

# BAYMAX

## Hololens2-based Navigation Assistant for the Visually Impaired

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User Study & Demo Video

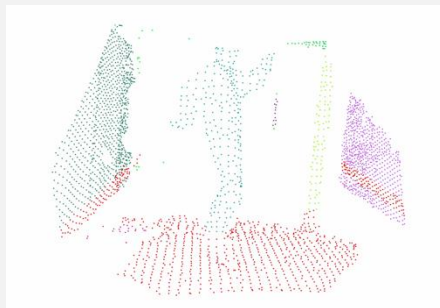
### Motivation and Contributions

With over 43 million people worldwide living with total or near-total blindness, the demand for innovative tools to **assist blind individuals in their daily life** continues to grow.

We propose a proof-of-concept **HoloLens app** to enhance spatial awareness for a blind user through scene descriptions, obstacle warnings and public transit (and walking) navigation instructions. By integrating real-time object detection, spatial audio and navigation features, our app aims to provide a **safer and more independent experience in navigating unfamiliar environments**.

### Method Overview

- **Data Streaming:** Unity app running on HoloLens, sending via hl2ss [1] app sensor data to Flask server on PC
- **Object Detection:** MobileNet [2]
- **Depth Estimation:** HoloLens longthrow sensors
- **Scene Description:** Gemini API
- **Collision Avoidance:** Floor detection (RANSAC [3]), Point cloud Clustering (DBSCAN [4])

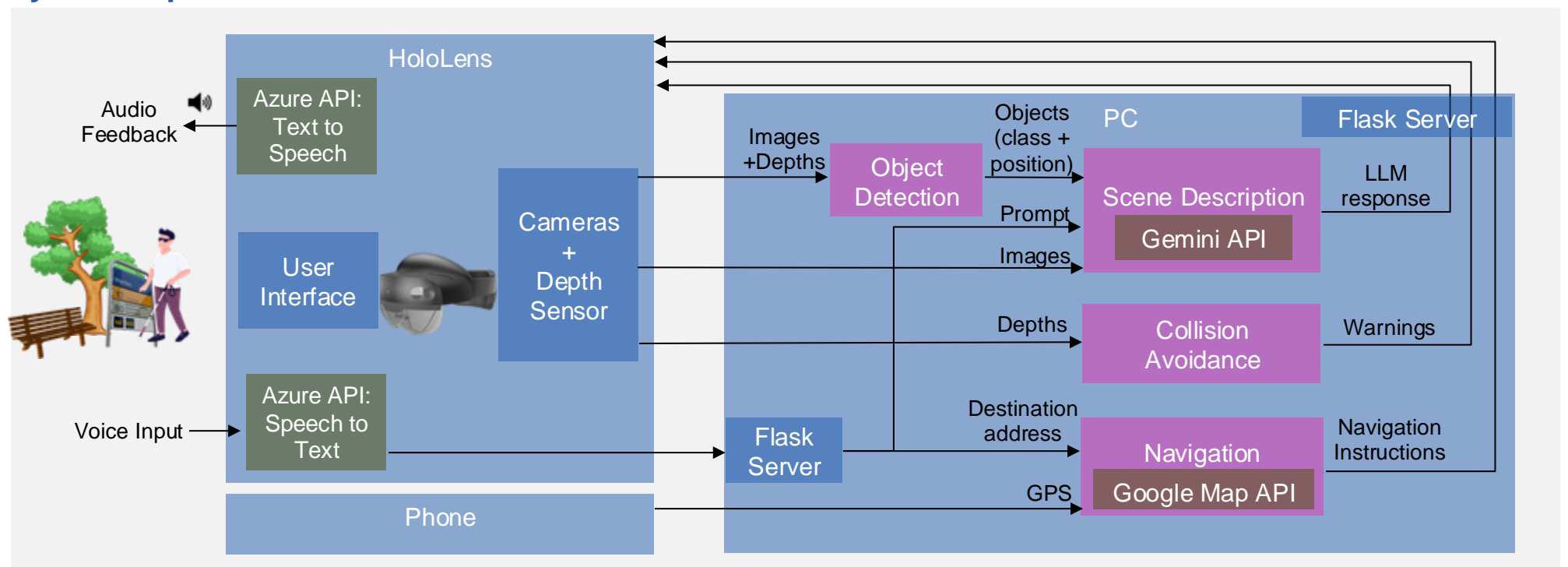


- **Navigation:** transit/walking directions by Google Maps API

### Limitations

- The image provided by HoloLens camera has **narrow view** and may have bad quality depending on the **lighting conditions**
- User voice input hard to be recognized in **noisy environments**
- **Latency** of data streaming depending on network condition
- Limited range of **reliable depth estimation** due to sensor capabilities

### System Pipeline



### References

Partner/Sponsor:



- [1] An open-source app for real-time streaming of HoloLens 2 sensor data over WiFi. <https://github.com/jdibenes/hl2ss>
- [2] Sinha D, El-Sharkawy M. Thin mobilenet: An enhanced mobilenet architecture. In 2019 IEEE 10th annual ubiquitous computing, electronics & mobile communication conference (UEMCON) 2019 Oct 10 (pp. 0280-0285). IEEE.
- [3] Bolles RC, Fischler MA. A RANSAC-based approach to model fitting and its application to finding cylinders in range data. In IJCAI 1981 Aug 24 (Vol. 1981, pp. 637-643).
- [4] Ester M, Kriegel HP, Sander J, Xu X. A density-based algorithm for discovering clusters in large spatial databases with noise. In kdd 1996 Aug 2 (Vol. 96, No. 34, pp. 226-231).

### Application

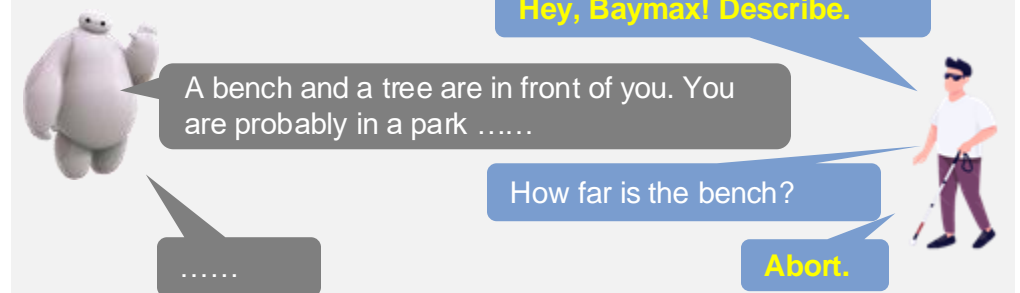
#### Welcome



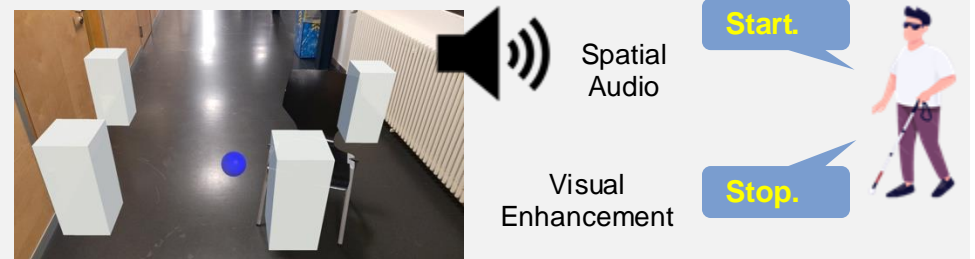
#### Text Visualization



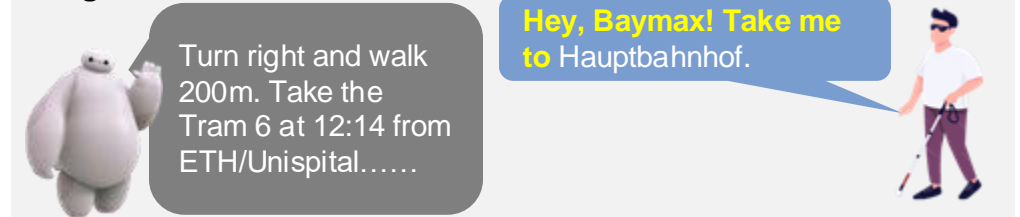
#### Scene Description



#### Collision Avoidance



#### Navigation



### Future Improvements

- **More specific path navigation** instructions
- More **user-friendly interface** for visually-impaired users (Audio introduction as the app tutorial)
- **Haptic Feedback** for more precise obstacle avoidance
- On-device processing