BusNet - A Prototype Implementation of an Intelligent Transportation System for Winnipeg Urban Transit

by
Ghavam Fayyazi

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Department of Electrical and Computer Engineering
University of Manitoba
Winnipeg,
Manitoba, Canada

Thesis Advisor: R. D. McLeod, Ph.D., P.Eng.

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BUSNET - A PROTOTYPE IMPLEMENTATION OF AN INTELLIGENT TRANSPORTATION SYSTEM FOR WINNIPEG URBAN TRANSIT

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To Winnipeg

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- Abstract

Intelligent Transportation Systems (ITS) are being used in many cities of the world. In this project, as a subset of such a system for the city of Winnipeg, an instance of an Advanced Traveler Information System (ATIS) is introduced and the implementation of a prototype of it is described. Such a system could be used to access to the real-time information of the operative buses of the city transit system. Using low price GPS receivers, specific computer applications, and wireless communication/ telecommunication systems capabilities, as well as, the Bluetooth wireless technology a positioning system is designed and employed to transfer the real-time information of the locations of the operative buses to a database. The information gathered in the database is provided to the end users connected to the Internet. The information is also provided to be used by the transit system monitoring and management centre. Fuzzy logic concepts in reporting the real-time positioning information and Neural Network methods in creating transit system timetables are discussed. The system architecture, following Canadian and US national ITS architecture, is introduced and closely investigated. Such a scaleable system could be a part of an integrated Winnipeg Transportation Management Center (TMC) in future.

Section 1 - Introduction

1- Introduction

Recent advances in computer and communication technologies have greatly enhanced our ability to manage transportation systems on an area-wide basis. Typical aspects of this capability are the monitoring of traffic flow, remotely adjusting the timing of traffic signals, detecting incidents and dispatching emergency equipment, tracking the movement of transit vehicles and communicating with their operators, monitoring the capacity of parking facilities, and issuing advisories to the traveling public.

Providing people with timely and accurate traveling information, as well as, improving the quality of it have been prime objectives of Intelligent Transportation Systems (ITS). Real-time information about traffic conditions and travelling options help travelers make more informed decisions about routes, travel modes, and times of departures. Such information provides passengers with faster commutes and more efficient transportation systems.

In this project, an ITS system is introduced and implemented, as a prototype, in which the real-time positioning information of the buses of Winnipeg Transit System are gathered on a database and accessed by users connected to the Internet. The main idea behind of this project, at the time of proposing, was to use the capabilities of evolving GPS, communication, and telecommunication technologies to provide the required building blocks for developing such an ITS system for the city of Winnipeg.

Figure 1-1 illustrates the various components of the suggested system from a general point of view. The figure is not a precise technical depiction of the project, named BusNet, and neither does it reflect all components involved in defining and/or implementing of the system. A detailed depiction of the system components, and their interaction with each other, will be presented and discussed in a later section when the system architecture is investigated. The figure, however, provides a general idea about the project and supports a visual description of it in an easily

understandable way. The figure shows the system as it was thought of, and suggested at its very early steps of proposing, as sketched on a white board.

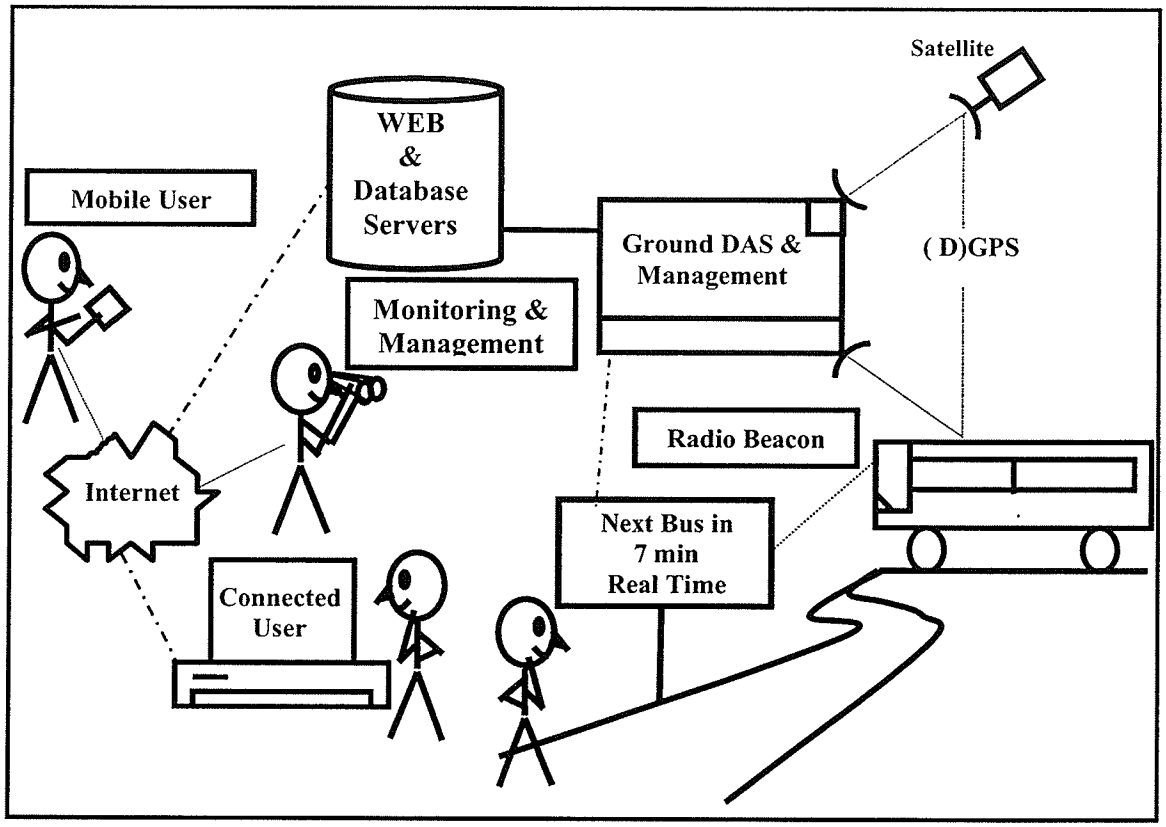

Figure 1-1 – General system layout of this project.

It is presented here, to support an introductory view over the system, as it historically did when the first part of the project was proposed.

The remaining part of this introduction overviews what this project provides for the system users and where more rigorous definition, explanation and implementation of its components can be found.

The next section, Section 2, reviews the present status and the future plans of the Winnipeg transit system, to provide a general background about a typical transit system as a model, based on which the present ITS system is designed. Section 3 discusses Intelligent Transportation Systems (ITS) in general, its present situation in Canada and around the world. It also describes the project

system architecture from the Canadian ITS Architecture point of view. In Section 4 an explanation about positioning systems employed in ITS systems is presented. Global Positioning System (GPS), Differential GPS (DGPS) are explained, and the type of DGPS used in this project are introduced. Section 5 discusses the mapping techniques employed in this project. In Section 6, the development of an application that simulates the behavior of a GPS receiver, installed in an operative transit bus, is explained. Section 7 is devoted to GPS receiver output analysis, various auxiliary-positioning methods deployed in this project, and fuzzy logic concepts implemented for making decisions about the reporting time of the detected out-of-schedule positioning events. A light prototype of a central monitoring unit is also introduced in the same section. Section 8 discusses how Bluetooth devices can be used as a part of a positioning system and the way that they could help in the interpretation of the on-board GPS receiver's output. Section 8 also explains how the Bluetooth scatternet topology might be employed to make a new positioning system, substituting GPS receivers in this project. Section 9 discusses accessing the system database over the Internet and developing the corresponding Internet applications. Section 10 describes, in detail, an application developed for PDA devices, equipped with Palm OS 3.5 or higher, which provides a mobile user of the transit system with the real time information of it. Using Kalman filters in anticipating bus arrival times to bus stops, employing Neural Networks in creating and/or modifying the system's timetables, and implementing the system's hardware are all briefly discussed in the Section 11 which also concludes the thesis. The application codes developed for the project are all available electronically.