

Retinoblastoma Detector:

Deep Learning-Based Eye Risk Assessment

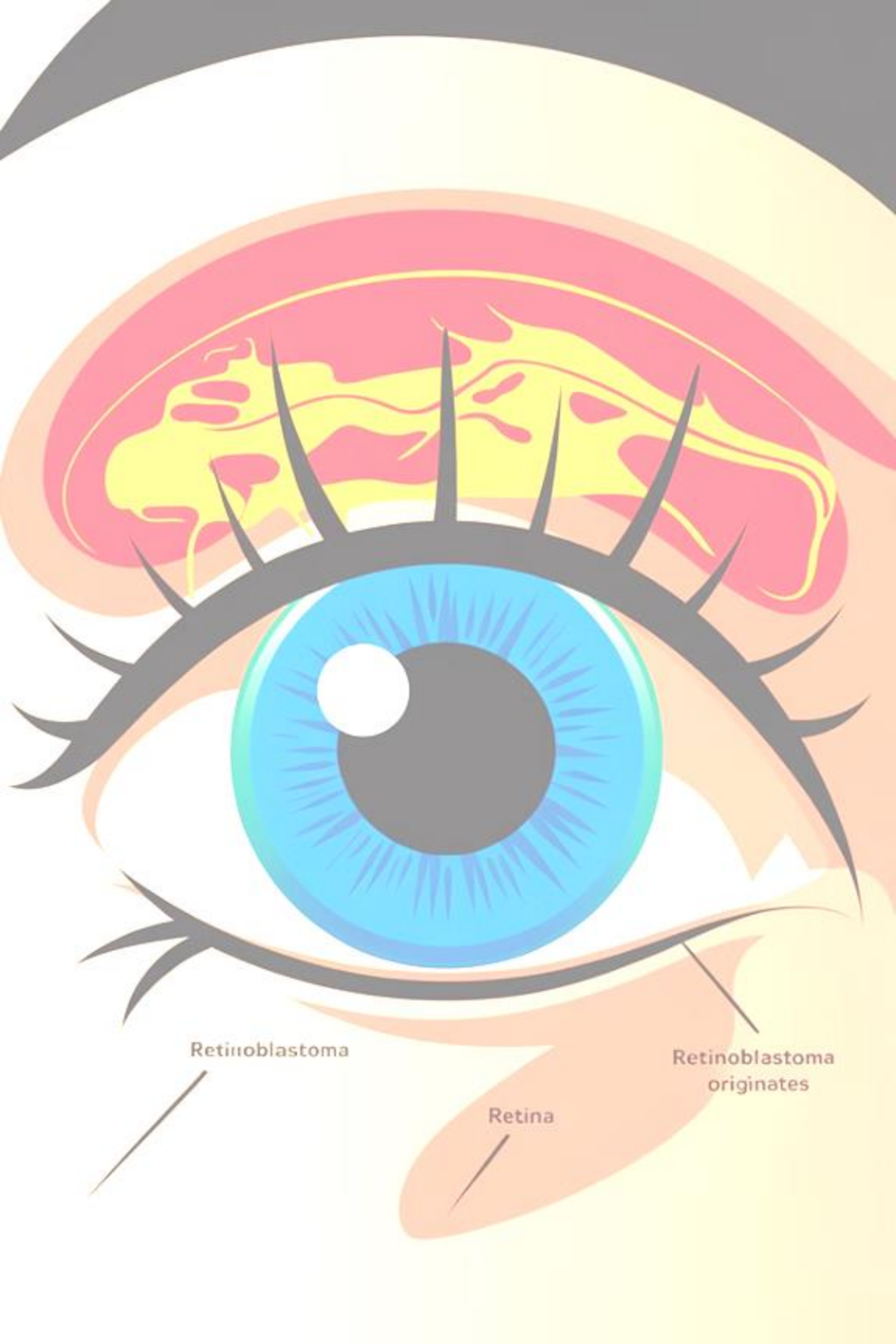
By: Amir Navon, Adi Albeg, Taina Trahtenberg



Retinoblastoma: A Childhood Eye Cancer

- Retinoblastoma is a rare and aggressive type of eye cancer that primarily affects young children.
- It originates in the retina, the light-sensitive tissue at the back of the eye, and can quickly spread if not detected and treated early.





Understanding Retinoblastoma: What is it?

1

Genetic Mutation

Retinoblastoma is caused by a genetic mutation that leads to uncontrolled cell growth in the retina.

2

Tumor Formation

The mutated cells form a tumor that can quickly grow and spread to other parts of the eye and body.

3

Affecting Vision

As the tumor grows, it can damage the retina and optic nerve, leading to vision loss and other complications.



Potential Consequences of Late Detection

Vision Loss

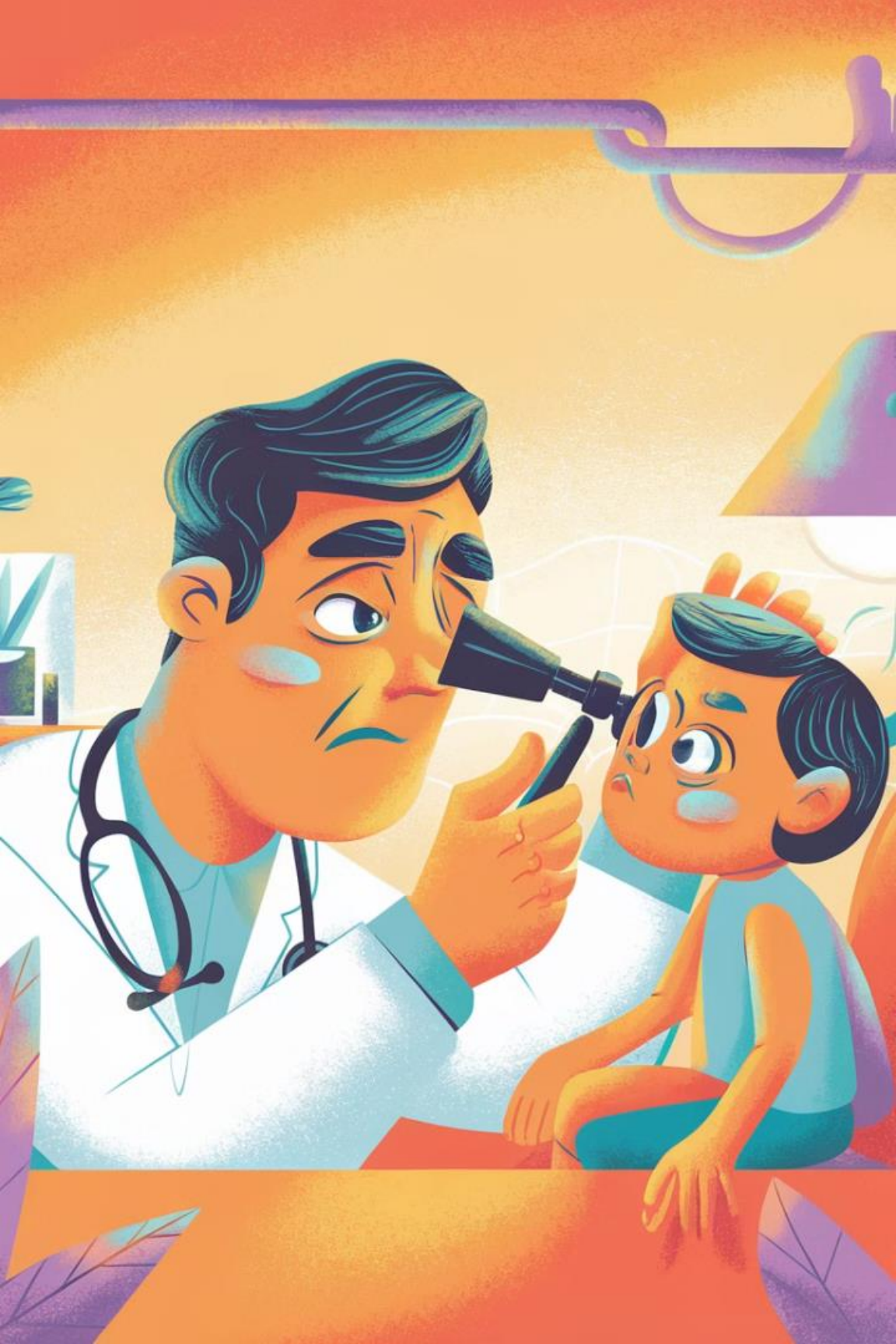
If retinoblastoma is not detected early, it can lead to permanent vision loss or even blindness in the affected eye.

Metastasis

Delayed diagnosis increases the risk of the cancer spreading to other parts of the body, making it much more difficult to treat.

Fatality

In the most severe cases, late detection of retinoblastoma can result in the child's death if the cancer is not successfully contained.



Early Detection Saves Lives

The Importance of Early Diagnosis:

With early detection and treatment, the survival survival rate for retinoblastoma can be as high as high as 95%.

Project Objectives and Challenges

■ Early Detection

Create a system to identify retinoblastoma signs from everyday photos

■ Accessibility

Design for use with basic cameras or smartphones

■ Overcome Challenges

Address subtle visual features, variable input data, and accessibility needs



Dataset Preparation and Processing

Dataset Organization

- Manually prepared dataset.
- Images are categorized into two groups: healthy eyes and retinoblastoma-affected eyes.

Image Preprocessing

We use Mediapipe for eye detection in facial photos, crop the eye regions, and standardize all images to 224x224 pixels with normalized pixel values.

Augmentation Techniques

These techniques artificially expand the dataset size, reducing overfitting and improving generalization.

They include: Horizontal Flip, Random Rotation, Color Jitter, Random Resized Crop.

Model Architecture: Convolutional Neural Network

Pytorch implementation

1

Convolutional Layers

Extract meaningful features like edges, shapes, and textures

2

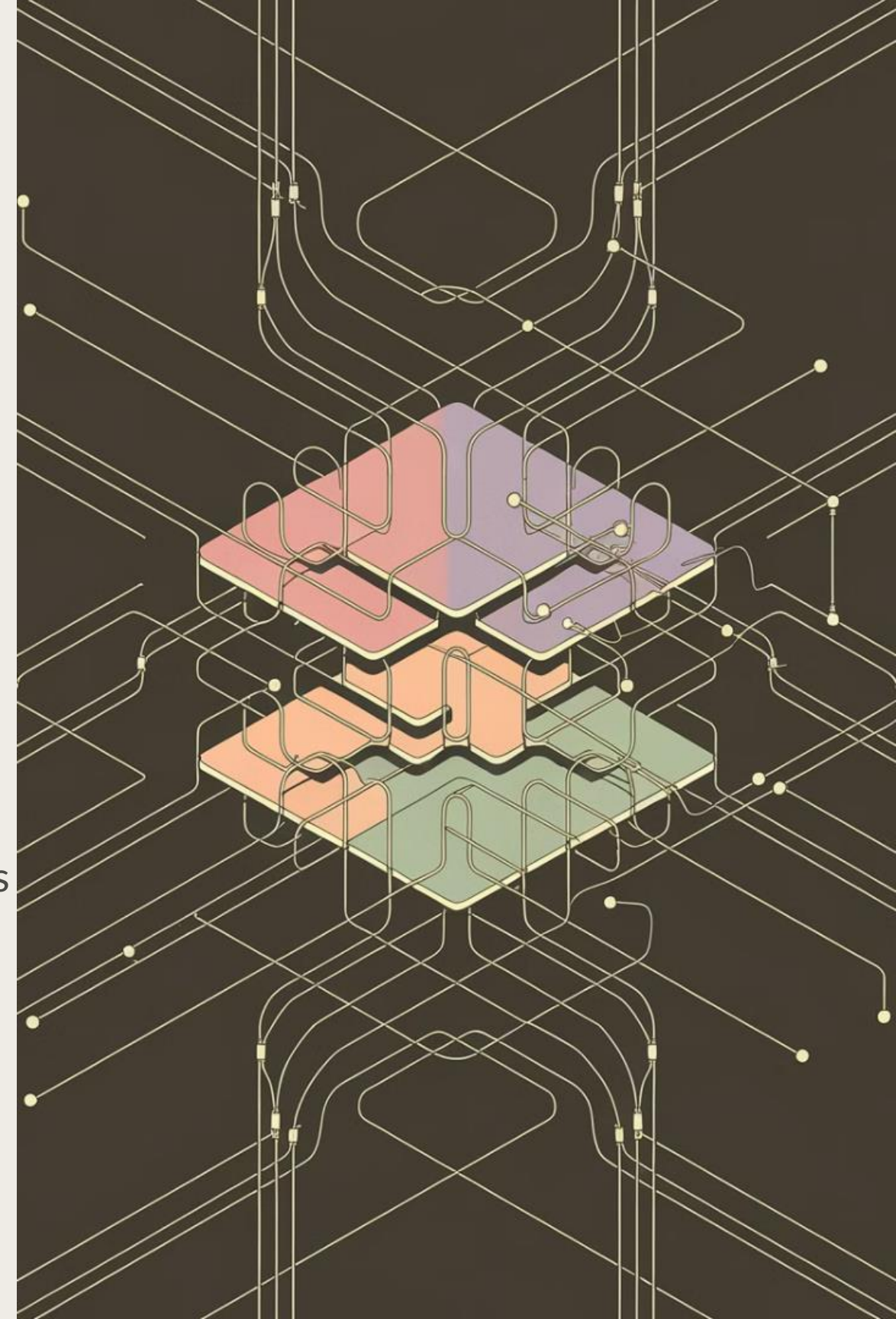
Pooling Layers

Reduce image representation size, focusing on important features

3

Fully Connected Layers

Combine extracted features to classify as Healthy or Retinoblastoma





Training and Evaluation Process

1

Data Splitting

80% training, 20% validation

2

Optimization

Adam Optimizer adjusts model parameters

3

Training Loop

Training until the best model is found based on validation lost

4

Evaluation

Confusion Matrix, Classification Report, ROC-AUC

Training and Evaluation Results

1 — Training Accuracy – 94%

2 — Validation Accuracy – 93%

3 — ROC-AUC Score - 0.97

4 — Confusion Matrix

**Overall
Accuracy
94%**

	No (0)	Yes (1)
No (0)	15	1
Yes (1)	1	14

- The results suggest that the model performs well.
- Indeed, 1 FN case may require consideration for improvement

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Upload

7

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Results

Deployment Using Streamlit



Upload Photo

User uploads eye or face photo



Eye Detection

App detects and crops eye regions if needed



Classification

Each eye classified as Healthy or Retinoblastoma



Display Results

Shows results with confidence scores

Why This Methodology?

Handling Variability

Image preprocessing and Mediapipe manage variability in photo quality, ensuring consistent, high-quality data for the CNN.

Specialized Image Analysis

CNNs excel at recognizing subtle visual cues, making them ideal for identifying reflections in the pupil associated with retinoblastoma.

Accessibility

The use of everyday photos and a web app interface makes the tool accessible to a wide audience, potentially reaching more people in need.

PyTorch

- Enables flexible debugging and real-time modifications during model development.
- Speeds up training and inference, critical for convolution-heavy architectures.
- Extensive libraries and support streamline implementation.

[GitHub](#)

[App](#)

Our Group Challenges

Limited Dataset

Larger data is desirable to improve the model's capabilities

Loss vs. Accuracy trade-off

Deciding what is more important for the specific model

Mediapipe and Streamlit Combination

- MediaPipe operations can block the Streamlit app.
- They might have conflicting dependencies.



Future Directions

1

Dataset Expansion

A larger dataset would improve the model's accuracy and generalizability

2

Advanced Augmentation

Implement techniques for better real-world robustness

3

Incorporate Pretrained Models

Use architectures like ResNet or EfficientNet

4

Mobile App Integration

Deploy model for use in remote areas

5

Batch Image Processing

Allow analysis of multiple images at once