



# DiabEats:

Smart Food Analysis for Diabetes Management

Ted

# Background

US diabetes cases to triple from 15.3M (2000)  
to 43M (2050)





Can we provide diabetes-friendly dietary recommendations for U.S. diabetic and prediabetic users using just a photo of their meal?

# Proposed Flow of DiabEats

Step 1:  
Upload  
Meal  
Image



Step 2:  
Identify  
the Meal  
Image



Step 3:  
Retrieve  
Nutrition  
Data



Step 4:  
Evaluate  
Diabetes  
Impact



Step 5:  
Offer  
Diet  
Recs



Step 6:  
Display  
Analysis  
Results



# Success Metric

## Food Recognition

80%+ top-1 food recognition **Accuracy** and 90%+ top-5 **Accuracy**



# Upload Meal Image



📷 Upload meal photo(s) for instant analysis

Supports JPG, PNG formats

Drag and drop files here

Limit 200MB per file • JPG, JPEG, PNG

📁 Browse files

**1: Upload  
Image**

2: Identify  
Image

3: Retrieve  
Nutrition

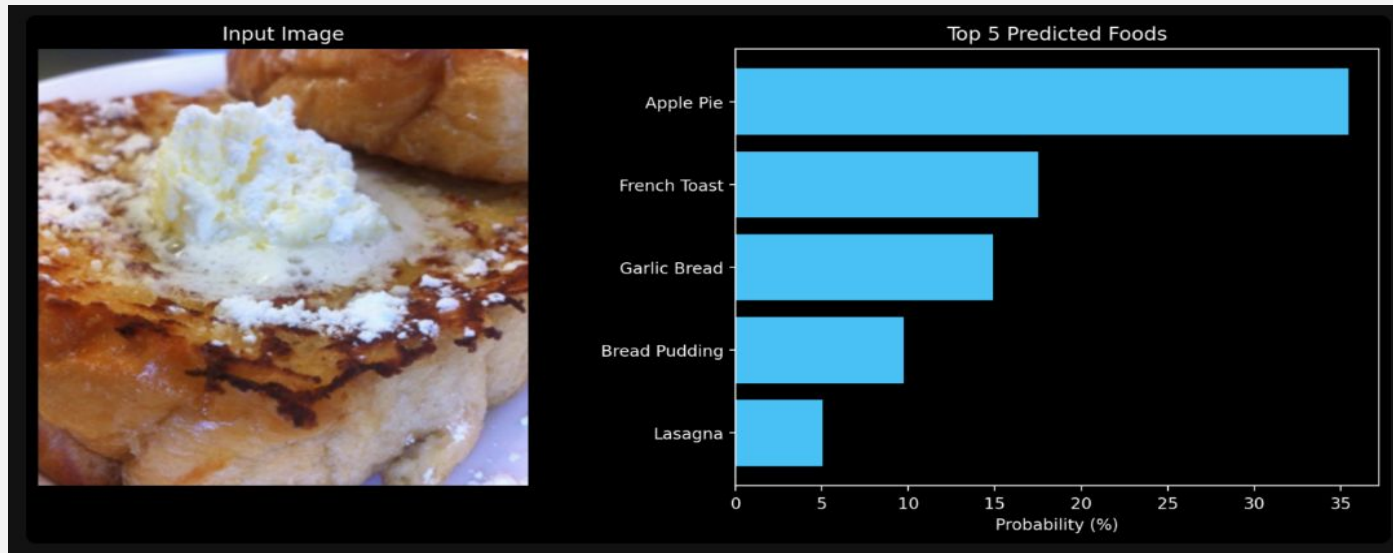
4: Evaluate  
Diab Impact

5: Offer Diet  
Recsl

6: Display  
Analysis

# Identify the Meal Image

- **Objective:** Identify foods from photos to support diabetes-friendly meal choices
- Recognizes foods from a set of 101 different foods
- Lists top 5 likely foods with confidence scores
- Sets foundation for nutritional analysis



1: Upload  
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# Augmentation for DiabEats

- **Objective:** Ensure accurate food recognition for all kinds of photos
- Tweaks photos with flips, rotations, and color changes
- Handles varied photos (e.g., dim light, odd angles) for reliable results
- Makes food identification trustworthy for diabetes management

Dim light Example

Before Augmentation



After Augmentation



1: Upload  
Image

2: Identify  
Image

3: Retrieve  
Nutrition


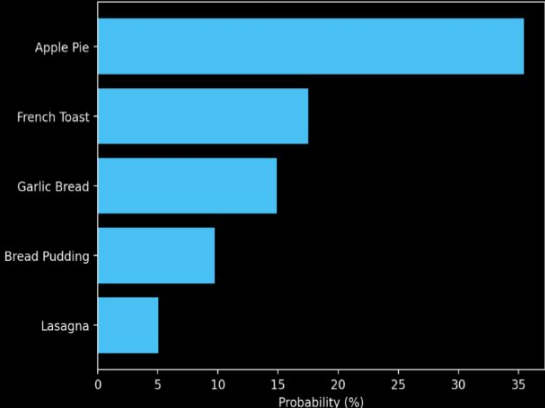
4: Evaluate  
Diab Impact

5: Offer Diet  
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6: Display  
Analysis



# Meal Image Recognition Model Performance

Model	Accuracy (%)	Example of Top-5 Food Prediction												
Food Recognition	Top-1: 80.5	<div><div>Input Image</div><div>Top 5 Predicted Foods</div><table><tr><th>Food</th><th>Probability (%)</th></tr><tr><td>Apple Pie</td><td>35</td></tr><tr><td>French Toast</td><td>18</td></tr><tr><td>Garlic Bread</td><td>15</td></tr><tr><td>Bread Pudding</td><td>10</td></tr><tr><td>Lasagna</td><td>5</td></tr></table></div>	Food	Probability (%)	Apple Pie	35	French Toast	18	Garlic Bread	15	Bread Pudding	10	Lasagna	5
	Food		Probability (%)											
Apple Pie	35													
French Toast	18													
Garlic Bread	15													
Bread Pudding	10													
Lasagna	5													
	Top-5: 94.6													

1: Upload Image

2: Identify Image

3: Retrieve Nutrition

4: Evaluate Diab Impact

5: Offer Diet Recs

6: Display Analysis

# Nutritional Data Retrieval

- Retrieves nutritional profile from Food101 dataset
- Scales nutritional values based on user-specified portion sizes
- Shows food details in easy-to-read tables

Nutrient	Amount
Calories	300.00 kcal
Protein	3.03 g
Carbohydrates	45.07 g
Fats	12.03 g
Fiber	2.20 g
Sugars	20.00 g
Sodium	150.00 mg

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# Diabetes Impact Assessment



Food Recognition Model

Apple  
Pie

Retrieve Nutrition

Nutrient	Amount
Calories	300.00 kcal
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Fats	12.03 g
Fiber	2.20 g
Sugars	20.00 g
Sodium	150.00 mg

Evaluate Diabetic Impact

Impact Score = 1 (Protein <10) + 2 (carbs > 40) + 2 (sugar > 10) = 5

Factor	Threshold per 100g	Score	Evidence Source
Calories	>400kcal	+1	ADA weight management guidelines
Protein	<10g	+1	ADA balanced macronutrient guidelines
Carbs	>40g 20-40g <20	+2 +1 -1	ADA carbohydrate monitoring recommendations
Fats	>30g	+1	ADA nutrition therapy position statement
Fiber	≥5g 3-5g	-2 -1	Reynolds et al., Lancet 2019 meta-analysis
Sugars	>10g 5-10g	+2 +1	WHO & ADA sugar intake guidelines
Sodium	>1200mg >800mg	+2 +1	ADA & AHA cardiovascular guidelines

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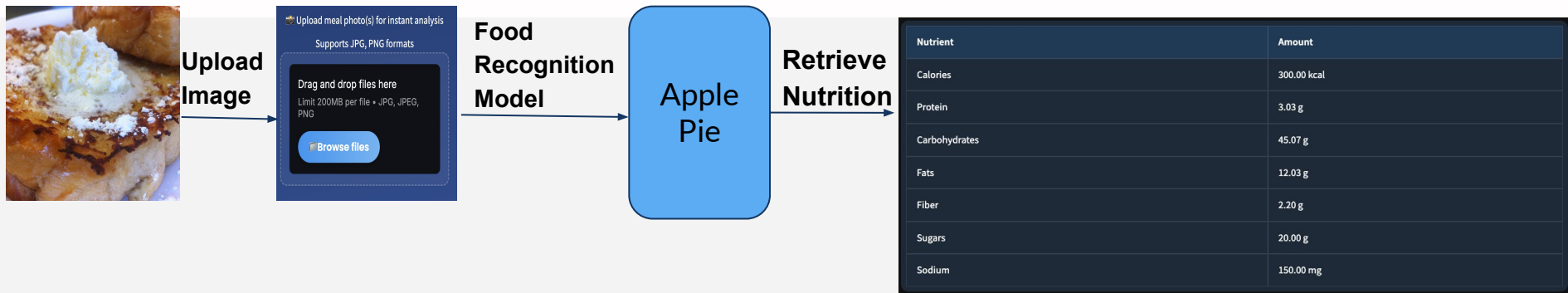
3: Retrieve  
Nutrition

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# Diabetes Impact Assessment ...



Classifies foods into:

- **Low** (impact score  $\leq 0$ )
- **Moderate** ( $1 \leq \text{impact score} \leq 2$ ), or
- **High** (mpact score  $> 2$ ) Diabetes impact categories

Evaluate  
Diabetic  
Impact

Metric	Value
Score	5.00
Impact Level	High
Top Impact Factors	1. Low Protein (3.03g) 2. Refined Carbs (45.07g) 3. Added Sugar (20.00g)

1: Upload  
Image

2: Identify  
Image

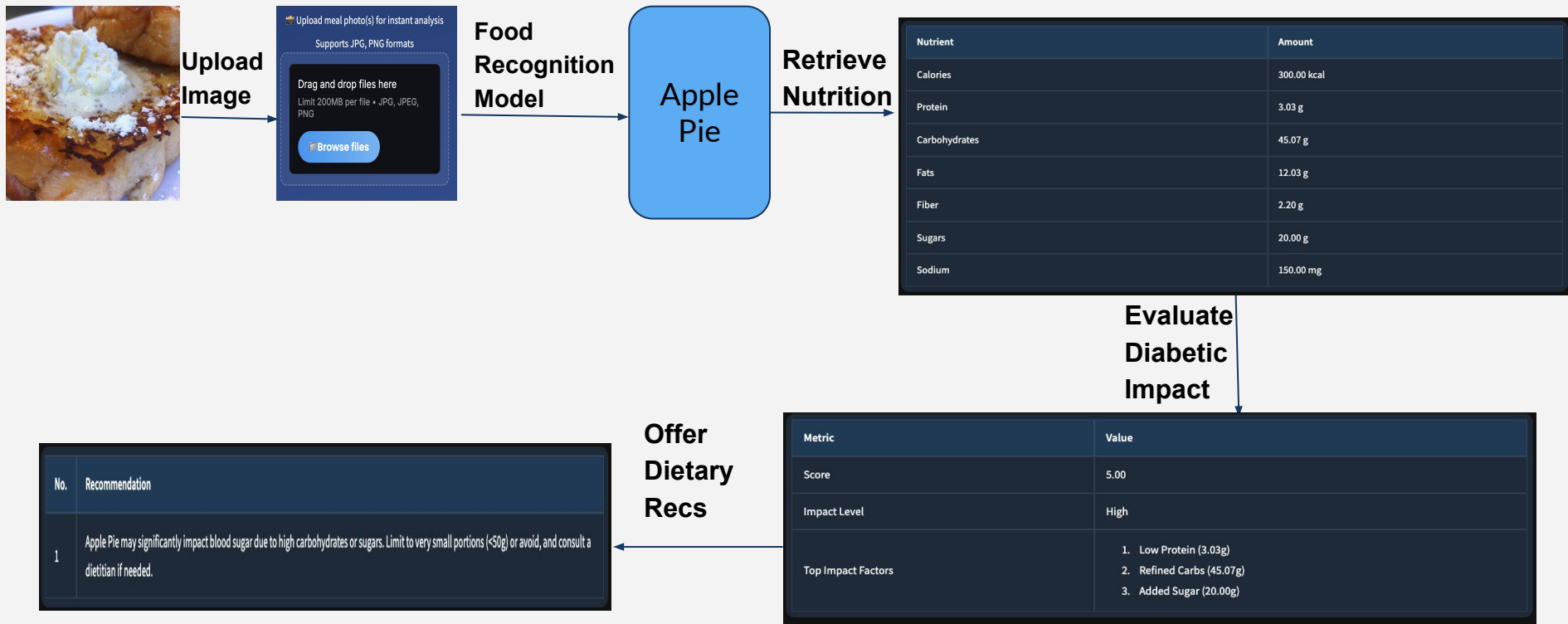
3: Retrieve  
Nutrition

4: Evaluate  
Diab Impact

5: Offer Diet  
Recs

6: Display  
Analysis

# Offer Dietary Recommendations (Single)



1: Upload Image

2: Identify Image

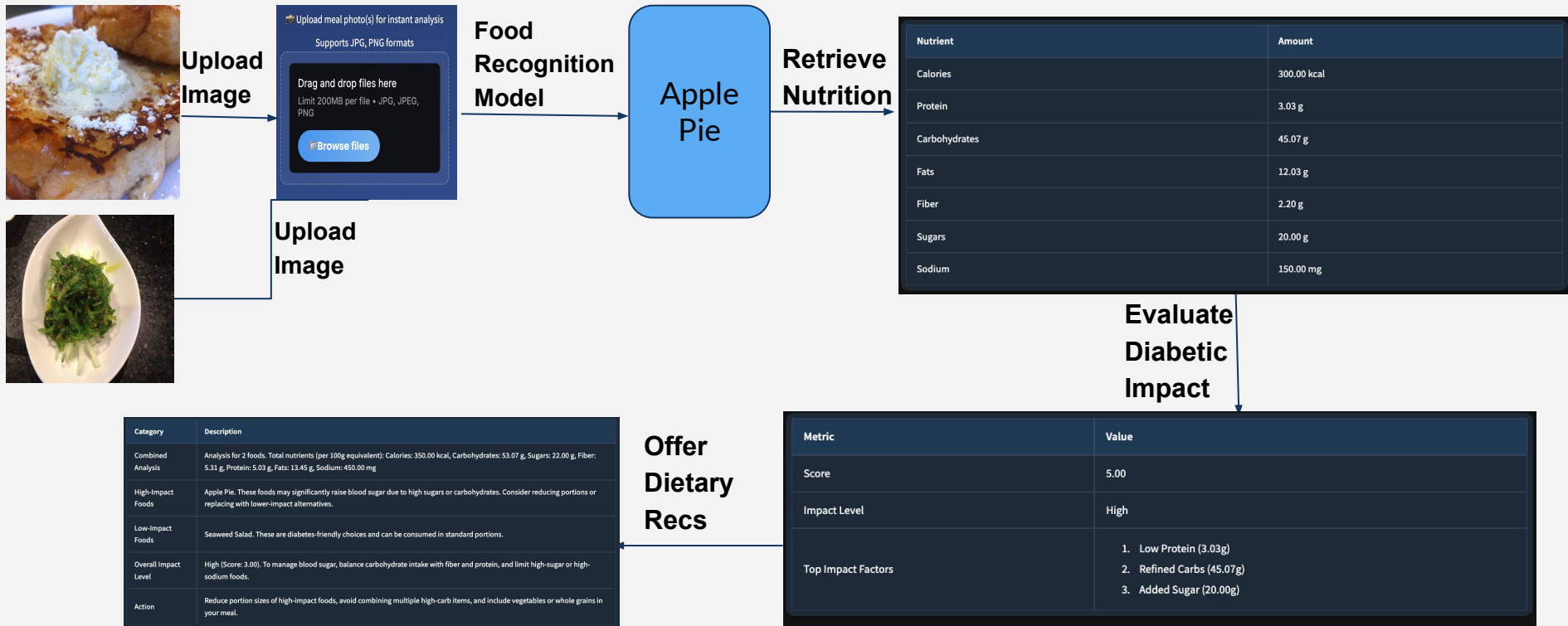
3: Retrieve Nutrition

4: Evaluate Diab Impact

5: Offer Diet Recs

6: Display Analysis

# Offer Dietary Recommendations (Multiple) ...



1: Upload Image

2: Identify Image

3: Retrieve Nutrition

4: Evaluate Diab Impact

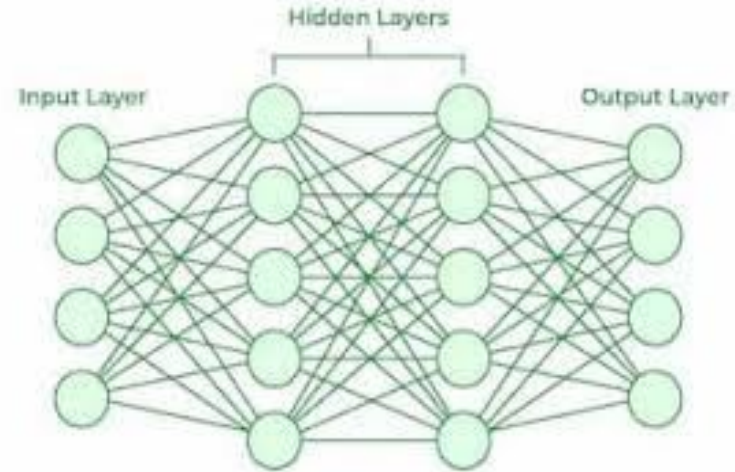
5: Offer Diet Recs

6: Display Analysis

# Analysis Dashboard

- Upload single or multiple food images (JPG/JPEG/PNG)
- Set custom portion sizes for each food
- View top 5 predictions with confidence levels
- Get detailed nutritional analysis and impact assessment
- Receive combined analysis for multiple foods

<https://diabeats.streamlit.app/>



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# Conclusions

- ✦ The system successfully meets its objectives, with the food recognition model achieving 80.5% Top-1 accuracy and the rule-based assessment delivering consistent, evidence-based classifications for Low, Moderate, and High diabetes impact categories.
- ✦ The rule-based diabetes impact assessment effectively identifies carbohydrates and sugars as key factors influencing blood glucose levels,
- ✦ The Streamlit-based user interface provides an intuitive and interactive experience, enabling users to easily upload meal photos, view nutritional breakdowns, and access personalized recommendations.
- ✦ The integration of portion size adjustments in the diabetes impact assessment enhances personalization, allowing the system to reflect real-world eating habits accurately.

# Next Steps

- + Expand the nutritional database beyond the current 101 food categories to include a broader range of regional and ethnic food varieties, enhancing the system's applicability to diverse diets.
- + Refine the rule-based diabetes impact assessment by incorporating additional nutritional factors (e.g., glycemic index)
- + Optimize the EfficientNetV2B3 model to increase Top-1 accuracy beyond 80.5%, potentially through advanced data augmentation techniques or further fine-tuning.
- + Implement a user feedback mechanism to allow users to correct misclassifications, improving the system's accuracy and personalization over time.

# References

- + [Senior woman with medical problems](#)
- + [Smiley covid recovery center female doctor checking elder patient's blood pressure](#)
- + [Doctor using tensiometer high angle](#)
- + [International Diabetes Federation](#)
- + [Mermaid](#)
- + [The Food-101 Data Set](#)
- + [FoodData Central](#)
- + [Edamam Food Database](#)
- + [Global Diabetes Trends and Burden \(PMC10591058\)](#)
- + [AI-Based Diabetes Risk Classification System \(IRJMETS\)](#)
- + [Machine Learning for Diabetes Risk Assessment \(Frontiers in Applied Mathematics and Statistics\)](#)
- + [Self-Reported Dietary Assessment Limitations \(JAMA Internal Medicine\)](#)
- + [Automated Food Image Analysis for Health \(PLOS Digital Health\)](#)
- + [Food Image Recognition Using Deep Learning \(Nature Scientific Reports\)](#)
- + [AI in Diabetes Risk Prediction \(npj Digital Medicine\)](#)
- + [Rule-Based Recommendation Systems for Diabetes \(SAGE Open Medicine\)](#)

# Appendix

## EfficientNetV2B3 Transfer Learning Loss and Accuracy

