간소화된 GPS 기반 궤적 추적 모델

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A Simplified Model to Extract GPS based Trajectory Traces

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Abstract

The growth in number and efficiency of smart devices such as GPS enabled smart phones and PDAs present an unparalleled opportunity for diverse areas of life. However extraction of GPS traces for provision of services demand a huge storage space as well as computation overhead. This is a challenging task especially for the applications which provide runtime services. In this paper we provide a simplified model to extract GPS traces of moving objects at runtime. Road segment partitioning and measure of deviation in angle of trajectory path is incorporated to identify the significant data points. The number of these data points is minimized by our proposed approach in an efficient manner to overwhelm the storage and computation overhead. Further, the competent reconstruction of complete itinerary based on gathered data, is also ensured by proposed method.

1. Introduction

GPS is a commendable technology to find location related activities. Presently a huge number of devices are enabled with this technology and getting more common with rapid speed. Currently more of these technologies are used for advancement of overall society and mankind. Like how to control traffic in a better way, finding peaks and low rush hours and movement behavior of people of a particular area.

A recent study used trajectory information of people for finding people attractive areas and their related movement patterns, which can lead to instructive insight to transport management, urban planning and location-based services (LBS) [1]. Similarly recent years have witnessed an increasing interest in the trajectory anomaly detection [2, 3, 4].However, these studies need a lot of space for storage of point to point data of moving object. This is a challenging issue for handheld small devices which works with small computation power and storage space. In this study, we aim to focus on reducing the number of recording data point (on which information is fetched by GPS device) however we also ensure that it is sufficient to reconstruct the appropriate trajectory path of moving object to provide corresponding service.

In our proposed approach, trajectory path of moving object is mapped on real world road maps. Further we use two main techniques for partitioning of trajectory. First is the angle deviation of the path and second is the change of road segment. On acquiring on every next data point both of these parameters are checked and data point and its corresponding information is recorded only if both of them got satisfied. This ensure us to limit the number of GPS point for the recording on the other hand it may compromise on the accuracy of the results but that will be minimal because of maintaining of both road infrastructure and also the movement patterns of the moving object.

This paper is organized as follows. In the 2nd section related work is discussed. The methodology of the proposed system and conclusion is exploited in 3rd section and 4th section respectively.

2. Related Work

Recently, innovations in GPS enabled smart device technologies and low-cost internet availability has tiled the way for development vital movement related services. Literature discusses a lot of solutions and different applications for the LifeCare provision of human life. Enormous techniques are discussed in the literature for trajectory simplification. In studies [7] trajectory simplification approach is proposed based on deviation of angle in path of moving object. This technique is efficient for the moving objects that do not follow pre-defined paths like road networks or tracking etc. Similarly, in study [8] author uses the road network partitioning technique to simplify the traces of moving object. Limitation of these techniques is the decision problem while intersection of multiple road segments even without the angle deviation of the trajectory path.

Our proposed approach provides the solution of both of issues. A hybrid approach is proposed by combining both of angle deviation and road segment partitioning based trajectory simplification technique. The decision issue in case of intersection of multiple road segments is decided by the angle of the trajectory path. The road segment having

corresponding angle is selected for reconstruction of the traces of moving object. To minimize the GPS recoding point, if angle of trajectory is deviated but the road segment is same new point is not recorded because in this case trajectory is reconstructed based on label of road segment.

3. Methodology of Proposed System

A vehicle's GPS trajectory is consists of a sequence of visited points i.e., $t: \{p_1, p_2, ..., p_n\}$ Where; $p_i = (x_i, y_i, t_i, S_i)$, x_i and y_i, shows latitude and longitude of trajectory respectively , t_i is time at which point i is recorded and S_i is the speed of moving object at point i. These points are called data points. Information of position of moving object is retrieved after a time interval of T_{CC}. It is stored if it meets the required parameter of data points otherwise it is ignored.

GPS traces of moving objects are recorded by handheld smart phone devices and then traces are mapped on real world road maps like openstreemaps. Further two main parameters are involved to select weather a new coming point should be significant enough to record or better to ignore. Here a point to be noted that T_{CC} is totally application dependent. Information fetched after each T_{CC} is evaluated that either it should be recorded or we can draw the trajectory without its involvement. This decision is made based on two parameters i.e. angle of deviation of trajectory path and change of label of road segment. At each step data point is evaluated based on both parameters e.g. if a moving object is moving on a road segment that is deviating the angle i.e. not a straight road, then our proposed methodology does not record the new point and same road label will be used to construct the path. In case of second scenario where if the moving object changes the road segment but the not the angle of its trajectory, the label of new road segment is not recorded since it can be traced back by the same angle of trajectory. Figure 1 illustrates the proposed methodology.

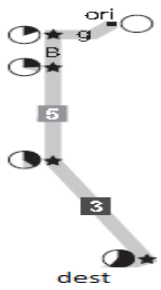

Figure 1: Road links in trajectory

In the above figure trajectory of a moving object is shown in the form of link of different roads. Trajectory starts from the origin "ori" and ends at destination "dest". Road segments which are used by moving object are g, B, 5 and 3 respectively. Here every star is showing the intersection of multiple road segments. In the start of trajectory first a point is recorded at the origin. Then at the middle of road segment g, since the angle is deviating but road label is same so no new point will be recorded. However at the intersection of g and B angle is changing as well as road segment so at this stage a new GPS point is recorded to identify the path. Similarly next point is recorded at intersection of road segment 5 and 3 due to changing condition of both of the angle and road segment.

4. Conclusion

In this paper we presented a simplified approach for trajectory simplification. We propose an angle deviation and road segment portioning based hybrid model to identify the recording of point. Only points satisfying these parameters are recorded. For reconstruction of the trajectory path these points and their provided label are used. We have explained how our proposed methodology can overwhelmed the limitation of the existing work and provide efficiency in storage space of recording of GPS points. It is also elaborated that even after decreasing the number of recorded points, trajectory traces of moving objects can be reconstructed efficiently and accurately. To the best of our knowledge, this is the first work that provides a hybrid model of both deviation angle and road segment portioning based trajectory simplification method.

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