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AI-Powered Diabetes Risk Prediction and Foot Ulcer Classifications

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Abstract

This project focuses on creating an intelligent system that can help predict the chances of a person developing diabetes and also detect foot ulcers, which are a common complication in diabetic patients. The system uses artificial intelligence (AI) to analyze health data like blood sugar levels, age, and body measurements, along with foot images, to give accurate results. It is designed in a way that doctors or medical staff can simply upload the patient's data or images on a website and get instant feedback without needing technical knowledge. One of the key features of this system is that it not only gives one-time results but also tracks the patient's health over time, helping doctors see if the condition is improving or getting worse. This can be useful in planning the right treatment at the right time. By combining advanced technology with an easy-to-use platform, the tool aims to support early detection, reduce human error, and help medical professionals make better and faster decisions. Overall, it is a helpful step toward improving the quality of care for people with or at risk of diabetes.

Keywords: *CNN, SVM, Diabetes, Deep Learning.*

1. Introduction

1.1 Overview

Diabetes is long-lasting chronic metabolic symptoms around the world and individuals live with every day. Diagnosing and managing this condition is complex due to variability in symptoms, late detection, and complications like diabetic foot ulcers (DFUs). Conventional diagnostic techniques typically depend on manual image analysis, a process that is both time-intensive and susceptible to human error. The rise of artificial intelligence (AI), especially smart systems that learn on their own, opens up new ways to make medical diagnoses more accurate and helps reduce the pressure on doctors and healthcare workers [1].

1.2 Objectives

The main goals of this project are:

- Build a best approach that can make future prediction for a person's risk of developing diabetes by monitoring their health data using machine learning.
- The tool uses AI-based image recognition, especially supervised and unsupervised models, to spot DFUs in medical images without manual effort.
- To reduce false predictions through dimensionality reduction.
- To provide real-time diagnostic results through a user-friendly web interface.
- 5) To help those who are in medical line in making timely and accurate clinical decisions [2].

1.3 Purpose, Scope and Applicability

1.3.1 Purpose

This work is designed to provide an automated tool for predicting diabetes and detecting foot ulcers, thereby supporting clinicians with faster, more accurate diagnoses and reducing dependence on manual evaluation.

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1.3.2 Scope

This system includes a diabetes prediction module using classification algorithms, a CNN-based foot ulcer detection module, and a web interface for data input and result viewing.

1.3.3 Applicability

The system is applicable in hospitals and clinics for screening, in rural healthcare centers with limited specialist access, and in personal health monitoring apps for diabetic patients [3].

2. Related Work

Over the years, advances in AI—especially in machine learning—have changed the way diabetes and its complications are detected and treated. In one study, DBNs combined with attention layers and GAN-based data augmentation significantly improved prediction accuracy by enhancing feature importance and handling data imbalance. Another approach used CNNs to classify diabetic foot ulcers (DFUs) by analyzing tissue types such as granulation, slough, and necrosis, supporting timely detection and guiding proper treatment decisions. Large-scale studies, such as those conducted in China and South Korea, revealed the importance of using diverse, real-world datasets for training. Algorithms like XGBoost, Random Forest, and CatBoost outperformed traditional models in terms of AUC and F1 scores. Despite promising results, existing models suffer from limited generalizability and explainability. Many rely on small, homogeneous datasets and lack tools for tracking disease progression over time. These limitations highlight the need for a more comprehensive, explainable, and scalable diagnostic system—one this project aims to provide [4].

3. Methodology

3.1 Overview

The proposed system adopts a structured machine learning pipeline to predict diabetes risk and detect diabetic foot ulcers. The methodology includes Collecting relevant data, Data preprocessing, Training models, evaluation, and deployment through a user-friendly web interface [5].

3.2 Data Collection

Clinical datasets containing patient health parameters such as glucose level, BMI, insulin, blood pressure, and age were sourced from public repositories like Kaggle and UCI. Additionally, image data of diabetic foot ulcers were collected for CNN-based classification [6].

3.3 Preprocessing

The datasets are handled to adjust the incomplete and inaccurate data and normalized it to ensure consistency. Irrelevant features were removed, and we made the data easier to understand and work with by removing unnecessary details and keeping only the most important parts keep in it to improve model performance and reduce overfitting [7].

3.4 Model Training and Classification

Most approaches were trained on structured data. For image-based classification of foot ulcers, supervised models were developed to extract features and identify affected tissue types [8].

3.5 Web Interface and Prediction Output

The trained models were integrated into a responsive web application. Users can input clinical parameters or upload foot images to receive real-time predictions. The system also visualizes parameters like accurate prediction, confusion matrix, and ROC curves for transparency [9].

3.6 System Architecture

The diabetic prediction system starts with collecting health data in CSV format, which is cleaned and preprocessed for accuracy. A system gets trained on this data to recognize patterns indicating diabetic or non-diabetic conditions. Finally, the trained model is integrated into a user-friendly application that provides real-time predictions based on user input [10].

4. Excepted Results

studies, such as those conducted in China and South Korea, revealed the importance of using diverse, real-world datasets for training. Algorithms like XGBoost, Random Forest, and CatBoost outperformed traditional models in terms of AUC and F1 scores. Despite promising results, existing models suffer from limited generalizability and explainability. Many rely on small, homogeneous datasets and lack tools for tracking disease the proposed diagnostic tool is designed to deliver fast, accurate, and explainable predictions for both diabetes risk and foot ulcer classification [11].

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4.1 Prediction Accuracy

The relevant systems are assumed to achieve it correctly identifies whether a person has diabetes or not in most cases of diabetic and non-diabetic cases using structured clinical data. CNN-based approaches for photos preprocessing and anticipated to demonstrate strong sensitivity and specificity in identifying ulcer regions.

4.2 Performance Metrics

To check how well the system is working, we'll use common performance measures like how often it's right (Accuracy), how precise it is (Precision), how well it finds real cases (Recall), an overall score (F1-score), and a table that shows what it got right or wrong (Confusion Matrix). ROC curves and AUC scores will help visualize the model's discriminative ability [12].

4.3 Progress Tracking

The system includes a module to monitor disease progression based on sequential clinical inputs. It enables medical professionals to observe trends over time, aiding in treatment planning and follow-up decisions.

4.4 Visualization and Explainability

To improve interpretability, the system will generate visual outputs such as bar charts, ROC curves, and prediction confidence scores. These insights advise the medical diagnostics to make them the clear image of the diagnosis and trust the AI-driven decisions [13].

4.5 Web-Based Deployment

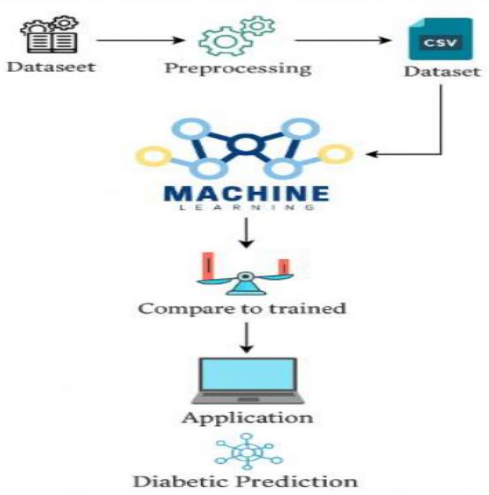

Figure 1 Machine Learning Process

The system will be deployed as a web application accessible on desktop and mobile devices. Users can interact with the platform in real time, upload inputs, and receive diagnostic results instantly Figure 1 Shows Machine Learning Process.

Conclusion

This project introduces a smart medical tool that uses machine learning and its sub fields to help predict the problems associated with diabetes. By analyzing both patient data and foot images, the system supports doctors in catching problems early and keeping track of patient health over time. For detecting foot ulcers, the system uses a powerful image-based techniques. For predicting diabetes risk, it uses common approaches. Together, these approaches help the medical to take appropriate decisions to tackle the diabetes. The tool also includes a feature to monitor a patient's condition over time, and helps patient's take carer to get the better medicines. It's built to be user-friendly and works through a web interface, so doctors can access it anytime. It even shows clear visual results to make predictions easier to understand. While the current version focuses on the main features, the system is ready for future upgrades—like connecting to hospital record systems, adding other disease detection modules, and using advanced AI explainability tools to show how the system makes its decisions. In short, this project takes a big step toward using AI to support and improve healthcare.

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