Smart Signs: Digital Signage for Improved Indoor Navigation Using Google Assistant SDK

Team Member: David Sheppard Project Managers: Dr. Schmalzel and Nick Felker

The Problem

- Indoor navigation in not easy, especially in a new place.
- Traditionally, maps have been placed in public buildings to give users a sense of their location, but they are not interactive.
- Recently, digital signs have been used to provide information in place of traditional static signs.
- Although many digital signs allow for a more dynamic display of information, few can easily provide custom information based on easily acquired user input.



An Example of Current Digital Signage

The Solution

- The Smart Sign is a small digital sign that is voice-forward.
- It makes use of a small microphone and a Wi-Fi connection to accept and process requests.
- It uses voice input and natural language processing to allow users to find information faster than a standard touchscreen-only modality.
- The Smart Sign extends the Google Assistant to provide natural communication between the user and the device.

Factors and Standards

Constraints

- Portability: the Smart Sign must be easy to install in any indoor location.
- Affordability: the Smart Sign must not be cost-prohibitive to buyers.
- Ease of use: the Smart Sign must be intuitive to interact with and encourage user interaction.
- Ease of development: the Smart Sign software must be easy to modify such that its maps and other information can be easily updated.

Considerations

- Public health, safety, and welfare: the Smart Sign does not interfere with fire codes electrically or spatially
- Global, cultural, and social factors: information can be presented in multiple languages if items are translated. Android development makes this simple.
- Environmental impact: the Smart Sign consumes little power when in use

Relevant Standards

- Internet Protocol version 6 states that every device connected to the internet must have its own IP address the Smart Sign complies with this standard.
- IEEE 802.11 regulates Wi-Fi as a 2.4 GHz or 5 GHz wireless connection

Design

Android Things

- The device used for development is the Android Things Pico Pro Maker kit a development board designed by Google.
- It features a Pico i.MX7 development board along with a 5-inch touch display, a Wi-Fi antenna, and a USB-C power cable.
- The simplicity of this device makes it both affordable and portable.
- It runs the Android 8.1 operating system and can run Android apps just like an Android smartphone. This allows for development of a user interface that is familiar to Android users and easy to understand.
- For portability, a case was 3D printed that could fully contain the Android Things device.



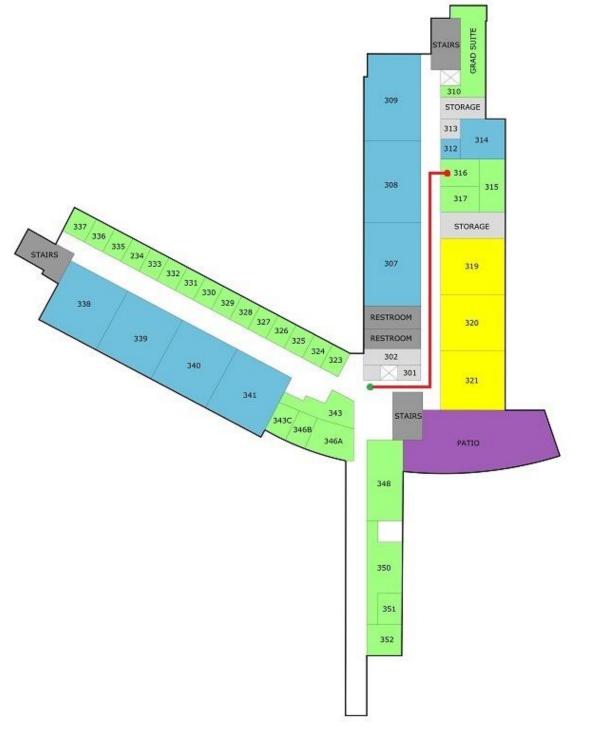
The Smart Sign in its 3D Printed Case

User Interface

- The user interface is designed to be simple and intuitive.
- An idle state provides the user with general information about the time, location, and weather.
- On the idle state is a button that the user can press to ask the Google Assistant a question.
- The Google Assistant processes the user's request and responds using either its own response or a custom response developed specifically for the Smart Sign.

Glassboro, NJ 12:24 AM High: 44°F Low: 25°F Wind Direction: ENE at 22mph TAP HERE TO ASK A QUESTION

The Smart Sign's Idle State



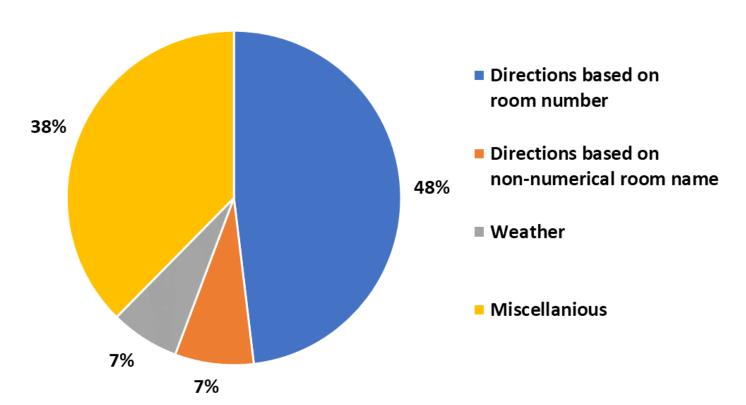
The Smart Sign's Navigation Instructions

Custom Commands

- In order for the Smart Sign to be able to give custom directions to the user, custom commands had to be created for the Google Assistant.
- Custom commands can include questions like "Where is room ____?"
- Using custom commands allows the Smart Sign to be adapted to virtually any situation
- Custom commands also enable the Smart Sign to respond to users in a much more familiar way conversation.

Testing

- The Smart Sign was available for alpha testing for about one week.
- During that time, over 200 queries were processed.
- These queries included topics like directions, the weather, and other miscellaneous questions.
- The categories of requests made to the Smart Sign can be seen below.



Requests Made to the Smart Sign During Testing

- The results of the testing gave insight into different terminologies that needed to be added to the library of custom commands.
- The Smart Sign's ability to receive quick and succinct directions to a room was appealing, while the integration of the Google Assistant allowed users to ask questions that they are accustomed to using with other digital assistants.

Future Work

- Three primary goals have been set for the future of the Smart Sign:
- 1. Expand the library of custom commands
- This will help the Smart Sign to better understand more types of requests from users.
- 2. Implement server-side integration of the code
- This will allow for the application to be modified remotely, further expanding the ease of development.
- 3. Add features to the idle state of the application
 - The idle state can be made to display a series of different items.
 - In addition to weather information, this can include announcements, current calendar events in the building, and suggestions on how to use the Smart Sign.
 - Additionally, advertisements can be incorporated into the idle state to help the owner of the Smart Sign offset its cost.

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