iRoam: A Navigation System for the Visually Impaired

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Introduction

Our sponsors at the National Federation of the Blind identified a need to help the visually impaired population a better solution to reaching their wanted destination.GPS is widely used among this population for navigation to a specified destination. However, a limitation of GPS is it is unable to further guide a visually impaired individual directly to the door of a store or a bus stop sign. Our project is currently focused on being able to bring the individual to their wanted destination with a focus on storefronts, their respective doors, as well as bus stops local to the Baltimore area

Bus Stop

The most relevant object in bus stop detection is the bus stop sign because it indicates the physical location of the bus stop and includes key information such as the route numbers and destinations of the stopping buses. We implemented an algorithm that can take any images and outputs the location of bus stops sign in the image. Using the output from the bus stop detection algorithm, the application will be able provide information about the distance and direction of the bus stop to user. In our approach, we primarily focus on detecting the new version of bus stop design in Maryland State.The three primary methods of detection is SURF, OCR, and shape and color detection.

Storefront Detection

The focus for storefront detection is to detect doors to storefronts. For this project, the detection method uses YOLOv5. Doors vary significantly between storefronts, requiring a large training set with varying images for robust performance. The variety of images included in the input dataset allowed the model to capture several common features among doors, allowing for robust detection of several doors of varying types and in varying conditions. Additionally, another class of "non-doors" was also labeled. This class represented objects that resembled doors but were not, such as rectangular-shaped objects and windows. This detection was performed under the hood in order to prevent false positive doors from being predicted by the model. A sample input image of a Starbucks storefront with labeled doors and non-doors is provided for reference

Results

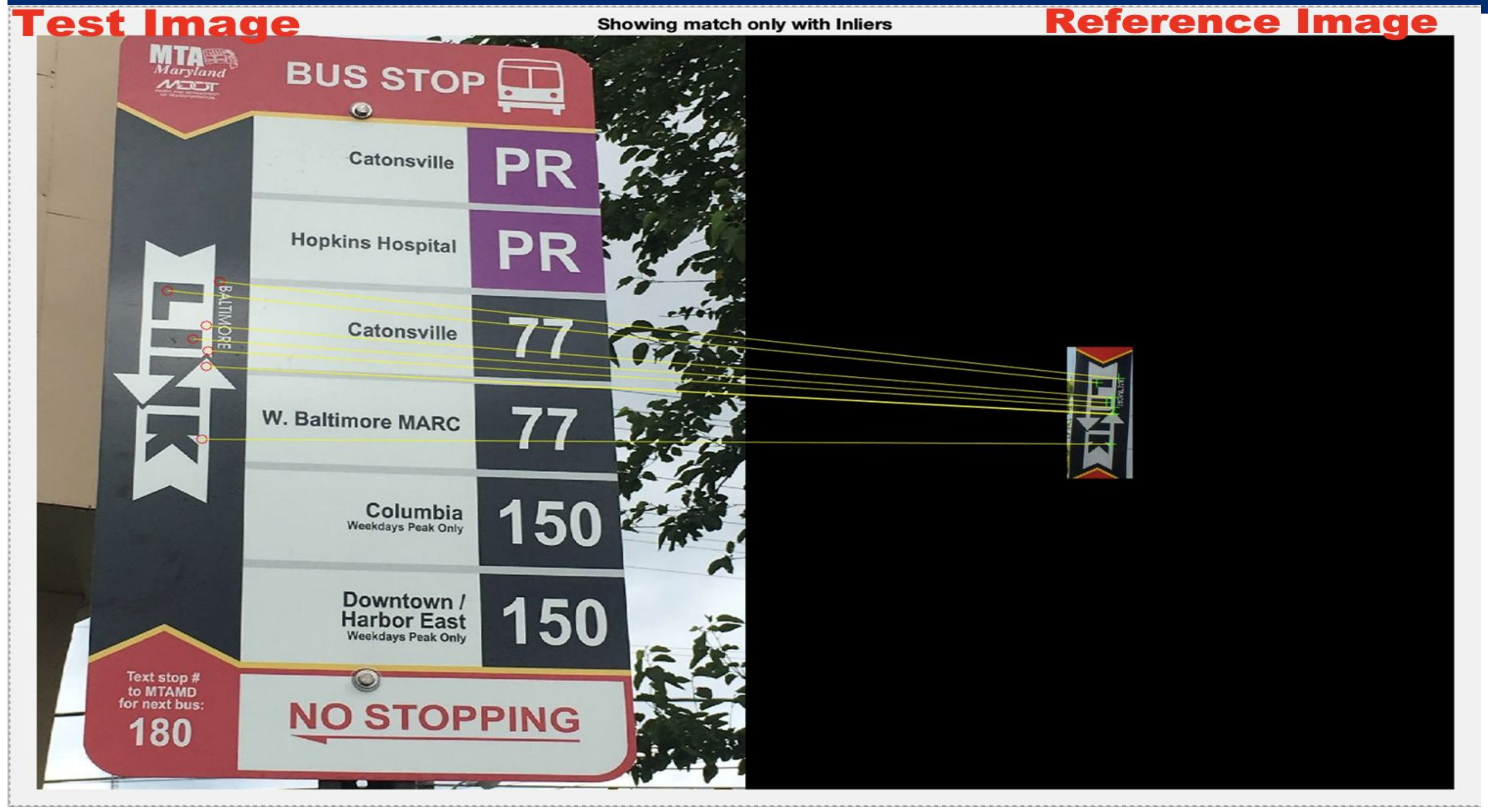
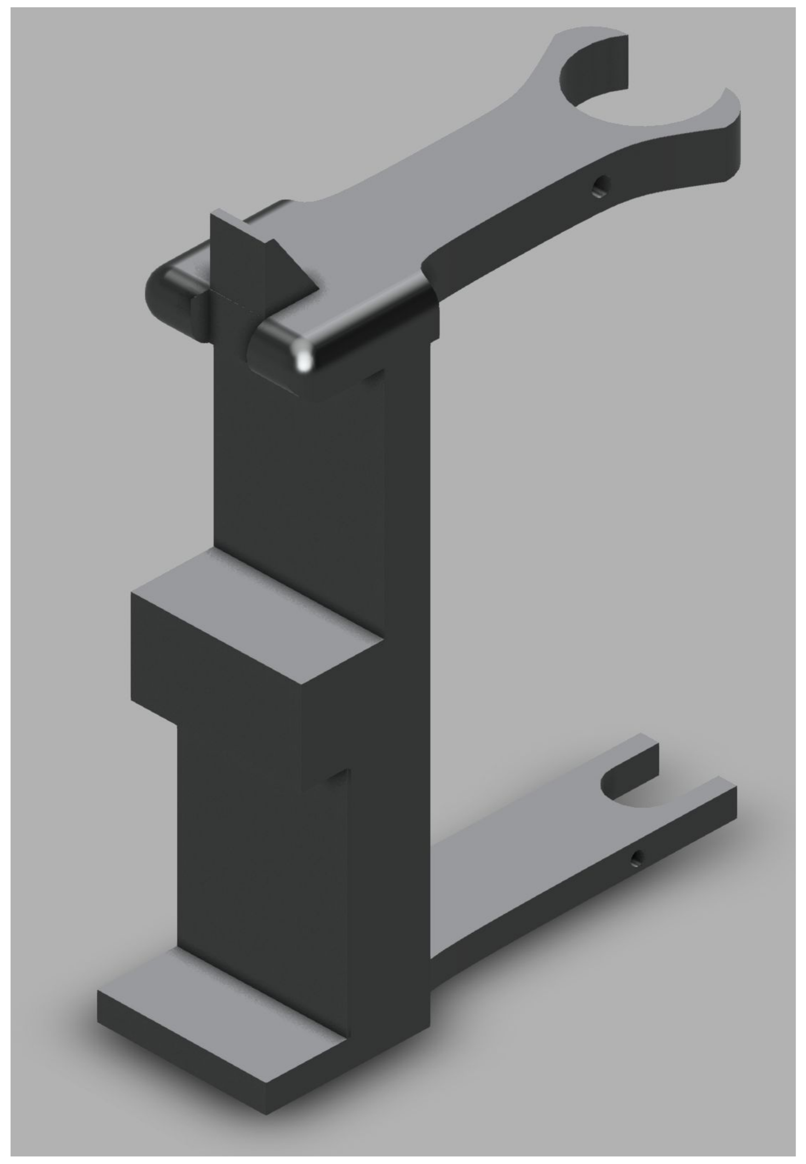


Figure 1- Bus Stop Detection (SURF)
Figure 2- Current Prototype CAD (on left)



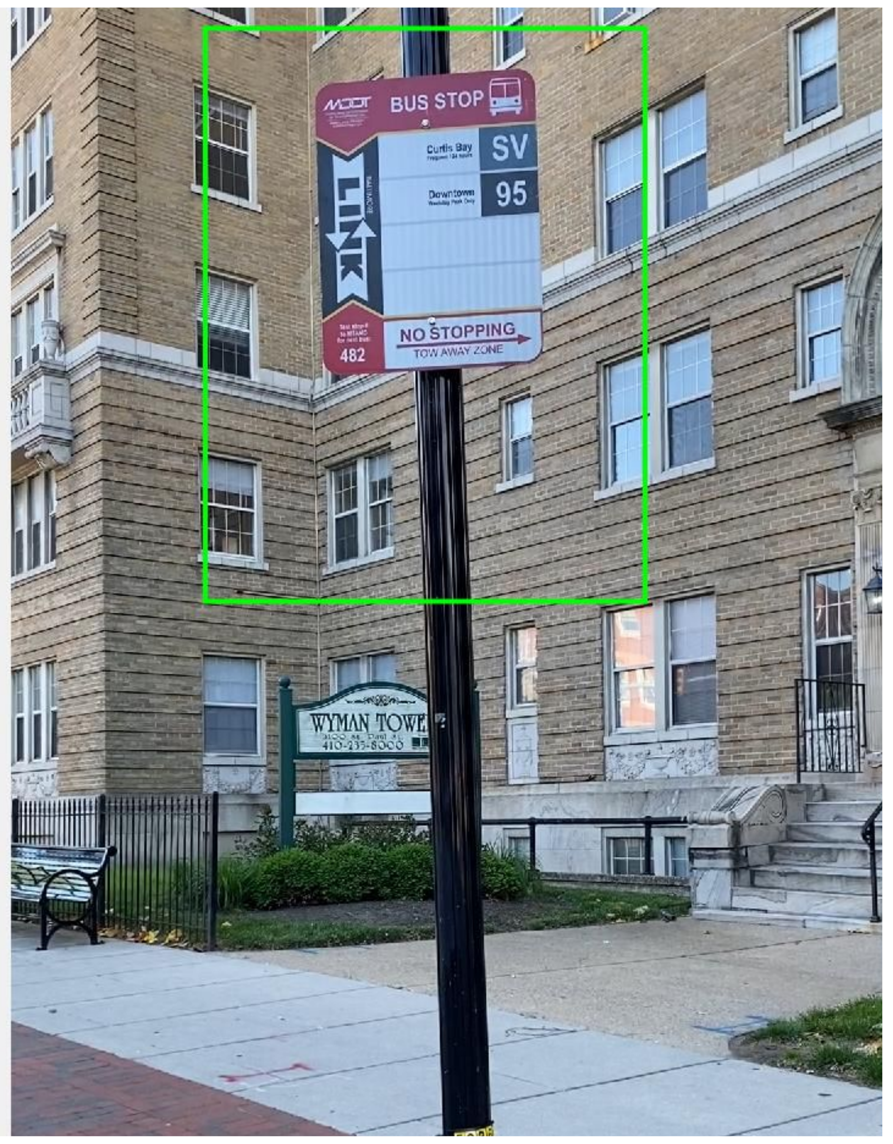


Figure 3- Example of detection (on right)

	Threshold	Present/Future Objectives
Cost	As low cost as possible	No Software Licensing Costs
Portability	Phone App with an optional hardware add-on	Individual hardware add-on to cane
Environment	Phone Battery Powered	Self-sustaining or long-life battery pack
Detection Performance	Operation under sunlight	Operation under range of weather conditions
Guidance	• Audibly gives direction to point of interest • Reads out what the user is facing and if it is the location desired	• Suggests path to walk • Accepts directional changes from user
Feedback	Audio Feedback	Audio and Haptic Feedback
User Input	• Can be opened and turned on from an app • User can specify desired destination • User pans phone camera around their surroundings	• Natural user feedback from using the cane

Figure 4- Project Objectives
Figure 5- Storefront Detection

Introduction

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Long-Term Objectives

The current focus of this project is to move the project into a formal hardware testing stage. We are currently working with various design prototypes but the project itself has future aspects as well. We want to move onto areas such as sidewalk navigation and obstacle detection.