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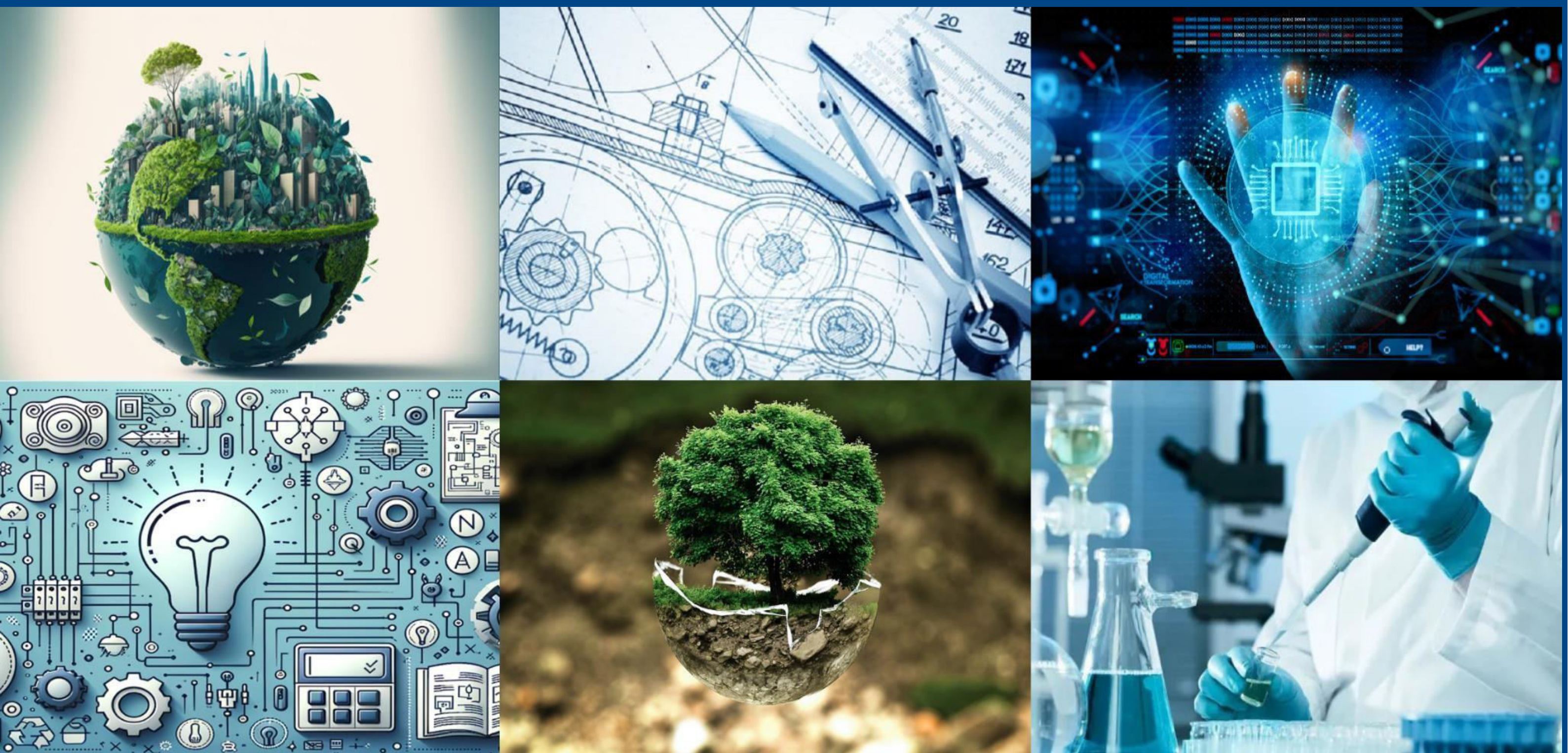

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Mookambigai College of Engineering, Keeranur, Tamil Nadu, India

Hybrid Multi-Diseases Prediction using Temporal Fusion Transformer (TFT) and CatBoost Based on Nutrient Intake

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ABSTRACT: Dietary nutrient intake plays a vital role in maintaining human health and is strongly associated with chronic diseases such as diabetes, hypertension, obesity, and cardiovascular disorders. Traditional disease prediction models mainly focus on single-disease prediction using static nutrient data, which limits their ability to capture complex and time-dependent dietary patterns.

To address these limitations, this study proposes a hybrid Temporal Fusion Transformer (TFT) and Cat-Boost model for multi-label disease prediction. The TFT model learns temporal changes and dependencies in nutrient intake, while Cat-Boost performs accurate classification across multiple diseases. By combining temporal learning and powerful tabular classification, the proposed model achieves higher accuracy and interpretability compared to traditional approaches, offering a more comprehensive understanding of the relationship between nutrition and chronic disease risk.

KEYWORDS: Temporal Fusion Transformer (TFT), Cat-Boost, Multi-Label Disease Prediction, Nutrient Intak, Time-Series Analysis, Chronic Diseases

I. INTRODUCTION

Diet plays an important role in keeping the body healthy. The nutrients we consume, such as carbohydrates, proteins, fats, vitamins, and minerals, have a direct effect on our health. Poor or unbalanced nutrition can lead to chronic diseases like diabetes, hypertension, obesity, arthritis, and heart disease.

Many existing models predict only one disease at a time using fixed nutrient data. They do not consider how a person's diet changes over time. In reality, eating habits vary daily or weekly, and these changes can strongly influence health outcomes.

To solve this problem, this project uses a hybrid model that combines the Temporal Fusion Transformer (TFT) and CatBoost algorithms. The TFT model learns patterns and changes in nutrient intake over time. The CatBoost model then classifies multiple diseases based on these patterns.

This combined TFT–CatBoost model improves prediction accuracy and gives a better understanding of how nutrition affects different diseases. It can help in early disease detection and support personalized health care.

1.1 Problem Motivation

Chronic diseases like diabetes, hypertension, obesity, and heart problems are becoming more common today. One of the main reasons for these health issues is poor or unbalanced nutrition

over time. The food we eat every day directly affects our health, so understanding how changes in our diet lead to diseases is very important. Most existing prediction models only focus on one disease at a time. They also use static data, meaning they look at a single snapshot of a person's diet instead of how it changes over time. But in reality, our eating habits are not constant — they change daily or weekly depending on lifestyle, mood, or availability of food. Ignoring these changes makes disease prediction less accurate. This project aims to solve that problem by creating a model that can study how a person's diet changes over time and how those changes affect different diseases. The

Temporal Fusion Transformer (TFT) helps capture time-based nutrient patterns, while **CatBoost** classifies multiple diseases at once. Together, these models can give a clearer picture of how nutrition affects health and help in early detection and prevention of chronic diseases.

1.2 Contributions

- This project develops a hybrid model using Temporal Fusion Transformer (TFT) and CatBoost for predicting multiple diseases.
- It studies how changes in nutrient intake over time affect health conditions.
- The model provides more accurate and clear results than traditional methods.
- It helps **in** early disease detection and supports better nutrition planning.

II. RELATED WORK

Many studies have used machine learning to predict diseases based on health and nutrition data. Models like LightGBM and XGBoost have achieved good results but mainly focus on single-disease prediction using static data. CatBoost has been shown to improve accuracy and handle complex data more effectively. Deep learning models such as LSTM and GRU can learn time-based health patterns but struggle with long-term changes. Recently, Transformer-based models like the Temporal Fusion Transformer (TFT) have been used to analyze time-series health data, showing strong results in capturing trends over time. Some research has also explored how nutrient intake affects diseases such as diabetes, hypertension, and obesity. Building on these studies, this project combines **TFT** and **CatBoost** to predict multiple diseases together while considering how dietary habits change over time.

III. METHODOLOGY

3.1 Architecture Overview

The proposed model includes three connected modules:
1. The system combines Temporal Fusion Transformer (TFT) and CatBoost to predict multiple diseases from nutrient intake data.
2. TFT learns how a person's diet changes over time and extracts important features.
3. CatBoost uses these features to classify and predict diseases like diabetes, hypertension, and heart disease.

3.2 Mathematical Components

Let $X_t$represent the nutrient intake data at time t, which includes features like carbohydrates, proteins, fats, vitamins, and minerals. The **Temporal Fusion Transformer (TFT)** processes this time-based data and extracts useful features:

$$h_t = f_{TFT}(X_t)$$

These learned features are then passed to the **CatBoost classifier**, which predicts the probability of multiple diseases:

$$\hat{y} = f_{CatBoost}(h_t)$$

The model is trained using the **binary cross-entropy loss function**, which measures how well the predicted values match the actual results:

$$L = -\sum_{i=1}^{n} [y_i \log(\hat{y}_i) + (1 - y_i)\log(1 - \hat{y}_i)]$$

This setup helps the model learn how changes in nutrient intake over time affect the risk of different

IV. EXPERIMENTAL RESULTS

4.1 Dataset

The dataset used in this project contains information on individuals' daily nutrient intake, including carbohydrates, proteins, fats, vitamins, and minerals, along with their health status for multiple chronic diseases such as diabetes,

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hypertension, arthritis, heart disease, and metabolic syndrome. The data was preprocessed by filling in missing values, normalizing numerical features, and encoding categorical attributes. It was then divided into **70% training data** and **30% testing data** to evaluate the model's performance.

4.2 Evaluation Metrics

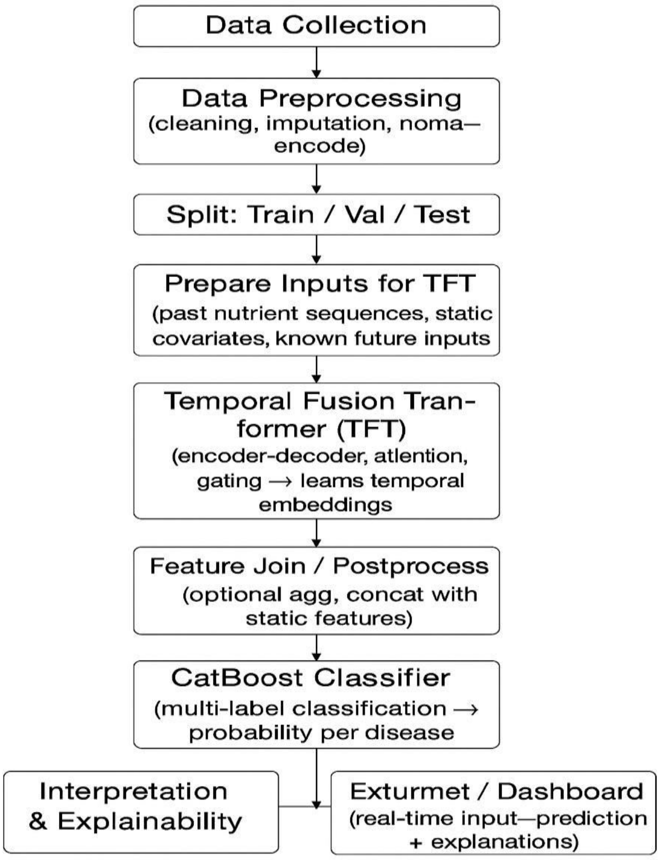
The model performance is evaluated using:

- **Accuracy (%)** – measures the proportion of correctly predicted disease labels.
- **Precision** – measures the percentage of correct positive predictions.
- **Recall** – measures how many actual disease cases were correctly identified.
- **F1-Score** – provides a balance between precision and recall.

4.3 Comparative Table

Model	Precision	Recall	F1-score	Accuracy (%)
LSTM	0.78	0.76	0.77	80.2
LGB-CatBoost	0.81	0.80	0.80	83.5
TFT-CatBoost	0.87	0.86	0.86	89.4

V. FIGURES



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VI. CONCLUSION

This project presents a hybrid Temporal Fusion Transformer (TFT) and CatBoost model for predicting multiple chronic diseases based on nutrient intake data. The TFT model effectively learns time-based patterns in dietary behavior, while CatBoost accurately classifies disease risks using these learned features. By combining these two models, the system achieves better accuracy, reliability, and interpretability compared to traditional methods. The results show that incorporating temporal nutritional data provides deeper insights into how diet changes influence health over time. This hybrid approach can support early disease detection and help in developing personalized nutrition and preventive healthcare strategies. In the future, the model can be expanded with real-time dietary tracking and larger datasets to enhance prediction performance and real-world applicability.

VII. ACKNOWLEDGEMENTS

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REFERENCES

1. P. Wang, Z. Liu, and H. Gao, "Multi-Disease Classification Based on Nutritional and Clinical Data Using Ensemble Learning," Frontiers in Public Health, vol. 11, pp. 1–10, 2023.
2. J. Lim, J. Lee, and H. Kim, "Nutrient Intake-Based Multi-Disease Prediction Using Machine Learning Techniques," IEEE Access, vol. 10, pp. 14526–14538, 2022.
3. M. Chen, J. Hao, K. Hwang, L. Wang, and L. Wang, "Disease Prediction by Machine Learning Over Big Healthcare Data," IEEE Access, vol. 5, pp. 8869–8879, 2017.

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