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Web-Based System for Blood Cancer Detection Using Convolutional Neural Networks with Integrated Doctor Recommendation

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Abstract: *Blood cancer, specifically leukemia, is one of the most lifestyles-threatening illnesses requiring well timed and correct prognosis. Traditional diagnostic tactics depend on guide inspection of blood smear images by means of pathologists, that is frequently time-eating, subjective, and dependent on expert availability. This paper affords a web-based application that leverages Convolutional Neural Networks (CNN) for the automated detection and category of blood most cancers from microscopic pix. The machine is built using Flask for the backend, included with a trained CNN version, and OpenCV for preprocessing of input photos. Users can add blood smear images through a person-pleasant interface, and the device performs actual-time classification into classes including Benign, Malignant Early Pre-B, Malignant Pre-B, and Malignant Pro-B. The application also connects customers with nearby experts primarily based on geographic area, and consists of functions inclusive of user registration, doctor critiques, and visible analytics of the prediction process. By combining deep studying with reachable net technology, this solution objectives to help medical professionals in early diagnosis and support better healthcare delivery, in particular in underserved or rural regions. Keyword Blood most cancers detection, CNN, Flask internet utility, TensorFlow, OpenCV, Medical photo category, Deep gaining knowledge of, Leukemia diagnosis*

Keywords: Blood cancer detection, CNN, Flask, TensorFlow, OpenCV, Deep learning.

I. INTRODUCTION

Blood most cancers, particularly leukemia, arises from the abnormal growth of white blood cells, main to disruptions inside the production of wholesome cells. Manual diagnosis via microscopic analysis of blood smears is exertions-in depth, time-consuming, and liable to inconsistencies. In rural or underneath-prepared healthcare settings, the dearth of specialist get admission to adds to the undertaking. To deal with those barriers, this venture introduces a web-primarily based diagnostic device that makes use of Convolutional Neural Networks (CNN) to classify blood smear pix. The application, developed the use of Flask and incorporated with TensorFlow and OpenCV, allows users to upload pictures for immediate evaluation. The CNN version classifies the photos into particular sorts of blood cancer, supporting faster and more dependable diagnosis. The platform consists of functions which include actual-time end result show, patient-medical doctor mapping, and stable information managing. This gadget bridges the gap between AI innovation and medical accessibility.

II. LITERATURE SURVEY

1, Bindusha et al. (2025) began to use a mild conventional neural network (CNN), Mobilnet to detect leukemia. Their work emphasizes the capacity of mobile-based AI applications in medical diagnostics, especially that offers fast and available leukemia in remote or subsequent areas.

2.Ganesh et al. (2024) discovered the integration of the AI in the 6G network to process and classify data from blood cancer. The study proposes a high-speed, low small system that supports the first detection of blood cancer through

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real-time analysis, distance-patient monitoring and future indicative models, which are capable of the possibilities of new 6G technologies.

3. Pujita et al. (2024) Focus on the use of a custom installation V3 model for automatic leukemia diagnosis. Their model was corrected to analyze the subtle blood-voted images more accurately and improve the identity of leukemia-specific patterns. This approach reduces manual workload for pathologists and increases clinical precision.

4. Gokul et al. (2024) also implemented deep teaching techniques, especially CNN for automated identification of leukemia. Their research has shown how machine learning models can identify microscopic deviations in blood cells, accelerate the diagnosis and reduce human errors in the interpretation.

5. Biswas et al. (2024) suggested a hybrid approach in combination with stack-educated and color direct algorithm to improve the leukemia detection. By merging color -based functional extraction and machine learning stacking techniques, the study achieved more classification accuracy by addressing the boundaries of traditional identification methods. Bindusha et al. (2025) began to use a mild conventional neural network (CNN), Mobilnet to detect leukemia. Their work emphasizes the capacity of mobile-based AI applications in medical diagnostics, especially that offers fast and available leukemia in remote or subsequent areas.

III. SYSTEM MODULES

A. Data Acquisition Module

This module collects high quality blood point images from hospital databases or medical research sources. These images are important for training and testing deep learning models. Each image is carefully marked as normal or cancer, ensuring accurately monitored learning. When collected, images are arranged and stored in a structured format for further procedure.

B. Image Preprocessing Module

Before analysis, images undergo several prerosaries to increase quality and uniformity. Techniques such as noise reduction, negative increase and generalization are used to clarify images. These phases improve the visibility of blood cell structures and eliminate objects, ensuring stability in the dataset regardless of lighting or image sources.

C. Feature Extraction Module

This module uses Convisional Neural Network (CNN) to automatically extract important functions from blood cell images. It identifies important symptoms such as cell size, size and nuclear structure, which are necessary to distinguish between normal and cancer cells. The accuracy of these extracted properties affects the general performance of the classification model to a large extent.

D. Classification module

The origin of the system, this module uses a CNN-based classifies to classify blood cells. Model is trained on marked data and learns to recognize patterns associated with leukemia. The features taken from new images are compared to their scientific patterns, it classifies the sample as normal or cancer, which enables automatic, reliable diagnosis.

E. Prediction and Result Module

Finally, this module gives the outcome to the user. It displays the predicted class (e.G., Malignant_early_Pre-B) along side a self assurance score indicating the model's fact. In a few instances, it can additionally spotlight photo regions that stimulated the prediction. This person-friendly result helps medical doctors speedy interpret the findings and make knowledgeable medical decisions.

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IV. DEVELOPMENT TOOLS AND TECHNOLOGIES

A. Technologies Used

1. Python

Python is an interpreted, object-oriented, high-level programming language with good readability and efficiency. Created by Guido van Rossum, Python has a large application in web development, data science, AI, and automation. Its vast library includes Machine Learning (TensorFlow, Keras), GUI (Tkinter, PyQt), image processing (OpenCV), web frameworks (Flask, Django), and data manipulation (Pandas, NumPy, Matplotlib). Python was employed here for image processing using CNNs to identify blood cancer.

2. TensorFlow & Keras

TensorFlow is an open-source system for machine learning with flexibility and deployment options on different platforms. TensorFlow is used to build Keras, which is a high-level API that makes it easy to create deep learning models with support for CNNs and RNNs.

3. Pandas & NumPy

Pandas gives high-performance data structures to enable easy data manipulation. NumPy provides effective tools for numerical computation with the use of arrays and matrices, which provide the foundation for most Python libraries.

4. Matplotlib

Matplotlib is a plotting library for the creation of static and interactive plots. It is utilized in conjunction with NumPy to plot data and model predictions.

B. Development Environment

1. PyCharm

A JetBrains IDE specifically designed for Python, providing code completion, debugging, and Git as well as virtual environment integration. Widely used for writing, testing, and code maintenance.

2. Flask

A micro web framework for creating web applications. It managed backend functionality, dispatched user requests, and interfaced the CNN model with HTML/CSS interfaces and MySQL databases.

3. WampServer

Offers a local development environment with Apache, PHP, and MySQL. Utilized for administering and testing database interactions using phpMyAdmin.

4. HTML, CSS & Bootstrap

HTML builds up web content, CSS makes it look good, and Bootstrap improves responsiveness with UI components built ahead of time. Combined, they made the application's frontend easily usable.

5. PHP

Server-side scripting language for handling form submissions and database interactions. It allowed for dynamic content generation and MySQL integration.

C. Database Management

MySQL

A strong, open-source relational database to store and handle user information, diagnostic findings, and model outputs. Has support for complex queries, relationships through keys, and performance, scalability, and security optimization. Utilized via WampServer with phpMyAdmin for simple table creation and CRUD operations.

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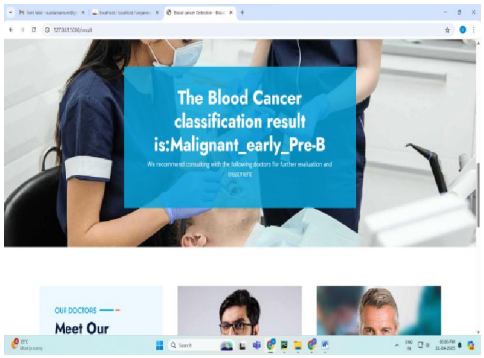
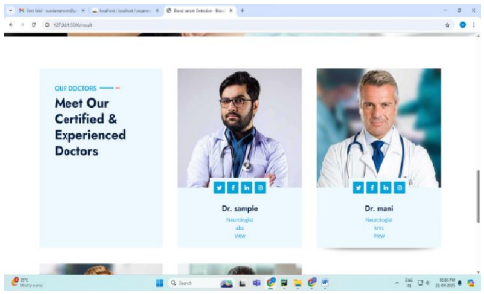
V. RESULT AND DISCUSSION



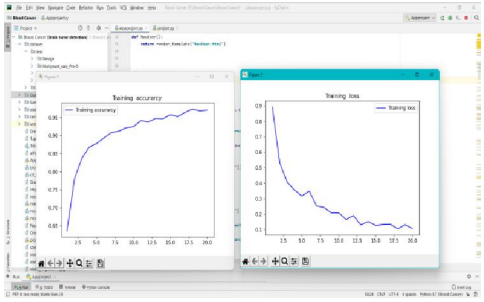
The last module of the blood cancer detection system is the Prediction and Result Module, which gives a friendly interface for presenting the output of the model. As can be seen from the screenshot (Figure X), after a user uploads an image of a blood smear and the system finishes classification with the trained Convolutional Neural Network (CNN), the result is displayed on the screen.

In the output shown, the system labels the image as "Malignant_early_Pre-B", representing an early phase of Pre-B cell acute lymphoblastic leukemia (ALL), a form of blood cancer that develops in immature B-cells in the bone marrow. The output is prominently displayed on a blue transparent overlay to make it visible and readable.



As shown in Figure Y, the system has a special section named "Meet Our Certified & Experienced Doctors," which is displayed right after the blood cancer prediction result. This feature is part of the Prediction and Result Module, aimed at filling the gap between early diagnosis and medical consultation.

After classifying a blood smear image (e.g., Malignant_early_Pre-B), the system shows profiles of nearby or relevant experts who can help the patient with further assessment.



The Convolutional Neural Network (CNN) model was trained on a dataset of two main categories: Benign and Malignant (early Pre-B) images of blood cells. These images were preprocessed and input into the model for classification. Over 20 epochs of training, the model exhibited robust learning capacity. From the graph representing training accuracy, the accuracy of the model improved consistently to about 97%, representing highly efficient feature extraction and classification. Concurrently, the training loss plummeted from 0.9 to almost 0.05, affirming effective

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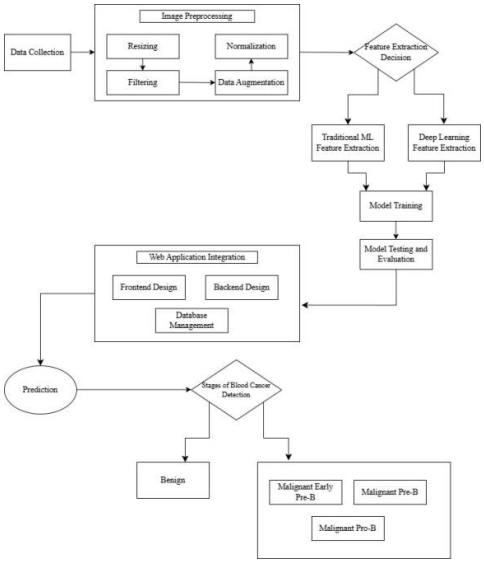
convergence and little overfitting. This pairing of high accuracy and low loss verifies that the model can generalize well on the training data and solidifies its capacity for credible blood cancer detection.

V. SYSTEM ARCHITECTURE



The architectural flowchart describes the entire workflow of the blood cancer detection web application with the aid of Convolutional Neural Networks (CNN). The workflow starts with Data Collection, wherein blood smear images are obtained from medical databases or clinical sources. The images are then processed with Image Preprocessing, encompassing resizing, normalization, filtering, and data augmentation to enhance quality and normalize inputs to the model. After preprocessing, a choice is made between employing machine learning-based traditional feature extraction or deep learning-based feature extraction. Deep learning feature extraction is used in this project using CNNs, which learn important features automatically from the input images.

The learned features are utilized in Model Training, in which the CNN is trained to classify images using labeled data. Following training, the model is tested in the Model Testing and Evaluation stage to ensure its performance and parameterization. The optimized model is then deployed in a Web Application using Flask. The application consists of a Frontend Design for user interface, Backend Design for computation and routing, and Database Management using MySQL for storing user information, predictions, and doctor information.

Whenever a user uploads a new image via the web interface, the model makes a Prediction and gives a diagnosis. The Blood Cancer Detection Stages are then shown, showing Benign, Malignant Early Pre-B, Malignant Pre-B, or Malignant Pro-B depending on whether the sample is benign or malignant. The classification is shown in an easy-to-understand format, with recommended next steps and doctor advice. The architecture provides seamless integration of AI-based diagnostics with real-time availability via a web platform.

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