

FTST-Tree: A Trajectory Privacy Protection-Enabling Spatio-Temporal Index Structure for Moving Object Databases

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Abstract: One of the significant factors affecting the prosperous development of location-based services is user privacy. The matter is raised by the idea of protecting personal information including user identity, position, query, trajectory, and their relationship. Upon further consideration, trajectory privacy becomes the big one in that it handles all privacy objects under spatio-temporal dimensions, first and foremost history, present, and future positions. Out of them, future aspect promises more potential benefits to decision supporting location-based applications of some sort not only for managers but also for advanced services. As far as we know, there are so many studies in this field of knowledge, but little is done towards privacy protection integrated at database level. Motivated from what have been specified, we propose FTST-tree as one of the vanguard database-centric approaches for trajectory privacy preservation in terms of prediction.

Two emerging issues occurring in our problem have primarily been identified as follows: (1) an efficient map-aware position prediction model of moving objects; and (2) an elastic privacy-aware spatio-temporal index structure. The former is examined to represent multi-dimensional moving objects and effectively predict their prospective positions. Actually, lots of techniques have yet focused on this issue in the wide range from many fields of all kinds. What we do need here, however, is to have a road network-based modeling, which makes the prediction become more meaningful in reality. On the other hand, the latter refers to how an up-to-date index works and its structure could be in such a dynamic environment. The index especially takes its responsibility to response to aggregation queries of some kinds such as “How many moving objects in this region in the next 10 minutes?” whereas unauthorized parties are not allowed to know where a moving object should be through its trajectory. Moreover, overheads in consecutive updates and query processing, the trade-off between privacy and quality of service, and the pros and cons of the index in comparison with others are also addressed. It is not so easy to resolve each single case because of its own specific characteristics, and making them live in harmony with each other is much more difficult due to their tight influence and adverse effect. As a whole, hardly can a comprehensive method be found at once, so some constraints and assumptions are essentially made to ease the complexity of the method. Last but not least, a traffic management system is chosen as a typical example to illustrate the problem as well as its solutions in which we have investigated.

Keywords: trajectory privacy, privacy protection, spatio-temporal index structure, location-based services, moving objects, FTST-tree.

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