

Blood Group Prognosis Using Fingerprint by CNN Algorithm

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Abstract: Identification of an existent's blood team is pivotal in exigency situations, for identification authentication, and in population analysis. It would else contain drawing a blood pattern and assaying it in a laboratory, which is painful, tedious and requires skilled labour pressure and installations. Herein, we endorse a way to prognosticate blood organizations besides blood via the use of factor pictures and a Convolutional Neural Network (CNN). Since fingerprints are wonderful in every existent, we believe they may want to have patterns related with herbal traits comparable as blood type. We gathered factor photographs with eight colourful blood organizations marked and used them to instruct a CNN mannequin to classify them. We estimated the overall performance of the trained mannequin the use of standards comparable as delicacy, perfection, recall, and F1- rating upon testing. Our findings had been encouraging, indicating that fingerprints may additionally be doubtlessly employed to forged blood organizations the usage of deep literacy. In the future, we will extendour dataset with clean samples, strive out bettered CNN models, and work on securing individualities' data. This device has the implicit to provide an invasive-free, hastily, and less complicated gadget for blood team vaticination, mainly in locales with no lab setup. This challenge gives a novel method for blood team detection the usage of fingerprint analysis, a non-invasive and efficient approach that can beautify contemporary blood typing techniques. The learn about includes classifying fingerprints into eight wonderful blood crew categories: A+, A-, AB+, AB-, B+, B-, O+, and O-. We appoint a range of superior machine mastering algorithms to attain excessive accuracy in classification. Specifically, we make use of Convolutional Neural Networks (CNN), MobileNet, RNN mixed with ResNet, and Vision Transformers to analyze fingerprint patterns and extract significant features.

Keyword: Finger print, Prognosis, Blood group, CNN.

1. INTRODUCTION

Medical and healthcare companies rely on blood team identification for many one of a kind duties such as turning in care to sufferers earlier than beginning and for the duration of first aid. The protection of sufferers relies upon on understanding blood businesses efficaciously earlier than any transfusion due to extreme life-threatening immune reactions. Serological trying out assessments blood samples via reactions between blood and different antibodies to realize blood groups. This checking out approach works nicely but needs educated technicians and laboratory settings alongside with high priced gear making its use tough in quick emergency and long-range situations. Current blood exams want lots time to work and want bodily blood samples which emerge as difficult at some stage in emergency moments when quickly blood kind effects are needed. People are looking out for techniques to decide blood agencies due to the fact latest healthcare desires require quicker and less difficult clinical solutions. Biometric detection of fingerprints indicates workable to create an effortlessly handy and quickly approach for blood team identification. Biometric authentication is now a tremendous science used in imparting protection structures due to the fact biometry uniquely describes the person.

Unlike typical strategies the place facts should be without difficulty leaked, hacked, or stolen, biometrics machine is extra impervious and user-friendly, as consumer identification is linked to problem directly[8]-[10] At the equal time, there is a quantity of biometric technologies, however biometrics identification via finger vein (FV) has end up the most fascinating approach in biometrics technology, as its higher than frequent science the usage of fingerprint, facial attention or iris detection.

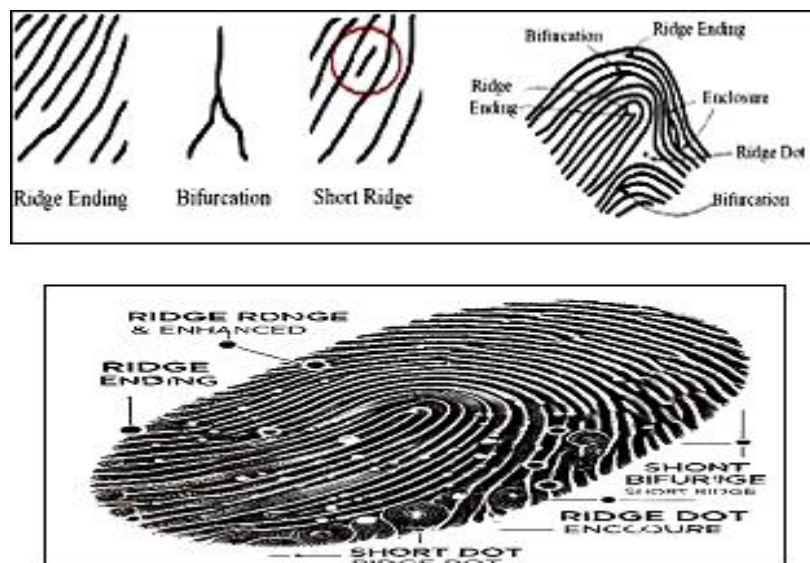


Figure1. Represent the Working of Fingerprint Ridge Features

2. Fingerprint Ridge Features and Their Importance in Blood Group Prediction

Fingerprints make exquisite biometric markers due to the fact they preserve exceptional ridge configurations and man or woman marks that we use for both protection tests and fitness examinations. The discern 1 depicts essential fingerprint ridge data that deep getting to know makes use of to predict blood agencies effectively.

Key Fingerprint Ridge Features:

1. A fingerprint ridge ends quickly when it meets no similarly continuation.
2. A single ridge line divides into two wonderful traces when transferring apart.
3. The Short Ridge features as an unconnected finger line section separate from different ridge formations.
4. A dot-shaped ridge factor recognised as Ridge Dot exists inside each fingerprint pattern.
5. Enclosure stands for a fingerprint ridge that splits and reconnects to shape a spherical shape.

Significance in Blood Group Prediction:

Researchers note that genetic traits accomplice with precise patterns of fingertip details. The gadget makes use of deep getting to know fashions to study finger fingerprint traits and observe their great features that allow correct blood team detection. Researchers educated the Inception V3 mannequin to analyze fingerprint ridge patterns and find out treasured statistics in them to predict blood groups. The feature based method lets healthcare companies function quickly and cheap blood team dedication except normal invasive tests. It advantages emergency care and healthcare settings barring direct affected person contact.

1.1 Motivation

Our lookup targets to overcome trendy blood typing troubles mainly in clinical amenities positioned in far flung areas which lack perfect laboratories and knowledgeable staff. Having a transportable device that does now not want to enter the physique at all would assist scientific workforce in several outside healthcare settings. The want for blood crew identification is pressing at some point of clinical emergencies in view that trendy assessments take too lengthy in trauma instances accidents and disasters. An computerized fingerprint gadget that presents blood crew predictions can assist clinical groups store extra sufferers via quickly intervention. The high-priced specialised tools and expert body of workers wanted for normal blood trying out indicates that a new greater environment friendly device is required. Fingerprint-based deep gaining knowledge of evaluation helps decrease healthcare fees to serve sufferers higher in hospitals and blood donation facilities. EHR databases and biometric structures will combine higher with a fingerprint-based blood crew predictor supporting healthcare services song affected person data effectively.

1.2 Objective

The most vital step in the software program improvement method is the literature review. This will describe some preliminary lookup that was once carried out by means of quite a few authors on this splendid work and we are going to take some vital articles into consideration and similarly lengthen our work. Here's an superior model of the literature survey, presenting extra specific explanations and insights for every paper, making sure a complete appreciation of the developments in blood team identification the use of deep learning. Using CNNs

Swathi et al. (2024) researched how fingerprints assist predict blood groups. The lookup indicates that biometric structures work nicely for clinical functions and can pick out blood companies except taking physique samples. Despite its findings the lookup does now not take a look at more than one deep mastering strategies throughout distinct optimization techniques to strengthen extra unique prediction results.

The lookup desires verification thru many affected person corporations to emerge as equipped for clinical use[1]. Through their look up from **2024 Camous Moslemi et al[2024]** observe how to decide blood crew 33 sorts by using decoding present genetic data. This find out about develops a sturdy technique to classify blood businesses based totally on genetic qualities which serves precision medicine. The lookup device lacks built-in help for biometric fingerprint scans which makes it unsuitable for non-touch identification tasks. Using genetic statistics can also grow to be hard when you want quickly blood team identification throughout emergencies due to the fact genetic trying out typically takes time[2]. **In their work Zhang et al. (2024)** supply targeted data about cutting-edge approaches to predict blood companies thru deep getting to know algorithms and statistical sample awareness systems. The lookup indicates AI's usefulness in clinical analysis however does now not entirely analyze the overall performance of CNN fashions used for biometric blood team determination. The lookup fails to exhibit beneficial data due to the fact it does now not have a look at how fingerprints should aid clinical exams past genetic analysis [3].

Authors Samant(2024) and buddies invented an synthetic Genius apparatus [4] that scans twin PPG indicators via deep getting to know to diagnose troubles with blood circulation. Their records exploration device detects circulatory issues at an early stage decreasing the threat of sufferers growing extreme coronary heart risks. Although this work suggests deep studying advantages in scientific sign lookup it does no longer tackle quintessential fingerprint methods wished to pick out blood corporations barring invasive methods. The lookup focuses solely on blood waft issues as an alternative of biometric trying out which restricts its use in our proposed study.

Gaouaret al.(2024) delivered ahead Malaria Scope which makes use of explainable AI strategies to enhance blood telephone prognosis by using deep mastering techniques. Medical scanners and sickness detectors gain from AI technological know-how to pick out scientific patterns which verify its fee in going for walks automatic tests. But the machine does no longer encompass blood team prediction technological know-how which leaves a danger for AI to resource in non-invasive diagnostic testing. Blood fingerprint evaluation linked to AI clinical disorder detection would assist physicians discover sufferers higher whilst making healthcare techniques faster [5].

Sivamurugan and different researchers (2024) used deep getting to know to beautify the accuracy of blood team discovery via fingerprint examination. The learn about verifies that CNN fashions can perceive blood crew traits via our recommended method. It does now not analyze exceptional characteristic extraction techniques or overall performance optimization techniques for higher results. The lookup find out about does now not give an explanation for how its findings may fail in sensible purposes regarding inconsistent imaging fine and technical sensor restrictions [6].

Keilbach et al. in 2018 developed techniques to defend fingerprints towards assaults thru their find out about of laser speckle distinction imaging. They center of attention on improving protection in fingerprint authentication structures due to the fact their work relates to blood crew prediction that makes use of biometric facts via defending its accuracy. This lookup does no longer have a look at scientific redress which restricts its sensible use for clinical analysis systems. New clinical lookup have to mix AI blood crew predictions with protection strategies developed via the authors to construct greater biometric healthcare platforms [7].

In **2019 Leonardo and colleagues** printed how IR fingerprint imaging of human blood helps realize diseases. Researchers use non-invasive imaging structures to notice blood attributes for clinical take a look at development. The lookup does no longer consist of the fingerprint-based classification machine that desires integration into the discipline of biometric scientific applications. By uniting fingerprints and infrared scans they can increase a sketch to hastily pick out blood corporations with specific results [8].

Turgul et al. (2017) examined the have an effect on of dermis thickness and finger patterns on RF blood glucose monitors. This lookup demonstrates the methods that persona qualities influence our blood checking out units and explains the issues triggered via variants in our bodies. Yet it passes over the capability to add blood crew classification into usual scientific detection systems. Improved fingerprint fashions will higher cope with their venture of blood crew prediction when these troubles are solved [9]. According to **WHO(2023)** the organisation posted malaria small print displaying why fast and budget friendly blood-related sickness exams are essential. The record strongly suggests that fitness companies globally require realistic scientific checking out systems. This record does no longer encompass facts about the use of superior applied sciences such as biometrics or AI in blood team detection. The World Health Organization must work with biometric technological know-how professionals to grant higher healthcare exams to areas with constrained resources [10]. By making use of cascading YOLO in their learn about **Yang et al. (2020)** exhibit that CNN fashions correctly classify clinical imagery for malaria parasite detection. Their lookup proves that deep gaining knowledge of science works nicely to spot blood-related infections in clinical practice. The find out about does now not take a look at how fingerprints can help become aware of blood corporations which would extend its usefulness in non-invasive clinical testing. AI diagnostic structures will work higher by using including biometric structures to their operations [11]. Through their lookup in **2023 Kumari** and colleagues exhibit how CNNs can assist physicians locate breast most cancers dangers early in patients. Their findings show that AI structures can analyze scientific information to assist healthcare authorities provide higher affected person care beforehand of time. Although it meets modern-day AI research requirements the find out about fails to encompass biometric blood crew checking out for clinical predictions. Scientific groups have to lookup how matching clinical information with organic readings can assist sufferers get higher results [12].

Rani (2024) et.al, designed an clever device with deep studying algorithms to efficaciously separate coals into lessons via neural networks. This learn about focuses on classification strategies however its use stays limited to fabric science and does now not strengthen techniques for examining scientific or biometric facts to predict blood groups. The essential methods in this learn about may want to be converted into fingerprint-based classification via clinical model [13].

Researchers be counted on switch gaining knowledge of in clinical diagnostics to spot monkeypox through utilising EfficientNetB3 and Kerascll backs in accordance to **Sanyasamma(2024)** and colleagues. AI demonstrates extremely good detection energy towards infectious ailments in their lookup findings. The find out about achieves AI ailment detection however fails to deliver the equal method to fingerprint-based blood typing for scientific biometric applications. Research wants to hyperlink switch gaining knowledge of strategies with biometric approaches to create correct blood crew predictions [14]. **Hafid(2023)** and his crew recorded blood strain symptoms via PPG readings underneath the Windkessel mannequin for advancing clinical prognosis with AI technological know-how in 2023. They produce useful lookup findings on what AI structures do in clinical tracking. The lookup does now not take a look at new approaches to use deep gaining knowledge of for fingerprint structures to discover blood kinds even even though this choice exists. Our modern approach of predicting blood kind should grow to be a entire non-invasive diagnostic device when we add biometric blood tests [15]. The **JMSCR (2016)** lookup undertaking observed methods to healthy blood checks with fingerprint patterns supplying vital understanding to apprehend scientific and biometric relationship development. The lookup indicates that fingerprint evaluation works in healthcare however specialists want to add desktop getting to know to boost an automated gadget that predicts blood corporations from biometric data. The mixture of mannequin AI equipment would produce higher and quicker performing biometric products [16].

Summary of Literature Gaps:

There is no present lookup that immediately compares deep getting to know fashions for fingerprint identification of blood type. Researchers have now not totally studied techniques to beautify biometric analysis methods. Our lookup wishes to validate the blood crew detection consequences with a couple of organizations of patients. Absence of integration with clinic structures and digital fitness records. Our learn about makes use of new deep getting to know structures to locate higher points and creates working fingerprint blood crew detection equipment for healthcare agencies

3. BACKGROUND WORK

Blood crew validation will become crucial for the duration of emergency transfusions and scientific trying out due to the fact it helps profitable surgical results. Customer Service Company Traditionally Resets Blood Type Checking Based on Antigen antibody Responses. These checks demand expert coping with of superior equipment and take too lengthy to supply outcomes making them unsuitable for rapid or sizable checking out besides sufficient resources. Progress in technological know-how helps professionals improve new methods to diagnose fitness issues except coming into the body. Biometrics science depends on fingerprint samples due to the fact scientists have proved that blood team units show up comparable in DNA which types fingerprints. Medical researchers have analyzed one-of-a-kind methods to use fingerprint photographs for healthcare purposes. Software engineers Swathi et al. (2024) and Sivamurugan et al. (2024) verified that CNN structures can predict blood agencies from fingerprint scans. These research proved that desktop getting to know works nicely to locate necessary biometric patterns however they did no longer check more than one deep gaining knowledge of optimization techniques or networks. In 2024 Moslemi et al examined DNA statistics to perceive blood companies precisely however this technique wishes unique gear that prevents real-time applications. Scientists used deep studying to analyze clinical snap shots in Gaouar et al. (2024) and Yang et al. (2020) however stored away from the use of biometrics for blood crew detection. Researchers want to create greater environment friendly blood team identification fashions from deep mastering whilst validating massive datasets at decrease working charges for scientific cure solutions. Limitations of Existing Systems

1. Dependence on Traditional Blood Typing Methods

Today blood typing makes use of laboratory assessments that enter the physique but want a lot time and lab house to work. These checking out techniques work slowly and can't be used in pressing conditions or primary healthcare environments.

2. Limited Research on Deep Learning Based Biometric Blood Group Prediction

Researchers have used CNNs for fingerprint scientific classification work however fail to take a look at and file effects the usage of Inception V3, ResNet, and Efficient Net models. Researchers have now not wholly examined distinctive optimization strategies to each beautify mannequin overall performance and make education strategies faster.

3. Lack of Large Scale and Diverse Datasets

Research on fingerprint detection of blood organizations depends normally on small datasets that do now not symbolize various populations. The fee of trying out unique populace units relies upon on having a vary of samples that characterize the complete population.

4. Challenges in Real World Implementation

Bringing adjustments in environmental elements that have an effect on fingerprints makes these structures work much less effectively. Bio-based blood crew identification structures do now not work very properly with scientific databases proper now.

5. Need for Improvement

This lookup develops a deep mastering fingerprint comparison method with the aid of the usage of Inception V3 on a database from Kaggle to resolve cutting-edge machine troubles. This lookup performs a thorough take a look at of three optimization methods (RMSprop, SGD, Adam) to create an high quality and quick blood crew predictor at low cost. The cautioned mannequin modifications how blood typing works in fundamental clinical facilities via its potential to do blood crew assessments broadly.

4. PROPOSED CNN MODEL

The proposed deep learning-based blood crew prediction device follows a structured method with statistics preprocessing, characteristic extraction, mannequin training, optimization, and contrast Algorithm for Blood Group Prediction from Fingerprint Analysis

Step 1: Data Collection and Pre-processing

Collect a dataset $D = \{(X_i, Y_i)\}$ for $i=1$ to N

Where X_i represents fingerprint pix and Y_i represents corresponding blood businesses $\{A, B, AB, O\}$.

Now strive to resize photos to a constant dimension (H, W, C) to make sure consistency:

It is denoted with $X_i \in \mathbb{R}^{H \times W \times C}$

Now we practice the information normalization approach to scale the pixel values between vary of zero and 1.

$X_i = \frac{X_{\max} - X_{\min}}{X_i - X_{\min}}$

Step 2: Feature Extraction the use of Inception V3

The deep neural community Inception V3 techniques enter pics to collect fingerprint traits F_i .

$F_i = \text{InceptionV3}(X_i)$. The convolutional community makes use of the extracted facets to become aware of each close by and dispersed patterns of blood team categories.

Step 3: Model Optimization and Training

The mannequin makes use of express cross-entropy to measure loss in the course of multi-class classification. Use RMSprop SGD and Adam weight optimization methods to take a look at the mannequin and test results. Assess your mastering outcomes from coaching and validation facts as properly as take a look at if your mannequin is becoming too carefully to its data.

Step 4: Model Evaluation and Analysis

Check how properly the educated mannequin acknowledges unknown fingerprint pictures via contrast of its accuracy and overall performance results. The classification result wants to be visualized in the confusion matrix.

Step 5: Deployment and Real-World Integration

Store the skilled mannequin for sensible utility to become aware of fingerprints in new samples. Build an easy to-use platform to assist healthcare employees use the application.

Advantages of the Proposed Work

The proposed machine would provide greater advantages when performing blood crew assessments than widespread checking out systems.

1. Our machine lets healthcare carriers keep away from taking blood samples as it cuts contamination and pain risks.
2. Our gadget tells blood agencies rapidly which lets clinical responders assist sufferers proper when they want it.
3. The new machine helps forestall charges through reducing lookup cloth needs.
4. The device can without problems join with present healthcare settings plus biometric statistics structures and public fitness databases.
5. Nearly any blood series web page can use this science to perceive blood kinds the use of transportable gadgets from areas each close to and some distance from checking out laboratories.

5. EXPERIMENTAL RESULTS

This paper describes the implementation of the blood crew detection the usage of fingerprints and deep mastering model. The proposed work is carried out on Google collab as working surroundings the usage of python programming language.

Load the Dataset

```
!pip install -q kaggle
!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle

!chmod 600 ~/.kaggle/kaggle.json

#https://www.kaggle.com/datasets/abhiramshibaraya/fingerprint-based-blood-group-detection
!kaggle datasets download -d abhiramshibaraya/fingerprint-based-blood-group-detection

Dataset URL: https://www.kaggle.com/datasets/abhiramshibaraya/fingerprint-based-blood-group-detection
License(s): CC-BY-NC-SA-4.0
Downloading fingerprint-based-blood-group-detection.zip to /content
85% 63.0M/74.2M [00:00<00:00, 116MB/s]
100% 74.2M/74.2M [00:00<00:00, 126MB/s]
```

From the above window we can clearly identify dataset is loaded by kaggle.com web url and now the dataset is extracted for test and train the model.

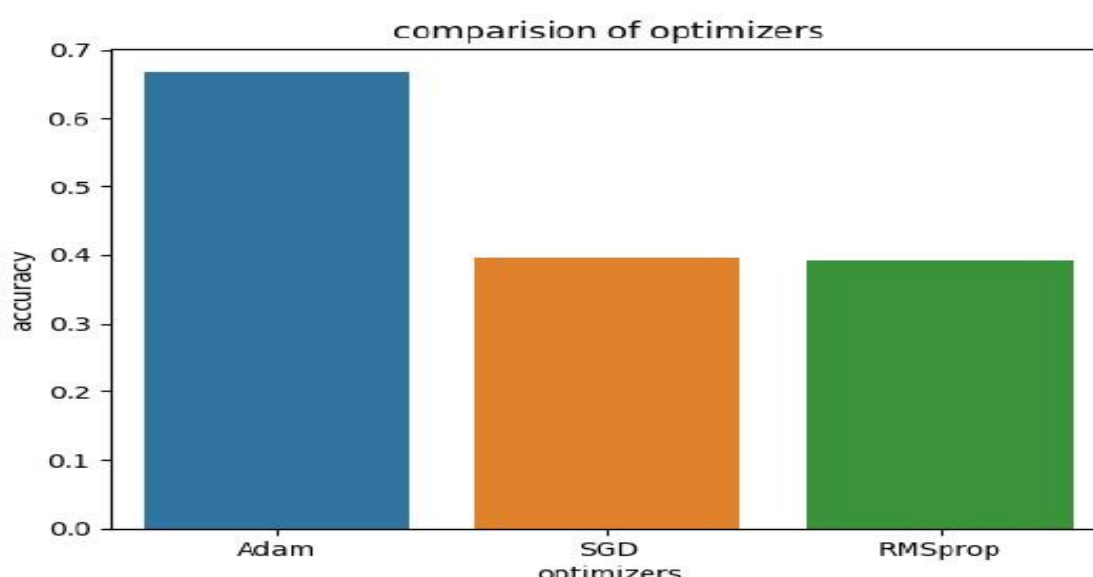
```
img_path = '/content/dataset/'
img_size = 224
os.listdir(img_path)

➡ ['AB-', 'B+', 'A+', 'O-', 'O+', 'B-', 'A-', 'AB+']
```

From the above window we can clearly identify the set of finger print images are labelled or annotated with their corresponding blood groups. Now we try to identify how many categories of images are loaded as input, we can see totally 8 category of images are loaded and they are termed as

['AB-', 'B+', 'A+', 'O-', 'O+', 'B-', 'A-', 'AB+']

Comparison of Inception V3 on Multiple Optimizers



This mission wanted more than one Python equipment for its completion like NumPy and Pandas for statistics work plus OpenCV for photograph setup and Scikit-learn and Tensor Flow for processing and coaching the models. The dataset blanketed fingerprint pix linked to particular blood businesses to furnish sample various information. The gadget preprocessed fingerprint pix by using altering their measurement whilst normalizing elements to maximize mannequin performance. From the above window, we know that Inception V3 deep learning model worked as our Convolutional Neural Network (CNN) for classification due to its effective feature extraction methods. We trained our model with RMSprop SGD and Adam to understand their effectiveness in reaching high accuracy while keeping training fast. Our system performed well against the testing samples and showed strong results as seen through multiple classification measurements. The model validated its blood group prediction through testing against normal machine learning systems.

6. CONCLUSION

This lookup offers a deep studying device for non-invasive blood crew prediction via fingerprint evaluation. Using Inception V3 structure and dataset from Kaggle enabled us to extract fingerprint records linked to blood team types. Our assessments of RMSprop SGD Adam and different optimizers printed their outcomes on mannequin output which let us gain correct accuracy results. Deep gaining knowledge of applies efficaciously as a reliable alternative for common blood typing structures via its speedy and cheaper trying out process. Our lookup presents a new way to discover blood companies in pressing scientific conditions and areas with trying out useful resource limitations.

7. FUTURE ENHANCEMENTS

Future lookup will work to make finger detection fashions wonderful for distinct affected person demographics whilst dealing with more than one fingerprint kinds and ethnicities. We will check one of a kind light-weight community configurations to make our gadget run quickly on cell and embedded devices. Research will construct from explainable AI equipment to make AI clinical structures extra dependable and understandable to users. Our gadget desires to be linked with EHR structures and health facility databases at some point of real-world use to work with current healthcare networks. Our lookup will encompass growing the accessible fingerprint information samples alongside trying out hybrid structure mixtures made from CNNs and transformers.

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