A CYCLE ROUTE PLANNER MOBILE-APP FOR DUBLIN CITY

Maurice Gavin,

Tyndall National Institute

Bidisha Ghosh,

Trinity College Dublin

Vikram Pakrashi,

University College Cork

John Barton,

Tyndall National Institute

Brendan O'Flynn,

Tyndall National Institute

Anneka Lawson

Trinity College Dublin

Abstract

In a road network, cyclists are the group exposed to the maximum amount of risk. Route choice of a cyclist is often based on level of expertise, perceived or actual road risks, personal decisions, weather conditions and a number of other factors. Consequently, cycling tends to be the only significant travel mode where optimised route choice is not based on least-path or least-time. This paper presents an Android platform based mobile-app for personalised route planning of cyclists in Dublin. The mobile-app, apart from its immediate advantage to the cyclists, acts as the departure point for a number of research projects and aids in establishing some critical calibration values for the cycling network in Dublin.

INTRODUCTION

Cycling as a green and sustainable mode of transport is continuously being encouraged in recent times. The concept of cycling as a lifestyle is being welcomed by the owners of public infrastructures, policy-makers, doctors, transport planners, insurers, media and end-users. In Ireland, the general tendency is positive towards cycling and finite but limited facilities have been provided. Most of the existing efforts are survey based, ad-hoc or piecemeal relating to the available geometry or some local condition. Network based formal transport planning is absent for cycles in cities in Ireland. Such formal modelling, scheduling and assignment are however established for other modes. Planners do try to integrate all modes for a system optimal approach but cycling is currently not a part of this. In short, the trip generation, trip distributions, modal split, levels of service and other related factors are not yet established for the mode.

In a road network, cyclists are the group exposed to the maximum amount of risk. Route choice of a cyclist is often based on level of expertise, perceived or actual road risks, personal decisions, weather conditions and a number of other factors. Consequently, cycling tends to be the only significant travel mode where optimised route choice is not based on least-path or least-time. To successfully eliminate this problem it is important to develop handheld, easy-to-use and multi-tasking route planners which can be used by bicyclists while riding their bikes without much discomfort. This paper presents an Android platform based mobile-app for personalised route planning of cyclists in Dublin. The mobile-app, apart from its immediate advantage to the cyclists, acts as the departure point for a number of research projects and aids in establishing some critical calibration values for the cycling network in Dublin.

LITERATURE REVIEW

To improve the cycling network and hence increase cycling numbers, the needs and preferences of Dublin cyclists must be understood. This has been done in other cities around the world through stated preference and revealed preference surveys on route choice. Stated preference studies have been popular in examining the route choice considerations of cyclists, as they offer the advantage of being able to assess attitudes towards facilities or features of the network which are not available. Surveys are used to ask specific questions on route choice, allowing comparison of many route features. Revealed preference studies on the other hand involve collection of information on actual routes taken. This involves creating a network of travel data. Generally study participants have been asked to draw on a map the route they took [1, 2]. Menghini et. al. [3] and Broach et. al. [4] used GPS devises carried by participants to record route information which could be easily mapped with the transport network data. In the study by Menghini et. al. [3] the GPS information was collected from all modes and contained no information on the personal characteristics of the participants or which mode they had used.

Most European cities and a number of American cities have developed bicycle route planners to inform cyclists of their route options between origin and destination. Route planners such as Google Maps consider only shortest distance in their calculation of an optimized route, offering alternative routes which are similar in length. Other route planners offer more route preferences, taking cyclists safety, cycle facilities, traffic volumes, scenery etc. into consideration. Copenhagen’s cycle route planner gives a choice to create take the shortest route, a route which uses cycle facilities as much as possible, the safest route, a ‘green’ (scenic) route or a quiet route (lower traffic volumes) [5]. The cycle route planner in Vancouver, Canada gives a choice between the shortest route, a route with a restricted maximum slope, the route with less elevation gain, the route with least air pollution on the route with most vegetation along designated cycling roads or to include major roads. This map also contains layers containing information on other cycle friendly routes, train stations, schools, drinking fountains and air pollution and vegetation levels [6]. In Germany there is a route planner which caters for all German cities. This route planner considers roadway grade and specific popular cycle routes only[7]. Hochmair [8] created a route planner interface which allowed users to place a weighting on selected attributes, important to them. This was done using slider bars between 0% importance and 100% importance. This system contained a set of higher-level and lower-level criteria, both of which carried weightings. The higher level criteria are ‘fast’, ‘safe’, ‘simple’, and ‘attractive’. Each of these criteria are broken down further, for example ‘fast’ breaks down to consider, ‘short’, ‘few traffic lights’, ‘few intersections’ and ‘few turns’. These lower level attributes also overlap with the higher level criteria. This system can offer the user a more route more suited to the users’ preferences but the large number of attributes to be considered and the use of higher- and lower-level criteria may be too much on the cognitive load of the user. In a later study [9], Hochmair created a much more user friendly route planner for use in Broward County, Florida [10]. This planner gives a choice of short, fast, simple, scenic and least interaction with traffic routes. This planner also allows the user to add layers to the map to view public transport networks, street network (traffic signals and rail crossings), bicycle suitability (colour coded according to suitability), bicycle facilities and recreational facilities.
To conduct similar studies in Dublin, a smart-phone based app “Rothaim” has been developed.

ROTHAIM OUTLOOK

A GPS based app for android phones has been developed to analyse/ or assess travel behaviour of cyclists which in turn will help in the development of a cycling route planner. The app fulfils mainly two purposes. Firstly, it collects the cyclist travel behaviour data and secondly, it has the ability incorporate a complex cycling route planner taking traffic congestion/ interaction with non-cycling mode into account. To fulfil these two purposes, the app will require having a two-way communication system with a backend database/server. The following stages of information transmission will be taking place in this process:

(1) Collection of information through, clock, timer and GPS unit on a mobile phone
(2) Transmission of this information (through email/sms/other feasible way) to backend database
(3) Processing of this information using complex algorithms in the backend database to develop a possible optimised route to the destination
(4) Transmission of the route information to app/mobile phone where the route will be seen on a map
(5) The app will have the possibility of accommodating future information in the form of accelerometer data output, photographs etc.

It is expected that the following information should be collected:
a) Phone and trip id (unique user id and trip id)
b) Trip purpose
c) Time of day
d) Location/GPS information
e) Calorie count (using speed based algorithm at this minute)
f) Personal information of the user and
g) Weather.

At this stage, the first step of development, i.e. the collection of cycle trip data has been completed (steps 1&2). In the next couple of figures the different elements of the app are shown. The app can record trips considering different attributes as shown in Figure 1.

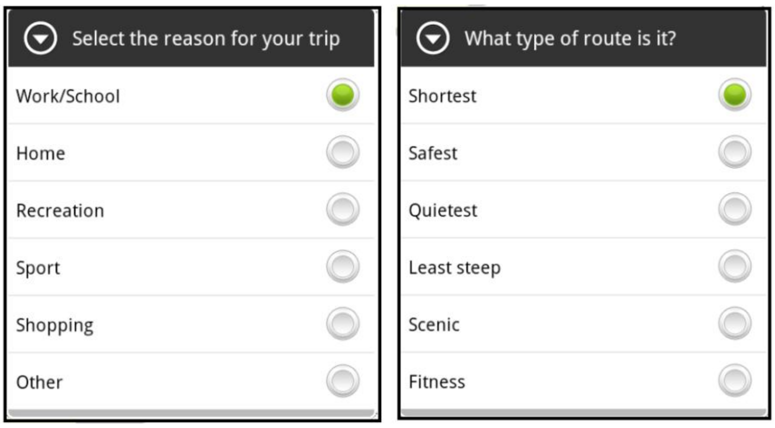


Figure 1: Trip attributes as shown on phone

The recording of the trip is performed using a simple setup.

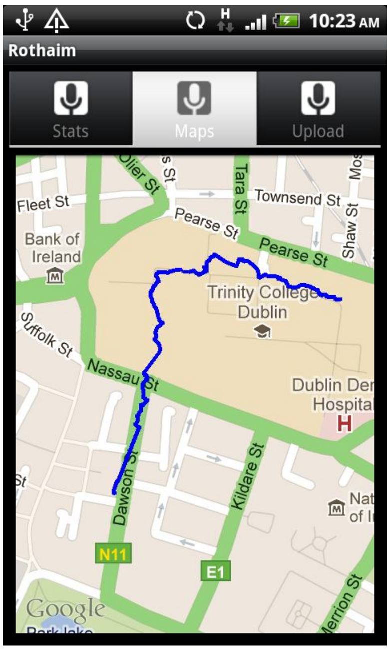


Figure 2: Map of route

The recorded trip can be seen on the phone. In future, the map of an optimum route will be visible on this screen along with the map of the travelled route.

DESIGN OVERVIEW OF ROTHAIM

The overall goal is to create an app to assist cyclists in planning their optimal route and to collect data about the choices that they make. The design principles are:

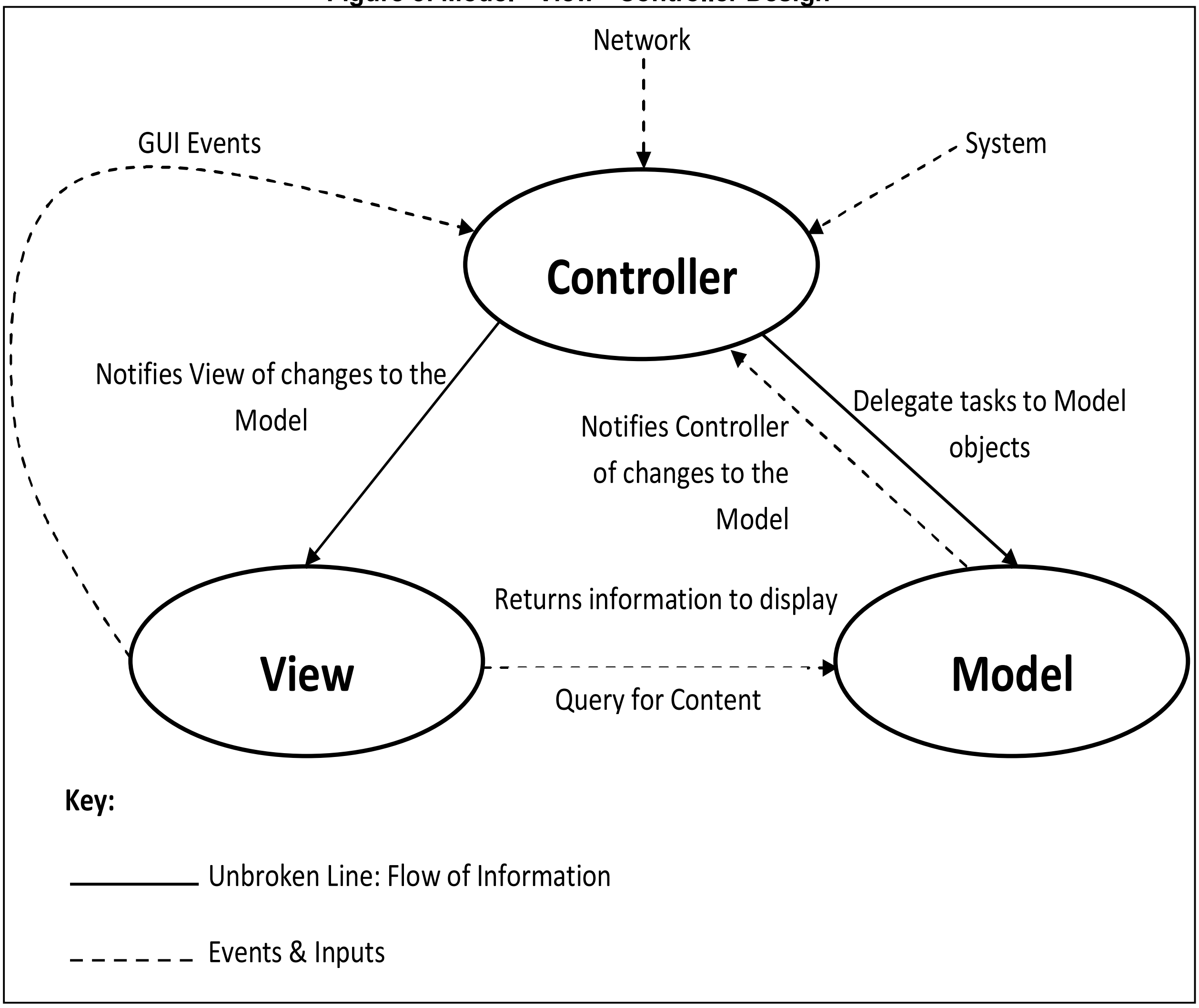
Robust: The application should not stop working if the user does something unexpected. This includes but is not limited to trying to upload data when no network connection exists or losing GPS signal midway through recording.

Scalable: The app should be able to scale to encompass cities other than Dublin.

Additionally it shouldn't matter how long a recorded trip is.

Flexible: It should also allow easy integration of future requirements without affecting the existing operations. This will require a modular approach to development.

Figure 3: Model - View - Controller Design



The app has three elements:

Model: The Model manages the behaviour of the application. It responds to information requests from the View and Controller. When a change is made to the Model it notifies its *Observers*. The model includes the classes, trip class (A Trip object contains all information associated with a single journey), route class(A Route object contains the geometric co-ordinates of the route), personalised route class(A Personalised Route object contains the information about the suggested personalised route), database adapter class (A database adapter object allows the programmer to interface with the underlying application database. All trip data is stored in a SQLite Database in internal memory), recording service (The Recording Service controls the recording of the current Trip).

View: The View displays the Model as an interface. It provides the user with a way of interacting with the Model. The View queries the Model to generate the content for the user interface. The Controller can instruct the View to re-render itself once it has been created.

Controller: The Controller will deal with any inputs and generates a response by interacting with the Model. Sources of input include GUI, Network and System. The controller interfaces with

- Model
- View
- System - clock, accelerometer, GPS
- Network - Internet database

The details of the design can be accessed through the detailed Rothaim manual.

DATA COLLECTION

Through the Rothaim app, trip data is being collected with the help of volunteers.

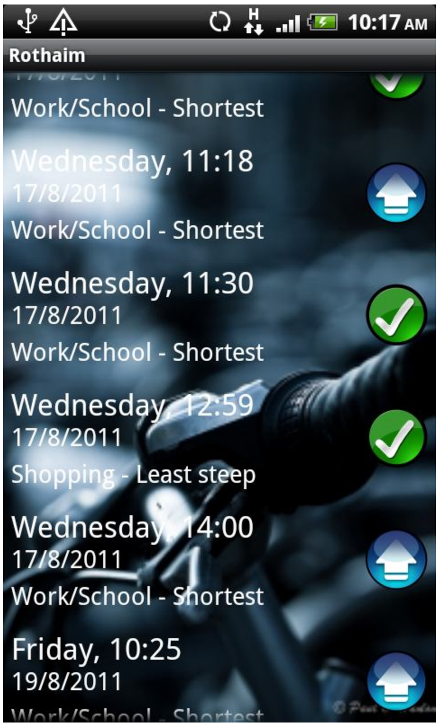


Figure 4: The History Application

This feature helps the volunteers/users to see the old recorded trips and also is useful in uploading trips later if internet connection is not available. The trips can be checked for behaviour statistics. The trips can be also bunched by using different trip attributes.

CONCLUSION

It is expected that the GIS based app will be critical in collecting significant amount of data using Smart Phones from selectively chosen volunteer cyclists in Dublin representing a wide cross-section of the entire gamut of cyclists. A repository will be established for the cycling routes and other variables (heartbeat or pulse, ride quality as a function of acceleration, weather conditions) for anonymous but uniquely identified cyclists. Interrelationships and clustering for targeted sub-groups within cyclists will be explored from this data. Available Dublin-Bike travel data will be used to test, enhance and modify the observed relationships. The results of this study immediately acts as the departure point for a number of related follow-up projects already in pipeline and provides with some critical calibration values for the cycling network in Dublin. The conceptual or qualitative outcomes of the project will be location independent.

REFERENCES

1. AULTMAN-HALL, L., HALL, F. & BAETZ, B. 1997. Analysis of Bicycle Commuter Routes Using Geographic Information Systems: Implications for Bicycle Planning. *Transportation Research Record: Journal of the Transportation Research Board,* 1578**,** 102–110.
2. HYODO, T., SUZUKI, N. & TAKAHASHI, K. 2000. Modeling of Bicycle Route and Destination Choice Behavior for Bicycle Road Network Plan. *Transportation Research Record* Paper No. 00-1434.
3. MENGHINI, G., CARRASCO, N., SCHÜSSLER, N. & AXHAUSEN, K. W. 2010. Route choice of cyclists in Zurich. *Transportation Research Part A: Policy and Practice,* 44**,** 754-765.
4. BROACH, J., GLIEBE, J. & DILL, J. 2011. Bicycle route choice model deveolped using revealed preference GPS data. *Transportation Research Board*.
5. Cycle Copenhagen. http://www.cyclecopenhagen.dk. (accessed 23 February 2011)
6. Cycle Vancouver. http://www.cyclevancouver.ubc.ca. (accessed 23 February 2011)
7. Radrottenplanner, Berlin. http://www.radroutenplaner.nrw.de. (accessed 23 February 2011)
8. HOCHMAIR, H. H. 2007. Dynamic Route Selection in Route Planners. . *Kartographische Nachrichten, .* 57 70-78.
9. HOCHMAIR, H. H., AND FU, J. (2009). Web Based Bicycle Trip Planning for Broward County, Florida. ESRI User Conference, San Diego, CA
10. Bike Broward. http://maps.fiu.edu/mpobike/index.html. (accessed 23 February 2011)