



Mobility Assistance for People with Cognitive Disabilities (MAPCD) Test Plan

for the Smart Columbus
Demonstration Program

FINAL REPORT | January 18, 2019



Produced by City of Columbus

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Chapter 1. Introduction

The Mobility Assistance for People with Cognitive Disabilities (MAPCD) project involves the adaptation and validation testing of an innovative smartphone application (WayFinder) for use by individuals with cognitive disabilities. In the course of the project, the adapted smartphone application will be pilot tested with 15 to 30 individuals in the Columbus region in partnership with the Central Ohio Transit Authority (COTA) and Ohio State University (OSU). The modifications to the WayFinder system will help to enable persons with cognitive disabilities to transition off costly paratransit services and travel independently on the fixed-route bus system. Phone-based GPS tracking allows WayFinder to safely guide users with step-by-step visual and audio instructions. The WayFinder system was developed through funding from the United States Department of Education (USDOE) and the National Institutes of Health (NIH). Data generated by the application will be written to the Smart Columbus Operating System (Operating System) to support data analysis and performance measures.

The Operating System is the essence of Smart Columbus – it brings to life the innovation. The Operating System is being designed and built to collect data from a variety of inputs; including public, nonprofit, education-based and private sector contributors. These inputs may come from other systems, devices and people. All of which are a critical part of building this ecosystem of innovation. Data will be available for analytics and visualization as well as for artificial intelligence required by various smart city applications. The Operating System is a platform designed for Big Data, Machine Learning and Artificial Intelligence, Analytics, and complex data exchange. It will capture the data and provide a means for multi-tenant access to aggregate, fuse and consume data.

The WayFinder system includes a mobile application and a web-based portal that both utilize a database system in order to assist users in planning and executing travel routes. The mobile application operates on iOS and Android smartphones, using the global positioning system (GPS) on the device to provide geolocation-based prompts to users of the system. Prior to the project described in this document, the WayFinder system had the ability to create person-specific routes via the route builder within the WayFinder mobile App. A travel trainer, support staff, or family members could create these routes in advance of their use by an individual. A route for an individual might include instructions for traveling to work, starting at the individual's front door and guiding the user to the bus stop, and throughout the bus trip, including telling the user when to notify the driver to stop the bus. The WayFinder App can have any number of routes setup for a person based on the user's typical travel destinations. While en-route, notifications can be sent to travel support staff or family members that provide Google map links showing the individual's location as they travel on their trip.

To meet the needs of the Smart Columbus Program, AbleLink is developing and implementing enhanced functionality to the WayFinder App, and the details of that enhanced functionality are outlined in the AbleLink Services Contract between AbleLink Smart Living Technologies and the City of Columbus Smart Columbus Program dated June 12, 2018. The enhanced functionality described in the AbleLink Services Contract shall be incorporated into the WayFinder system prior to the Smart Columbus Program's testing activities currently scheduled to begin after January 22, 2019. Prior to that time, AbleLink shall provide updates to the WayFinder App as they become available during the project period.

Ohio State University has been collaborating with the developer of the AbleLink System over the past two years during the development phase of the project. The goal of this collaboration is to provide feedback to the software developers to improve functionality of the app for users with cognitive disabilities. As part of that collaboration, a trade study was performed with several community partners, with the goal of soliciting feedback that could be provided to the system developers, in order to assist them in optimizing

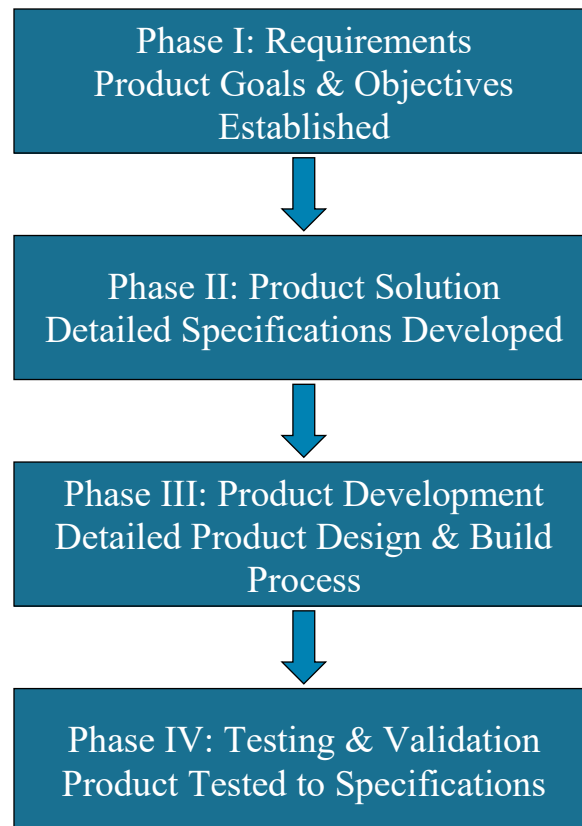
the system's capabilities and performance. The insights and information gained from that collaboration have proved useful in the development process, and the collaboration is now continuing into the testing phase of the project. As part of that collaboration, the team members at Ohio State University have worked with the City of Columbus and AbleLink Smart Living Technologies to develop a detailed training program for system users, as well as to develop this testing plan to measure and evaluate the system performance. The details of that testing plan are outlined in this document.

1.1. DOCUMENT PURPOSE

The WayFinder Testing Plan (WTP) incorporates information regarding the integrated WayFinder system functionality, the enhancements implemented specifically for the Smart Columbus project, and the individual functions the system must perform to meet that integrated system functionality. The WTP also specifies a set of individual test cases, which are specific test scenarios intended to evaluate the degree to which the both the individual functions and the integrated system functionality conform to the system requirements.

1.2. DOCUMENT STRUCTURE

The MAPCD project involves the development and validation testing of a smartphone application, including the computer and hardware systems and functionality necessary to support the application. The project follows the normal phases of a structured engineering design process. A diagram of the primary phases of this process is shown in Figure 1.



Source: City of Columbus

Figure 1: MAPCD Project Design Process

The individual phases of this process each build upon the information and data from the prior phases. Therefore, the final testing and validation phase of the product is dependent on each of the preceding phases. With regard to Phase IV: Testing & Validation, it is important that the testing requirements and procedures are based upon the product objectives and specifications developed in Phases I and II of the process, to ensure that the product meets the original goals and objectives. This test plan first outlines and summarizes the information from Phases I and II of the MAPCD project, and details the connections between that information and the specific functions to be tested. The test plan will ensure that the goals, objectives, and specifications that were developed and agreed upon throughout the project are all being tested and verified.

In the context of the MAPCD project, Phase I: Requirements, in which the project goals and objectives are established, was performed through the combined efforts involved in the MAPCD trade study, the ATTRI grant process for the WayFinder system, and the feedback and evaluation of the WayFinder system performed by the Ohio State University project team. The goals and objectives for any design project are normally stated in a manner that communicates the integrated functionality and performance of the system, and Table 1 lists the objectives for the MAPCD project, as well as the source of each objective.

This document contains the following sections:

- **Chapter 1. Introduction** provides an overview of the AbleLink project and referenced materials.
- **Chapter 2. System Description** outlines the previous and enhanced functions of the AbleLink System, including the required functions that are specified in the agreement between AbleLink Smart Living Technologies and The City of Columbus Ohio, as well as functions identified as desirable, but not required per the agreement.
- **Chapter 3. Test Conditions and Scenarios** provides a description of the specific test scenarios that are planned to evaluate the system as well as the associated test metrics, which will be used to assess whether the system meets the requirements detailed in **Chapter 2**.

1.3. REFERENCES

Smart Columbus - Interface Control Document for the Mobility Assistance for People with Cognitive Disabilities Project for the Smart Columbus Demonstration Program - Final Report – July 26, 2018; FHWA-JPO-17-557

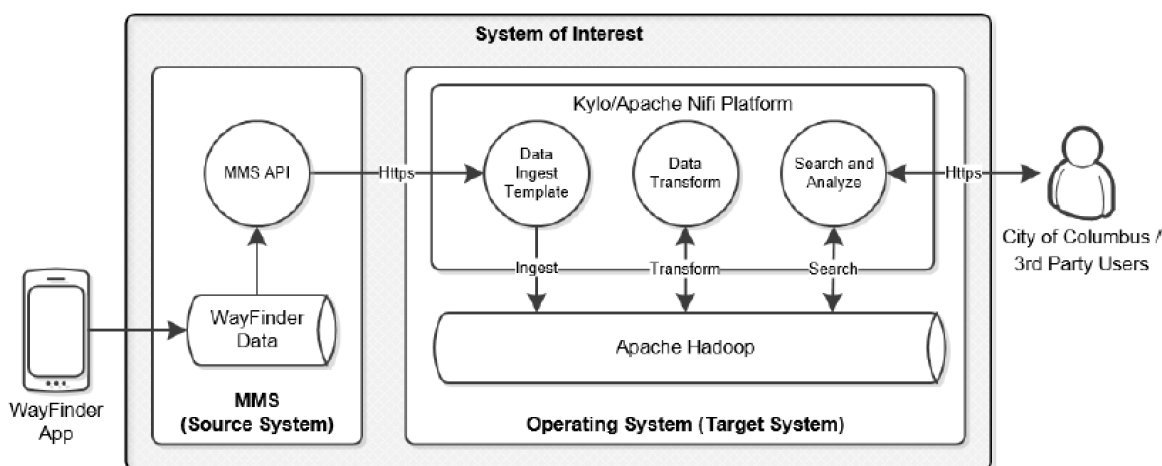
Smart Columbus - Mobility Assistance for People with Cognitive Disabilities Trade Study - March 19, 2018

Professional Services Contract Between City of Columbus, Ohio and AbleLink Smart Living Technologies, LLC for SCC - Mobility Assistance Capital Improvement Project 530163-100017

Chapter 2. System Description

2.1. SYSTEM OVERVIEW

Users can interact with the WayFinder system through either a mobile application or a web-based portal interface. The data for either access method is managed via a combination of a Mobility Management Server and an Operating System. A high-level overview of the system workflow is shown in Figure 2, which is taken from the Interface Control Document (ICD).



Source: City of Columbus

Figure 2: High-Level System Overview

The mobile application operates on iOS and Android smartphones, using the global positioning system (GPS) on the device to provide geolocation-based prompts to users of the system. Prior to the project referenced in this document, WayFinder had a range of abilities for the creation of person-specific routes. AbleLink demonstrated the following capabilities during evaluation by The Ohio State University (OSU) in July 2017 as part of the MAPCD Trade Study: (i) ability to provide voice and turn-by-turn directions, (ii) ability for the traveler to speak to the caregiver, (iii) ability to send alerts to the caregiver, (iii) WCAG 2.0AA standard / 508 compliance, (iv) delivery of a simple, non-cluttered user interface, and (v) ability for the user to "check in" with a caregiver while on route. As stated previously, AbleLink is adding a range of new functionality to the WayFinder App in order to meet the needs of the Smart Columbus Program. Included in the functionality of the AbleLink App and Portal is the ability to interface with the Smart Columbus Operating system.

As stated in the "Document Structure" section of the WTP, the overall goals and objectives for the modification of AbleLink software for the MAPCD project were developed from three sources. AbleLink is currently developing and implementing all enhancements to the WayFinder App identified below as "Essential Items" in accordance with the Mobility Assistance for People with Cognitive Disabilities (MAPCD) Trade Study. Further, AbleLink is also developing and implementing all enhancements to the WayFinder App identified as "Essential Items" in accordance with the OSU evaluation conducted in July

2017. The Ohio State University Evaluation Report can be found in Appendix E of the Trade Study. AbleLink is also adding enhancements as part of an Accessible Transportation Technologies Research Initiative (ATTRI) contract. The goals and objectives for AbleLink from these three sources are summarized in Table 1. This information corresponds to Phase I of the engineering design process, which is known as the Requirements phase.

Table 1: MAPCD Project Objectives Based on MAPCD Trade Study, OSU Evaluation Report, and ATTRI Contract

AbleLink Services Contract Requirements		
Source	Goal/Objective	Corresponding Individual Functions
MAPCD Trade Study Essential Items	AbleLink shall develop a web-based application allowing caregivers the ability to create routes for WayFinder using a map-based interface and the ability to view real-time location tracking to show an individual's progress on a map. Users shall be required to opt-in and provide explicit permission to be tracked by a caregiver. The route creation ability shall include a mapping interface for setting locations and adding the necessary media for instructions to the traveler (text, images, and audio).	MAPCD-UN004-V01 MAPCD-UN005-V01 MAPCD-UN006-V01 MAPCD-UN008-V01 MAPCD-UN011-V01*
MAPCD Trade Study Essential Items	AbleLink shall collect data to support the following performance metrics, in addition to other metrics the PARTIES may mutually agree upon: trip selection (route, date, and time), on-trip performance (on/off route, mode (e.g. bus, walking, etc.), help button usage, diagnostics (GPS accuracy, battery charge, cellular network coverage).	MAPCD-UN007-V01
MAPCD Trade Study Essential Items	AbleLink shall be responsible for providing API documentation to COLUMBUS describing its external interfaces (inputs to and outputs from) the WayFinder system and/or subsystems. Documentation provided by AbleLink shall be limited to only a description of the interfaces themselves, and not the characteristics of the systems which use it to connect. AbleLink shall be responsible for transmitting performance metrics to the Smart Columbus Operating System (SCOS) using an Application Programming Interface (API) developed by COLUMBUS for the same purpose. AbleLink shall coordinate the recurring transfer of the collected data to the SCOS at intervals to be mutually agreed upon by the PARTIES.	MAPCD-UN0013-V01*
MAPCD Trade Study Essential Items	AbleLink shall be responsible for delivering eight (8) Android smart phones with AbleLink's most current released version	MAPCD-UN001-V01

AbleLink Services Contract Requirements		
Source	Goal/Objective	Corresponding Individual Functions
	of the WayFinder App preinstalled to COLUMBUS on or before June 14, 2018 to support OSU testing during the summer of 2018. In addition, twenty-two (22) Android smart phones with the most current released version of the WayFinder app preinstalled to COLUMBUS prior to January 22, 2019. The cost of phone service and/or data plans shall not be included in the cost of the bundled WayFinder application and phones to COLUMBUS. The Android phones shall be unlocked devices and not tied to any carrier such that they can be used on any/all of the four major U.S. cellular providers (Verizon, AT&T, Sprint and T-Mobile). The Android phones shall also be 4G/LTE capable.	
MAPCD Trade Study Essential Items	AbleLink shall be responsible for hosting and maintaining the web-based route builder application and route libraries for the duration of the project, as well as all data created by the application and system users.	MAPCD-UN009-V01* MAPCD-UN011-V01* MAPCD-UN013-V01*
OSU Evaluation Essential Items	AbleLink shall provide the capability for the text font size used to display textual information to be modified in user settings. The objective is to allow the text information to not obscure the image associated with a WayFinder location.	MAPCD-UN003-V01 OSU-UN001-V01
OSU Evaluation Essential Items	AbleLink shall provide the ability for users who accidentally press the “OK” button before in range of the next waypoint to be able to replay the audio and redisplay the text for the previous direction.	OSU-UN002-V01
OSU Evaluation Essential Items	AbleLink shall provide documentation to explain common errors that may be encountered while using the WayFinder App.	OSU-UN003-V01
OSU Evaluation Essential Items	AbleLink shall incorporate COTA's existing General Transit Feed Specification (GTFS) and GTFS-RT (real-time) to display real-time bus location, schedule, and system	MAPCD-UN002-V01

AbleLink Services Contract Requirements		
Source	Goal/Objective	Corresponding Individual Functions
	alerts for COTA's fixed-route bus system, as appropriate based on the user's level of cognitive ability. WayFinder users need to be alerted to any changes in scheduled service that might impact their ability to complete a trip.	
ATTRI Grant	SMART Travel Manager: a web-based tool for simplifying the ability to create travel routes for various destinations	MAPCD-UN0010-V01* MAPCD-UN0011-V01* ATTRI-UN001-V01
ATTRI Grant	SMART Route Library: a cloud-based library of routes to specific destinations that will provide easy access to cloud-based routes for specific geographic areas which can be downloaded and used as is or modified to meet the needs of travelers with cognitive disabilities	ATTRI-UN002-V01
ATTRI Grant	WayFinder Enhancements: the WayFinder App will utilize cloud-based routes for desired destinations to provide geo-location based multimedia instructions to individuals with cognitive disabilities to facilitate independent travel	ATTRI-UN003-V01
MAPCD Trade Study Desirable Items	AbleLink, at its option, may provide the caregiver the ability to create custom reports showing activity of the Traveler.	MAPCD-UN0012-V01 MAPCD-UN0014-V01
MAPCD Trade Study Desirable Items	AbleLink, at its option, may provide a roles-based security model to manage system access for individual users to perform tasks such as view, create or modify a route.	MAPCD-UN009-V01

* denotes a desirable function in trade study that supports an essential item in contract

Source: City of Columbus

The goals and objectives for the MAPCD project shown in Table 1 can be further broken out into the individual functions and requirements necessary for the system to provide the overall functionality to meet those goals and objectives. These detailed functions and requirements are what constitute the product specifications that are produced in Phase II of the engineering design process. Each of these individual functions and requirements can then be effectively tested through a combination of test procedures and scenarios, thereby verifying the desired functionality of the system. The following table lists the Essential (EF) and Desirable (DF) Items, as stated in the MAPCD Trade Study and in the AbleLink Services Contract, grouped by category (Table 2). Also included in the tables are the corresponding individual functions that must be included and operating properly in order for the system to meet the requirements. These individual functions are described in Section 2.2, System Functions and Capabilities, together with the metrics for their acceptable performance.

Table 2: Essential and Desirable Functions

Note: The corresponding individual functions refer to the descriptions found in **Table 3**.

Source Identifier	Description	Corresponding Individual functions
MAPCD-UN001-V01	Phone-based application	EF4-EF7
MAPCD-UN002-V01	Knowledge of real-time transit information (COTA GTFS)	EF5b, EF6a, EF6b
MAPCD-UN003-V01	Voice and turn-by-turn directions (visual instructions)	EF2a, EF2b, DF2a
MAPCD-UN004-V01	Ability for the traveler to speak to the caregiver	EF8a
MAPCD-UN005-V01	Ability to send alerts to the caregiver (passive and monitoring)	EF8b
MAPCD-UN006-V01	Ability to track an individual (active monitoring)	EF3
MAPCD-UN007-V01	Caregiver experience	EF8c
MAPCD-UN008-V01	WCAG 2.0AA standard / 508 compliant	EF9
MAPCD TRADE STUDY DESIRABLE ITEMS		
MAPCD-UN009-V01	Roles-based permissions (caregiver, traveler)	DF5
MAPCD-UN0010-V01	Simple non-cluttered user interface	EF4
MAPCD-UN0011-V01	Ability to customize map (COTA GIS web services)	EF2a
MAPCD-UN0012-V01	Ability for user to “check in” on route	DF6
MAPCD-UN0013-V01	API	DF4
MAPCD-UN0014-V01	Ability to create custom reports	DF1
OSU ESSENTIAL ITEMS		

Source Identifier	Description	Corresponding Individual functions
OSU-UN001-V01	Appropriately sized text font size within app	EF2b, EF4a, EF4b
OSU-UN002-V01	“OK” button modifications	EF5a, DF2b
OSU-UN003-V01	Documentation to describe common errors	EF8d
ATTRI ESSENTIAL ITEMS		
ATTRI-UN001-V01	SMART Travel Manager	EF1, EF2a, EF2b, EF2c, EF2d, DF3
ATTRI-UN002-V01	SMART Route Library	EF2e
ATTRI-UN003-V01	WayFinder Enhancements	EF7a-e

Source: City of Columbus

2.2. SYSTEM FUNCTIONS AND CAPABILITIES

The functions and capabilities for the system are grouped into three sections or categories, based on the structural components of the overall system. The first category is the WayFinder Portal, the second category is the WayFinder App, and the third category is the WayFinder System Documentation. In order for the integrated system to function properly and optimally, all three components of the system must function properly and must integrate with one another in a seamless and intuitive fashion. The individual functions and capabilities for each of these components are broken out and listed in the following sections. In Chapter 3, Test Case Scenarios, information is provided with regard to the series of individual test procedures that will be used to evaluate the system in a real-world test environment. This approach assesses the performance of the various functions and capabilities are performed in their targeted applications. Functions and capabilities that were not identified in the original contract, and which are desired but therefore optional under the terms of the contract are noted as such. The WayFinder system will be deemed to have acceptable performance provided the required functions and capabilities meet the defined criteria. Feedback on the performance of the optional functions will be provided for informational purposes only.

Table 3: Essential and Desirable Functions with Corresponding Metrics and Criteria

Function Category		Function Title		Function Description	Metric	Criteria
Essential Functions (EF): WayFinder Portal (SMART Route Builder)						
EF1	Access	EF1	Login access	Ability to login and access the webpage	5 people will attempt logging in 10 times each	Login access function criteria will be considered met with 100% success rate (all login attempts successful)

Function Category		Function Title		Function Description	Metric	Criteria
EF2	Route Creation	EF2a	Route creation via web-based application	Ability to generate a route composed of individual waypoints, which includes at least a start and end point.	5 people will each create 3 roundtrips (a total of 6 routes per tester) with at least 5 waypoints on each route using the web portal.	<p>Manual route function creation criteria will be considered met with 100% success rate. To be successful the route will be created on the portal without the site freezing, logging the individual out, the routes not being saved correctly.</p> <p>User will be able to successfully create a one way route or a roundtrip route.</p> <p>A roundtrip consists of two routes, the first route going from a starting point to a desired destination. The returning route will be from the desired destination back to the starting point.</p>
		EF2b	Waypoint content	Ability to add the following media types to each: <ol style="list-style-type: none"> 1. Text 2. Audio 3. Photos 	5 people will add text, audio, and photos to each waypoint in all 6 routes	Waypoint creation function criteria will be considered met with 100% accuracy and ability to add text, audio, and photos to all waypoints
		EF2c	Route Modification	Ability to edit an existing route by modifying any of the following: start, end, all way points on the route, audio, pictures, text.	5 people will attempt to edit/change 6 routes	Route modification function criteria will be considered met with 100% ability to edit a start point, end point, all waypoints on the route, audio, pictures and text

Function Category		Function Title		Function Description	Metric	Criteria
		EF2d	Upload route from the SMART Travel Manager to the SMART library	Ability to upload a route and set the route access type 1. Private 2. Public	5 people will attempt to upload 6 routes to the private cloud and the same 6 routes to the public cloud	Uploading route function criteria will be considered met with 100% success rate (all attempted routes successfully uploaded to both the private and public cloud without changes to created route)
		EF2e	Download route from SMART library to an Android phone	Ability to download existing routes simply	5 people will attempt to download the previously uploaded 6 routes from both the private and public library	Download function criteria will be considered met with 100% success rate (all attempted routes will be successfully downloaded from both the public and private library onto an android phone without changes to created route)
EF3	Tracking		Real-time tracking of users via web-based application	Ability to track users by appropriate/intended caregiver(s) via web-based application 1. Multiple levels of users (e.g. traveler, caregiver, supervisor) 2. Requires opt-in by traveler for tracking	5 people will attempt to track at least 2 users	Tracking function criteria will be considered met if able to track within 100 feet of users' actual location
Essential Functions: WayFinder App						
EF4	Accessibility	EF4a	Text	Text font size	5 people will attempt to read waypoint text on an android phone with 6 different routes	Accessibility function criteria will be considered met with 100% success rate in accurately reading the full direction as written on screen

Function Category		Function Title		Function Description	Metric	Criteria
		EF4b	Image visibility	Picture visibility with text OR Resize photos or change photo position to increase visibility of text	5 people will attempt to see waypoint images on an android phone with 6 different routes	Image visibility function criteria will be considered met with 100% success rate in accurately seeing pictures for all waypoints while in the app
EF5	App Features and settings	EF5a	Error response	If accidentally hit “OK” button before in range of next waypoint, provide capability to replay previous waypoint (text, audio, photo) OR have the option to get rid of the “OK” button in the settings	5 people will attempt to press the “OK” button 500ft before the next waypoint during a route.	Error response (accidental key press) function criteria will be considered met with 100% success rate in replaying previous waypoint OR there will be a setting to turn off the “OK” button and the button won’t appear on the bottom of the screen.
				If the user deviates from the app, upon opening the app again there should be an option to continue with previous route	5 people will attempt to close out of the app while on a route 5 times.	Error response (app deviation) function criteria will be considered met with 100% success rate in providing the user with the option to continue with previous uncompleted route upon reopening.
		EF5b	Transportation notification	Notification the bus is approaching within app; GTFS incorporation into the app	5 people will wait at the appropriate waypoint bus stop within a route.	Transportation notification function criteria will be considered met with GTFS user notification within 2 minutes of the bus arriving at bus stop

Function Category		Function Title		Function Description	Metric	Criteria
EF6	Alerts	EF6a	Real time alerts	Real-time bus location, schedule, and system alerts for COTA Fixed Route System	5 people will verify 2 bus notifications within the WayFinder app to align with the COTA Transit app	WayFinder app will be within 1-minute accuracy of the COTA Transit app to meet real time alerts function criteria
		EF6b	Notifications	Notification of changes to scheduled service.	5 people will verify 2 bus notifications within the WayFinder app to align with the COTA Transit app	The WayFinder app will populate a notification of a changed bus route within 1-minute accuracy of the COTA Transit app to meet notifications function criteria
EF7	Route Creation	EF7a	Route creation via app	Manual: Ability to enter a start and end location and the web portal creates an "auto" route. The user can then edit way points along that route (This and the following 4 descriptions copied/modified from EF2a)	5 people will each create 3 roundtrips (a total of 6 routes per tester) with at least 5 waypoints on each route using the web portal.	Manual route function creation criteria will be considered met with 100% success rate. To be successful the route will be created on the portal without the site freezing, logging the individual out, the routes not being saved correctly. A roundtrip consists of two routes, the first route going from a starting point to a desired destination. The returning route will be from the desired destination back to the starting point.

Function Category		Function Title		Function Description	Metric	Criteria
		EF7b	Route Modification via app	Ability to edit an existing route by modifying any of the following: start, end, all way points on the route.	If feature available, 5 people will each create 3 roundtrips (a total of 6 routes) using the web portal.	Route Modification function creation criteria will be considered met with 100% success rate. To be successful the route will be created on the portal without the site freezing, logging the individual out, the routes not being saved correctly.
		EF7c	Waypoint creation via app	Ability to create a waypoint and add the following media types to each: <ol style="list-style-type: none"> 1. Text 2. Audio 3. Photos 	5 people will add text, audio, and photos to each waypoint in all 6 routes	Waypoint creation function criteria will be considered met with 100% accuracy and ability to add text, audio, and photos to all waypoints
		EF7d	Upload route to cloud via app	Ability to upload a private	5 people will attempt to upload 6 routes to the private cloud and the same 6 routes to the public cloud	Uploading route function criteria will be considered met with 100% success rate (all attempted routes successfully uploaded to both the private and public cloud without changes to created route)
		EF7e	Download route from SMART library via app	Ability to download existing routes simply	5 people will attempt to download 6 existing routes	Downloading route function criteria will be considered met with 100% success rate (all attempted routes successfully uploaded to both the private and public cloud without changes to created route)

Function Category		Function Title		Function Description	Metric	Criteria
EF8	User Communication and Caregiver Support	EF8a	Contact button	Ability for traveler to speak to the caregiver	5 people will attempt to use the contact button to reach the assigned caregiver	All individuals will be able to reach caregiver through the app within 1 minute of pressing the contact button
		EF8b	Caregiver alerts	Ability to send alerts to the caregiver	5 people will select an alert to be sent to their account	All caregivers will receive 100% of requested information alerts
		EF8c	Caregiver experience	Ability to use the app and portal independently with little difficulty	5 people will rate the app and portal on a scale from 1-5	The app and portal will receive an average rating of 4 from all users
		EF8d	Documented errors	Ability to see common documented errors	5 people will read through the documented errors document	100% of the information will be easily understood with solutions in the document
EF9	Accessibility	EF9	WCAG 2.0AA standard/ 508 compliant	Ability to prove app and website are accessible within WCAG 2.0AA standard/ 508 compliant standards	AbleLink will provide documentation of compliance to City of Columbus	All content will be provided to City of Columbus

Function Category		Function Title		Function Description	Metric	Criteria
Desirable Functions (DF): WayFinder Portal						
DF1	Reporting	DF1	Report generation of traveler activity	System generates reports for the appropriate caregiver only at the following times: when a route is started, if the individual goes off track, if waypoint is missed, and when the route is ended.	5 people will initiate a route, deviate from route, miss a way point, and end the route, allowing the portal opportunity to send appropriate caregiver notifications	Reporting function criteria will be considered met with 100% success rate as indicated by notifications sent for each of the of the following occurrences: when a route is started, if the individual goes off track, if waypoint is missed, and when the route is ended.
Desirable Functions (DF): WayFinder App						
DF2	App Features and settings (Corresponds to EF5)	DF2a	Audio repetition	Function to repeat audio by clicking on the screen when in route. Test that the delay function setting is accurately providing the proper amount of delay.	5 people will click on screen when in route	Audio repetition function criteria will be considered met with 5/5 audio repeats upon clicking on screen when in route with delay.
		DF2b	Waypoint advancement	Automatically advance to next waypoint without hitting OK. (i.e. the next waypoint will automatically populate once in the GPS range)	5 people will carry out route without hitting OK when advancing long way points	Waypoint advancement setting function criteria will be considered met with 100% success rate. To be successful the progressive waypoints will automatically populate without hitting OK once in the GPS range

Function Category		Function Title		Function Description	Metric	Criteria
DF3	Documentation	DF3	System documentation*	API	City of Columbus will independently verify the availability and validity of information via API	100% of the necessary information will be available to all individuals who attempt to access it.
DF5	Roles	DF5	Roles based permissions	Ability to create a role-based security model to manage system access for individual users to perform tasks such as view, create, or modify a route	5 people will attempt to create 2 different roles	100% of the roles created will demonstrate appropriate access and ability
DF6	Communication	DF6	“Checking in”	Ability for the user to check-in while on route and communicate their location to the caregiver	5 people will attempt to check-in while on a route	100% of the check-ins will appear to the caregiver within 30 seconds of sending it

Source: City of Columbus

Chapter 3. Test Conditions and Scenarios

A range of real-world testing scenarios will be utilized to test the proper functioning of the entire system in its intended applications. Each individual test case scenario is outlined in the following chapter, with each scenario detailed in a separate table. Test Case Scenarios are divided into two categories, the first being scenarios that involve a walking route and the second being those that involve a COTA transportation system route.

TESTING PRECONDITIONS:

The phones that will be used will be android Motorola g6 smartphones. The specific routes will be determined to be an obstructed space (areas with episodes of limited GPS due to buildings and/or foliage) environment by being within the downtown Columbus area surrounded by tall urban buildings.

3.1. WALKING ROUTES

Table 4: Walking Route Test Scenario 1

Test Number	Walking Scenario 1
Test Title	Walking route – open space (unobstructed GPS signal) – app only
Function(s) Tested	EF4 (a & b), EF5 (a & b) EF6 (a & b), EF7(a, b, c, d, & e),
Test Objective	Create route in open space (area without obstructions of GPS signal) using app only. Test route using app only.
Description	<ul style="list-style-type: none">▪ Evaluate the effectiveness of the app in generating a pedestrian route on the OSU campus from one building to another building▪ Evaluate the effectiveness of the app when completing the pedestrian route.▪ Evaluate accessibility considerations when testing route▪ Evaluate alerts as appropriate and available when testing routes▪ Evaluate notifications and error response when testing routes
Equipment & Setting/Environment	Route script information, Android device, access to Web Portal as needed
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.

Test Number	Walking Scenario 1
Procedure & Evaluation Criteria	<ul style="list-style-type: none">• Create route: record the number of waypoints, the location of waypoints and the WayFinder App settings.• Initiate route: record the number of icon selections the individual takes to initiate the start of route.• Navigate route: record the number of times the next waypoint doesn't appear.• Complete route: record the number of times the route doesn't terminate when reaching destination.• Web-based portal: record time and location of route initiation, navigation and completion. Record time and location of route deviation. Compare with real-world observations.

Source: City of Columbus

Table 5: Walking Route Test Scenario 2

Test Number	Walking Scenario 2
Test Title	Walking Route – obstructed space (areas with episodes of limited GPS due to buildings and/or foliage) – app only
Function(s) Tested	EF4 (a & b), EF5 (a & b) EF6 (a & b), EF7(a, b, c, d, & e),
Test Objective	Create route within an area with line-of-sight obstruction to GPS (buildings and/or foliage) using app only. Test route using app only.
Description	<ul style="list-style-type: none"> ▪ Evaluate the effectiveness of the app in generating a pedestrian route downtown Columbus (urban canyon) from one building to another building ▪ Evaluate the effectiveness of the app when completing the pedestrian route. ▪ Evaluate accessibility considerations when testing route ▪ Evaluate alerts as appropriate and available when testing routes ▪ Evaluate notifications and error response when testing routes
Equipment & Setting/Environment	Route script information, Android device, access to Web Portal as needed, location with limited GPS access: urban canyon
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Create route: record the number of waypoints, the location of waypoints and the WayFinder App settings. • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Complete route: record the number of times the route doesn't terminate when reaching destination • Web-based portal: record time and location of route initiation, navigation and completion. Record time and location of route deviation. Compare with real-world observations

Source: City of Columbus

Table 6: Walking Route Test Scenario 3

Test Number	Walking Scenario 3
Test Title	Test Title: Walking Route – open space – app only – route deviation
Function(s) Tested	EF5a
Test Objective	Test app behavior when users leave planned route that is an open space environment.
Description	Evaluate the effectiveness of the app when users deviate from an open space route. Note: Route must be created with the “Corridor Data” checkbox turned on in settings in the WayFinder App for the system to be able to detect when the traveler deviates from the path of travel (corridor).
Equipment & Setting/Environment	Open space route script information, Android device, access to Web Portal as needed, location with excellent limited GPS access: open space
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn’t appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn’t terminate when reaching destination • Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations

Source: City of Columbus

Table 7: Walking Route Test Scenario 4

Test Number	Walking Scenario 4
Test Title	Test Title: Walking Route – obstructed space – app only – route deviation
Function(s) Tested	EF5a
Test Objective	Test app behavior when users leave a previously created planned route that is in an area with line-of-sight obstruction to GPS (buildings and/or foliage).
Description	Evaluate the effectiveness of the app when users deviate from a route in an area with line-of-sight obstruction to GPS (buildings and/or foliage). Note: Route must be created with the “Corridor Data” checkbox turned on in settings in the WayFinder App for the system to be able to detect when the traveler deviates from the path of travel (corridor).
Equipment & Setting/Environment	Route script information, Android & iOS devices, access to Web Portal as needed, location with excellent limited GPS access: open space
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn't terminate when reaching destination • Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations

Source: City of Columbus

Table 8: Walking Route Test Scenario 5

Test Number	Walking Scenario 5
Test Title	Test Title: Walking Route Creation Evaluation
Function(s) Tested	EF1, EF2(a, b, c, d, & e), & EF3
Test Objective	Create an open space type route using online portal and save the route. Test route using app only.
Description	<ul style="list-style-type: none"> • Evaluate ability to log into portal system • Evaluate the accuracy and effectiveness of the online portal route creation functionality • Evaluate portal tracking capabilities throughout route
Equipment & Setting/Environment	Open space route information to be used in creating the route: start point, end point, and route points along the way. Access to the web-based portal to create the route, Android and iOS devices to download the route and use in route evaluation
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<p>Ability to accurately and easily create the route</p> <ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn't terminate when reaching destination <p>Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations</p>

Source: City of Columbus

3.2. COTA SYSTEM ROUTES

Table 9: COTA System Route Test Scenario 1

Test Number	COTA Scenario 1
Test Title	COTA bus route – open space – app only
Function(s) Tested	EF4 (a & b), EF5 (a & b) EF6 (a & b), EF7(a, b, c, d, & e),
Test Objective	Create route in open space using app only. Test route using app only.
Description	<ul style="list-style-type: none"> • Evaluate the effectiveness of the app in generating a COTA bus route on the OSU campus from one destination to another • Evaluate the effectiveness of the app when completing the bus route. • Evaluate accessibility considerations when testing route • Evaluate alerts as appropriate and available when testing routes • Evaluate notifications and error response when testing routes
Equipment & Setting/Environment	COTA bus route script information, Android device, access to Web Portal as needed
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Create route: record the number of waypoints, the location of waypoints and the WayFinder App settings. • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Complete route: record the number of times the route doesn't terminate when reaching destination. • Web-based portal: record time and location of route initiation, navigation and completion. Record time and location of route deviation. Compare with real-world observations.

Source: City of Columbus

Table 10: COTA System Route Test Scenario 2

Test Number	COTA Scenario 2
Test Title	COTA bus route – obstructed space – app only
Function(s) Tested	EF4 (a & b), EF5 (a & b) EF6 (a & b), EF7(a, b, c, d, & e),
Test Objective	Create route in area with line-of-sight obstruction to GPS (buildings and/or foliage) setting using app only. Test route using app only.
Description	<ul style="list-style-type: none"> • Evaluate the effectiveness of the app in generating a COTA bus route, from one destination to another in a minimum of two settings: 1) on the OSU campus and 2) downtown Columbus • Evaluate the effectiveness of the app when completing the bus route. • Evaluate accessibility considerations when testing route • Evaluate alerts as appropriate and available when testing routes • Evaluate notifications and error response when testing routes
Equipment & Setting/Environment	COTA bus route script information, Android device, access to Web Portal as needed
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Create route: record the number of waypoints, the location of waypoints and the WayFinder App settings. • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Complete route: record the number of times the route doesn't terminate when reaching destination. • Web-based portal: record time and location of route initiation, navigation and completion. Record time and location of route deviation. Compare with real-world observations.

Source: City of Columbus

Table 11: COTA System Route Test Scenario 3

Test Number	COTA Scenario 3
Test Title	Test Title: COTA BUS Route – open space – app only – route deviation
Function(s) Tested	EF5a
Test Objective	Test app behavior when users leave planned route that is an open space environment.
Description	Evaluate the effectiveness of the app when users deviate from a COTA bus route that is an open space setting. Note: Route must be created with the “Corridor Data” checkbox turned on in settings in the WayFinder App for the system to be able to detect when the traveler deviates from the path of travel (corridor).
Equipment & Setting/Environment	Open space COTA bus route script information, Android device, access to Web Portal as needed, location with excellent GPS access: open space.
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn’t appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn’t terminate when reaching destination • Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations

Source: City of Columbus

Table 12: COTA System Route Test Scenario 4

Test Number	COTA Scenario 4
Test Title	Test Title: COTA BUS Route – obstructed space - app only – route deviation
Function(s) Tested	EF5a
Test Objective	Test app behavior when users leave planned route that is an area with line-of-sight obstruction to GPS (buildings and/or foliage).
Description	Evaluate the effectiveness of the app when users deviate from a COTA bus route that is in a setting with tall buildings and/or foliage. Note: Route must be created with the “Corridor Data” checkbox turned on in settings in the WayFinder App for the system to be able to detect when the traveler deviates from the path of travel (corridor).
Equipment & Setting/Environment	Open space COTA bus route script information, Android device, access to Web Portal as needed, location with limited GPS access: concrete canyon.
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn't terminate when reaching destination • Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations

Source: City of Columbus

Table 13: COTA System Route Test Scenario 5

Test Number	COTA Scenario 5
Test Title	Test Title: COTA Bus Route Creation Evaluation
Function(s) Tested	EF1, EF2(a, b, c, d, & e), & EF3
Test Objective	Create an open space type COTA bus route using online portal and save the route. Test route using portal only.
Description	<ul style="list-style-type: none"> • Evaluate the accuracy and effectiveness of the online portal route creation functionality in the creation of COTA bus routes. • Evaluate ability to log into portal system • Evaluate the accuracy and effectiveness of the online portal route creation functionality • Evaluate portal tracking capabilities throughout route
Equipment & Setting/Environment	Open space route information to be used in creating the route: start point, end point, and route points along the way. Access to the web-based portal to create the route, Android and iOS devices to download the route and use in route evaluation
Personnel Required	Research personnel (x3). One researcher will generate route and then complete route. 2 nd researcher will document visual observations. 3 rd researcher will document observation from web-based portal.
Procedure & Evaluation Criteria	<p>Ability to accurately and easily create the route</p> <ul style="list-style-type: none"> • Initiate route: record the number of icon selections the individual takes to initiate the start of route. • Navigate route: record the number of times the next waypoint doesn't appear. • Deviate from route: record time and location of route deviation, and app behavior • Correct route deviation: record time and location of route correction, and app behavior • Complete route: record the number of times the route doesn't terminate when reaching destination <p>Web-based portal: record time and location of route initiation, navigation, deviation, correction and completion. Record time and location of route deviation. Compare with real-world observations</p>

Source: City of Columbus



THE CITY OF
COLUMBUS
ANDREW J. GINTHER, MAYOR