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SenseRun: Real-Time Running Routes Recommendation toward Providing Pleasant Running Experiences

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Abstract

In this demo, we develop a mobile running application, SenseRun, to involve landscape experiences for routes recommendation. We firstly define landscape experiences, perceived enjoyment from landscape as motivators for running, by public natural area and traffic density. Based on landscape experiences, we categorize locations into 3 types (natural, leisure, traffic space) and set them with different basic weight. Real-time context factors (weather, season and hour of the day) are involved to adjust the weight. We propose a multi-attributes method to recommend routes with weight based on MVT (The Marginal Value Theorem) k-shortest-paths algorithm. We also use a landscape-awareness sounds algorithm as supplementary of landscape experiences. Experimental results improve that SenseRun can enhance running experiences and is helpful to promote regular physical activities.

Introduction

Physical inactivity, connected with cancers, heart diseases, diabetes, etc., has become a global threat to people's health (WHO, 2016). To prevent these diseases, running is wildly recommended. Most running applications just focus on running data management while (Besenski, L. 2009) states that motivation of physical activity depends on experiences. Increases in pleasure during running (e.g. enjoyment, relaxation and energy) may help generate positive memory for exercises (Dishman, R.K. and et al, 1985). With scenic landscape along the running routes, these enjoyable experiences, called landscape experiences, can be further promoted. However, existing mapping services can not realize such experiences as they only provide the shortest routes.

In this demo, we develop a mobile running application, SenseRun, to involve landscape experiences for routes recommendation with multi-attributes related to landscape experiences: public natural area, traffic density and real-time context factors (weather, seasons and hour of the day). They are set weight in our method based on MVT (The Marginal Value Theorem) k-shortest-paths algorithm. (Szeremeta, B. and et al, 2009) shows that introduction of natural sounds that are easily covered by traffic noise can greatly enhance comfort. Therefore, we propose a landscape-awareness sounds algorithm as supplementary of landscape experiences.

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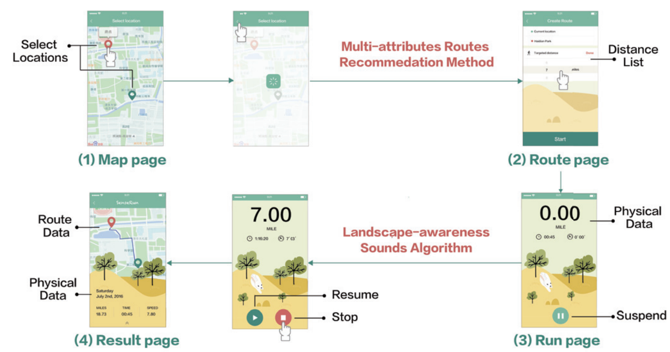

Figure 1: *The workflow of SenseRun*

System Overview

Figure 1 shows the workflow of SenseRun which consists of 4 main steps: 1) User selects start and destination in the Map page. 2) SenseRun recommends 10 routes based on our method and provides a list of distance in Route page. 3) SenseRun shows physical data in Run page when running with simulated natural sounds based on our algorithm. 4) User can check physical and route data in the Result page after running. Key method and algorithm are described as follows.

- **Definition**

Since landscapes with high-density traffic or lack of natural area can prevent people to become active (WHO, 2016), the landscape experiences are defined by 2 attributes: public natural area and traffic density. We categorize locations from Baidu Map into 3 types based on the above 2 attributes from the best experiences to the worst: Natural Space (*N*), Leisure Space (*L*) and Traffic Space (*T*). The basic weight can be defined: $\mathbf{w} = (w_N, w_L, w_T)$, $0 < w_T < w_L < w_N < 1$ in this paper. We use $\mathbf{s} = (s_1, s_2, ..., s_A)$, $\mathbf{h} = (h_1, h_2, ..., h_B)$ and $\mathbf{t} = (t_1, t_2, ..., t_C)$ to indicate seasons, weather, hour of the day and all the combinations in each factor respectively where $A, B, C \in N_+$. For example, **s** might includes "spring" or "spring & summer" or "spring & summer & autumn". Next, we define $\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\chi}$ as influence factors $\boldsymbol{\alpha} = (\alpha_1, \alpha_2, ..., \alpha_A)$, $\boldsymbol{\beta} = (\beta_1, \beta_2, ..., \beta_B)$, $\boldsymbol{\chi} = (\chi_1, \chi_2, ..., \chi_C)$ where $\alpha_e, \beta_f, \chi_g \in R_+$ of *s, h, t* respectively.

- **Real-time Context Factors Adjustment**

SenseRun gets the context factors from openweathermap API to adjust the basic weight as $f(w_i) = w_i^{(\alpha_e + \beta_f + \chi_g)}$ where $i \in (N, L, T)$. Since *N* in sunny spring morning creates a delightful environment, w_N increases with $0 < \alpha_e + \beta_f + \chi_g < 1$.

- **Multi-attribute Routes Recommendation**

We calculate the total weight $\mathbf{w}_m$ based on the distance (*d*) between each node $m, m \in (1, n)$ and its nearby landscapes.

$$\mathbf{w}_m = \left(w_{mN} = \frac{\sum_j \frac{(w_i)_j}{d_j}}{\sum_i \sum_j \frac{(w_i)_j}{d_j}}, \quad w_{mL} = \frac{\sum_k \frac{(w_i)_k}{d_k}}{\sum_i \sum_k \frac{(w_i)_k}{d_k}}, \quad w_{mT} = \frac{\sum_l \frac{(w_i)_l}{d_l}}{\sum_i \sum_l \frac{(w_i)_l}{d_l}} \right)$$

where *j*, *k*, *l* mean the number of *N*, *L* and *T* within 10 km. Now SenseRun explores 10 appropriate routes by considering the best weight in all possible routes based on MVT k-shortest-paths algorithm (Quercia, D. and et al, 2014).

- **Landscape-awareness sounds algorithm**

We setup sound database (including water, bird, etc.) in SenseRun. Each sound entry in the database includes labels in *N*, *L*, *T*, *s*, *h* and *t*. This process is also referred to as getting the current user running context. If the current context matches one of the specific labels for a sound, then that sound's rating is increased from 0 to 1. SenseRun ranks all sounds in the database and plays the highest ranking one.

Experiments

To evaluate our proposal, we compare SenseRun results against with a baseline system (Baidu Map) in 3 experiments.

- **Comparison of the number of Natural Space**

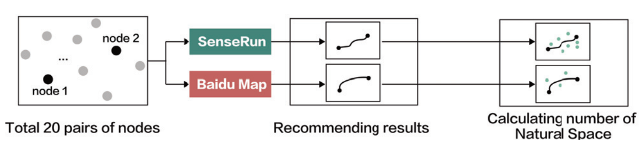

Figure 2: Comparison of the number of Natural Space

SenseRun is able to recommend more scenic routes. Since Natural Space represents best landscape experiences as definition, SenseRun yields a 15% -74% improvement compared with baseline in total 20 pairs of nodes (Figure 2).

- **User's preference to recommending results**

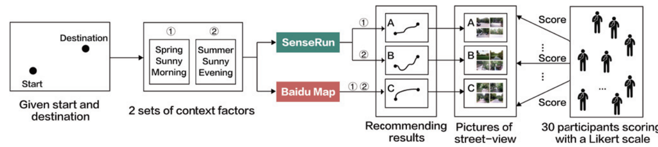

Figure 3: User's preference to recommending results

SenseRun provides more popular routes. We validate that SenseRun performs statistically significant better with average of 3.93 and 3.83 compared with baseline (2.43 and 3.1) with 30 participants scoring with a Likert scale (Figure 3).

- **Effectiveness of simulated natural sounds**

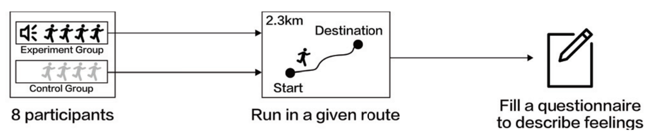

Figure 4: Effectiveness of simulated natural sounds

Landscape-awareness sounds can further promote experiences. Experimental process is shown in Figure 4. Results show that 4 participants running with simulated natural sounds feel more actively environmental involved than those 4 without.

Conclusion

We propose a running application, SenseRun, in this demo. Experimental results show SenseRun is effective in improving running experiences and helpful to encourage regular physical activities by providing real-time running routes with scenic landscape and simulated natural sounds.

Acknowledgements

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