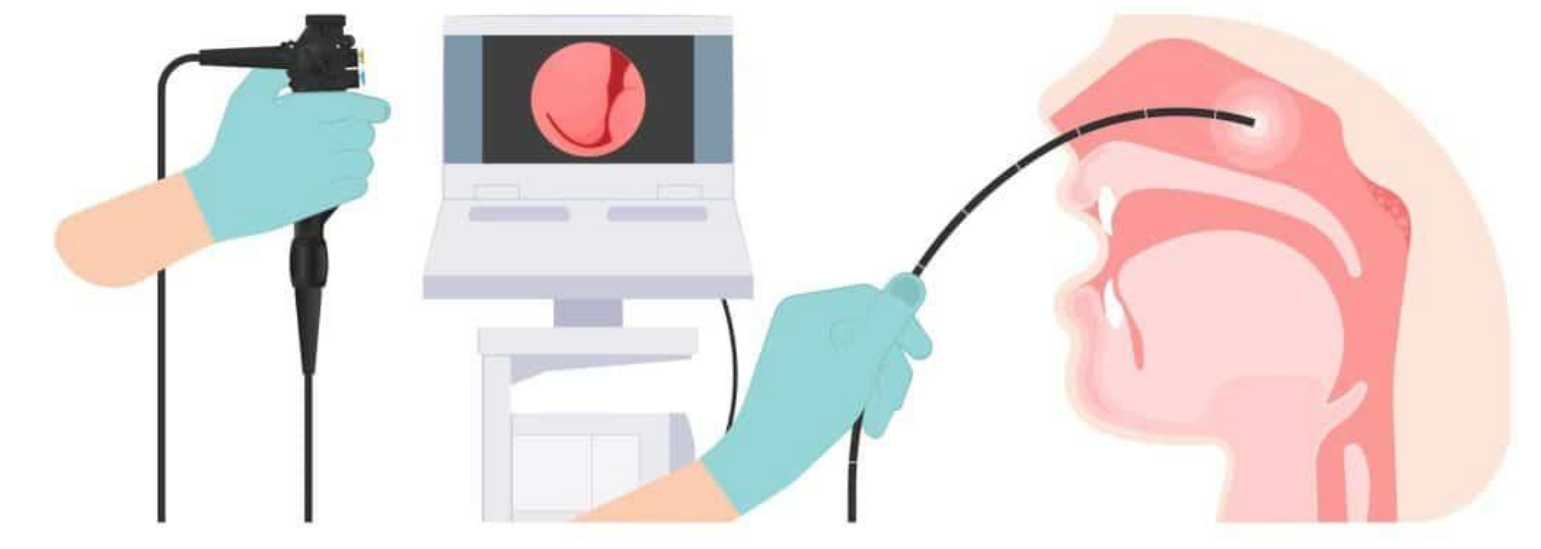




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Efficient AI-based Triage Framework for Head and Neck Cancer Screening

Sean Shao Wei LAM, SingHealth, Duke-NUS
 Yunyun, Cao, SingHealth, NUS
 Boon Yew, Ang, SingHealth, Duke-NUS
 Samuel, Altonji, Duke Health System
 Marcus Eng Hock ONG, SingHealth, Duke-NUS
 Walter Tsong, Lee, Duke Health System
 Hiang Khoon, Tan, SingHealth, Duke-NUS



Introduction

- Early diagnosis of head and neck (H&N) cancers is of primary importance in reducing global health burden and patient morbidity.
- In the developing world, there is a disproportionate growth in the incidence and mortality of H&N Cancers.
- AI enhanced decision support system (DSS) would enable personnel in low and middle-income countries (LMICs) to effectively screen, triage and refer diseases of the head and neck for advanced care at specialized centers.

Aims

Develop an AI-based decision support system to enable health workers in low resource settings to triage patients more accurately for laryngeal and other head and neck cancer (HNCs) and refer patients to medical facilities for further evaluation

Data and Methods

Data and Image Processing

- Cohort summary and analysis
- Image extraction and reshaping using Python

Predictive Framework

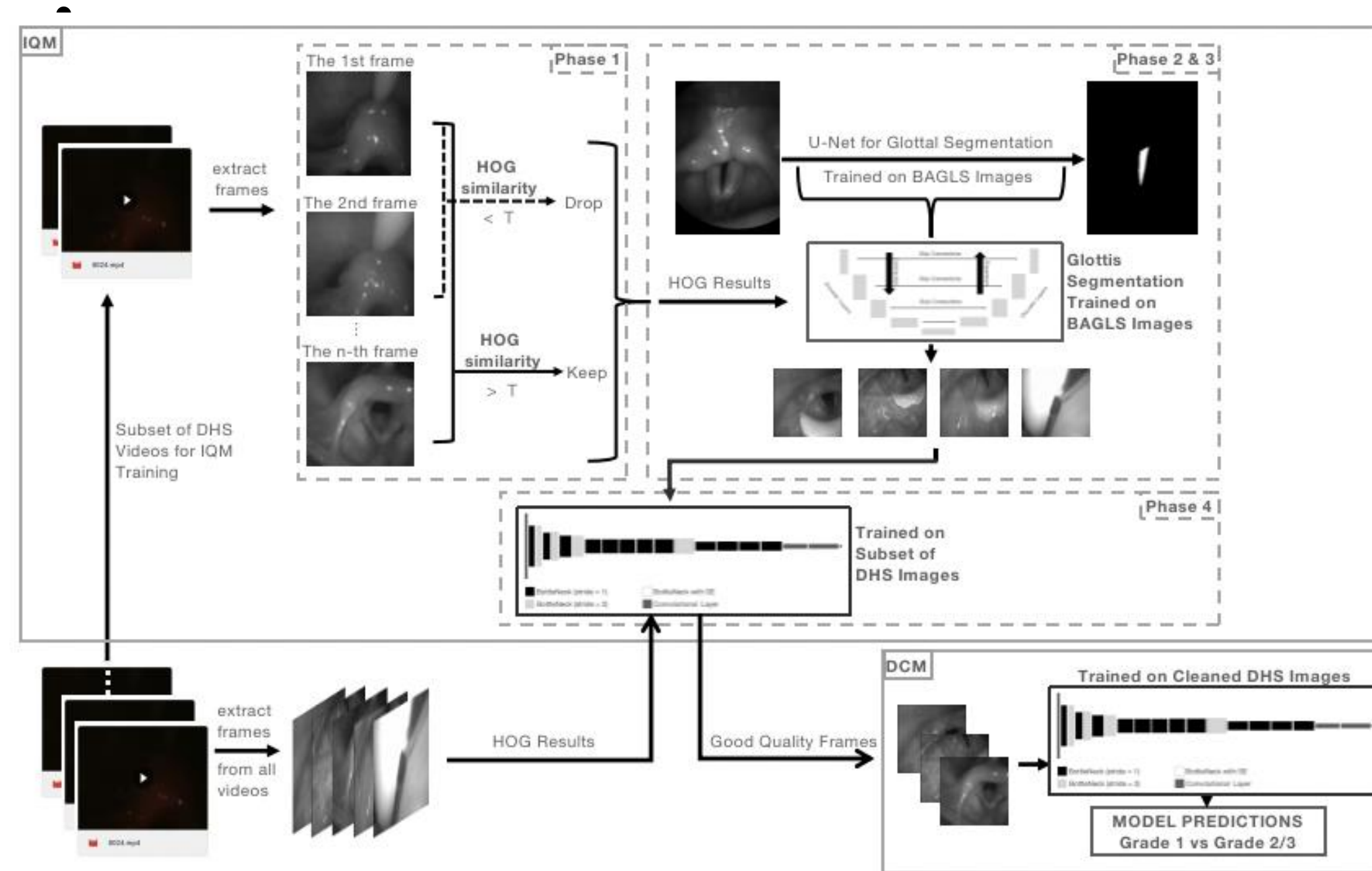
- Image quality module (IQM) development
- Disease classification module (DCM) development
- Evaluating against metrics

Validation and Interpretation

- Validation of the quality of input images
- Model explainer built upon Gradient class activation maps (GradCam)

Datasets

- The Benchmark for Automatic Glottis Segmentation (BAGLS) dataset[1] – 559 videos (59,250 frames)
- Duke University Health System (DHS) Cohort – 132 videos (190,978 frames)



IQM Model

- UNet for Glottal Segmentation and automatic labelling
- Manual checking of quality labels
- CNN, ResNet50, GhostNet[2] for quality detection

DCM Model

- 116 patients with 20,040 good quality frames
- CNN, ResNet50, MobileNetV2, GhostNet for classification of referral vs non-referral

Technology Stack



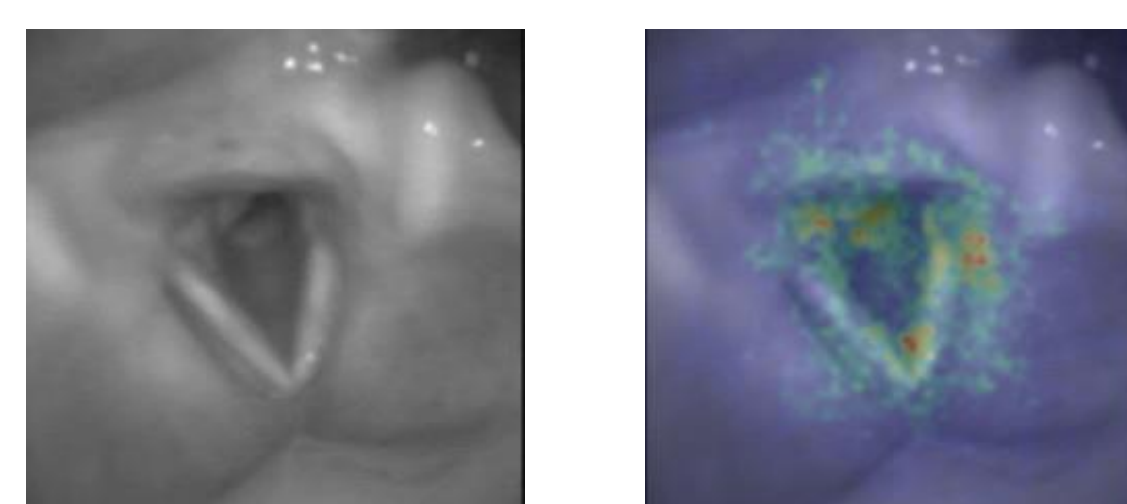
Results

IQM Classification Results

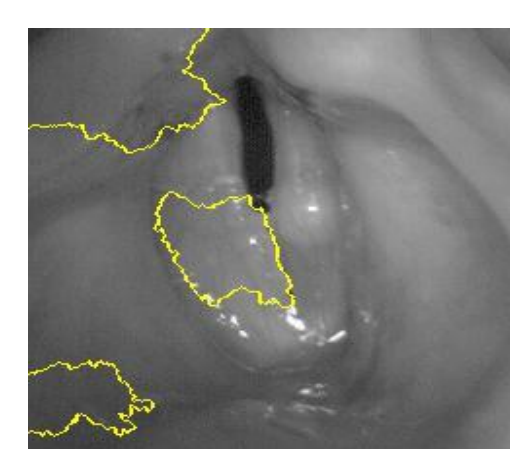
Model	Accuracy	F1-score	AU_ROC	AU_PRC	FLOPS
CNN	0.699	0.673	0.724	0.729	50.0G
ResNet50	0.833	0.832	0.746	0.957	245.0G
GhostNet	0.829	0.827	0.895	0.878	8.7G

Explainer Module

Referral Grade GradCam



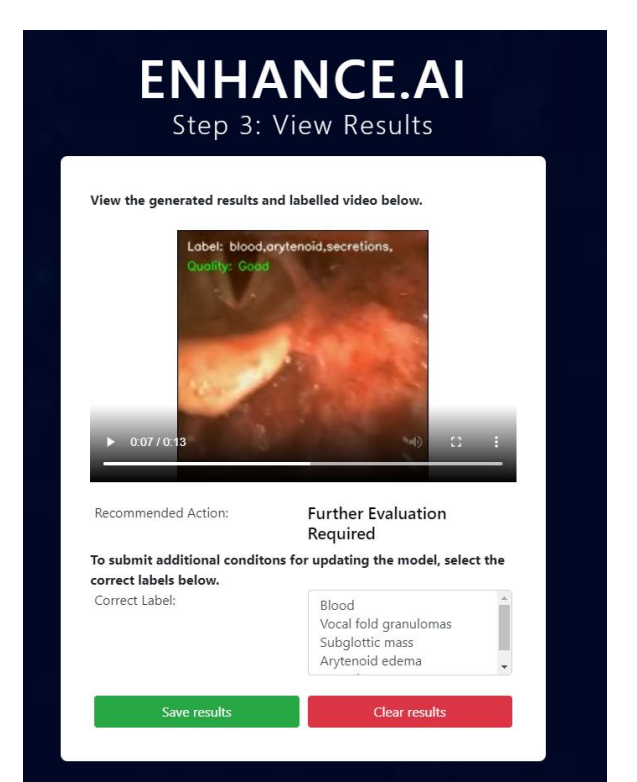
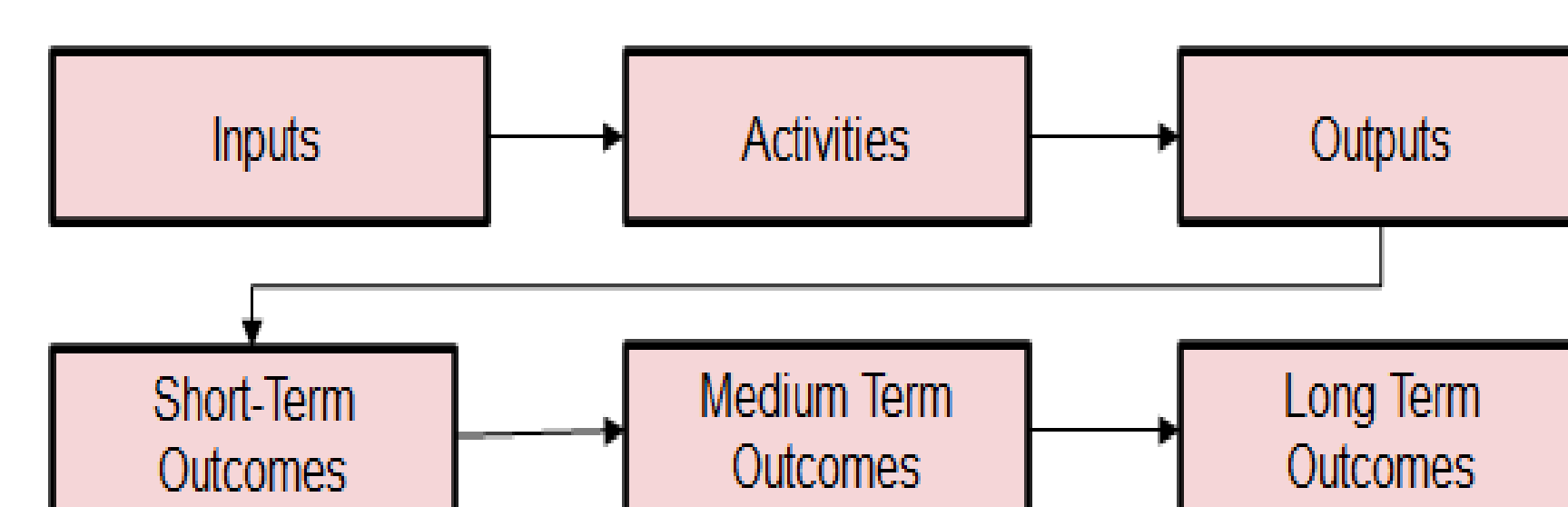
LIME



DCM Classification Results (patient-level)

Model	Accuracy	F1-score	AU_ROC	AU_PRC	Inference Time	FLOPS
CNN	0.652	0.624	0.595	0.805	8.09s	50.0G
ResNet50	0.739	0.697	0.667	0.850	16.71s	245G
MobileNetV2	0.696	0.629	0.611	0.833	8.62s	20.3G
GhostNet	0.870	0.863	0.833	0.912	7.95s	8.7G

Implementation Study



Conclusion

- Efficient AI-augmented DSS for video classification of FNS videos is demonstrated and it achieved acceptable performance.
- DSS envisioned to enable health workers in LMICs to triage patients more accurately and refer for further evaluation.

References:

1. Gómez, P. et al. BAGLS, a multihospital Benchmark for Automatic Glottis Segmentation. Sci. Data 7, 186 (2020). Søreide K et al. Br J Surg 2020;107(10):1250-1261. doi:10.1002/bjs.11670
2. Han, K. et al. GhostNet: More Features from Cheap Operations. (2019) doi:10.48550/ARXIV.1911.11907.

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