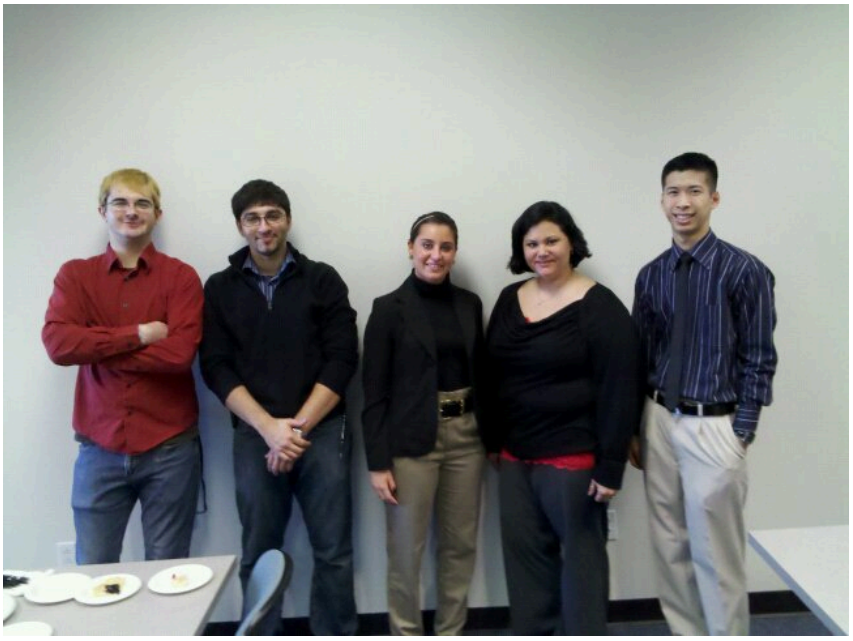
Mobile Landmark Identification for Visually Impaired and Blind Person

AUTHORS



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ABSTRACT

The primary goal of this project is to design a portable device that assists visually impaired and blind persons (VIBP) to select a bus and find the exact location of that bus at a bus stop. This device will ultimately enable the VIBP to board their chosen bus with minimal outside assistance. The first phase of the project is a proof of concept that will focus on identifying buses and guide the user to them. The completed system will be a portable device that is able to locate buses and guide visually impaired and blind users to the correct buses through tactile prompts.

BACKGROUND

Initially, a member of the Association of the Blind and Visually Impaired (ABVI) brought to the attention of one of RIT's faculty members that VIBP's have an immense difficulty locating correct buses at bus stops. Specifically, the only way they have been able to resolve this difficulty is to approach each bus that comes to the station and ask the driver about the bus' destination. This method has obvious downsides to the VIBP's, not the least of which is that it is time-consuming and unhelpful.

The problem was brought to professors within the Engineering Department and a project

was proposed to the team to pursue. The team began researching the project in the form of specific interviews with two blind students who could elaborate on their experiences and difficulties with public transit systems around Rochester, NY. This dialog helped the team visualize the problem within the correct perspective so that actions could be taken to form a project plan.

Immediately after these discussions it was brought to the team's attention that Rochester's main mass-transit authority, Rochester Genesee Rural Transit Authority (RGRTA) was interested in a very similar issue dealing with its own system. It was proposed that the team work alongside RGRTA towards a common solution to the problem.

STATEMENT OF THE PROBLEM

In response to the difficulties facing VIBP's with respect to way-finding among bus stops, the primary goal of this project is to design a portable device that assists these individuals in selecting a bus and finding the exact location of that bus at a particular stop. Buses do not wait for their passengers and VIBP's ultimately have a very hard time catching the correct bus and/or making it to the correct bus on time without a significant amount of outside assistance.

This device will enable the VIBP to board their chosen bus with minimal outside assistance. The first phase of the project will primarily focus on the interfacing of the tagging technology chosen with the user interface selected. The combined system will be able to locate buses and guide visually impaired and blind users to the correct buses.

METHODS/APPROACH

In order to cut down on the amount of time it takes for a VIBP to find their correct bus at a bus stop, it is proposed that a device be created that will identify and locate buses within a certain range of the bus stop using the GPS system established and managed by RGRTA. The device must be capable of communicating clearly with the user and give clear directions (primarily tactile-based) to guide the user to the correct bus. Furthermore the device must convey real-time information about bus arrivals in order for the VIBP's to have the most correct and the most up-to-date information.

The team decided to use GPS to locate the buses and estimate their arrival times RFID tags are used to set a static landmark at the bus stop as a starting point for the user. The landmark will have a known GPS coordinate, which will aid in guiding the user to their chosen bus. The following flowchart describes how the system works.

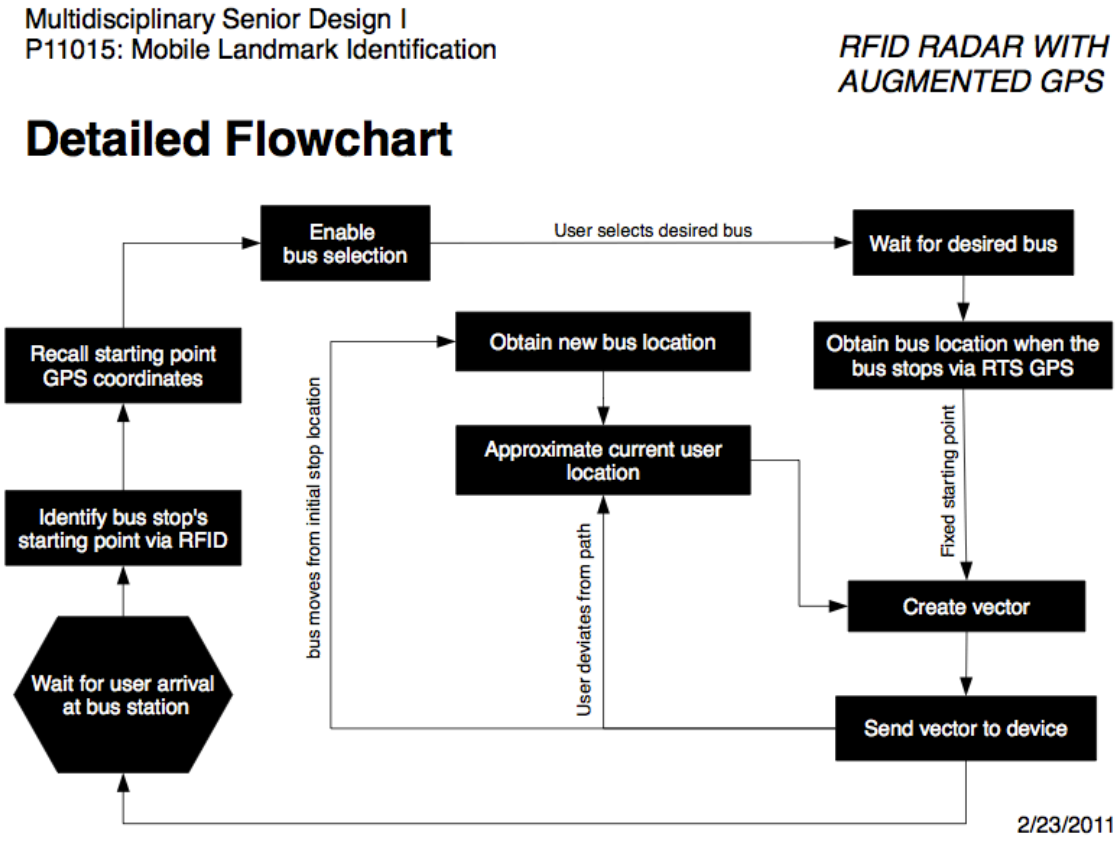

Figure 1: Detailed flowchart describing device functions

The solution the team chose was based on many discussions and a lot of information collection that led to several ideas and brainstorming sessions. Those discussions resulted in several ideas including using speakers on the buses to guide the users, using GPS for both identification and navigation, using computer vision and many other ideas, but the concept that seemed best fitting for the functions was a combined system using both GPS and RFID. GPS can be used to identify the buses as they arrive at the bus stops as well as guide the user closer to the bus, but with an error margin of about 10 feet. The RFID compensates for the lack of accuracy of the GPS system because it is used for much shorter ranges (about 5 feet). This way the user can select a bus and get close enough to navigate themselves to board the bus.

Concept Selection

P11015: Mobile Landmark ID
Possible Concepts
A-6:B-2:C-7

Part 1: Bus Identification Methods

Selection Criteria	Public Assistance	Long-Range RFID Tag (On the Bus)	LED Billboard (Text-to-Speech)	Image Processing	GPS	Remote Personal Assistance	RTS GPS Database
	A-0	A-1	A-2	A-3	A-4	A-5	A-6
Detection Range	0	+	+	0	+	0	+
Weatherproof	0	+	+	-	+	-	+
Accuracy	0	0	0	-	0	0	0
Repeatability	0	+	0	0	+	+	+
Low Expense	0	-	-	-	-	-	-
Simple to Integrate	0	0	0	-	-	-	0
Independently Reliable	0	+	+	+	+	+	+
Fast Indentification	0	+	+	-	+	-	+
Database Cost	0	-	0	-	-	0	0
Net Score	0	3	3	-5	2	-2	4

Part 2: Communication Methods (System to-from User)

Selection Criteria	N/A	Talking Bus Station	Portable User Device
	B-0	B-1	B-2
Noise Immunity	0	-	+
Need not carry	0	+	-
Disturb another user	0	-	+
Repeatabilty	0	-	+
Additional Features Cap.	0	-	+
Net Score	0	-3	3

Part 3: Navigation Methods

Selection Criteria	Dog/Cane	Monster Guide Roomba	2 IR Stations	2 Laser Stations	Computer Vision w/ GPS System	RFID RADAR System	Augmented RFID With GPS
	C-1	C-2	C-3	C-4	C-5	C-6	C-7
Likelyhood of success	0	+	++	++	++	+	++
Time to Code	0	--	-	-	-	-	-
Startup cost	0	0	-	-	-	--	-
Reliability	0	+	++	++	++	++	+
Repeatability	0	0	++	++	++	++	++
Time to Build	0	--	-	-	-	--	-
Accuracy of Bus Detection	0	0	+	++	+	++	+
WeatherProof	0	-	--	--	-	+	++
Obstacles	0	0	--	--	-	+	+
Ability to interface	0	0	+	+	+	+	+
Range	0	0	+	+	+	0	+
Implement elsewhere	0	-	0	0	0	+	++
Marginal Cost	0	0	--	--	--	-	0
Number of Failure Points	0	-	-	-	-	-	-
Work Dispersal	0	++	+	+	-	+	+
Ease to test	0	-	-	-	+	--	-
Absence Factor	0	-	0	0	-	0	0
Net Score	0	-5	-1	1	0	3	9

Figure 2: Shows how the team determined the current concept

RESULTS/DISCUSSION

As of now the project is currently in progress. The time frame set for this project by the Multidisciplinary Engineering Design Program is a total of 22 weeks. The team is currently in their 14th week and the current actions being taken are: establishing requirements of and preparing setup for testing all data received from RGRTA; determining and setting up all test procedures, test plans, and post-processing of results. The test plan as well as any other relevant documentation can be found at:

http://edge.rit.edu/content/P11015/public/Home

COST

Item	Quantity	Price per unit	Total price	Model	Link
Accelerometer and compass	1	124.95	124.95	RB-Spa-393	http://www.robotshop.com/sfe-imu-16g-triple-axis-accel-three-300-gyro-combo-2.html
USB to serial breakout board	1	15.45	15.45	RB-Dfr-74	http://www.robotshop.com/dfrobot-ftdi-usb-serial-basic-breakout-board-4.html
Circuit Board	1	19.47	19.47	1V2011	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=V2011-ND
Voltage Regulator	3	6.75	20.25	TPS75833KC	http://search.digikey.com/scripts/DkSearch/dksus.dll?Det
Miscellaneous	-	200	200	(Circuit Surfboard, Resistors, Capacitors, etc.)	--
Netbook	1	259.99	259.99	Acer10.1"	--
Shipping total	--	--	100	--	--
Total cost			740.11		

Table 1: Bill of materials and total cost

As for the RFID reader and tags, another design team under the same group of assistive devices has purchased those for VIBPs. However, the reader is the Skyetek M9 model, which costs $274.00. The tags are passive RFID tags of different ranges and each bundle (50 tags) costs $100.00.

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