

# ICY Vision-Contextual Awareness for the Visually Impaired

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## ABSTRACT

The ICY Project was designed to use voiceover technology and locator beacons to assist the visually impaired, as a means of informing the person's location and its context, so they can feel confident and safe as they navigate their way around their local community.

**Keywords:** Visually Impaired, Beacon Technology, Bluetooth Low Energy Beacons, Smart Technology

## 1. INTRODUCTION

Visually impaired people are reliant on canes, guide dogs and audible cues to manoeuvre their way around outdoor environments, experiencing trust issues as a result of unknown surroundings and individuals. They're unable to visually identify points of interest or landmarks that would give them location awareness or an understanding of their current environment. The ICY Team was established to develop an application using modern mobile technology that could be used by hundreds of visually impaired people to enhance their day-to-day movements around their local communities, safely and with confidence.

Advances in modern technology have given mobile phone users access to the internet via mobile data, which has become more affordable, faster and available in more locations. Additional features such as voiceover and digital assistants have been added, giving the visually impaired and others from the disabled community the opportunity to reach out and interact with smartphones and additional technologies in their everyday lives. The team could see a need to provide audible contextual location information in real-time via reliable voice recognition and mobile phones, to relay real-time information about predetermined locations of interest or necessity.

Their solution was to develop a system utilising Bluetooth Low Energy (BLE) Beacons, multi-touch gestures, and smartphone technology to achieve this.

## 2. AUTHORS

The project team consisted of three students completing their third year capstone project as part of their Bachelors Degree of Information Technology- Software Engineering Major.

## 3. THE EXTENDED ABSTRACT

ICY is a play on words that best describes this project providing contextual location information for the visually impaired. A solution for an existing need that was based on statistical data gathered from a disability survey, summarised by MacPherson (2014), for Statistics New Zealand. That survey revealed 4% of our population (168,000) is affected by some sort of visual impairment. Other supporting evidence supplied by The Royal Foundation of the Blind (2011) estimated that 12,000 people were classified as legally blind with the total cost of visual impairment to New Zealand's economy at approximately \$2.8 billion.

The team's intent was to provide a solution that would provide the visually impaired with information about their location and its context, so they felt safe and confident moving around their communities. This could be achieved using three components: BLE Beacons placed at points of strategic interest, a database driven website to store and manage location information, and an iOS application to provide that information to the user. The web management portal would contain an interface for managing the location information associated with each individual BLE Beacon.

If a user wished to visit an area, they use the iOS application which queries the database for locations within an 8km radius. The user then registers for groups of nearby locations that they would like to visit. That information is then stored on their device and when the user approaches one of those locations, the application discovers the nearby beacon and delivers the stored information associated with that location via voiceover - audibly responds on that person's smartphone.

This has previously been achieved by using one of today's smartphones with GPS, which could only provide point-to-point locations outdoors on the run, which was very power hungry, and had performance issues indoors.

With BLE Beacon Technology, this could now provide additional information in voiceover, for the following: hazards, points of interest, bus and train timetable information, and strategic locations of interest to the user both



Fig 1 ICY Vision - Contextual Awareness for the Visually Impaired

This poster appeared at the 6<sup>th</sup> annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2015) and the 28<sup>th</sup> Annual Conference of the National Advisory Committee on Computing Qualifications, Queenstown, New Zealand, October 6-9, 2015. Michael Verhaart, Amit Sarkar, Rosemarie Tomlinson and Emre Erturk (Eds).

indoors and outdoors. To improve mobility around their community essential information could be furnished, like the opening hours of banks, post offices and, libraries; police stations, toilets, and other key locations of interest or necessity, making full use of this smart technology to provide contextual audible location information in real-time without clutter or data overload. Additional information indicating a dangerous street that needs to be crossed, warnings of commercial driveways or any other information of potential hazards that may exist within the specific location, could also be incorporated.

To achieve this, the project had to incorporate many safety features to include:

### 3.1 Trust in data throughout their journey

It had to provide: accurate, precise data without having to obtain data accessing the system with voice commands, transmitted in clear and understandable audio, and free of directional or transmission errors; and only give the recipient essential information required without being bombarded with information about every business they pass. The user chooses the information they want to hear which creates less annoyance without distraction through excessive information overload.

### 3.2 Providing indoor and outdoor points of importance

It had to overcome the location limitations normally imposed by using GPS, both indoors and outdoors. It is designed to notify users when approaching important public services and hazards, and upon entry into any of the facilities, the visually impaired person can then use their smartphone in the same way to be notified on additional points or specific items of interest within these buildings.

### 3.3 A MetLink transport integrated data facility

The use of public transport, although not impossible, can be a challenge, as public transport stops do not have audible information to help them make informed decisions around which bus or train to take, or even which current stop they may already be waiting at. Having information in audible form, can give them reliable use of public transport, increasing their confidence in their ability to use it more frequently.

As it had to integrate and link into the MetLink bus and train timetables, it had to be designed to incorporate and utilise the information provided by MetLink's General Transit Feed Specification (GTFS). In doing so transit arrivals and route information at the current stop are now provided in soft real time.

### 3.4 80% Reliability

It was required that the system achieve 80% satisfaction feedback from testers with an easy system of toggling down (activating/deactivating) with voiceover via Siri or Multi-touch gestures.

To test this stand-alone system, several representatives from the New Zealand Foundation of the Blind and a local disability company Adaptive Technology Solutions Ltd, were involved throughout the project during the requirements gathering and testing stages. Where the web management portal managed the contextual information, the mobile application delivered the visual and audio feedback, and the

BLE Beacons triggered the application when the user was near the set location.

## 3.5 Methodology

The Team used an iterative technical/development methodology throughout the project life cycle in order to perform rework and future additions. These were based on tester feedback and functional testing. Change requests were created which lead to further development, testing and evaluation as required. This cycle continued until that 80% tester satisfaction feedback was attained, and then deployed once the client had signed off each iterative.

This Project has been in operation successfully throughout our local community for nine months now and is in the testing and rollout phase. Partnerships with the Jackson Street Programme, Hutt City Council, Petone Settlers Museum and Dowse Art Gallery have seen the rollout of over 130 Beacons in the Lower Hutt region. Phase two of the project is currently being deployed with a more stable version of the application and versatile Application Programming Interface (API) nearing release. The ICY Platform is also being used as a base to develop other applications that rely on micro-location services. These include an Educational Resource/Heritage Trail for local schools in conjunction with Petone Heritage month and a Fitness Trail for The Smart Body, (a Lafayette, CA based Fitness Company.)

## 4. ACKNOWLEDGEMENTS

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