AI to Prevent Vision Loss for Millions Globally

ITU / WHO Workshop on "Artificial Intelligence for Health“
New York, Nov 14, 2018

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@arunshroff #AI4H
The Problem

Diabetic Retinopathy (DR)

A complication of diabetes that damages the retina and leads to impaired vision and vision loss.

Diabetic Retinopathy (DR) is the leading cause of blindness among working-age adults worldwide.
422 million people worldwide suffer from diabetes

- 422m ADULTS LIVING WITH DIABETES
- 148m (35%) HAVE SOME FORM OF DR
- 46m (11%) HAVE VISION-THREATENING DR

YEAR 2015

YEAR 2040

- 642m ADULTS LIVING WITH DIABETES
- (35%) 225m HAVE SOME FORM OF DR
- (11%) 64m HAVE VISION-THREATENING DR

http://www.who.int/mediacentre/factsheets/fs312/en/
Detection & Diagnosis of Diabetic Retinopathy

Eye Exam by a trained eye-care specialist using a Fundus Camera

Diagnosis by manual examination of images for DR
Shortage of Ophthalmologists

- India: 15,000 for 1.3B = 9 per million
- Somalia: 4 for 17.5M; Niger 7 for 20M; Angola: 15 for 28M

200,000 total ophthalmologists worldwide

<table>
<thead>
<tr>
<th>Ophthalmologists per Million Population</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.99</td>
<td>23</td>
</tr>
<tr>
<td>1 to 3.99</td>
<td>30</td>
</tr>
<tr>
<td>4 to 24.9</td>
<td>48</td>
</tr>
<tr>
<td>25 to 99.9</td>
<td>74</td>
</tr>
<tr>
<td>100+</td>
<td>18</td>
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</tbody>
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How AI Can Help

Diagnosis probabilities
- Mild DR (96.2 %)
- Moderate DR (2.8 %)
- Severe DR (0.7 %)
- Normal (0.3 %)

Retina Input Images from Camera

An AI Deep Learning CNN Model

Output Diagnosis with Probabilities

In 2016, Google’s DR Detection AI model had an accuracy score of 0.95 - on par/better than median of 8 ophthalmologists at 0.91

Objectives of Project

• End-to-end solution to automate DR detection
• Meet medical standards for acceptable levels of diagnostic accuracy
• Able to be deployed and used remotely
• Scalable to thousands of locations
• Comply with local laws and regulations
• Portable, low cost, easy to deploy, use, maintain
Overview of Our Solution

Cloud Based AI Server

AI Model

Image Uploaded to Cloud & Processed

Retina image capture via low-cost device or smartphone

AI Diagnosis

Clinics / Screening Kiosks

Diagnosis Report sent to patient

Remote Ophthalmologist
Verify/Validate Diagnosis

Validate images to improve model
Current Status

- Partnership with national tele-ophthalmology group
- 275 centers in 22 states
- 25,000 Patients screened / month
- 50,000 to 100,000 images screened / month
- National network of remote clinicians
- AI Trained to acceptable levels of accuracy (90% accuracy)
- Cloud based AI solution completed & in beta testing
The AI Model in Action

AI Diag Probabilities:
- Normal: 2%
- Retinopathy: 96%
- Nongradable: 1%
Challenge #1 : Accurate Data

Incorrect / Invalid Data

Low resolution
Out-of-focus Images
Challenge #2: Speed/Scalability

- Speed
- Accuracy
- Scalable
- Low Cost
- Easy to Use

Logos: PyTorch, Keras, Flask, redis, NGINX, Amazon Web Services
Challenge #3: Compliance

Standards / Benchmarking
- Acceptable accuracy levels
- Benchmark against standards - WHO - FGAI4H

Privacy / Security of Data
- Informed consent & confidentiality
- Encryption & anonymization
- Data Security

Legal / Medical Regulations:
- India: CDSCO Certification
- USA: FDA / HIPAA
- EU: EMA
Challenge #4: Remote Deployment

Fundus Camera Size & Costs

Non-portable / Desktop Models

- Costs: ~$1000 to $5000+
- Mydriatic – 30° to 45° FOV
- Clinically approved

Portable / Handheld Models

- Costs: ~$200 to $400
- Non-mydriatic – no-dilation
- Limited 30° FOV
- Needs to be clinically validated
Next Steps

• Finish beta testing & field trial of software
• Complete smartphone based imaging device
• Validate against external standard / benchmarks
• Obtain any required certifications
• Partner for collaboration in other regions
• Resources / Funding for scale-up and deployment
“We believe that it is feasible to use AI to solve the global healthcare challenge of Diabetic Retinopathy and prevent blindness for millions globally. And that would truly be AI for Global Good!”
Thank you!

Arun Shroff

www.xtend.ai

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