Team - CU WARRIOR

Cardiac Radiographic Diagnostic Tool

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Code for our AI Model

https://colab.research.google.com/drive/18sWrwISWw_-UY6X0TFACCfibjdMadJ2I?usp=share_link

Abstract

CVD is a major cause of death globally, necessitating early detection for effective treatment. X-ray imaging is commonly used, but interpretation can be challenging.

- We propose a novel strategy that can increase the precision and effectiveness of medical diagnostics is an **AI-powered medical imaging tool** that can analyse chest X-rays and forecast ailments. This application uses machine learning algorithms to rapidly and correctly assess a variety of medical data, including chest X-rays, and offer insights that can assist medical professionals in making better decisions.
- The machine learning approach is capable of detecting **14 different cardiovascular or chest related diseases** like emphysema, cardiomegaly, pneumonia based on feature extracted from Xrays.
- The proposed model sets a benchmark by achieving an accuracy of **92%** in cardiomegaly and **83%** in emphysema detection.

In summary, our proposed method offers a promising solution for automatic detection of CVD, enabling early diagnosis and effective treatment.

Problem Statement

- Junior doctors with less education and experience are frequently given the responsibility of diagnosing and treating patients in numerous healthcare settings. In complicated conditions like cardiovascular illness, this might result in incorrect diagnosis and inadequate treatment.
- X-ray interpretation frequently calls for specialist knowledge and training, especially when it comes to complicated medical diseases like cardiovascular disease. Unfortunately, patients might not always have access to knowledgeable staff or be able to comprehend complicated medical lingo, which could cause misunderstanding and result in a mistake.
- Particularly in locations with low healthcare resources or where experts are hard to come by, patients might not always have access to a second opinion from a specialist. Delays in therapy as well as missing or inaccurate diagnosis may come from this.
- There may not be adequate control or responsibility for the standard of treatment delivered by clinicians in various healthcare settings. Patients may also suffer injury as a result, which can result in inadequate diagnosis and treatments.

Why this Idea?

Cardiovascular diseases refers to the diseases that are related to heart. Sadly, the failure to accurately anticipate CVDs and chest diseases at an early stage contributes to a large number of fatalities. **Both efficient health status surveillance and precise prediction techniques are lacking.**

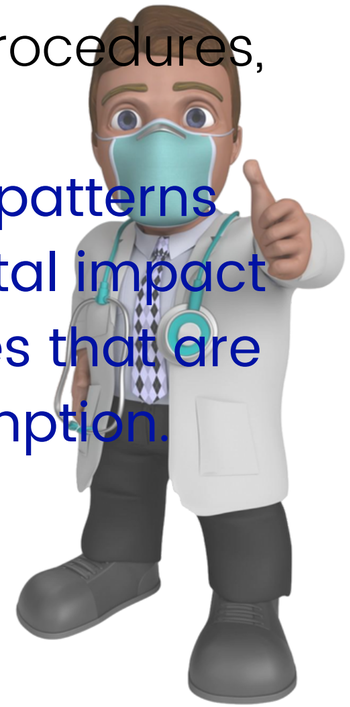
Fortunately, there are many projects that have been launched to address this issue, such as the euHeart Project, which is developing a patient-specific cardiovascular modeling framework, the Cardiome Project, and the Physiome Project.

Even after such advancements no project is able to solve the issues of lack of knowledge of x rays or shortage of radiologists. The proposed solution aims to solves all the problems by not only making the usage accessible but also detects variety of diseases with much better accuracy

However, the existing solution only applies on gold standard machines and the doctor opinion is considered as the last and final opinion.

A step towards sustainable healthcare

- By providing a more accurate and efficient way to diagnose cardiovascular disease (CVD), your model can help reduce the number of unnecessary tests and procedures that are performed. This can lead to a reduction in medical waste and energy consumption, which can help make healthcare more sustainable.
- By improving patient outcomes and reducing healthcare costs, your model can help create a more sustainable healthcare system. When patients receive more accurate diagnoses and treatments, they are less likely to require additional tests or procedures, which can help reduce healthcare costs.
- By using machine learning algorithms to analyze chest x-rays and identify patterns that are associated with CVD, your model can help reduce the environmental impact of healthcare. By reducing the number of unnecessary tests and procedures that are performed, your model can help reduce medical waste and energy consumption.



Proposed System Model

1

DATA COLLECTION

The first step is to gather a large dataset of chest X-rays. to identify various patterns

2

PRE PROCESSING

Preprocessing helps to reduce the noise in the images and makes the model to recognise patterns.

3

SPLITTING

Create training, validation, and testing sets from the dataset. The model will be trained using the training set.

4

ARCHITECTURE

Choose an appropriate deep learning architecture for the task. One common choice for image classification tasks like this is a CNN.

5

TRAINING

Train the model using the training set.

6

EVALUATION AND EVALUATION

Trained, evaluate its performance on the testing set. Calculate metrics like accuracy, precision, recall, and F1 score.

A brief overview of methodology used.

Approach

First, we study the patient's medical history, including their blood pressure, sugar level, systolic and diastolic pressure, and other relevant factors, using certain algorithms to predict whether the patient has any CVD-related problems.

If symptoms of CVDs are found, the patient is asked to submit an X-ray report, which our model will analyze to determine which heart disease the patient is suffering from.

Our model can predict more than five different heart diseases based on input, and we can predict even more diseases with the help of data. The most unique feature of our project is that it is cost-efficient and highly accessible.

We plan to make it available on the web and through an app, making it easy to use for everyone. With the help of this technology, we can predict CVDs at an early stage, allowing for timely treatment and potentially reducing the number of deaths caused by CVDs.

Social Impact

- The proposed approach for automatic detection of cardiovascular disease (CVD) using X-ray images has significant social impact potential. CVD is a major cause of mortality worldwide and places a significant burden on healthcare systems. **Early detection and accurate diagnosis of CVD** is crucial for effective treatment and improving patient outcomes. However, the accurate interpretation of medical images, such as X-rays, can be challenging and requires significant expertise.

- The proposed approach has the potential to address these challenges by providing an automatic and accurate method for CVD detection. This could **reduce the need for invasive procedures** and enable more timely and accurate diagnosis, improving patient outcomes and reducing healthcare costs. In addition, the proposed approach has the potential to improve access to specialized medical expertise in areas where it may be limited.

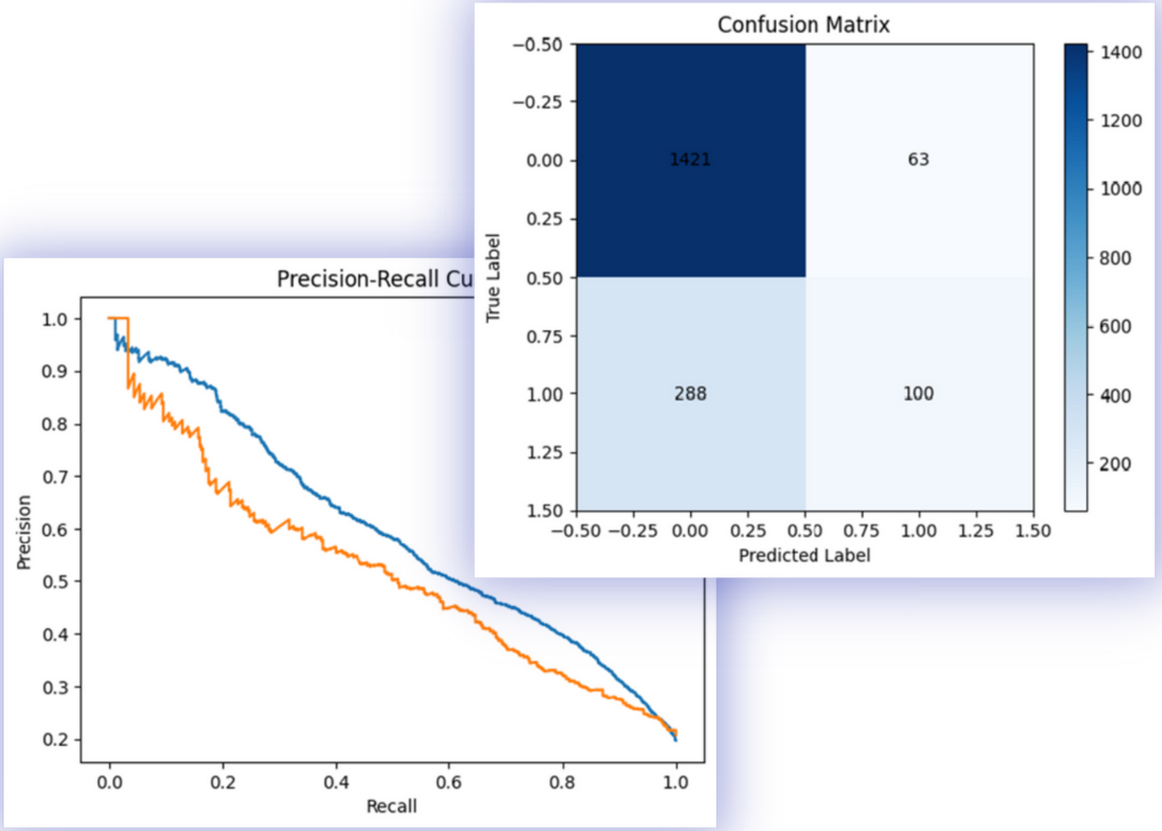
- Overall, the proposed approach is capable of being integrated into mobile application such than the X-rays that can be scanned using mobile camera at anytime and anywhere making it the most **accessible and affordable solution.**

Results Obtained

The CNN model was taught for 5 epochs with a 32-person batch size, according to the model's findings. During training, the model achieved a decreasing loss and increasing accuracy on both the training and validation sets.

Specifically, the loss decreased from 0.2146 to 0.1657, while the accuracy increased from 0.9191 to 0.9340 on the training set.

```
Epoch 1/5
293/293 [==============================] - 50s 171ms/step - loss: 0.2146 - accuracy: 0.9191 - val_loss: 0.2229 - val_accuracy: 0.9214
Epoch 2/5
293/293 [==============================] - 47s 160ms/step - loss: 0.2058 - accuracy: 0.9228 - val_loss: 0.2485 - val_accuracy: 0.9226
Epoch 3/5
293/293 [==============================] - 47s 160ms/step - loss: 0.1922 - accuracy: 0.9267 - val_loss: 0.2638 - val_accuracy: 0.9178
Epoch 4/5
293/293 [==============================] - 47s 160ms/step - loss: 0.1816 - accuracy: 0.9293 - val_loss: 0.2630 - val_accuracy: 0.9214
Epoch 5/5
293/293 [==============================] - 47s 160ms/step - loss: 0.1657 - accuracy: 0.9340 - val_loss: 0.2861 - val_accuracy: 0.9226
```



while the accuracy increased from 0.9191 to 0.9340 on the training set. On the validation set, the loss decreased from 0.2229 to 0.2861, while the accuracy increased from 0.9214 to 0.9226.

Future Scope

- **Extension to other medical imaging techniques**: In addition to CT scans, MRI, and ultrasound, AI-powered medical imaging tools may also be utilised with additional modalities than chest X-rays, which are a frequent diagnostic tool. Adding other modalities to the tool's scope can provide users a more complete view of the patient's health state.

- **Cooperation amongst medical professionals:** Radiologists, doctors, and other healthcare practitioners can utilise the AI-powered medical imaging technology as a collaboration tool. Better patient outcomes may result from this since it can increase the diagnostic procedure' accuracy and effectiveness.

- **AI algorithm development:** AI algorithms may be developed further to increase diagnosis accuracy and speed. This may be accomplished by continuously improving the algorithms and training them utilising big data and machine learning methods.

- **Usage in public health:** The tool may be used in initiatives to track illness trends and identify disease outbreaks. This might aid in enhancing public health response and surveillance leading to not only early but also faster detection and prevention of diseases

Conclusion

Cardiac radiographic Diagnostic Tool is a highly versatile medical imaging tool driven by AI that can assess chest X-rays and identify disorders has the potential to change the healthcare industry. This programme may accurately and quickly diagnose **cardiac disease** by fusing machine learning algorithms with medical data, assisting medical personnel in making defensible choices for patient treatment. The technology may be utilised in clinical trials and public health initiatives, developed to assess various kinds of medical imaging and forecast more diseases, and integrated with telemedicine systems. With any technical development, there may be ethical and legal issues to consider, such as data privacy and the precision of diagnoses. It is crucial to address these concerns and make sure that the tool is developed ethically and in accordance with moral and legal obligations. An AI-powered medical imaging tool can significantly improve patient outcomes and the healthcare industry as a whole with further research and improvement.

Ground Work

Validation from doctor
https://drive.google.com/file/d/1PU7eE5MByJYYAqQBbGzTT1or3Bt1D5bB/view?usp=sharing

Data set used

HIH chest xray dataset
https://www.kaggle.com/datasets/nih-chest-xrays/data

Framingham heart study dataset
https://www.kaggle.com/datasets/aasheesh200/framingham-heart-study-dataset