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Collaborative Filtering Recommender System for Timely Arrival Problem in Road Transport Networks Using Viterbi and the Hidden Markov Algorithms

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ABSTRACT

In this study, a timely arrival recommender system (TARS) using Viterbi and hidden Markov Model (HMM) was developed. Ratings from current road users were used as inputs and trained to provide recommendations to prospective road users on the best routes to follow to get to their destinations from any source in time. The system was deployed on Android devices and iPhones with Google map. Real time data on current road conditions were collected from twenty-one (21) bolt drivers in Calabar Metropolis traversing various routes from Unical to Watt Market. The system could calculate arrival time in km/h, generate nearest nodes on each route, detect routes with free or congested traffic flow, and then recommend the best route in real time to users for timely arrival. The application, if adopted, can aid road users to save time, cost, and reduce stress on both humans and the vehicles used.

KEYWORDS

Arrival, Collaborative, Networks, Ratings, Recommendation, Road, Timely, Transportation

INTRODUCTION

One of the major problems affecting global transportation system is timely arrival of travelers at their destinations. Transportation, whether public or private, plays an important role in peoples' lives by helping them to move from one place to another, providing them an easy means of transporting their goods and services for optimum business transactions. There are different means of transportation; some people choose to travel by air, water or by land/road.

Road transportation involves the movement of people and goods from one point to another on roads. On roads, motor vehicles and animals are used to move humans, goods and services. A road is a land route that traverses between two destinations, constructed to enable transportation by way of motorized and non-motorized carriages (Nanzip, 2020). People engage in transportation for various reasons such as business, tourism or socialization. In most cases, many people travel via a given

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route at the same time of the day resulting in congestion on such routes. Consequently, commuters often get disgruntled with time wastage on the road, stress, and untimely arrival at their destinations.

The quality of a road transport system can be improved upon with the help of modern technology and intelligent transportation systems (ITS), resulting in more reliable and convenient road transport services. Accordingly, collaborative filtering recommender systems (CFRSs) can be suitable for optimum road transport services (Alexander, et al., 2017). Recommender systems are algorithms designed to make suggestions about items that are relevant to users. Such systems are designed to help users filter out irrelevant targets and recommend targets that may be of help to them. A recommender system helps a user to make choices following recommendations by the system when there is no sufficient personal knowledge or experience of the available alternatives (Isinkaye, Folajimi & Ojokoh, 2015).

Recommender systems are software tools and techniques for suggesting items to users by considering their preferences in an automated fashion. The suggestions provided are aimed at supporting users in various decision-making processes. Technically, recommender systems have their origins in different fields such as Information Retrieval (IR), text classification, machine learning and Decision Support Systems (DSS). They have proven to be worthy tools for online users to deal with information overload and have become one of the most popular and powerful tools in E-commerce (Mehrbakhsh et al., 2013).

Recommender Systems (RSs) are used in a variety of areas, with commonly recognized examples taking the form of playlist generators for various services desired by users. These systems can operate using a single input or multiple inputs within and across platforms. Since recommendations are usually personalized, different users or user groups receive diverse suggestions. In addition, there are also non-personalized recommendations (Jannach, 2016). Recommender systems development is initiated from quite a simple observation: individuals often rely on recommendations provided by others in making routine, daily decisions (McSherry & Mironov, 2019). In simple form, RSs try to predict what is most suitable based on the user's preferences and constraints. In completing such a computational task, RSs collect from users their preferences, which are either explicitly expressed, (e.g. ratings for path), or are inferred by interpreting user actions. In the case of road transportation, path recommender systems assist road users to consider a path to take before traversing such path.

A path or route recommender system can be used to identify multiple optional paths available in a given location, influenced by user rating or preferences using a subclass of information filtering system that seeks to predict the alternative desired route to the destination. The Collaborative Filtering Recommender System (CFRS) can provide such guidance on what path or route to choose among the vast available options that can lead to timely arrival (via rating or preference). The system can be applied for the provision of dependable traffic information to help road users including pedestrians to make better route choice decisions.

Timely arrival is a priority to every road user, saves transportation cost, promotes productivity and optimizes profit maximization. Timely arrival is measured by a road user's ability to arrive at the desired destination from a particular source on time and is stochastic due to the unprecedented dynamic nature of both travel time and the waiting time during transit services. In the research community, however, the problem of finding good alternative routes to arrive on time has received far less attention than the classical shortest path problem. Most of the techniques that accelerate shortest path computations in a specific setting often rely on a unique representation of distance between any given locations. Given this distance, they operate by pruning as much of the road networks from a search as possible, thus discarding anything that does not describe an optimal path. As a result, these techniques complicate the process of finding good alternative routes. Each of the possible routes may only be *optimal* in a setting described by the personal preferences of a group of users (Moritz, 2015).

Almost all transportation systems have timetables that designate vehicular arrival at scheduled stops. Road transport systems are highly utilized where services run on time, as anyone planning on making use of the service can program his/her activities with that of the transport system (Moritz,

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