Using AI to turn a smartphone into a stethoscope - 2425MED1009			
Student Name:	CHENG Yu Ting	Project Mentor:	Prof. HO Joshua
Major:	BASc (Applied AI)	Department:	School of Biomedical Sciences

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Introduction

Atrial fibrillation (AFib) : Heart disease in atrium

Definition : Irregular & rapid heart rhythm

Potential issue : blood Clots, heart failure, stroke

Previously, AFib screening require the use of an ECG machine, which could be unwieldy and inconvenient to use.

There has also been machine learning (ML) algorithms for audio analysis for cardiovascular diseases.

We would therefore like to propose using a ML model to identify atrial fibrillation with audio information from the chest.

Audio signs of AFib include erratic, unorganized and inconsistent heart rhythm. Our model hope to capture this feature and predict AFib using a short audio track on stethoscopes as well as phones.

Method

Data used : 713 audio tracks from 60 patients

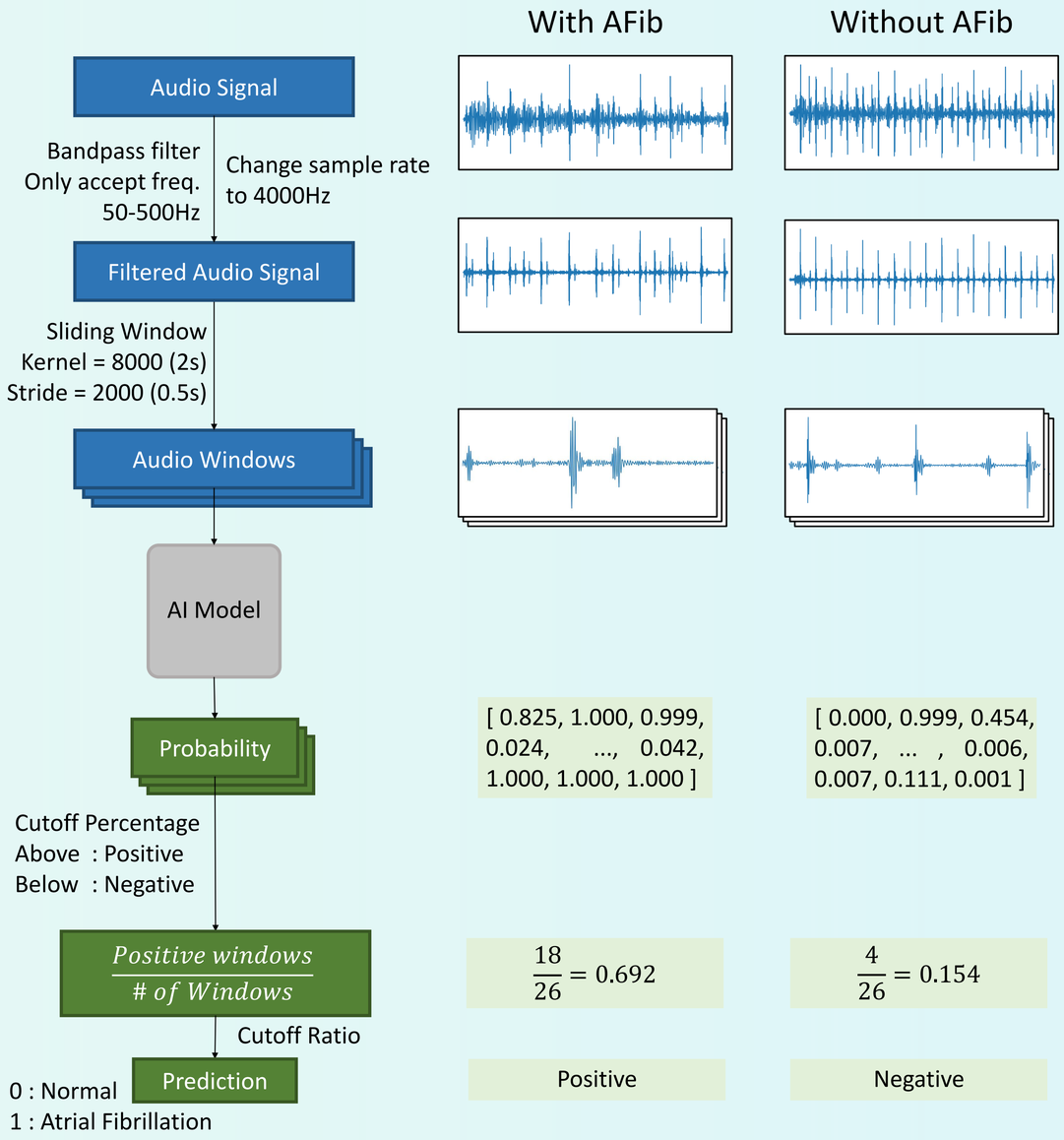
20 patients Positive for AFib

Audio from 3 different devices (Eko CORE stethoscope, iPhone, Android), on 4 auscultation positions (Aortic, Pulmonic, Tricuspid, Mitral)

48 patients' data are used for training (30 negative,18 positive)

12 are used for testing (10 negative, 2 positive)

Model : 1D CNN with ResNet Blocks, trained for 140 epochs



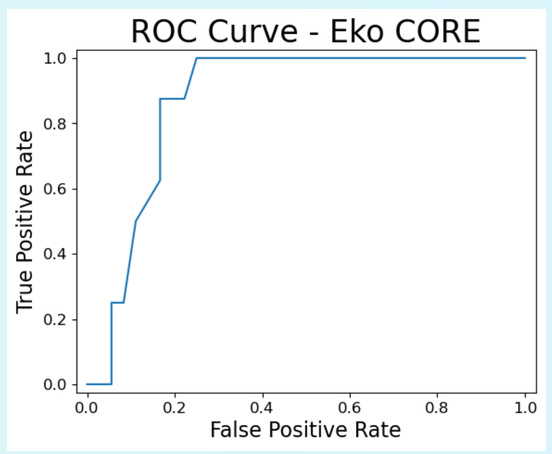
Objective

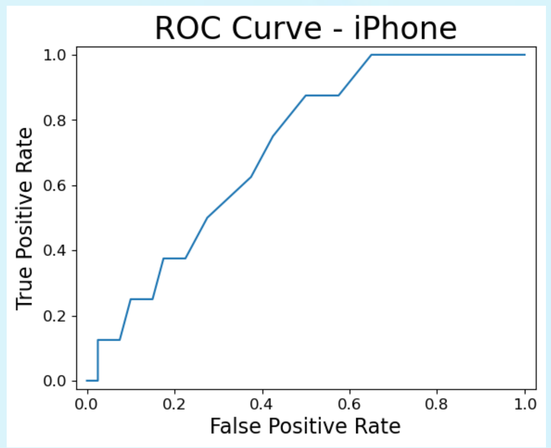
Provide a machine learning pipeline that can identify Atrial Fibrillation with audio input recorded from stethoscopes as well as smartphone microphones recording of heart sounds.

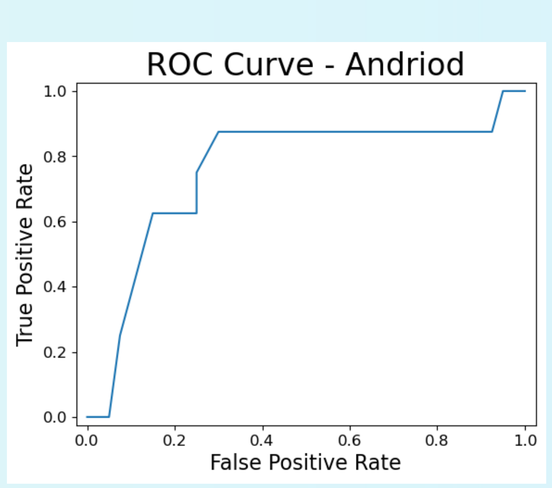
Results & Limitations

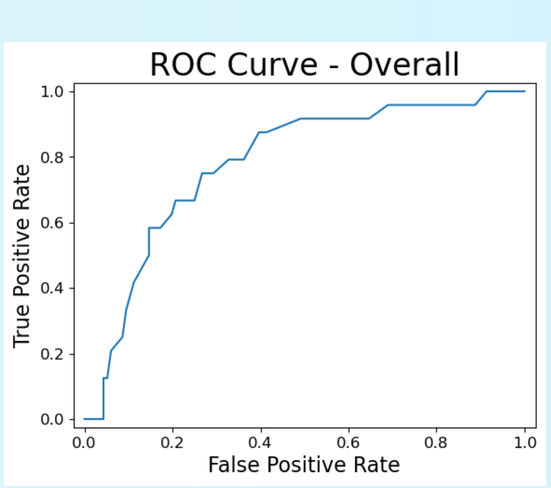
The model has achieved the following metrics

When the cutoff percentage = 0.5









ROC curves of different devices, the AUC is mentioned in the table below

Additionally, when cutoff ratio = 0.5

Device / Metric	AUC	TPR	FPR	Precision	Accuracy
Eko CORE	0.873	100.0%	36.1%	38.1%	70.5%
iPhone	0.709	62.5%	37.5%	25.0%	62.5%
Android	0.759	75.0%	25.0%	37.5%	75.0%
Overall	0.797	79.2%	28.4%	36.5%	72.9%

The model achieved encouraging results, with accuracy of around 70%. However, the false positive rate is high across all devices. The performance of iPhone surprisingly is the lowest among 3 device classes

However, all data collected are from patients who have valvular heart disease (VHD), which may lead to inaccurate results when tested with patient without VHD.

Moreover, the limited testing data may not reflect the true results of the model well. The model may not work well when new testing data is introduced.

Conclusion : Audio information can be used detect atrial fibrillation with the help of AI models. Using microphones from smartphones is also possible to detect atrial fibrillation

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