Third Eye
Phase 2

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TABLE OF CONTENTS

Introduction

We are the Third Eye. We are working to develop a tablet-based device that helps visually impaired individuals navigate unfamiliar environments. Visually impaired individuals face many challenges that sighted people don't have to worry about. A sighted person would have no difficulty going to a meeting in a building they've never been to before or finding the food court in a mall for the first time. All they would have to do is walk in the door, look around for a few seconds, and they instantly acquire a wealth of information, including the location of exits, signs pointing to the restrooms or elevators, directories listings, and other useful information about the building. What's striking is that sighted individuals don't even realize the extent to which they rely on their vision. All of this information is available to them in the blink of an eye and all day everyday, a constant influx of visual data. Most people couldn't imagine a life where this flow of information suddenly disappeared. Unfortunately, that's what everyday life is like for visually impaired individuals.

The inability to gather information about their environment has profound effects on the lives and independence of visually impaired individuals. Everyone wants the ability to live their life without having to completely rely on someone for help. Blindness affects a person's life by limiting the places to which they can travel. Traveling any further than the area immediately surrounding a person's home or place Think about it, if a sighted person wants to travel somewhere a couple hundred miles away, they would most likely take a plane. From the point a person arrives at an airport to the point they arrive at their destination, there are thousands of times that the person must rely on visual cues to get around. To check in, a person has to looks for the name of their airline on signs. To discover which gate their flight is leaving the airport from, a person must find the area where departures are displayed on tv screens, find their flight on the screen followed by the time of departure and the number of the gate. Once the person has the gate, they have to follow more signs to get there. And thats just at the airport of departure. Once the individual boards the plane and arrives at their destination, they must find the baggage claim and the transportation area. A blind person would be hung up at every single point that a sighted person relies on visual cues to determine where to go next.

To make traveling independently easier for blind people, we want to make information about the layout and interior of public buildings readily available to blind people through the use of a tablet computer. The software running on the tablet would contain all of the information about a building that people are usually able to gather from visual cues. The tablet would contain the information common to all buildings, such as the location of exits, restrooms, and floor layouts. It would also contain information that may be specific to certain buildings. In the case of an airport, the tablet would contain the locations of check-in for all the different airlines, the location of security, directions to different gates in the terminal, baggage claims, police and security, food courts, and any other information that is needed to navigate an airport. All of this information would then be

The name third eye represents our goal to provide an alternative way of gathering visual information for people who can't see the world themselves.

History

For centuries, white canes have been used by visually impaired as a mobility aid and to detect obstacles in their path. These canes were painted white in color to indicate that the person carrying it is blind. Richard E Hoover, “The Father of lightweight Long cane Technique”, developed the standard method of “long cane” training to have a smooth navigation. In certain countries, the users of white cane were afforded the right-of-the-way when crossing a road. They were afforded the right to use their canes in any public place as well.

Besides white canes, Guide Dogs were also other major mobility aid for the visually impaired. These dogs were trained to lead blind people around the obstacles. Later on many Navigation-assistance devices were invented to make the visually impaired independent while commuting.

Current Solutions

Some of the Devices that are available for navigation-assistance for the blind are:

Trekker: A personal digital assistant application devised for the blind and visually impaired with talking menu, talking maps and GPs information.

BrailleNote GPS: A fusion of PDA, Map-quest software and speech synthesizer. It directed the user to their destination with spoken information from the speech synthesizer. It uses the GPS network to pinpoint the user’s location and near-by points of interests.

Orcam: Orcam is an easy to use portable device with a camera which has multiple functionalities such as reading printed text in real time, identifying personal objects, finding items etc. It responds to a simple gesture and reads the text or identify the objects which the finger is pointing to.

Deficiencies of current solutions: Though the GPS devices are helpful for navigating the streets, these aren’t exactly useful when it comes to navigating the interiors of a building as there are no maps of buildings available so far. In spite of having the ability to read text and identify objects, Orcam still lacks at helping the blind navigate new surroundings as it cannot read the environment.

Upcoming projects: Google Tango: This Project aims at designing software and hardware that creates the map of the environment in 3D. The device makes 3D measurements of the space and updates its position and orientation, combining the data into a 3D model of the space around the user. This device can be used by the visually impaired to study their surroundings and interact with the environment thereby reaching their destination with the help of the audio instructional feedback given by the device.

Objectives & Goals

Vision is an acquired skill that gives us the ability to take in information and it also allows us to understand the things that we cannot touch, taste, smell or hear. With our eyes we are constantly judging distances, recognizing colors, and reacting with body movements to the things we see. With the loss of one's eyesight you begin to live a life of darkness. Our ultimate objective is to some how restore a person's eyesight with a single device.

The "Third Eye" is a life-changing device that will give the blind a chance to see. We want to increase the overall quality of life for the visually impaired. Necessary to do this we must make the device as minimal as possible. The public should not view the user of Third Eye as a blind person, but instead looks at them as another normal human being navigating around a room or building. In order to increase the mobility of blind individuals, we wish to propose a system for enabling the blind to be able to create a virtual map for themselves with the help of our tool. Our software can be installed on any ordinary tablet and can be placed at the entrance of buildings and rooms after loading the respective maps into them. Placing your hand on the screen would activate the device, which would respond by a greeting followed by instructions to use the device. Through the use of voice commands or our keyboard braille-extension you can navigate the User Interface to travel through the building. A user should be able to travel alone without the help of outside sources such as walking dogs or other people. This device will help the blind become more accustomed to untraveled areas. Third Eye has to be reliable given the fact that users are putting their lives into the hands of our software. Third Eye must have every detail of a building mapped out because the wrong information can lead to serious injuries or even worst outcomes such as death. We need 100% reliability in order for Third Eye to be operative. A blind person should be able to learn how to use the device quickly and easily. There should be a very small learning curve. Similar technologies already on the market are expensive and have a limited amount of functionality. Our product would provide an affordable alternative to existing devices and hopefully reach a larger audience.

Functional Requirements

When it comes to a product's functionality, one of the most important aspects pertains to the user's interaction with the system. The key is to provide an efficient method of adapting the system to behave more 'naturally' for the user. When there is a high degree of intuition behind designing the interface, a minimal amount of difficulty will be experienced by the user during their onboarding. The overall functionality of our system can be described by three separate categories, the input, the processing, and the output.

The input of Third Eye has been carefully considered to enable the user an array of options due to their own personal preferences. In order to produce value, versatility is priority. Third Eye, as the name suggests, refers to bringing the reliability and efficiency of the human eye by other means. Therefore, incorporating the input would take advantage of multiple physical and/or verbal techniques via the user's desire. One imparticular is utilizing the accuracy and reliability of a built-in touchscreen to collect input data. By sensing where the users finger(s) are located within the screen, the device could easily translate this physical stimulus into useful actions. Since most mobile technology (smartphones, tablets, etc…) provides strong support for touchscreens, this will be a strong focus for collecting data.

While physical interaction with the device is a viable option and solution, we still wish to provide the user with multiple choices. Perhaps the user feels that the response time by using their hands is not feasible. Taking this into account, Third Eye will provide support for voice commands. By utilizing the existing built-in microphone in the tablet or through a bluetooth headset, the user will be able to activate an "active listening mode" in which the tablet will await voice commands by the user. These streams of commands will be broken down in the software to be translated to their corresponding actions.

Being aware of the current environment and location is critical. To achieve this information, Third Eye will take full advantage of the tablet's radio adapter, accelerometer and wireless adapter for assistance. By using the tablet's wireless adapter, connecting to available wireless networks can provide a positioning system that will be able to pinpoint the user. The wireless adapter is power efficient and accurate, however the radio adapter can be used in tandem to provide backup in case of failure with the wireless adapter's connectivity, or vice-versa. The device's accelerometer can assist in local directional positioning, such as pointing in the correct direction during navigation. This is not limited to horizontal positioning, but vertical angular calculations as well.

Processing connects the input data to the output feedback. With the consistent streams of raw input data from multiple adapters and accessories, there needs to be a way to translate it all to a respectable output. One feature of Third Eye, is the ability to pull up-to-date building layouts (or maps) from wireless servers in the current area. These maps will contain all the vital

information pertaining to features of the building such as, but not limited to, elevators and specific rooms. Once this data has been processed, the user will have the option to select “views” or “filters” to find specific information more rapidly. These views will consist of a structural, emergency and a people mode. In the structural mode, the user will have quick and easy access to information such as the locations of walls, windows, staircases, elevators, and more. In emergency mode, the user will receive information such as the nearest fire exits, first aid kits, telephones, extinguishers, and more. And finally, the points of interest mode will include the locations/coordinates of individuals rooms/offices as well as distinct locations, such as cafeterias or information desks.

By using voice commands or physical interaction with the downloaded building layouts, the software can processes mappings from keywords to the appropriate action. For example, a voice command that queries “Where can I find the nearest elevator” can be broken down into keywords that will search and provide navigation to the nearest elevator according to his/hers current location.

When using physical interaction with Third Eye, the device will act as an overview of the current environment the user is in. By using the accurate touchscreen, the device will calculate where the user is pointing to and map that to a real object/location in the user’s proximity.

While there is some preference with choosing the perfect input method, Third Eye shines with the options between output modes. The essential goal is to provide the user with reliable and rapid responses from their device. The device needs to be able to address the user’s queries rapidly and provide the correct response immediately. One method the user can use to receive information is through haptic or vibrational feedback. This can be used to quickly locate a point of interest based on the intensity of the feedback. Another option is convenient for user’s who may be familiar with braille. Third Eye is integrated with a system that will transform the touch screen's top layer into a physically readable surface of braille. This will allow the user the option to read instructions pertaining to their requests right off their tablet. And finally, since Third Eye offers a built-in speaker and bluetooth headset, voice feedback is a more natural approach for receiving data. The voice feedback will emulate a human social interaction that can take queries and respond in a coherent and accurate fashion; it is much alike having your own personal assistant at all times. These options are available for individual use or can be used together to provide more information at a time.

By providing the user with multiple unique preferences, the user can become more comfortable and acquainted with their device without sacrificing any functionality. We want the user to feel a great deal of power and confidence when interacting with Third Eye, and the implemented input and output methods will deliver the user an unparalleled experience like no other.

User Profile

The Third Eye should be designed primarily for the blind to use in day to day situations. Secondary target demographics could include anyone with a lesser visual impairment, or a fully sighted individual in a situation where vision is obscured. Though these secondary demographics would not benefit as much from the touch and sound based interface, the aid in navigating would still be useful.

Depending on how accurate and reliable the system is, it could be useful in an emergency situation as well. It could help the blind or visually impaired locate an emergency exit, for example. However, for the Third Eye to be reliable in an emergency situation, it would have to be usable in situations where it is cut off from the internet and GPS.

The database of building layouts might also be useful to emergency workers. Firefighters, for example, could use it to navigate a burning building.

Proposed Solution - from the domain perspective

In order to increase the mobility of blind individuals, we wish to propose a tool for enabling the blind to be able to familiarize with his immediate environment. The tool should be placed at the entrance of buildings and rooms and should able to provide the following information:

- Various exits in the room
- Hazardous points
- Stairs / Obstacles etc.
- Room Capacity

Also the tool should provide tactile and audio feedback to the user.

Customer Constraints – budget, schedule, technical (note: not a budget or schedule, but *constraints*)
Budget: $1.2 million
Schedule: We will develop an initial prototype by Dec 7, 2014
Design: We have chosen Android Tablet as our platform

Future Plans and Expandability

The ability to manoeuvre in visually impairing situations is ground breaking. Although Third Eye is specifically designed for blind people, it has future applications in any low light environments. Many first responders and military personnel often struggle to see in low light environments while relying on thermal and infrared imaging. However, this is not an adequate solution because these imaging devices are unintelligent. Our Third Eye hardware may help detect objects via infrared, satellite, and 3d imaging. With these technologies, we may effectively map, in real time, a dynamic environment via object identification using an extensive database and heuristic recognition. Relaying the imagery back by voice or visual assistance will effectively allow first responders not only to see in zero light situations, but also to identify high risk objectives while maintaining situational awareness.

For these applications, we propose using a mobile form of Third Eye which could be embedded in helmets or goggles, to provide a heads up display as well as voice alerts. The advantage over a tablet is obvious; the first responders or military will be able to use their hands. For control of the device, we would enable eye orientation navigation in menus to further promote mobility. Thus, customizable hardware is a key feature of future Third Eye deployments and will allow us to meet specific needs and different objectives.