Tracking Filter for Multiple Route Selection based on GPS Trajectories

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Abstract - *Path instruction is the main aspect of GPS (Global Positioning System) for exploration systems. Here we first generate a tracking filter and visualization process that verifies the areas where complexity exists and also we develop navigation systems to view highly recommended figures with various paths to help end users to choose shortest path. Some methods have been used to the RTD (Real Trajectory Data) and we retrieve some divergence path. Our method can be used to get better paths for users and also it verifies traffic bottlenecks for transit administration.*

Key Words*: *Route-Choice Model, Route Choice Behaviour, Visual Analysis, Interaction

1. INTRODUCTION

Route navigation is an issue for transit administration. Many paths are present from origin to destination than others. In between routes some traffic exists because user contains less choice. By giving path navigation data user can select their original direction for given origin or destination combination. Therefore it is very necessary to analyze path direction from a trajectory data. We propose graphical method to analyze areas and various routing techniques are utilize for taxi drivers.

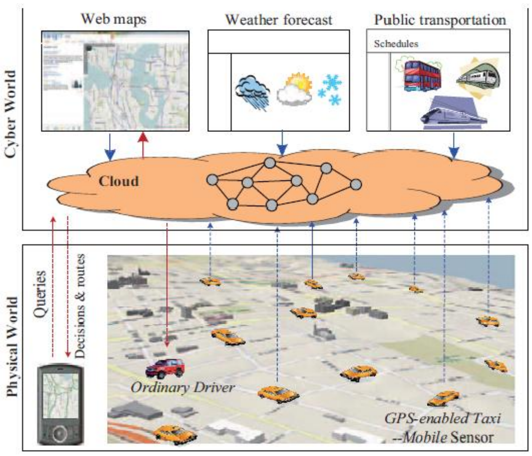


Figure 1 A cloud based driving direction service

From above figure, in physical world, GPS (Global Positioning System) equipped taxies are used as mobile sensors probing the traffic flow of a city. To combine and store the information from these taxies as well as some other origin from internet, like weather forecast and web maps, a cloud in the cyber world is built. Finally, in a user's GPS (Global Positioning System) phone, a mobile client that is running will communicate with cloud, accepts a user query and presents the result to the user.

The Contributions of this Paper are:

- To analyze the route choice behavior with real GPS (Global Positioning System) data, we develop a visual analytic system.
- Based on general GPS (Global Positioning System) data, we explore the possibility of analyzing various route choice behaviors.

We introduce a graphical analytics system that leverages users' connection and web based selection in the process of trajectory data mining from the graphical analytics. Feasible routes are constructed automatically based on filtered tracking information to get highest rank based solutions. Paths are selected automatically according to system configurations.

2. RELATEDWORK

Analysis is done in related work*:* research progress in visual analytics of trajectories, route choice behavior analysis in transportation field and route visualization.

2.1 Trajectory Visual Analysis (TVA):

Various mining techniques [1], including pattern mining, outlier detection etc, has been analysis in trajectory mining field. The three type of visual analysis [2] are: visual aggregation, pattern extraction and direct depiction. To extract basic data patterns [3], pattern extraction methods have been applied to automatic analysis. To declare high level movement graph, aggregation methods anticipate movement groups. Because of visual cluttering direct plotting has been simply fail .In comparison with Trajectory Lenses, our architecture also allows for the direction assignment.

2.2 Route Choice Behavior Analysis (RCBA):

In transportation area route choice behavior has been widely studied. In [4] the users do not use similar paths. To obtain problem related information involving personal details, questionnaires are correctly constructed, here statistical numerical analysis play an essential role. Some effective aspects are declared, such as highway percentage, perception of time and traffic light numbered. In [5] the path selection behavior depends upon GPS (Global Positioning System). The distinction between recalled and observed situations, realism is also a problem.

2.3 Route Visualization (RV):

A well-known technique in geographical application to visualize a geographical of a route in 3D space has been used [6]. With analogy of lenses, to encode more details, [8] authors place a magnified lenses. Find combination of 2D-3D graph to display the tracking filter aspect 7]. A time flow of map view in a parallel is time form has been granted for acceptable analysis among routes. To show the topology architecture the abstract route view from flow diagram are collected. The topological information of various routes can be encoded with accurate method.

3. METHODOLOGY

In this section, we describe Data Structure Constructions (DSC) and Extracting the Optimal Location (EOL).

3.1 Data Structure Construction (DSC):

The leading data structure applied in this area is trajectory vertex, vertex trajectory indexes and trajectory edge.

- **Trajectory –Vertex Index, Itv:** The hidden vertices of all trajectories are documented by the trajectory-vertex index.
- **Vertex-Trajectory Index, Itv:** Each entry is described by a vertex VI on the road network and this index is inverted trajectory vertex index. The statistic for each road segment and location through an averaging operation can be calculated directly.
- **Trajectory-Edge Index, Ite:** A GPS (Global Positioning System) trajectory is an arrangement of time ordered spatial points. We firstly apply a map-matching algorithm and then trajectory edge index can be constructed. With these indexes, we can identify, the road segments passed by a given trajectory.

3.2 Extracting the Optimal Location (EOP):

To assist the domain experts in selecting the billboard location, smarted add an interactive query, called K-location query. The main purpose of K-location query is to extract K-location from the candidates. The weights in this query are different for each trajectory. These queries are placed on different schemes. To achieve a satisfactory advertising effect, these query aimed at extracting a set of locations with maximum coverage value.

Algorithm 1 k-location query

```
    Algorithm KLocation( Candidate vertices V_can, Trajectory-vertex index I_tv, Vertex-
    trajectory index I_vt, OD regions R_od, Normal weight w_nor, OD weight w_od, k)
1:  identify all the trajectories covered by V_can → TR_can
2:  for each trajectory Tr in TR_can do
3:      set w(Tr) to w_nor
4:  identify all the trajectories that one of its OD vertices located in R_od → TR_od
5:  for each trajectory Tr in TR_od do
6:      set w(Tr) to w_od
7:  for each vertex v in V_can do
8:      calculate the coverage value c(v) as Σ_{Tr∈I_vt[v]} w(Tr)
9:  V_result := ∅; TR_covered := ∅
10: for i := 0 to k-1 do
11:     pickup v_max in V_can with the maximum coverage value
12:     V_result := V_result ∪ v_max
13:     for Tr in I_vt[v_max] − TR_covered do
14:         for v in I_tv[Tr] do
15:             c(v) := c(v) − w(Tr)
16:     TR_covered := TR_covered ∪ I_vt[v_max]
17: return V_result
```

In each iteration, the algorithm contains two steps.

- Selection: The vertex with maximum coverage value is selected by the algorithm and put it into result set (in line 11 to 12).
- Updating: The coverage value of all vertices is updated at this step. Passing vertices can be identified by using trajectory-Vertex index. The coverage value of every passing vertex V is updated to c (v)-w (Tr) (in line 15).

3.3 Local Smoothing:

Algorithm 1: LocalSmoothing

```
Input: a sequence L = l_1 → l_2 → l_3 → ... → l_{n-1} → l_n,
       dist(l_i,l_j), i, j = 1, 2, ..., n
Output: a subsequence (of L)
       L' = l'_1 → l'_2 → l'_3 → ... → l'_{m-1} → l'_m that satisfies:
       ∀i = 1, 2, ... m − 1, dist(l_i, l_{i+1}) = min_{j>i}{dist(l_i, l_j)}
for i ← 2 to n do
    for j ← i − 1 downto 1 do
        if SL(j) == ∅ then
            Insert the sequence l_j → l_i to SL(j)
        else
            Binary search in SL(j) for the largest integer p such
            that dist(l_j,l_{j_p})≤dist(l_j,l_i), if no such value exists,
            p := 0;
            /* where l_j → l_{j_p} → ··· is the p-th
               sequence in SL(j)                                  */
            Insert l_j → l_i after the p-th sequence of SL(j);
            /* if p == 0, insert l_j → l_i as the first
               element of SL(j)                                   */
            for w ← 1 to p do
                if SL(j)^(w) ⊖^l l_j ⊕^r l_i ∈ SL(j_w) then
                    /* SL(j)^(w) == l_j → l_{j_w} → ··· is the
                       w-th sequence of SL(j)
                       SL(j)^(w) ⊖^l l_j ⊕^r l_i represents that
                       the SL(j)^(w) removes the first
                       landmark l_j from the
                       beginning(left) and adds l_i to
                       the end(right), i.e.,
                       SL(j)^(w) ⊖^l l_j ⊕^r l_i == l_{j_w} → ··· → l_i
                       */
                    SL(j)^(w) := SL(j)^(w) ⊕^r l_i;
                    /* add l_i after the sequence
                       SL(j)^(w), i.e.,
                       SL(j)^(w) := l_j → l_{j_w} → ··· → l_i     */
    return The longest sequence L' in {SL(i)|i = 1, 2, ..., n}
```

To satisfy next nearest principle, this algorithm is design to detect the longest arrangement from the emerge array of the global smoothing. The brute force algorithm that checks all arrangement will takes exponent time. We introduce, polynomial time algorithm as shown above. The whole smoothing processing is quite efficient as the number of landmarks in a rough route is small.

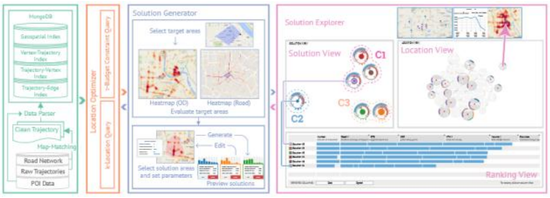


FIGURE 2: SYSTEM ARCHITECTURE

The system consists of three important parts: graphical explorer, location reformer and data administrator. The system is based on internet software which is develop under a framework of mean. The above figure shows system architecture. In this part we integrated back-end support and implementation is done on graphical analysis module. According to the solution generated by system solutions users can select locations and explores multiple solutions into which users can easily switch to best routes.

4. MULTIPLE ROUTES GENERATION (MRG):

The system grants a collection of graphical filters for the great taxi GPS (Global Positioning System) filter trajectory. An algorithm is formed to extract all possible paths with the help of filtered trajectory.

4.1 Trajectory Filtering (TF):

A two level temporal filter is prepared from the temporal aspect: time and date. In time filter, time range is set and in date filter, date range is set. We can describe filter identical to trajectory lenses. According to spatial relationship between circular area and trajectory, the six constraints are represented. The approach is shown in figure 3[b]. Figure 3[a] shows that some areas is covered to handle filter trajectories.

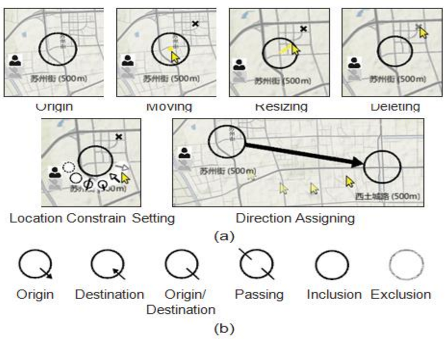


Figure3: Tracking Filter of source and destination.

4.2 Multiple Routes Extraction (MRE):

We apply grid based algorithm to drive multiple routes with filtered trajectory. Figure 4 shows route extraction process. Filtered trajectories are shown in figure 4[a]. Combined integrated cells are covered over the box as shown in figure 4[b]. One by one cell is pointed as shown in figure 4[c]. The directions are estimated as vertical or horizontal as shown in figure 4[d]. In figure 4[e], the detected cells are merged. After that, routes are formed as in figure 4[f]. Cells are detected as splitting nodes as shown in 4[g]. Finally different routes are encoded visually as shown in figure 4[h].

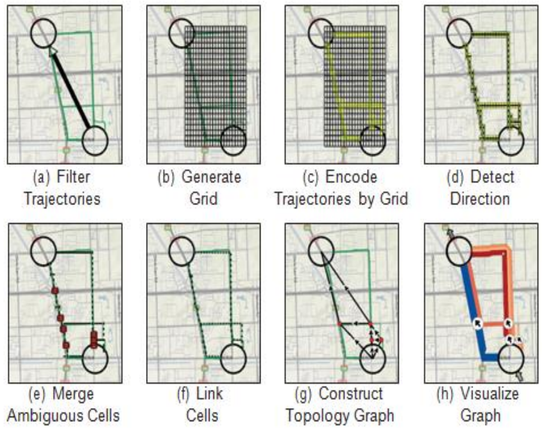
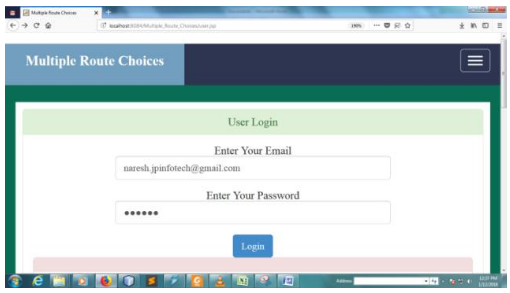


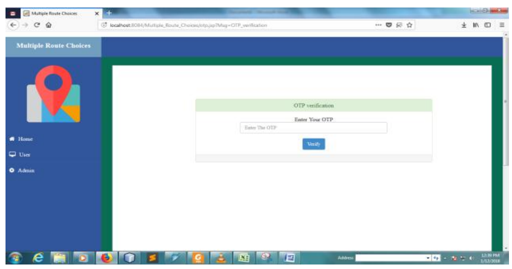
Figure4. Multiple Route Construction

5. RESULTS

- User Login

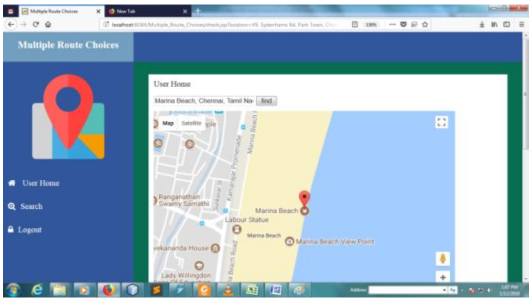


- OTP verification

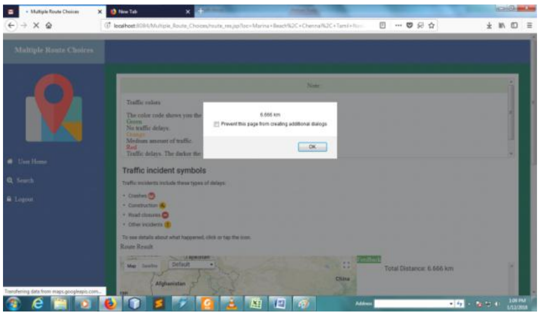


- User Home

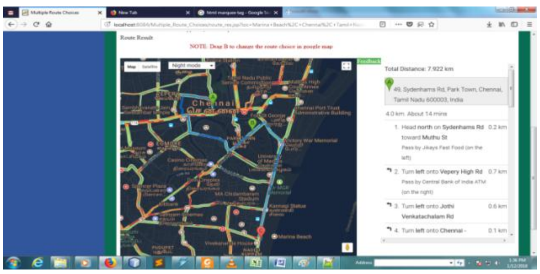
- User Search Menu



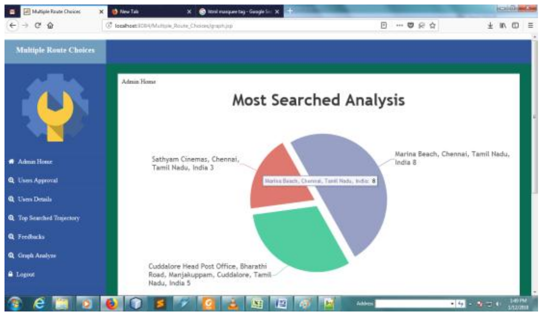
- Trajectory Length



- Route Choices



- Graph Analysis



6. CONCLUSION

We analyze the opportunity of considering route choice behavior based on taxi GPS (Global Positioning System) trajectories. The scheme grants factors, exploration with route choice and visual analysis in massive trajectories. We considered the parts from tracking filter data that supports GPS data solutions. According to task oriented applications, interactions and system's visualizations are created. The system allows factors exploration in massive trajectory. In the future, we authorize to cover the system to more datasets.

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