

Online Campus Navigation Tool for Students with Mobility Difficulties

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Abstract

In response to a need identified by the Disability Services division of Flinders University the creation of an online tool to aid campus navigation was initiated. By marking up maps of the campus with important nodes and joining these nodes, a tree like structure was created where navigation from one node to another was accomplished by traversing the segments. Recorded video attached to each segment can be dynamically “stitched” together to display an appropriate route for those with mobility difficulties. Requests for paths can be entered into a web form with the route displayed as a video within a browser.

This tool has the potential to improve the experience of all students in the early weeks of their university education. By removing the anxiety of navigating a foreign environment, students are better equipped to focus on the content being taught in those crucial first weeks.

Introduction

When a student first begins their university education there is a lot for them to take in before they sit in their first lecture or tutorial. The university campus is a completely alien environment to them. The many buildings, rooms, and people can be overwhelming. Imagine the difficulties that a new student may face. Where is this room located? How much time will it take to reach a particular destination? What is the most appropriate path to take? Are there any obstructions that may cause me difficulty? Now compound these navigation difficulties by sitting in a wheelchair.

Flinders University has implemented an online tool to aid in navigation across the two ridges of the campus. This tool allows students to indicate starting locations and final destinations. The application will provide them with video and still image guidance to their ultimate target. The system has been developed to specifically address the needs of students with limited mobility by plotting routes that can avoid stairs or other impediments.

This paper will discuss the reasoning for the development of this tool, the process for its creation, and conclude with an indication of the impact it is likely to have.

The Need

Universities are required by the Disability Discrimination Act 1992, and appropriate standards (Disability Standards for Education, 2005), to ensure students with disabilities have access to courses, services or facilities of the institution on the same basis as students without disabilities. To address these requirements, Flinders University (2007) has its own Disability Action Plan, and in 2008 the Disability Committee commissioned an access audit (Disability Consultancy Services Pty Ltd, 2008) of the campus that identified many of the difficulties for people with disabilities in finding accessible routes through buildings.

Also, the Review of Australian Higher Education Report (Bradley et al., 2008) urges universities to attract students from disadvantaged groups who have previously been under-represented in higher education. This goal is reflected in the strategies of Flinders University Strategic Plan (2010) to enhance the student experience.

In response to these drivers the Accessibility Wayfinding Project was initiated by the Disability Services division at Flinders University. They saw the difficulties faced by students with wheelchairs, crutches, and other impairments when trying to access the resources of the campus. Many students found it frustrating and in some situations dangerous to navigate the university grounds.

To provide some background details the Flinders University main campus is made up of two ridges, creatively named North and South. Travel between the two ridges is mandatory for most first year courses to cover all the topics that a student may be enrolled in. The North ridge has an elevation of approximately 143m above sea level, while the South ridge is 141m above sea level. The gully between the two ridges is approximately 113m above sea level. The incline leading up to one of the ridges at its maximum is approximately 30 degrees.

The University has defined access paths that are advertised on campus maps that are publically available to all students. For some, the translation between these static 2D maps and the real world is difficult. What happens to a student who successfully navigates into the required building, but is then confronted by a flight of stairs, when they need a lift? So by creating a system that could navigate the student to their destination by showing a video of the route the user could orient themselves better with their environment. Many institutions employ a combination of traditional maps and still shot images to help direct their students and users. This has proven to be an effective tool but has some limitations, especially for first year students new to the campus and its landmarks.

By making the tool an online application it could be provided to students anywhere within and beyond the campus. Students could use the campus computers to query routes to their next lecture. Users with modern phones could access the service while at the University to aid in their navigation. Students at home could plan the routes they would need to take before starting the day. It is this last point that relates specifically to those individuals with mobility issues. Instead of finding themselves lost or restricted from entering a particular area they are able to plan a path before they arrive at the campus and know with confidence that they can reach their destination.

The Development

The development of the system comprised four distinct stages: preparation of the relevant maps, video recording, still shot capture and editing of the paths and nodes, allocation of video content to each segment and images to each node, and development of the online tool. Following is a discussion of these development tasks.

Stage 1: Preparation

The first stage required the identification of important and relevant aspects for each building that could be recorded within the system. Items of interest included security phones, emergency exits, access toilets, access car parks, lecture theatres, elevators, bus stops, and School, Faculty and Student Services offices. Using a purpose built administration application; each map for the campus was marked up with nodes representing these locations.

The capacity for this tool to assist all students, not just those with mobility difficulties, was soon recognised and additional areas were identified as important including general toilets, car parks, and stairs. Each node was assigned a specific colour based on the target that it represented. Figure 1 illustrates a typical map in its marked up form.

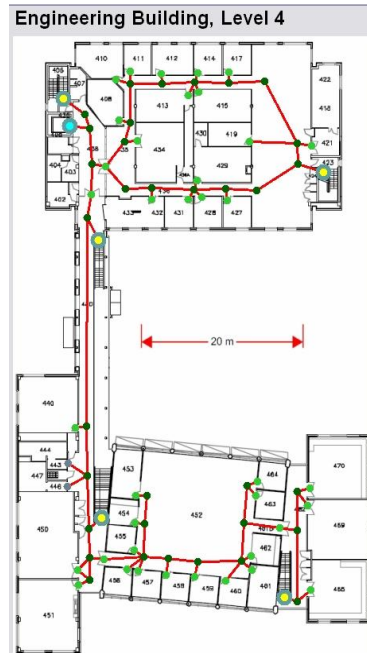


Figure 1: Typical map with nodes and edges marked up

Once these node locations were highlighted edges were created to join the nodes. Each edge or segment was assigned a cost; this cost was calculated from the length of the segment in metres multiplied by a difficulty factor. These difficulty factors ranged from 1 (or no modifier) for clear corridors through to 100 for stairs. By using this multiplier scheme we were able to make a 10m section of stairs equivalent to 1km of clear corridor. These costs for the various segments would be used when generating a dynamic path.

Stage 2: Capture and Editing

The process of recording to video the entire University was lengthy. A custom built trolley was created to mount forward and rear facing web cameras which were connected to a laptop. The two web cameras recorded individual video as the developer walked the corridors, paths, and roads of the campus. Given the nature of the nodes not all areas of the University were required to be mapped. Areas used by general staff, maintenance and high level administration were not recorded. It was assumed that students would not have a need to access these areas and therefore their capture was not necessary.

The rear facing recorded video stream was reversed before editing began. This gave the impression of the user travelling forward. By using the two cameras to record simultaneously, each segment only had to be traversed once.

After the video was captured for the buildings and paths around the campus it was edited by hand. Again this was a lengthy task requiring many hours to complete. These video segments ranged from approximately 2 seconds up to 3 minutes. The raw video elements were then converted to Flash format for easy web distribution.

Still shots were taken using a conventional digital camera. Initially images were extracted from the video streams but the quality and field of view offered by these images was limited. Each shot was then re-sampled for optimal web publishing on desktop and mobile devices.

Stage 3: Allocation of Video and Images

The administration tool was used to allocate the video to the each map. Each segment had two distinct video elements attached to it for both directions of travel. Video was attached to segments using file naming conventions. A video element was named with a combination of the segment and the node the segment would travel towards. For example a typical segment id would be IST1_Seg0001 and a node id would be IST1_E0001, therefore the video file name for that segment would be IST1_Seg0001_IST1_E0001.flv. This convention allowed for easier identification of video elements when generated dynamically for each query.

Images were attached to nodes in a similar way to the video and segments. Each node had one image for each segment leading from it. Therefore a node that was the hub of 4 segments would have four images attached. The naming convention used made use of the node id combined with the segment id. Again, this structure provided an easy way to reference the images from the web tool.

Stage 4: The Online Tool

With extensive use of PHP, the online tool takes user queries and dynamically generates videos from retrieved segments. The tool makes use of the well known Dijkstra's algorithm (Dijkstra, 1959) for determining the shortest path; this algorithm is used in various computing scenarios. The algorithm steps through edges in a tree structure and finds the shortest path from source to destination based on the cost of each step.

User queries can be supplied through two techniques dependent on the platform that they are accessing the system on. If a desktop environment is being used then an image selection process can be used. However, if the system is being used from a hand-held, mobile device then drop down menus can be used to select the source and destination for the path.

For the desktop environment the user is able to select an area from the campus map to indicate their starting location. If the user selects a building then a menu appears asking for the floor number. Once the user has completed this selection they are presented with a marked up image of the floor plan they indicated. When the user selects a node on the map the coordinates of the mouse click are used by the system to determine the node selected. This information is stored in hidden details and the destination process begins. The user can follow the same series of steps for selecting a destination or they are able to indicate that they wish to navigate to the closest of the following targets: access toilet, lift or security phone. These details are provided to the Dijkstra's algorithm which identifies each segment and retrieves the necessary video and image files.

For a hand-held device the user is able to bypass the large campus map and use the pull down menus to drill down into a building. They need to select which building they are interested in and then which floor. This will display a map of the floor where they can select the node they wish to consider. To determine the destination they complete a similar series of steps or they can select the closest access toilet, lift or security phone as with the desktop version of the application.

The Impact

By providing this valuable tool, Flinders University is enabling the independence of all its students. This tool is primarily aimed at assisting the first year university experience of individuals experiencing difficulties with access. It is expected that it will maintain heavy use throughout the first several weeks of each semester and then as needs require. It is expected that students at the University will be made aware of the tool at enrolment and will be encouraged to use it to plan their daily itineraries. For all first year students, including those with mobility issues, this tool will remove some of the anxiety that they will inevitably encounter when they first begin their university career. By reducing navigation stress they will be better equipped to understand the material being taught during the early weeks of their first year.

Session Plan

Presenters (10 minutes): Discuss the motivation for the system, present case studies

Group Discussion + Presenters (5 minutes): Invite group to share their own experience on access at their institutions and their ideas on identifying appropriate access to first year students unfamiliar with the environment. What is the impact on the first year experience?

Presenters (10 minutes): Discuss and demonstrate the application

Group Discussion + Presenters (5 minutes): Invite comments and questions on the need for this technology in other environments and alternative strategies for creating guidance systems

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