EMPIRICAL STUDY OF CLASSIFICATION DATA MINING ALGORITHM USING GPS TRAJECTORY

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ABSTRACT

The knowledge of the travelling mode used by humans (e.g. bicycle, on foot, car, and train) is critical for travel behavior research, transport planning and traffic management. Nowadays, new technologies such as the GPS have replaced traditional survey methods (paper diaries, telephone) since they are more accurate and problems such as under reporting are avoided. GPS Receiver gets the location information from satellites in the form of latitude and longitude. The presented application is a low cost solution for automobile position and status, very useful in case of car theft situations, for monitoring adolescent drivers by their parents as well as in car tracking system applications. Assembly of these modules will enable the tracking device to obtain GPS data of the bus locations, which will then transfer it to centralized control unit and depict it by activating LEDs in the approximate geographic positions of the buses on the route map. The proposed approach is the first to distinguish between motorized transportation modes such as bus, car and aboveground train with such high accuracy. Additionally, if a user is travelling by bus, we provide further information about which particular bus the user is riding. Five different inference models including Naïve Bayes, Multilayer Perceptron, SMO, KStar and J48 algorithms are tested in the experiments. The final classification system is deployed and available to the public.

Keywords *— Performance, Vehicle tracking, Real-time systems, GPS.*

I. INTRODUCTION

The motivation for GPS Tracking System is the desire for advanced features in an inexpensive receiver [1]. Travel behavior is concerned with how people travel, where they go, how often, which transportation mode they use, whether they chain trips, which route they choose, and so on. Researchers try to understand the impact that the built environment, the quality of the public transport and the cost of various transportation modes have on humans [2]. In ubiquitous and context aware computing, understanding the mobility of a client from sensor data is an important area of research. The transportation mode, such as walking, cycling, or train denotes some characteristics of the mobile user's context. Many GPS trace sharing social networks has been implemented [3, 4, 5, and 6]. These social networks enable friends to upload and share their GPS traces. Knowledge of transportation mode, added to these GPS traces, will enable the users to reflect on their past motion more meaningfully. It also allows users to obtain additional information from their friends' travel experience.

Additionally, awareness of transportation mode of a user may help to determine the user's carbon footprint, or track the amount of calories burnt. Another application of transportation mode detection is crowd sourced real-time traffic information in which traffic speeds are aggregated from probes such as mobile phones carried by travelers. Transportation mode detection enables the aggregation system to filter out the speed data submitted by non-motorized travelers or travelers on trains [7]. Every day, people purchase vehicles for different purposes, but for which ever reason, a lot of money is spent in the transaction which demands that adequate provision should be provided for its security and safety (Bajaja et al. 2012). Auto theft is a serious crime which is getting rampant day after day. It is then necessary for car users everywhere to have a way to track down their cars in case it is ever stolen. Real Time Vehicle Tracking System is one of the measures of securing vehicles. The word tracking means to find or follow something, therefore, Real time vehicle tracking is a method used to track and monitor any remote vehicle equipped with a hardware unit that receives and transfers signals through global positioning system (GPS) satellite. It makes use of GPS to provide actual geographic

real time position of each vehicle [8].The main aim is to find out the location of the college bus using GPS (Global Positioning System) and GSM (Global System for Mobile communication) by a message request from the user's mobile phone and without using internet at the user's end. Using GPS and with GSM the user can know the location of the bus by sending an SMS (Short Message Service) [9].

II. GLOBAL POSITIONING SYSTEM (GPS)

GPS modules are popularly used for navigation, positioning, time and other purposes. GPS Antenna receives the location values from the satellites. GPS gives information about:
1) Message transmission time
2) Position at that time [10]

A. GPS Technology

The Global Positioning System (GPS) is the only fully functional Global Navigation System (GNSS). The GPS uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals that enable GPS receivers to determine their location, speed, direction, and time. A GPS receiver receives the signals from at least three satellites to calculate distance and uses a triangulation technique to compute its two dimension (latitude and longitude) position or at least four satellites to compute its three dimension (latitude, longitude and altitude) position. Therefore GPS is a key technology for giving device its position. GPS was developed by the United States Department of Defense. Its official name is NAVSTAR-GPS. It is originally used in military services but later allowed the system available free for civilian use as a common good. Since then, GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, and scientific uses. In This device we use a GPS receiver of HOLUX GR-67 series [11].

B. Need of GPS

You may think that you only need a GPS tracking device to get you from point A to point B if you are unsure of where you are driving, but did you know that there are many other tracking systems that you may have a use for? GPS tracking systems are used to track anyone and anything these days. Technology has rapidly advanced in the past few years and it has become very easy for the average person to use a tracking system. If you have a vehicle, then you will want to place a GPS tracking system under your dash or in your glove compartment. This way, if your car ever gets stolen, you will be able to locate it within seconds. If you have a small child, you will want to have a tracking system in place in case they get lost or wander. Every second counts with a lost or abducted child, so a tracking device is imperative to avoid a possible disastrous and heartbreaking outcome. If you have valuable items in your home like jewelry, or electronics you will want a GPS tracking system in case they are ever stolen. There are also various tracking systems that can locate items inside buildings and parking garages. If you have a teenager, you will want to use a GPS tracking system to make sure that they are driving responsibly and they are going where they told you they were going. If you suspect your spouse or significant other of cheating, a good tracking system will be able to confirm or absolve your suspicions [12] [13].

C. Working of GPS

The GPS satellite gives the exact position of the device which is situated in the Car. This device is in turn which is connected to the local GSM service provider via a GSM network as it has SIM card present in it thus the GPS parameters which the device has are send to the tracking server which has a Static IP address via a GPRS network. The tracking server consists of a Socket listener application running in the back-ground which listens at a particular port. The GPS parameters received by the port listener are given to the Parser and converter for proper conversions

and this data is stored in the database. These values from the database are fetched and are manipulated to get the reports in proper format. [14][1]

III. PROPOSED SYSTEM

GPS based vehicle tracking system uses the GPS technology, GSM service and Android mobile. It tracks the vehicle through GPS and transmits its current location to the server. The main function of monitoring side is to provide login interface to user and to show the Google map with vehicle locations. Server woks as a central connector for transmitting unit and monitoring unit. As both transmitting side and monitoring side communicate with each other through Server only. As shown in Fig. 1 mobile application communicates with server and access the remote database. Where at transmitting side Tracker application obtained its current location through GPS technology and updates it to server.

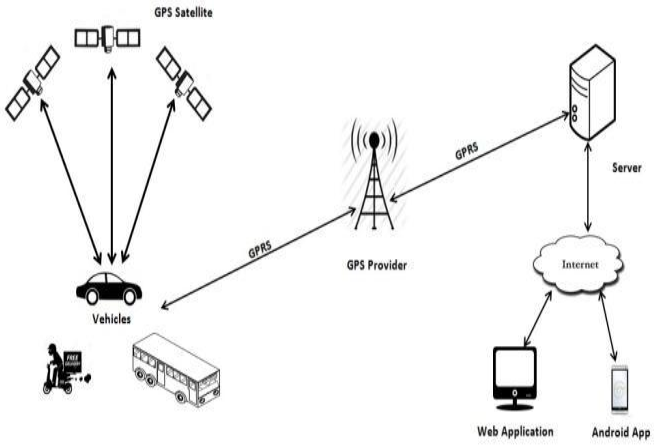

Fig.1. GPS System Architecture

IV. CLASSIFICATION TECHNIQUE

We applied different classification algorithms such as NaiveBayes, MultilayerPerceptron, SMO, KStar and J48 on the dataset to identify the result. KSTAR classifier algorithm is an instance-based classifier that is the class of a test instance is based upon the class of those training instances. Multilayer Perceptron (MLP) algorithm is a non-linear classifier based on the perceptron. The learning rule for the Multi-layer Perceptron is named as Back Propagation Rule also known as Generalized Delta Rule. MLP is a back propagation neural network with one or more layers. Sequential minimal optimization (SMO) is an algorithm for solving the quadratic programming (QP) problem that arises during the training of support vector machines. SMO breaks this problem into a series of smallest possible sub-problems, which are then solved analytically. The Naïve Bayes classifier works on a simple, but comparatively intuitive concept. Also, in some cases it is also seen that Naïve Bayes outperforms many other comparatively complex algorithms. It makes use of the variables contained in the data sample, by observing them individually, independent of each other. A J48 is a predictive machine-learning model that decides the target value (dependent variable) of a new sample based on various attribute values of the available data. The internal nodes of a decision tree denote the different attributes; the branches between the nodes tell us the possible values that these attributes can have in the observed samples, while the terminal nodes tell us the final value (classification) of the dependent variable [15].

V. RESULT AND ANALYSIS

As per shown in Table 1, the different standard parameter of GPS Trajectory and according to the parameter such as id, id android, speed, time and distance parameter are taken as sample dataset. This table provides Minimum, Maximum, Mean and Standard Deviation values. As per our research and identification we found best result in Multilayarpeceptron classifier algorithm among multilayarperceptron, KSTAR, SMO, J48, naivebayse algorithms and that is clearly identify from TABLE 2. Researcher applied these all classifier algorithm on data set. We found that time taken to build model is 1.76 seconds, Time taken to test module on training data is 0.01 seconds, Co-relation co-efficient is 88.75%, Kappa Statistic is 0.8605, Mean Absolute Error is 0.0249, Root Mean Square Error is 0.0942, Relative Absolute Error is 32.7207 %, Root Relative Square Error is 49.1007 %, Coverage of

cases (0.95 level) is 97.5 % and Mean rel. region size (0.95 level) is 21.4205 %.We also analysis that how much people crowded on weather which is either sunny or raining and that is displayed in Table 4. From Table 5 we found how much people crowded in bus, little people crowded in bus or no people crowded in bus. Table 3 shows the overall rating which is Good, Normal or bad and we clearly identify that it is good only. At the last we analysis that also people travelling on vehicle but either from car or bus at that is identify from Table 6. 0.0 values are available in ratings on weather and ratings on bus paper because of more peoples are not interested to give rating values. So, that many values are counted under the unrated values which is 0. That data are shown on respective Table IV and V.

VI. Conclusion and Future Scope

This system allows to track their vehicles and to get exact location of vehicle whether it is bus or car and whether it is raining day or sunny day. The general study result is that the system proved to be reliable as to identify the location of the devices. Having a GPS is truly benefit that you can identify your position, whether you are travelling on bus or car and whether you are travelling in rainy day or sunny day and if you think you are lost, you can use your GPS receiver to know your exact location. In the system we may provide features like Car locking, thief photo capturing. This will help the user to have an anti-thief feature. We may merge other related devices in a vehicle such as sensors. We can create one main server to see the vehicle exact route and other relevant data on our computer and we can save the trajectory of it. The sensors installed in our vehicle can report the vehicle information to our server and it can form an intelligent tracking system.

Table I
Standard Parameter of GPS Trajectory

Parameter	Minimum	Maximum	Mean	Standard Deviation
Id	1	38092	15607.65	18644.257
Id android	0	27	7.387	7.349
Speed	0.01	96.206	16.705	16.016
Time	0.002	1.943	0.264	0.293
distance	0.001	55.77	5.302	7.639

Table II
Different Classification technique applied on dataset

Algorithm Used	Time taken to Build Model	Time taken to test module on training data	Co-relation co-efficient	Kappa Statistic	Mean Absolute Error	Root Mean Square Error	Relative Absolute Error	Root Relative Square Error	Coverage of cases (0.95 level)	Mean rel. region size (0.95 level)
NaiveBayes	0.01 seconds	0.06 seconds	81.25 %	0.777	0.0194	0.1268	25.5346 %	66.0705 %	83.75 %	5.5114 %
MultilayerPerceptron	1.76 seconds	0.01 seconds	88.75 %	0.8605	0.0249	0.0942	32.7207 %	49.1007 %	97.5 %	21.4205 %
SMO	0.9 seconds	0.01 seconds	68.75 %	0.6075	0.0831	0.201	109.3087 %	104.7446 %	100 %	78.2386 %

KStar	0.01 seconds	0.19 seconds	63.75 %	1	0.0003	0.0034	0.4356 %	1.7657 %	100 %	4.6023 %
J48	0.04 seconds	0.01 seconds	85 %	0.8125	0.017	0.0923	22.4274 %	48.0987 %	100 %	6.875 %

Table III
Rating

Rating Values	Count	Weight
Good	101	101.0
Normal	45	45.0
Bad	17	17.0

Table IV
Rating on weather

Rating on Weather	Count	Weight
0.0	116	116.0
Raining	10	10.0
sunny	37	37.0

Table V
Rating on Bus

Rating on Bus Travelling	Count	Weight
0.0	116	116.0
Crowded	3	3.0
Little people	34	34.0
Not crowded	10	10.0

Table VI
Vehicle

Vehicle	Count	Weight
Car	87	87.0
Bus	76	76.0

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