

RouteMate, a location based route learning system for users with disabilities

a playful methodological experience in different urban European landscapes

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Abstract. In this paper, we will present the piloting methodology as well as the results from four different European countries, using RouteMate in a series of piloting sessions targeted to people in a vast age and ability range. We will also document the integration of RouteMate with playful scenarios, as well as the motivational qualities of such an integration for users with disabilities on open route learning in five different European cities.

Keywords: location based games; disabilities; route learning; motivation; methodology; playfulness

I. INTRODUCTION

A. Route learning in Urban Environments for people with disabilities

Adolescence and the transition to adult life are a demanding time for everyone and one of the core skills required for leading an independent life, social inclusion and self-determination in the city, is the achievement of independent travel skills and having the confidence to learn and travel new routes. Our first independent routes become a way to express our will and project our decisions while we create memories as well as mental maps of our surroundings.

However, especially in the urban settings, the situation for a young person with disabilities is more complicated and demanding. For young people with disabilities, the increasing desire for greater independence and freedom of choice, runs parallel with a decreasing requirement for supervision and protection same as their peers without disabilities. Conscious of the sometimes unfriendly urban environment and its dangers, parents and caretakers do not feel able to allow to young people with disabilities the degree of independence allowed to non disabled peers. Consequently, on reaching school leaving age, young people with disabilities have less chance of being independent, accessing further education and training and even less chance of finding employment [1].

As part of a European project we worked on the development of an accessible location based mobile and web application named RouteMate, to help people with various disabilities learn simple routes. This was supported by structuring the software using principles of game based learning, in order to scaffold the learning of new routes and promote ultimately independent travel [2].

RouteMate is not a route guidance system since route guidance systems suppress cognitive map development [3] and for a group of people who are described as having ‘poor spatial skills’ route learning should be adopted so as not to further suppress the development of these key navigational skills [4]. Moreover, in order to allow more efficient representation and development of spatial representation external frames of reference and map-based strategies were used. The main idea behind that decision is that alternative routes can be taken, shortcuts can be made and destinations changed, because they cover a more complete representation of the environment from a number of perspectives [5],[6]. Cartwright states that “We have a need to produce artifacts that provide the stimulus for humans to create a mental map or a synthetic world. Development of applications influenced by the need for creating accurate representations of the world by gaming strategies and more intuitive methods for interacting with and moving through cartographic representations of the world” [7].

Regarding the games based learning approach, it was based on the idea that learning should be combined with fun and use approaches that are motivating to enhance effectiveness [8]. Today’s mobile devices, like smartphones and PDAs, are often used as gaming instruments. There has been a recent explosion in the number of creative new games that are facilitated by mobile devices in such a way that the game activity evolves according to players’ location. Mobile location-based games, or pervasive and locative games, are described as compelling for young players as well as adults with or without disabilities [9].

Admiraal [10] reported that mobile games are excellent ways to combine situated, active and constructive learning with fun” (p 302). The mobile games be-come learning experiences when embedded in places of information such as museums or street settings, since they create an augmented reality setting which helps people to better experience the environment. According to Hinske [11], four main characteristics contribute both to the mobile game’s appeal and to the emotional attachment that players feel: (i) physical experience; (ii) mental challenge; (iii) social experience; (iv) immersion. Physical experience relates to what it is felt when interacting with real and tangible objects as well as with virtual elements. Players do enjoy additional mental stimuli by having to solve riddles or tasks. These games require people to meet, socialize and combine their efforts in order to be more effective while playing (social experience). Finally, the feeling of immersion in the game setting provides the main entertainment factor [12]

B. RouteMate Route Learning Application

RouteMate is designed for the Android Operating System, and provides the user with the option to create a new route, or load and modify an existing route with the help of a parent, care taker or trainer. RouteMate reinforces the learning of new routes, by allowing the user to rehearse the route a number of times accompanied by a trainer or teacher before independent travel through game based learning elements embedded on the actual application as well as playful scenarios during training supported by the design of RouteMate. The overall goal is to allow the user to travel more independently and rely less on the application and more on their own skills.

There are three modes of RECALL include Plan, Use and Challenge. Plan and Use allow the development of a new route and its practice. This system doesn’t guide the user; rather scaffold their journey should they make navigational errors (time or geographical divergence) by comparing current progress with their first (ideal) use of a newly planned route. The Challenge Mode provides a range of playful activities to help people with disabilities understand the connection between map-based representations and their corresponding real world locations. The Plan and Challenge Setting mode are available via the ‘Console’ (see Figure 1).

The playful narrative approach takes the form of digital scavenger hunts, by ex-tending the landmark style and interactions in different ways, and using them to scaf-fold different phases of use of the application. This approach seeks to teach and reinforce the concept of maps and route learning, as well as promoting the connection between the map representation and its real world counterpart.

Before the piloting application the main games based learning asset of RouteMate was a “Where-to-go-next” screen in Route Mate while on route and the playful concept of choosing photos, however this changed after the initial piloting phase, when it was

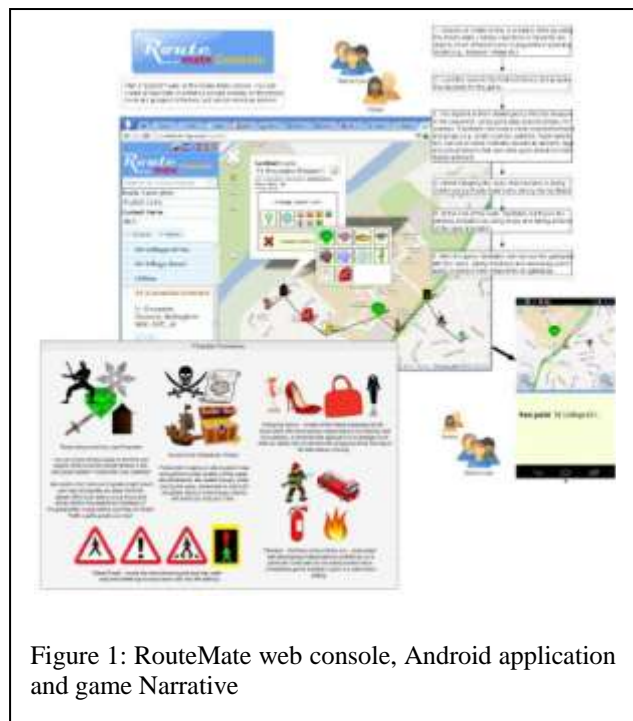


Figure 1: RouteMate web console, Android application and game Narrative

realized that a playful narrative should be integrated in the application.

During the Plan mode and by using different icons (see Figure 1) that promote narrative, playful storytelling and safety, the facilitator can easily design playful games using many different narratives. For example: Pirates – associated with route planning and creation activities while locating treasure and possible enemies in an urban setting. Ninjas – a “scavenger hunt” to find as many treasure items as possible, easily associated with being road cautious and aware of ourselves, of other pedestrians and staying safe and on route while using Route Mate. Firemen – find fires and put them out – associated with developing independence confidence on a particular route and can be easily turned into a competitive game between users in a safe urban setting. Shopping Spree – locate all the latest shopping trends – associated with developing independence and taking care of ourselves. Street Smart – locate the next street trouble and stay safe – map and street signs association with real life settings.

II. PILOTING STUDIES AND RESULTS

A. Methodology

A Case Study Methodology was adopted via a mixed qualitative and quantitative analysis for a period over two months.

Participants: 43 end users in four different countries, by five different research partners (UK, Greece, Romania and Bulgaria). Participants worked together with their caretakers and parents together with one or two researchers. Gender balance: 55.8% male, 44.2% female. Ages ranged from 8 to 68 years. Ethnicity: 15 were British, 1 Pakistani British, 9 Bulgarian, 7 Romanian and 8 Greek. 45.2% were beginners (referring to technical knowledge), 45.2% were average users

and 9.5% (4 out of 43) were described as experienced users. 34.9% experienced learning disabilities, 14% with autism and 4.7% communication problems. Cognitive, physical disabilities and sensory impairment were recorded in almost equal rates ranging from 25.6% to 27.9%.

Evaluation Tools: At this later stage of evaluation three phases of evaluation were conducted. First, a Soft Outcome Star measurement tool was used [13] to gather and systemize qualitative observations focusing on eight basic areas (Confidence, Engagement, Self Esteem, Concentration, Attendance, Participation and Timekeeping), applied before and after user trials to establish a baseline and to measure the application's impact.

The second stage took place in real settings using qualitative methods of analysis. Routes were created with Route Mate in caretaker or teachers/end user dyads. An observation checklist for six areas of interest (Satisfaction with usability/accessibility features, General attitude towards RouteMate, Verbal and non-Verbal expressions, Caretaker/teacher and end-user interaction and communication, User's progress, Impact/change after use), was used to order to organize the field notes. In depth analysis of selected cases was also included. Piloting spaces were free to use RouteMate as a route learning tool or as part of a playful narrative, as described below.

The third stage used a Likert-scale questionnaire to measure caretakers' evaluation of Route Mate, comprising 19 items in three sub-scales.

Two supplementary methods took places that are also worth mentioning. "Recreating the Route" was a way to test the construction of cognitive maps through the use of mobile assistive technologies. After the end of a journey each group gathered around and with the guidance of the re-searchers and the help of the caretakers, recreated the trip using markers and a printed Google map copy of the general area. The aim was to recall the entire journey, stop-by-stop and draw them on the map. In this way the researchers could test whether or not the end-users could create a cognitive line of their trip and if Route Mate helped them to do so. The "Where-to-go-next" screen in Route Mate and the playful concept of choosing photos was also evaluated.

The "Ninja Game Route" was an example of a playful user experience research method. The basic concept was to implement a game narrative structure in the session and create goal-orientated actions. The narrative here was a Ninja scavenger hunt game where participants had to "unlock" and thus collect virtual and real hidden diamond props. The diamonds were "unlocked" each time a predefined stop was reached and were given to the participant who could recall that stop at the end of the session. All diamond props were placed upon a wooden sword. Incorporating game-like elements, such as this, made the journey not only more fun but also helped the users to concentrate and be more cautious while walking and could possible contribute to spatial map formation.



Figure 2: Previous games based learning approach

B. Results

The data analysis showed possible link between the level of satisfaction while using Route Mate and previous technological knowledge, while the reliability of the application, defined both as the actual problems that may occur during a test trial and as the negative expectation based on personal experience, seemed to play an important role. Stress levels correlated with user's confidence and in turn became an encouraging/discouraging motivational factor for using Route Mate and playful mode seemed to eliminate stress and link to positive view of assistive application and better recollection of places.

During the piloting sessions, when RouteMate would be used as part of a playful narrative and as the technical problems started to resolve, stress levels decreased whilst participants' confidence increased and their intrinsic motivation to use Route Mate motivated them to learn new routes. The stress levels of the more experienced users are significant lower. An interesting aspect was that in testing sites that the playful mode was used, RouteMate usage triggered the desire for self-improvement and learning other skills (independence, learning to read, finding similar programs and information about assistive technologies).

The role of Route Mate as an educational tool was evaluated by caretakers and in some cases parents. 83,7% of the responders agreed that Route Mate is a useful tool for training disabled people, while the 79,1% answered that mobile assistive technologies can be a potential educational method. Finally, responses from users with intellectual disabilities show no qualitative differences in contrast with individuals with no intellectual disabilities (but with other kinds of impairments/disabilities) regarding usability/accessibility, impact and change after use and attitudes to use, providing an important indication that Route Mate can be an equally useful as a learning and assistive tool for both categories.



Figure 3: Users after a succesful playful journey using RouteMate

Interestingly, preliminary qualitative results and focus groups at the end of each playful session concluded, that users retained information much better when using Route Mate as a scaffolding game than when using it as an assistive route learning application. More research data is required in order to determine that the playful use of Route Mate improved the understanding of map based representations. An increase in self-determination, motivation and memory was also recorded in participants at the gamified piloting sites. Combining games based learning elements (GBL) with location based services (LBS) has proven to be a successful methodological approach with high motivational qualities for participants and caretakers. In summary participants made important progress in their IT skills and self-determination after the Route Mate sessions. Research results, together with users' and caretakers' comments, showed that using Route Mate can lead to an increase in autonomous travel, producing at the same time the necessary motivation for further personal development.

According to case studies in various locations, an increased interest in using Route Mate associated with a positive future image of the self. For example, according to our subjects, Route Mate could support future plans like an independent trip, applying for a job or going to school. In general, an assistive location based technology like Route Mate, raised issues about independence and self-preservation and in more than one cases, the need to reassure their parents and their caretakers that one can function as a normal adult, even with the help of technology. Reaching a new destination and future planning became a new kind of discourse among the individuals who participated in our piloting sessions. Another interesting aspect was that in some cases getting to know and use a technology like Route Mate, triggered the desire to improve oneself.

A 25year old girl with mild mental and learning disabilities, unable to read or write, expressed a change towards academic goals. After the first playful session and the first successful journey, she confessed to her family that she would like to learn how to read. RouteMate as an assistive mobile application in the social context of our sessions helped her to confront

herself and motivated her to evolve and probably start claiming her independence. In a second case, RouteMate's functionality motivated a young 19 y.o. individual who wasn't previously aware about the use of technology in an educational context, started to search the internet for similar games and programs as well as information about assistive technologies and location based applications towards his goal to apply for a job for the first time.

III. PLAYFUL APPROACH IN AN URBAN ENVIRONMENT

A. *Practical Implications of Observation and Future Work*

The RECALL project has led to the development of a Console – a web based route planning device that can push routes to the Route Mate App; and the App itself that users can use to also plan and practice routes. A series of playful narrative have also been created to engage users in independent travel training.

In evaluating the route learning modes of App participants require significantly less help and make fewer errors in later playful stages of route learning than in earlier stages showing that it is an effective semi-independent route learning system. A qualitative evaluation showed the system's use can increase measures of self-determination, motivation and memory with high motivational qualities for participants with disabilities and their caretakers. There are also emergent indications that the gamified version promotes the development of better spatial mental models and further evidence to support or refute this finding will be pursued in the future.

Users with intellectual disabilities and their caretakers embraced playful user experience research method, while users with physical limitations preferred RouteMate as a learning tool, however the playful element augmented positive results regarding change and will for autonomous travel. Even though the urban landscapes amongst the piloting countries differ both in safety, accesibility as well as in social acceptance towards people with disabilities (some of the piloting cities were: Athens, Bucharest, Nottingham, Birmingham and Plovdiv), users embraced location based applications as an assistive and as a gaming medium.

In the special education national curriculum of the majority of our piloting countries, seems to be a lack of activities related to map understanding and construction. Users seldom learn how to use different type of maps and young users with disabilities are not involved in authentic and conceptual activities, since for safety reasons or lack of time, location play activities are known and visible, thus far away from real situation of problem solving while on route. User initially defines and orients itself from its surroundings and its objects, then defines and correlates the objects together and gradually develop a realistic perception of space and including himself in it [14].

Maps, however, are intricate and contain vast amount of information, involving complex representations, symbols and icons [15] while the main categories of concepts involved in its creation and use are representations, the notation, the orientation the scale [16]. Moreover involve concepts of geometric and representational correspondence reference systems [15]. For the above mentioned reasons maps are not usually part of the educational curriculum for users with disabilities and especially intellectual disabilities.

However, according to our findings, users with intellectual disabilities were more than keen to learn map usage when part of a playful location based system and also in some, but worth to highlight, cases, users expressed the will to make changes in their life in a more creative way and problem solving. According to the piloting experience, users with intellectual disabilities embrace location based applications both as an assistive route learning app as well as a location based game. It is a different and inspiring process that allows them to try their limits in an amusing and safe way while being able to choose their own path in the city. J.R.R. Tolkien was quoted to say “If you're going to have a complicated story you must work to a map; otherwise you'll never make a map of it afterwards” [17] and after our experience, we believe this can apply to life stories of users with disabilities in an urban environment.

Future work will also expand the use of the playful narratives and to add haptic feedback to the Android interface to allow accessibility by people with visual impairments.

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