

Distance:  
2.3M

Move RIGHT!

Bicycle  
CART!!  
CART!!

car: 80% car: 80%

## CamVisors:

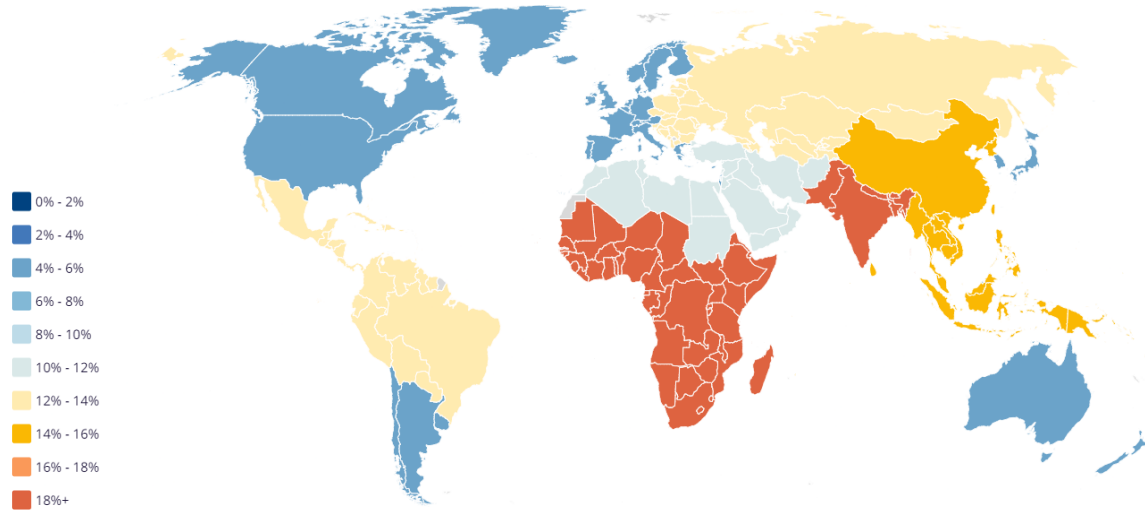
A Low-Cost Smart Glass System Utilizing Computer Vision for the Blind

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# Background

- ❖ Over **40 million** suffer from blindness worldwide
- ❖ **300 million** suffer from severe vision loss
- ❖ Mostly in developing countries in **Asia** and **Africa**

Age-std prevalence of all vision loss by GBD Super Region 2020  
(all ages, males & females)



Source: Data from VLEG/GBD 2020 model, accessed via the IAPB Vision Atlas

- ❖ White canes are **flawed** and require training
- ❖ Current innovations are **expensive** and **inaccessible**



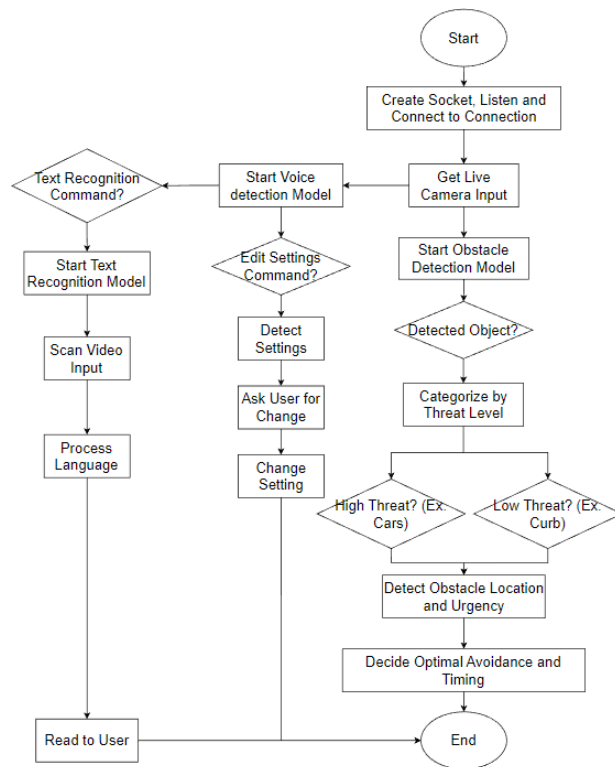
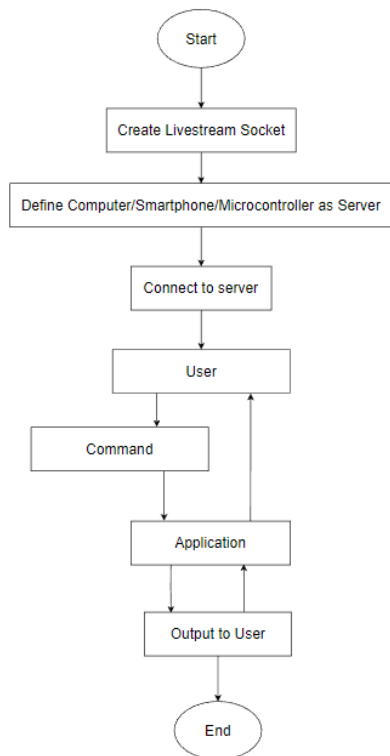
- ❖ **Computer vision-based** system
- ❖ Developed for **affordability** and **accessibility**

World Health Organization. (n.d.). World Report on vision. World Health Organization. Retrieved February 13, 2023, from <https://www.who.int/publications/i/item/9789241516570>

Kim, Dae, et al. "Travel in Adverse Winter Weather Conditions by Blind Pedestrians: Effect of Cane Tip Design on Travel on Snow." *Journal of Visual Impairment & Blindness*, vol. 110, no. 1, 2016, p. 53,

# Methodology

- ❖ **Client-Server** style architecture
- ❖ Utilize **smartphone** to run computer vision models
- ❖ **Livestream** camera to send input to server

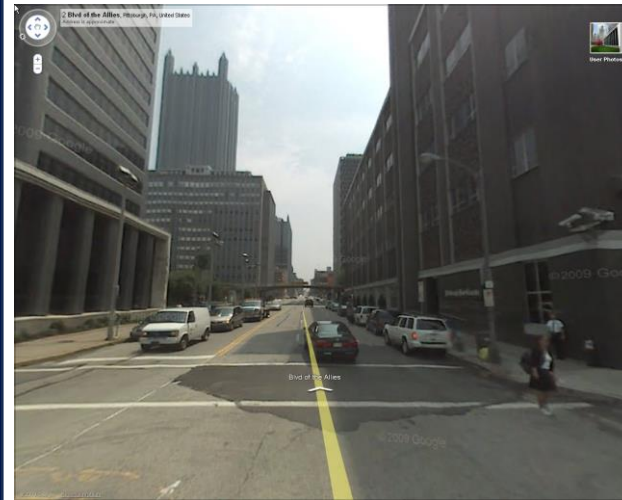
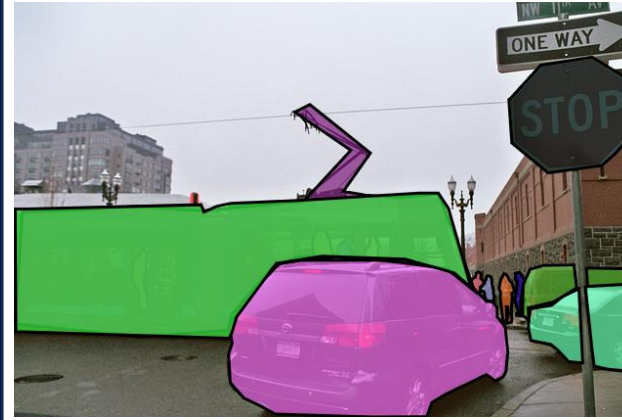


- ❖ Tested and compared **7 livestream cameras**
- ❖ Compatible with **iOS, Android**, and others
- ❖ **Localization** of models to ensure usability



# Methodology (cont.)

- ❖ Trained on **NVIDIA GTX 1660**
  - ❖ 1408 CUDA & 6 GB VRAM
- ❖ Used **TensorFlow** and **TFLite** for mobile
- ❖ Used a Google Street View **dataset** in training
- ❖ Prevented **overfitting** by training on **COCO**
- ❖ **Weighted** obstacles by danger level
- ❖ Used **OpenCV** to estimate **distance**
- ❖ **Region-based** path detection
- ❖ Calculated ideal user path through modified **Dijkstra's algorithm**



Lin, T., Maire, M., Belongie, S., Bourdev, L., Girshick, R., Hays, J., Perona, P., Ramanan, D., Zitnick, C. L., & Dollár, P. (2014). Microsoft COCO: Common Objects in Context. ArXiv. /abs/1405.0312

Amir Roshan Zamir and Mubarak Shah, "Image Geo-localization Based on Multiple Nearest Neighbor Feature Matching using Generalized Graphs", IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), 2014

# Results

- ❖ Highly accurate **object** and **distance** recognition
- ❖ **2-ounce camera** with a total cost under **\$200**
- ❖ **Compatible** with current approaches

	Samples	Percentages
Baseline	1126	
Detection Recall	1120	99.5%
Missed	6	0.5%
True Classification	1058	94.5%
False Classification	62	5.5%



All information is read to the user, these are visualizations of the models for demonstrative purposes

# Conclusion

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- ❖ The system costs **95% less** than most current computer vision-based solutions
- ❖ Accuracy over **90%** in **all models**
- ❖ **Detailed** obstacle avoidance directions, surrounding information

## Future Applications

- ❖ **Affordable**, accessible, and comfortable assistance system
- ❖ Can easily be **mass manufactured** and distributed
- ❖ Potential to impact the lives of over **40 million** blind individuals and over **300 million** visually impaired
- ❖ Add more features such as **navigation**, currency counting, and **touch-enabled** commands

Distance:  
2.3M

Move RIGHT!

# Thank You!

## References

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All images, graphs, tables, and data generated by Matthew Yao unless otherwise stated.

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