www.ijbar.org
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

FORECASTING AND ESTIMATION OF HUMAN MOVEMENT PATTERNS

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ABSTRACT

The study of human movement patterns is integral to numerous fields, from urban planning and transportation management to public safety and healthcare. In an increasingly interconnected world, the ability to forecast and anticipate human movement holds immense potential for optimizing resource allocation, enhancing infrastructure planning, and enabling timely interventions. This project delves into the development of an innovative framework for forecasting and anticipatory estimation of human movement patterns.

The proposed framework leverages advanced data analytics techniques and machine learning algorithms to analyze and interpret diverse sources of data, including historical movement data, demographic information, social events, and environmental factors. By synthesizing this multifaceted information, the framework aims to uncover hidden patterns and trends that influence human mobility.

A critical aspect of this project involves the creation of predictive models that can extrapolate future movement patterns based on past observations and contextual cues. These models empower decision-makers with the ability to foresee population flows, congestion hotspots, and travel trajectories. Furthermore, the project emphasizes the significance of anticipatory estimation, where the framework proactively identifies potential anomalies or disruptions in movement patterns, allowing for timely response strategies.

The potential applications of this research span a wide spectrum, including optimizing public transportation routes, mitigating traffic congestion, enhancing emergency response planning, and enabling personalized healthcare interventions. The results of this project contribute to the growing body of knowledge in predictive analytics, underscoring the power of data-driven insights in shaping a more efficient and responsive urban landscape.

In conclusion, this project advances the field of human movement pattern analysis by introducing a comprehensive framework for forecasting and anticipatory estimation. By harnessing the potential of data analytics and machine learning, this research opens avenues for informed decision-making and proactive intervention, ultimately fostering smarter, more resilient communities.

I. INTRODUCTION

With the rapid development of the wireless and networking technology, mobile networks have imposed a profound impact on people's daily life for their marvelous capability. These applications utilize the users' current and historical location information records (LIR) to analyze their mobility patterns to enable numerous applications, such as targeted advertising, city planning and smart navigation.

Generally speaking, the LIR data collected from the mobile networks can be divided into two categories, data collected by Internet service provider (referred to as ISP-collected data) and data collected by applications (referred to as app-collected data). The ISP-collected data are passively and periodically collected regardless of behaviors of the users. This sort of data preserves the complete and consecutive trajectory of each user. Most of the existing studies are based on users' ISP-collected location data. quantified the predictability in human mobility by studying the regularities shown in the trajectory. According to their studies, the potential predictability reaches 93% on a mobile phone record dataset. Wang et al. link the human mobility with the social network, by segregating the similar users using the information from social media, more general and

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ISSN 2249-3352 (P) 2278-0505 (E)
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universal mobility patterns on a certain group of people were extracted, suggesting the huge predictability of the individual's movements. Moreover, applying the predictability into practice, many researches have also been conducted on the prediction of human mobility on various models, such as Markov Chain models, neural network, Bayesian network, finite state machine. On the other hand, however, few researches have focused on either predictability or prediction algorithm on app-collected location data. These aspects of researches remain to be explored.

In comparison to ISP-collected data, app-collected LIR data is actively triggered by users themselves in applications. This kind of location data will be collected when using the applications while the location information of the rest time remains unknown. It is exactly the characteristics of the app-collected data that arouses several difficulties to our study. First, the app-collected data contains the physical context of the location because the purpose of using the application certainly correlates with the location recorded, e.g., ordering a taxi, searching a restaurant. Such correlations provide valuable information to analyze the human mobility patterns. However, simple grid for the city apparently loses the information. Hence, it is essential to find a proper spatial division of the city to reserve the physical context of app-collected data. Second, the app-collected data are partially missing since usually the applications do not record users' locations when they are not using the apps. Third, the app-collected data are heterogeneous in spatial and temporal domain since the time when people use the application is unevenly distributed. Under these circumstances, the methods aroused in the previous study apparently are not suitable for accurate predictions on the dataset. We need to propose new methods to adapt to these features of the app-collected data.

In this paper, we address the above three challenges to facilitate the analysis. Our work can be summarized as follows:

In order to preserve the physical context of the locations, we contextually cluster the locations into multiple nonoverlapping districts of the city instead of using fixed coordinate grid that will lose the physical context. We also compare the predictability and the prediction accuracy between the two divisions to analyze the effect of context on prediction. Results reveal that the trajectories on context-based division are more predictable than those on division without context under the same spatial granularity.

We design a Markov-based method using Gibbs sampling to solve the unevenly distribution and the high missing rate of the app-collected data. By restoring the trajectory, we estimate the transition matrix to make prediction of users' movement. Results show that, based on app collected dataset, our method achieves the same accuracy of the previous studies on the ISP- collected dataset.

In order to investigate the effect of heterogeneity, we carry out a thorough analysis of the predictability and prediction accuracy based on our designed method on the app-collected dataset. The varying factors include the spatial and temporal resolution, the orders of Markov models, the radius of gyration etc.

II. LITERATURE SURVEY

TITLE: Limits of predictability in human mobility

AUTHORS: Chaoming Song, Zehui Qu, Nicholas Blumm, Albert-Laszlo Barabasi.

ABSTRACT:

A range of applications, from predicting the spread of human and electronic viruses to city planning and resource management in mobile communications, depend on our ability to foresee the whereabouts and mobility of individuals, raising a fundamental question: To what degree is human behaviour predictable? Here we explore the limits of predictability in human dynamics by studying the mobility patterns of anonymized mobile phone users. By measuring the entropy of each individual's trajectory, we find a 93% potential predictability in user mobility across the whole user base. Despite the significant differences in the travel patterns, we find a remarkable lack of variability in predictability, which is largely independent of the distance users cover on a regular basis.

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ISSN 2249-3352 (P) 2278-0505 (E)
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TITLE: Human mobility, social ties, and link prediction

AUTHORS: Dashun Wang, Dino Pedreschi, Chaoming Song. Fosca Giannotti, Albert-Laszlo Barabasi.

ABSTRACT:

Our understanding of how individual mobility patterns shape and impact the social network is limited, but is essential for a deeper understanding of network dynamics and evolution. This question is largely unexplored, partly due to the difficulty in obtaining large-scale society-wide data that simultaneously capture the dynamical information on individual movements and social interactions. Here we address this challenge for the first time by tracking the trajectories and communication records of 6 million mobile phone users. We find that the similarity between two individuals' movements strongly correlates with their proximity in the social network. We further investigate how the predictive power hidden in such correlations can be exploited to address a challenging problem: which new links will develop in a social network. We show that mobility measures alone yield surprising predictive power, comparable to traditional network- based measures. Furthermore, the prediction accuracy can be significantly

TITLE: Approaching the limit of predictability in human mobility.

AUTHORS: Xin Lu, Erik Wetter, Nita Bharti, Andrew Tatem.

ABSTRACT:

In this study we analyze the travel patterns of 500,000 individuals in Cote d'Ivoire using mobile phone call data records. By measuring the uncertainties of movements using entropy, considering both the frequencies and temporal correlations of individual trajectories, we find that the theoretical maximum predictability is as high as 88%. To verify whether such a theoretical limit can be approached, we implement a series of Markov chain (MC) based models to predict the actual locations visited by each user. Results show that MC models can produce a prediction accuracy of 87% for stationary trajectories and 95% for non-stationary trajectories. Our findings indicate that human mobility is highly dependent on historical behaviours, and that the maximum predictability is not only a fundamental theoretical limit for potential predictive power, but also an approachable target for actual prediction accuracy.

TITLE: A class of mobile motion prediction algorithms for wireless mobile computing and communications

AUTHORS: George Liu, Gerald Maguire Jr.

ABSTRACT:

This paper describes a class of novel mobile motion prediction algorithms for supporting global mobile data accessing. Traditionally, mobility and routing management includes functions to passively keep track of the location of the users/terminals and to maintain connections to the terminals belonging to the system. To maintain uninterrupted high-quality service for distributed applications, it is important that a mobile system be more intelligent and can anticipate the change of the location of its user. We propose an aggressive mobility and routing management scheme, called predictive mobility management. A class of mobile motion prediction algorithms predicts the “future” location of a mobile user according to the user's movement history, i.e., previous movement patterns. By combining this scheme with mobility

TITLE: Applied neural network for location prediction and resources reservation scheme in wireless networks

AUTHORS: Shiang-Chun Liou, Hsuan-Chia Lu.

ABSTRACT:

In this paper, NPS (neural network prediction scheme) is proposed to provide high accuracy location prediction of mobile host (MH) in target cell. Multimedia communications is urgently expected in wireless networks. One of the most important and complicated issues is quality of service guarantees in third-generation (3G) wireless networks. In other words, the problem to maintain the continuity of multimedia playing during the handoff is hard to solve NSP and TTRR can efficiently improve the accuracy of MHs

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trajectory prediction, increase the success probability of resource reservation, and enhance bandwidth utilization.

TITLE: Movement prediction using Bayesian learning for neural networks

AUTHORS: Sherif Akoush, Ahmed Sameh.

ABSTRACT:

A technique for reducing the wireless cost of tracking mobile users with uncertain parameters is developed in this paper Unfortunately, such uncertainty is unavoidable for mobile users, especially for a burst mobility pattern. In this paper, we present a novel hybrid Bayesian neural network model for predicting locations on Cellular Networks (can also be extended to other wireless networks such as WI-We investigate different parallel implementation techniques on mobile devices of the proposed approach and compare it to many standard neural network techniques such as: Back-propagation, Elman, Resilient, Levenberg-Marquart, and One-Step Secant models. . Bayesian learning for Neural Networks predicts location better than standard neural network techniques since it uses well founded probability model to represent uncertainty about the relationships being learned. The result of Bayesian training is a posterior distribution over network weights. We use Markov chain Monte Carlo methods (MCMC) to sample N values from the posterior weight's distribution.

III. SYSTEM ANALYSIS & DESIGN

EXISTING SYSTEM

Most of the existing prediction methods are based on Markov model, which can only model one transition patterns, since it has only one transition kernel. For example, if a user visits his/her office in the morning, then he/she is likely to stay at the office in the following few hours. In contrast, if he/she visits his office in the afternoon, he/she probably will leave in the following time. If this example is modelled by a Markov chain, the prediction result will be the same, since the transition of Markov chain only relies on its previous state, regardless of the time when the transition happens.

Disadvantages:

- Plenty of previous work adopted traditional Markov model, which suffers when the trajectory becomes sparse or it shows distinct mobility patterns in different time of day.

PROPOSED SYSTEM

We need to propose new methods to overcome the problem aroused by these features of the app-collected data. In this paper, we address the above three challenges to facilitate the analysis. Our work can be summarized as follows:

In order to preserve the physical context of the locations, we contextually cluster the locations into multiple non-overlapping districts of the city instead of using fixed coordinate grid that will lose the physical context. We also compare the prediction accuracy between the two divisions to analyze the effect of context on prediction. Results reveal that the trajectories on context-based division are more predictable than those on division without context under the same spatial granularity.

Advantages:

- We comprehensively analyses the mobility and predictability of each user.
- We adopt Gibbs sampling method to simultaneously recover the missing part of trajectories
- Markov chains, in order to solve the unevenly distribution and the high missing rate.

SYSTEM ARCHITECTURE

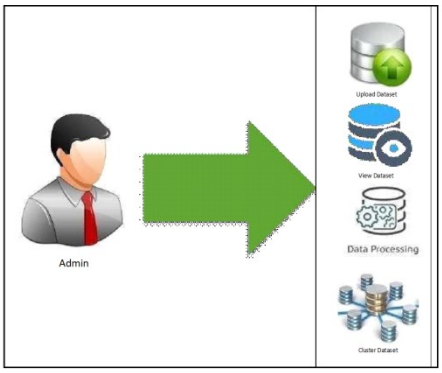

Fig: System Architecture

IV. IMPLEMENTATION

MODULES

- Admin

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MODULE DESCRIPTION

Admin

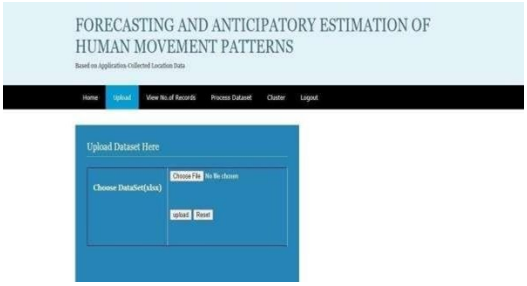
In this module here admin can directly login with the application after admin successful login he can upload dataset and view dataset and also clean data set by preprocessing and we are clustering based on the country available in dataset.

V. SCREENSHOTS

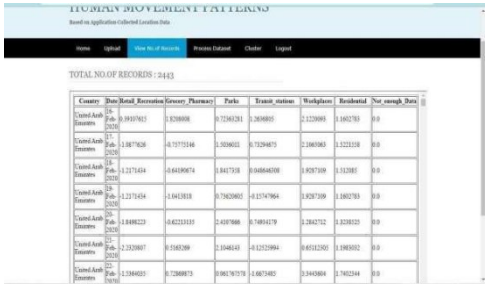
HOME PAGE

ADMIN LOGIN

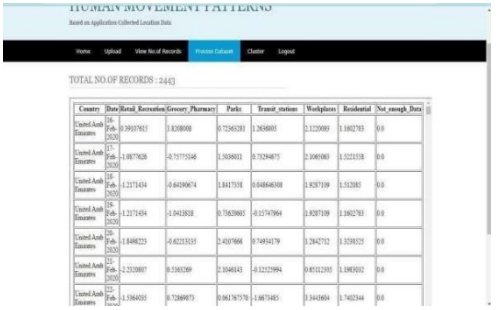
UPLODE DATA



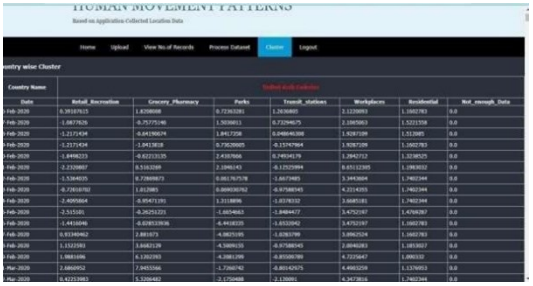
VIEW NO. OF RECORDS



PROCESS DATA



CLUSTER



VI. CONCLUSION

CONCLUSION

Prediction based on users' historical trajectories is of great importance to improve the location- based services. In this paper, aiming at addressing the three challenges of app collected dataset, we carry out a comprehensive analysis of predictability and prediction method over a large- scale app collected location data. First, we employ a context-based segmentation method to preserve the physical context of app collected data. Under the division, trajectories achieve the prediction accuracy 10% higher than those without context. Second, we design a Markov chain method based on Gibbs sampling in order to solve the unevenly distribution and the high missing rate. The prediction accuracy of the method reaches a high level with the correlation coefficient between prediction accuracy and predictability reaching 0.86. Third, we comprehensively analyze various factors that affect the prediction accuracy, including spatial and temporal resolution, orders of Markov models, radius of gyration. In general, our analysis provides a systematic and comprehensive understanding of predictability of user's mobility patters on app- collected dataset.

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JUNE 2025, Volume 15, ISSUE 2
UGC Approved Journal

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