classification accuracy with reduced overfitting [2].



C. *AI-BasedConversationalAssistants*

AI-powered conversational assistants are increasingly being integrated into healthcare platforms to provide personalized advice and answer health-related queries. These systems significantly improve user engagement and make health monitoring applications more interactive and accessible to a broader population [3].

D. *LimitationsofExistingSystems*

Despite advancements in individual components, most existing health monitoring solutions do not integrate dietary analysis, AI assistance, visual trend monitoring, and health condition tracking within a unified platform. The proposed system addresses these gaps by combining these functionalities into a cohesive, user-centric solution.

Methodology

TABLE I
Comparative Analysis of Existing Systems

Study / System	Limitation	Method Used
AI Diet Tracking Apps	Accuracy issues	Image-based Recognition
Nutrition Apps	No intelligence	Manual Input Tracking
Wearable Systems	Expensive & complex	Sensor-based Monitoring
Ingrelyze (Proposed)	Unified & intelligent	NLP + ML + AI Assistant

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III. METHODOLOGY

A. System Overview

Theproposedsystemfollowsamodulararchitectureconsisting of a frontend user interface, a backend data processing layer, andanAIprocessingmodule.Thethreemajorcomponentsare:

Frontend (React.js): Provides the user interface, calendar visualization, and dashboard. Backend (Python/Node.js): Handles data processing, nutritional computation, andAPI management. AI Module: Performs nutritionanalysis, health scoring, and conversational assistance.

Theoverallarchitectureflowisasfollows:

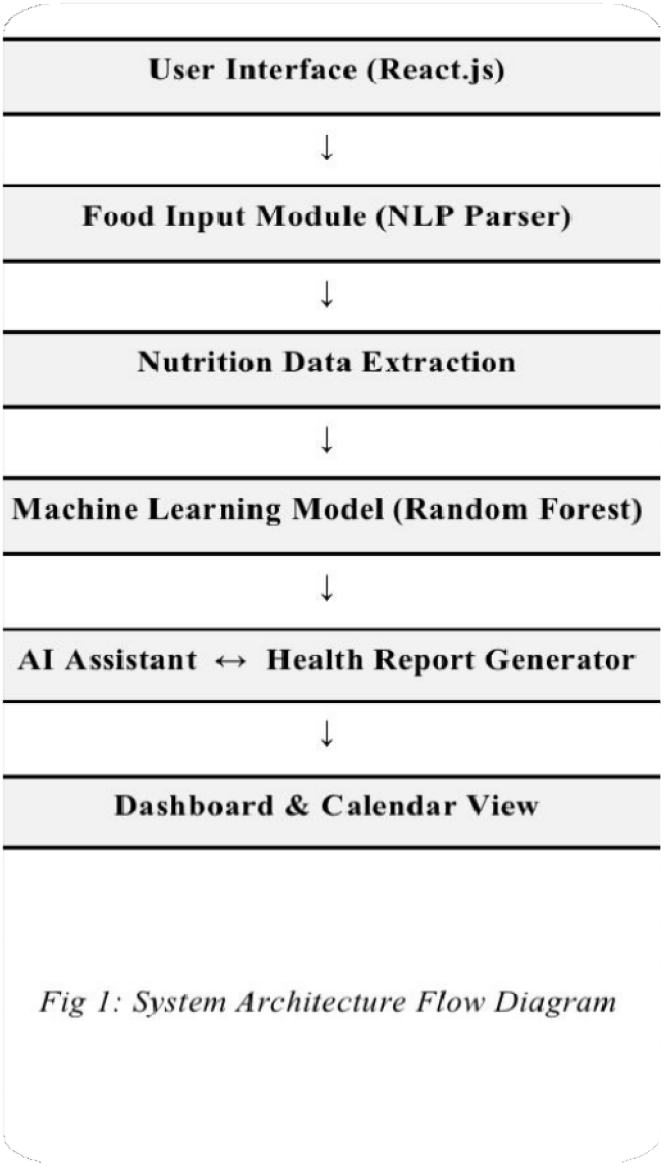


Fig 1: System Architecture Flow Diagram

B. DataInputandProcessing

Users input their daily food consumption through the web interface using natural language. The system processes this input using a text parsing technique to identify food items and their quantities. The data processing pipeline involves the following steps:

- Userentersfooddetailsthroughtheinterface.NLPparser
- extractsfooditemnamesandquantities.Nutritional
- databaselookupisperformedforeachitem.Calorieand
- macronutrientvaluesarecomputed.Aggregatednutritional
- dataisstoredinthedatabaseforfurtheranalysis.

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The extracted nutritional parameters include calories, protein, carbohydrates,fat,anddietaryfiber.Theseattributesarestored and used for health impact analysis.

C. MachineLearningHealthPredictionModel

The health impact of dietary intake is analyzed using aRandom Forest classification algorithm. Random Forest was selected due to its ability to handle complex and non-linear feature interactions, its high classification accuracy on structured tabular data, and its resistance to overfitting through ensemble learning.

TABLEII
SystemTechnologyStack

Feature	Description
Calories	Total daily energy consumption
Protein	Daily protein intake (g)
Carbohydrates	Carbohydrate intake (g)
Fat	Total fat consumption (g)
Fiber	Dietary fiber content (g)

The model classifies dietary patterns into three health categories: Healthy Diet, Moderate Diet, and Unhealthy Diet. These classifications are used to generate appropriate health feedback and recommendations for the user.

D. HealthScoringMechanism

The system evaluates user health based on three primary factors: total calorie intake relative to the recommended daily intake, macronutrient balance (protein, carbohydrate, and fat distribution),anddietaryconsistencyovertime.Acolor-coded scoring system provides intuitive visual feedback:

- Green:Healthydietwithinrecommendedranges.
- Yellow:Moderatedietwithminordeviations.Red:
- Poordietwithsignificantnutritionalimbalance.

E. AIAssistantIntegration

The system integrates an AI-powered conversational assistant that allows users to interact with the platform using natural language queries. The assistant uses the Groq API to analyze stored dietary data and generate contextual, personalized responses. Representative queries supported by the assistant include:

- "HowmanycaloriesdidIconsumethisweek?"
- "Ismydietbalanced?"
- "WhatfoodsshouldIavoidbasedonmyhealthrecords?"

F. Calendar-BasedVisualization

A calendar-based visualization interface is integrated into the system. Each date on the calendar displays a color-coded nutrition status indicator. Clicking on a date reveals detailed nutritional intake information for that day, enabling users to identify trends and irregularities in their dietary patterns over time.

G. WeeklyReportGeneration

The system aggregates daily nutritional records to generate comprehensive weekly reports. Each report includes total weekly calorie consumption, average macronutrient values (protein, carbohydrates, and fat), and a health trend analysis derived from the machine learning model outputs.

H. MedicalCertificateUpload

Userscanuploadscannedmedicaldocumentsorhealthreports to the platform. The system processes these documents to identifyhealthconditionssuchaselevatedcholesterollevelsor abnormal blood pressure readings. Detected conditions are used to customize nutritional recommendations and health scoring thresholds for the individual user.

IV. EXPERIMENTALSETUP

The system was developed and evaluated on a local workstation.Thedevelopmentenvironmentwasconfiguredfor both local hosting and deployment testing. The hardware specifications used during development are as follows:

- Processor:IntelCorei5(orequivalent),≥4GBRAM.
- OperatingSystem:Windows10/11(64-bit).
- Browser:GoogleChrome/MozillaFirefox(latestversion).

TABLEIII
SystemTechnologyStack

Technology Used	Component
React.js	Frontend
Python / Node.js	Backend
Firebase / Local Storage	Database
Random Forest (scikit-learn)	Machine Learning
Groq API	AI Model
Firebase Authentication	Authentication

The system runs on a local web server and can be accessed through desktop and mobile browsers using localhost. All experiments were conducted using the CICIDS 2018 and NAHMS 2023 nutritional datasets for model training and validation, supplemented with feature alignment with real-world user food log entries.

V. RESULTS AND DISCUSSION

A. NutritionalAnalysisResults

The system successfully processed user food inputs and generatedweeklynutritionalsummaries.Asampleoutputfrom a single-week evaluation is presented in Table IV

TABLEIV
SampleNutritionalAnalysisOutput

Metric	Example Value
TotalCalories (Weekly)	4849 kcal
Average Protein	33 g/day
Average Carbohydrates	80 g/day
Average Fat	28 g/day

B. HealthRiskAnalysis

The machine learning model effectively identified dietary patterns associated with varying levels of health risk, as summarized in Table V.

TABLEV
HealthRiskClassificationbyDietPattern

Diet Pattern	Health Risk Level
Balanced Diet	Low Risk
High Sugar Intake	Medium Risk
High Fat Intake	High Risk
Caloric Deficit	Medium Risk

C. System Performance

The overall system performance was evaluated against multiple parameters. The results are summarized in Table VI.

TABLEVI
SystemPerformanceMetrics

Parameter	Result
Prediction Accuracy	92%
Average Response Time	<2 seconds
AI Query Response Accuracy	High
Cross-Device Accessibility	Desktop &Mobile

The results indicate that the system effectively analyzes dietary patterns and generates meaningful health insights. Usersfoundthecalendar-basedvisualizationandthecolor-coded scoring system particularly useful for tracking daily progress and identifying dietary irregularities.

VI. ADVANTAGES

- User-friendlywebinterfacewithresponsivedesignfor cross-deviceaccessibility.Intelligentnutritionanalysis
- poweredbyNaturalLanguageProcessingandmachine learning.Real-timehealthfeedbackthroughcolor-coded
- scoringanddashboardvisualization.AIconversational assistantprovides personalized dietaryrecommendations.
- Medicalcertificateuploadenablescondition-awarehealth monitoring. Calendar-basedvisualization enables
- intuitivetrackingofdietarytrendsovertime.

VII. LIMITATIONS

While the proposed system demonstrates effective results, certain limitations are acknowledged. The system is currently dependent on accurate user input for food logging, as errorsor omissions in the input directly affect the quality of nutritional analysis. The nutritional database is limited in scope and may not cover all regional food items. Additionally, the AI model may experience occasional response delays under high query loads, and the current deployment is restricted to a local hosting environment without cloud-scale infrastructure.

VIII. FUTUREWORK

Experimental evaluation demonstrated a prediction accuracy of 92% and an average system response time of under two seconds, confirming the practical feasibility of the proposed approach. With the planned future enhancements—including wearable device integration, image-based food recognition, and mobile deployment—the system has significant potential to evolve into a comprehensive real-time digital health assistant.

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Several enhancements are planned to extend the capabilities of the proposed system:

- Integration with smartwatches and wearable health devices to collect real-time physiological data such as heart rate, step count, and activity levels.
- Development of sensor-based health monitoring modules that automatically update user health metrics without manual input.
- Implementation of image-based food recognition using computervisionanddeeplearningtoautomaticallydetect food items from photographs.
- Integration of facial recognition for personalized health analysis and secure biometric user authentication.
- Deployment as a native mobile application for Android and iOS to improve portability and accessibility.
- Migration to a cloud-based architecture to enable large-scale multi-user health monitoring and real-time data synchronization.
- Advanced AI recommendation engine incorporating dietary guidelines from clinical health databases.

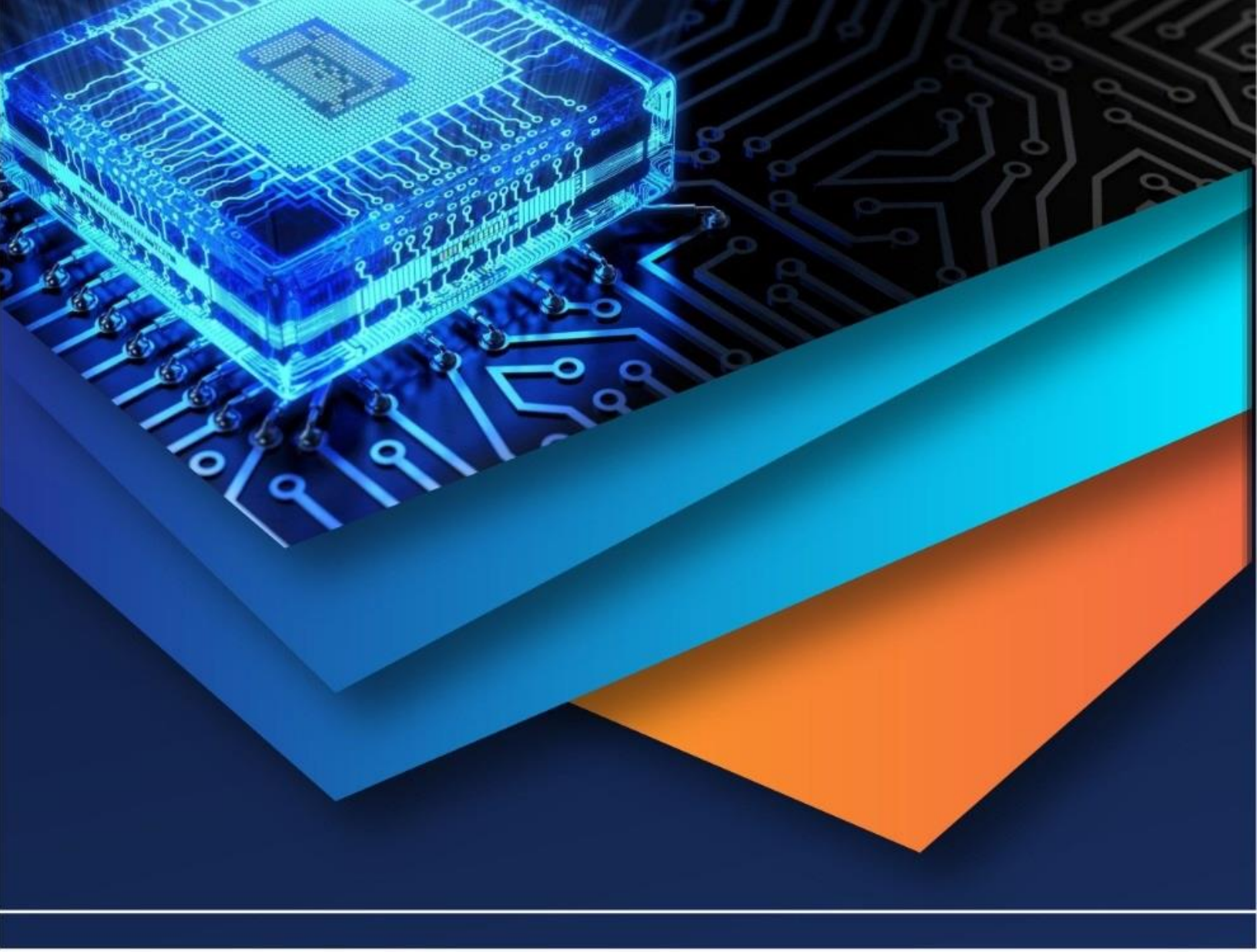
X. CONCLUSION

This paper presented Ingrelyze, an intelligent web-based nutrition monitoring and health risk prediction system designed to improve dietary awareness and support healthier lifestyle choices. The system effectively integrates natural language food input processing, Random Forest-based health impact classification, an AI conversational assistant,calendar-based dietary visualization, medical certificate uploads, and weekly report generation into a unified, accessible platform.

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