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A PROACTIVE WORKFLOW MODEL FOR HEALTHCARE MONITORING SYSTEM

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ABSTRACT

Advances in real-time location systems have enabled us to collect large amounts of fine-grained semantically rich location traces, which give unparalleled opportunities for better understanding of human activities and generating gainful knowledge. This, in turn, handover intelligence for real-time decision making in various fields, such as workflow management. Naturally, it is a new method to model workflows through knowledge discovery in location traces. On the other end, we provide a focused study of workflow modeling by integrated analysis of indoor location traces in the hospital set-up. Here we develop a workflow modeling framework that automatically constructs the workflow states and evaluates the parameters describing the workflow transition patterns. More uniquely, we propose effective and efficient regularizations for modeling the indoor location traces as stochastic processes. At first, to improve the interpretability of the workflow states, we are going to use the geography relationship in-between the inner rooms to define a prior of the workflow state distribution. This prior boosts each workflow state to be a contiguous region in the block. Second, to further improve the modeling performance analysis, we show how to use the correlation between related types of medical devices to reinforce the parameter estimation for multiple workflow models. In comparison with our prior work we not only develop an integrated workflow modeling framework applicable to

general inner rooms and environments, but also improve the modeling accuracy significantly. We will reduce the average log-loss.

INTRODUCTION:

Real-time location systems (RTLS) are being quickly developed and deployed. Of note, hospitals are more and more exploitation these systems to trace the movement of medical devices, doctors, and patients also as the interaction among them. However, their utilization is presently restricted to basic tasks, like locating a wheelchair or checking the supply of an inpatient bed. In the close to future, we tend to expect indoor location tracking information to be wide accessible in several hospitals, furthermore as in alternative environments (e.g., shops, schools, warehouses, etc). Understanding sequences of procedures that replicate workflows (e.g., surgery, from admission to recovery) remains a very important challenge that we address during this work. Workflows reveal semantically purposeful patterns that may facilitate (i) understand however space and assets (e.g., medical instrumentation, classrooms, and shopping areas) are used (workflow auditing); (ii) ensure that such utilization complies with rules and regulations (workflow compliance); and (iii) perform any of those tasks in real time (workflow monitoring). For instance, several health care suppliers have their own work protocols to make sure that health care practices are executed in a very controlled manner. Non-compliance to those protocols could also be expensive and expose the health care suppliers to severe risks, like litigation, prosecution, and injury to brand reputation. Thus, there's a true need for effective scrutiny of work flow compliance. This work focuses on basic models to support the entire on top of tasks. Hospital managers historically accomplish these tasks by inspecting the elaborated work flow logs which might be in heterogeneous formats, stored in several media (including paper), and provided passively by personnel and, therefore, could also be biased and incomplete. The overall task is kind of daunting, and also the opportunities to develop proactive approaches to assist with work flow management tasks are unparalleled. However, RTLS deployments are still utilized in a comparatively basic approach, as noted on top of, with very little work specializing in how to leverage huge indoor location traces. On the other end, here we given a focused study of work flow modeling via integrated analysis of indoor location traces, evaluated on real information from hospital environments. Such work flow models functions basic building blocks in a very big selection of work flow management issues.

LITERATURE SURVEY:

Multiple-goal recognition from low-level signals

The development of sensors with the micro electromechanical systems technology expedites the emergence of new tools for human-computer interaction, such as inertial pens. These pens, which are used as writing tools, do not depend on a specific embedded hardware, and thus, they are inexpensive. Most of the available inertial pen character recognition approaches use the low-level features of inertial signals. This paper introduces a Persian/Arabic handwriting character recognition system for inertial-sensor-equipped pens. First, the motion trajectory of the inertial pen is reconstructed to estimate the position signals by using the theory of inertial navigation systems. The position signals are then used to extract high-level geometrical features. A new metric learning technique is then adopted to enhance the accuracy of character classification. To this end, a characteristic function is calculated for each character using a genetic programming algorithm. These functions form a metric kernel classifying all the characters. The experimental results show that the performance of the proposed method is superior to that of one of the state-of-the-art works in terms of recognizing Persian/Arabic handwriting characters.

Topeye: top-k evolving trajectory outlier detection

Outlier detection is an important task in data mining and has been well studied on precise data. However, outlier detection on uncertain objects is particularly challenging. In this paper, firstly, the conceptions about density-based top-k uncertain outlier detection are defined. Secondly, an algorithm of density-based Top-k outlier detection on uncertain objects is proposed, the time complexity of which is polynomial. Finally, the experiment illustrates the effectiveness and efficiency of the algorithm.

A taxi driving fraud detection system

Advances in GPS tracking technology have enabled us to install GPS tracking devices in city taxis to collect a large amount of GPS traces under operational time constraints. These GPS traces provide unparallel opportunities for us to uncover taxi driving fraud activities. In this paper, we develop a taxi driving fraud detection system, which is able to systematically investigate taxi driving fraud. In this system, we first provide functions to find two aspects of

evidences: travel route evidence and driving distance evidence. Furthermore, a third function is designed to combine the two aspects of evidences based on Dempster-Shafer theory. To implement the system, we first identify interesting sites from a large amount of taxi GPS logs. Then, we propose a parameter-free method to mine the travel route evidences. Also, we introduce route mark to represent a typical driving path from an interesting site to another one. Based on route mark, we exploit a generative statistical model to characterize the distribution of driving distance and identify the driving distance evidences. Finally, we evaluate the taxi driving fraud detection system with large scale real-world taxi GPS logs. In the experiments, we uncover some regularity of driving fraud activities and investigate the motivation of drivers to commit a driving fraud by analyzing the produced taxi fraud data.

Concurrent and interleaving goal and activity recognition

Plan recognition is a ubiquitous task in the artificial intelligence and pervasive computing research. Multiple-goal recognition problem is a major challenge in the real-world of plan recognition, in which users often pursue several goals in a concurrent and interleaving manner, where the pursuit of goals may spread over different parts of an activity sequence and may be pursued in parallel. Existing approaches to recognizing multiple-goal problems are probabilistic approaches assuming the existence of plan libraries, which require much human effort in predicting and formalizing plans, and may be unrealistic in many cases. In this paper, we present a novel logic-based approach to solve the multiple-goal problems efficiently, without the need of plan libraries, using a state-of-the-art heuristic search planner LAMA. In particular, we propose the first formulation of multiple-goal recognition problem based on planning, and present a two-level probabilistic plan recognition approach that deals with both concurrent and interleaving goals from observed activity sequences. Experimental results over several domains show that our method can recognize multiple-goal problem with flexibility and scalability.

EXISTING SYSTEM:

One important aspect of training ProWM is how to choose an appropriate number of latent workflow states. A commonly used approach for estimating the latent states of HMMs is to leverage domain knowledge or some existing algorithms to pre-cluster the observations. In our problem, we shall pre-cluster the indoor location records to guide the training of ProWM.

To this end, we adopt the density-based clustering algorithm proposed in Liu et al. which computes the neighborhood of a location record as well as its density based on the historical location traces. Using this algorithm, the number of clusters can be automatically determined, and the detected clusters can be of different densities and arbitrary shapes.

DISADVANTAGE:

In terms of analytics of location traces, trajectory pattern mining is also related to in work. For instance introduced trajectory patterns as frequent behaviors in terms of both time and space, where the frequent trajectory patterns are computed based on given thresholds.

In methods were proposed to discover periodic patterns from spatio-temporal data, where a periodic pattern is defined as a regular activity which periodically happens at certain locations.

PROPOSED SYSTEM:

The model with reduced space has average logloss comparable to that of the model using the full space. Second, in the scenario with substantially limited training data, the running time of the proposed ProWM model with reduced modeling space is close to that of the baseline model developed in However, our ProWM model has significantly better prediction performance. In other words, we reduce the average log-loss while maintaining computational efficiency.

ADVANTAGE:

The multiple models are not independent with each other. For instance, in hospitals, many different types of medical devices are often used together for a particular task. Therefore although different types of medical devices have different workflow patterns, there is some natural correlation among their location traces.

Modeling such correlation not only helps reinforce the robustness of the workflow models, but also provides better understanding of the overall workflow patterns.

IMPLEMENTATION:

Indoor Location Traces

The overall task is quite daunting, and the opportunities to develop proactive approaches to help with workflow management tasks are unparalleled.

However, RTLS deployments are still used in a relatively basic way, as noted above, with little work focusing on how to leverage massive indoor location traces.

To this end, this paper provides a focused study of workflow modeling via integrated analysis of indoor location traces, evaluated on real data from hospital environments.

Such workflow models serve as fundamental building blocks in a wide range of workflow management problems.

Workflow Modeling

In methods were proposed to discover periodic patterns from spatio-temporal data, where a periodic pattern is defined as a regular activity which periodically happens at certain locations. Also proposed methods to discover sequential patterns from imprecise trajectories of moving objects.

However, these methods were not developed for indoor spaces, were not designed for the purpose of workflow modeling and, more importantly, the mined frequent patterns cannot provide a parsimonious description of healthcare activities in hospitals, o support the applications we have considered.

Healthcare Operation and Management

The learned workflow model is valuable, since a range of practical problems can benefit from the modeling results.

Indeed, we have implemented a management information system to exploit the discovered knowledge for healthcare operation and management.

Multiple locations may be used either concurrently or interchangeably and, therefore, should be grouped together.

However, this grouping will depend on the workflow/procedure, and may change over time.

We model the functional significance of a location in the context of a workflow as a hidden state.

Therefore, a state is a probability distribution over rooms. However, in order to obtain interpretable results, we need to regularize it.

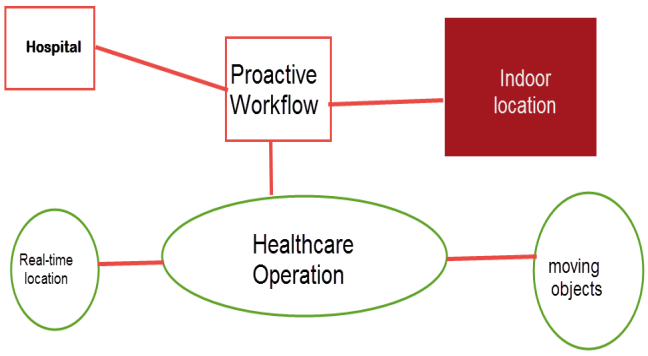
Location traces

Workflow modeling is central to many building operations and management tasks, systematically constructing and estimating those models based on massive indoor location traces is a nontrivial endeavor.

Next we identify specific challenges in workflow modeling from indoor location traces, and we outline the ingredients of our proposed solution, which revolve around representation of position location and of mobility transitions at three different levels: micro, meso, and macro.

At the "micro" level, we have the raw data, which consist of three-dimensional coordinates and geometric (Euclidean) distance between them. Based on these, we have to construct or infer appropriate representations for workflow modeling Proactive Workflow.

Architecture Diagram:



CONCLUSION:

We leveraged location traces of medical devices to model the healthcare workflow patterns in hospital environments. Specifically, we developed a stochastic process-based framework, which provides parsimonious descriptions of long location traces.

This framework provides new opportunities to concisely understand the logistics of a large hospital.

From a technical perspective, we proposed a unified modeling approach based on a novel regularized HMM method that produces interpretable states and leverages correlations between devices for improved robustness.

From an application perspective, the discovered knowledge, such as workflow states and transition patterns can be integrated into management information system we developed.

With this system, we showed that valuable intelligent applications for healthcare operation and management can be enabled to manage, evaluate and optimize the healthcare services.

Extensive experimental results on both the synthetic data and the real-world data validated the effectiveness of our proposed work.

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