A Mobile Phone Solution to Improve Geographic Mobility

Sacha Miteche[1], Alfredo Terzoli[2] and Hannah Thinyane[3]
Department of Computer Science
Rhodes University,
Grahamstown, South Africa.
email: g10m4201@campus.ru.ac.za[1], {a.terzoli[2], H.Thinyane[3]}@ru.ac.za

Abstract-Motor vehicle ride sharing is a popular way of travelling in most countries. Different incentives have made this mode of travelling to exist formally and informally, for example as in carpooling clubs and hitchhiking respectively. Advances in Information and Communication Technology (ICT) have facilitated developments of formal Dynamic Ride Sharing (DRS) systems that target mobile devices. These are seen as solutions to people's preference of flexible ride sharing services. In developing countries, hitchhiking is a common technique for ride sharing travels. This paper describes a proposal to develop a DRS system that primarily targets mobile phone users in South Africa for informal ride sharing methods done in hitchhiking.

Index Terms—Dynamic Ride Sharing (DRS), hitchhiking, ICT4D.

I. INTRODUCTION

In many developed countries, formal ride sharing is promoted as a solution to the reduction of environmental degradation and traffic congestions. The practice involves car owners with similar origin and destination points agreeing on sharing available vehicle space for their road trip. In this way, the presence of High Occupancy Vehicles (HOV) is increased which reduces road congestions and rapid carbon emissions [1]. To encourage ride sharing, several incentives are provided e.g. use of faster HOV lanes and reduced toll fees [2]. Over the years, people's preference of Dynamic Ride Sharing (DRS) services have initiated projects [2] aimed at delivering appropriate DRS systems. Levofsky [1] describes DRS as a form of ride sharing used for single, one-way trips that accommodates random points at random times.

In developing countries, ride sharing is commonly done through the informal method of hitchhiking than formal ride sharing methods. Hitchhiking is an example of informal DRS in which ride seekers strategically position themselves at points of pickup by car owners without any prearrangements of the trip. It provides an alternative to public transport and in some areas it is the only means of travel.

Information and Communication Technology (ICT) has been a key enabler in ride sharing systems. Recent research in DRS have focused on how today's technology can best be utilized to deliver modern DRS operations as shown by the examples of Avego and Carticipate projects reported in [2]. Increased computational abilities in today's mobile phones have provided a platform to deliver DRS services for people on the move.

In 2010, the number of mobile connections worldwide passed over the 5 billion mark. Africa being the least developed region reached an estimate of one mobile connection for every two people [9]. These statistics make a mobile phone an ideal platform to deliver DRS services that can reach people of different levels within a developing country.

In this paper, the research environment and motivation factors are explained followed by an overview of the proposed approach and implementation of a DRS system.

II. BACKGROUND

This research is being conducted in the Eastern Cape province of South Africa and specifically in Grahamstown, its surrounding towns and the community of Dwesa. These areas represent communities of urban and rural living in South Africa, with different socio-economic backgrounds and resources. Despite the diverse communities, people representing each group actively participate in hitchhiking travels.

Therefore, the expected composition of owned mobile phones has a range of old and new models with different capabilities. The telecommunication infrastructure in urban areas (e.g. Grahamstown) have good connectivity (GSM, GPRS, 3G, etc.) while in other rural areas (e.g. Dwesa) it is sometimes erratic and not always available. Within the research area there are some mobile phone users with low computer literacy levels mostly in rural areas [12].

Ride sharing systems are available in South Africa in the form of web applications e.g. carshare.co.za [3] and Greenwheels [4]. As reported in [5], the Mobility 2011 survey from Word Wide Worx found 39% of urban South Africans and 27% of rural dwellers are now browsing the internet from their mobile phones. Hence, web based ride sharing services are not available to a significant percentage of internet users from different levels of communities: with many using resource constrained mobile phones. In addition, these ride sharing systems do not accommodate spontaneous ride sharing practices depicted in hitchhiking travels.

Under the Siyakhula Living Lab (SLL) project, multidisciplinary ICT for Development (ICT4D) solutions are being implemented within our research area using relevant technologies [13]. It is expected that our proposed DRS system will be part of the SLL solutions to modernise the current hitchhiking travel method.

III. MOTIVATION

Communication is an important aspect for the success of any real time ride sharing system and determines the system's reliability [1, 2]. South Africa, like many African countries, has seen significant reductions in internet service prices by mobile service providers due to competitions in broadband markets as a result of the undersea cable connection [5]. Therefore, mobile phone users are expected

to incur reasonable costs when using real time communications through the Internet in our proposed DRS system.

Many mobile phone users in South Africa have gained experience in using Internet and Short Message Service (SMS) based mobile applications from services such as social networking and banking [5]. Familiarity with these applications will enable most users adopt a DRS system that use similar interaction methods to deliver its services.

Hitchhiking has several risks which include travelling with possible car hijackers, unknown vehicle particulars and uncertain destination points. Despite the risks, hitchhiking is still popular in South Africa. Therefore, by understanding the incentives behind it and the participants' expectations in improving the practice, an appropriate DRS system can be developed to become part of the people's travelling process.

IV. APPROACH

In general, Iterative Design approach will be used in developing the system with the key steps done as follows:

1. Requirements Gathering.
   Study of similar works in DRS systems will provide a basis for our proposed system. Then, it will be adapted to our research area's perspective by getting firsthand information from the residents through formal and informal interviews. Further understanding will be achieved by participating in hitchhiking travels within the research area.
2. System development.
   The system will be deployed in the Reed House Systems (RHS), a software factory hosted at Rhodes University [10]. As such, Java Spring Framework and Spring Dynamic Modules will be used to develop a DRS application with OSGi specifications [11] to run in the RHS's Teleweaver container [10].
3. System Testing.
   Initial testing using emulators and mobile phones will be done and followed by usability tests involving a sample of representatives from the research area.

VI. DESIGN AND IMPLEMENTATION

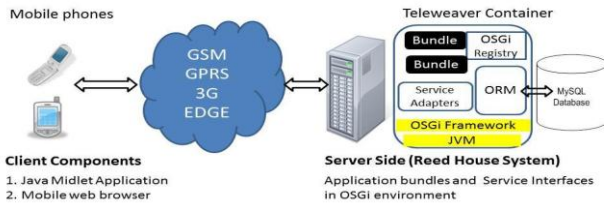

Figure 1: System Overview

As shown in Figure 1, the system will use client/server architecture. The server side will be deployed in the RHS. Clients will be in the form of mobile web browsers and a Java Midlet application [6].

In the Teleweaver, DRS system bundles (Java Archive files) will perform the required business logics. The container will provide access to all necessary service adapters e.g. the Object Relational Mapping (ORM) service using Hibernate [7] for persistent data management with a database (e.g. MySQL).

On the client side, a Java Midlet application will be developed using the Sun Java Wireless Toolkit [6]. For web clients, the Java Spring Framework has several web front end frameworks. The Google Web Toolkit (GWT) is one example. Using GWT will enable the deployment of an AJAX-style DRS web application, after using Java programming development [8].

Data transfer between mobile phone clients and the server side will use the Internet provided by the mobile service networks. In addition, SMS communications will be used for faster two way interactions and delivery of notifications. Use of SMS will also be convenient for users in areas that are not always connected to the internet and for mobile phones that do not support internet communication [5].

VII. CONCLUSION

This paper describes an investigation aimed at delivering a DRS system to improve current hitchhiking practice in South Africa. The DRS services must be simple to use for people with different computer literacy levels and available to a range of mobile phone types. In addition, the system should play a role in formalizing hitchhiking operations with actions such as recording of trip details and feedbacks of users' travel experiences.

VIII. REFERENCES

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Sacha Miteche received his Honours in Computer Science in 2010 from Rhodes University and is presently studying towards his Master of Science degree at the same institution. His research interests include computer networking, mobile and database technologies.

This work was undertaken in the Distributed Multimedia CoE at Rhodes University, with financial support from Telkom SA, Comverse, Stortech, Tellabs, Easttel, Bright Ideas 39 and THRIP.