International Journal of Trend in Scientific Research and Development (IJTSRD)
International Open Access Journal
ISSN No: 2456 - 6470 | www.ijtsrd.com | Volume - 2 | Issue – 3

Mining Human Movement Patterns for Big Data for Healthcare Applications in Smart Home

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ABSTRACT

Nowadays, there is an ever-increasing migration of people to urban areas. Health care services are one of the most challenging aspects that is greatly affected by the vast influx of people to city centers. Consequently, cities around the world are investing heavily in digital transformation in an effort to provide healthier ecosystem for people. In this paper, we propose a model that utilizes smart home big data as a means of learning and discovering human activity patterns for health care applications. We propose the use of frequent pattern mining, cluster analysis and prediction to measure and analyze energy usage changes sparked by occupants' behavior.

Keywords: *Big data, smart cities, smart homes, smart cities, health care applications, Behavioral Analytics, Frequent Pattern, Cluster Analysis, Incremental Data-Mining, Association Rules, Prediction*

INTRODUCTION

Studies show that by year 2050, 66% of the world population will be living in urban areas [1]. The demand for health care resources will be greatly affected by this vast influx of people to city centers. This unprecedented demographic change places enormous burden on cities to rethink the traditional approaches of providing health services to residents. In responding to the new needs and challenges, cities are currently embracing massive digital transformation in an effort to support sustainable urban communities, and provide healthier environment [2] [3]. In such transformation, millions of homes are being equipped with smart devices (e.g. smart meters, sensors etc.) which generate massive volumes of fine-grained and indexical data that can be analyzed to support health care services. Advancement of big data mining technologies, which provide means of processing huge amount of data for actionable insights, can aid us in understanding how people go about their life.

For example, monitoring the changes of appliance usage inside a smart home can be used to indirectly determine the person's wellbeing based on historical data. Since people's habits are mostly identified by everyday routines, discovering these routines allows us to recognize anomalous activities that may indicate people's difficulties in taking care for themselves, such as not preparing food or not using shower/bath [4] [5]. The underlying correlation between appliance usage inside the smart home and routine activities can be used by health care applications to detect potential health problems. This is not only going to alleviate the burden on health care systems, but also providing 24 hour monitoring service that automatically identifies normal and abnormal behaviors for independently living patients or those with self-limiting conditions (e.g. elderly and patients with cognitive impairments). In existing system .studies show that by year 2050, 66% of the world population will be living in urban areas .There is no chance to know about their health issues which may lead a problem the demand for health care resources will be greatly affected by this vast influx of people to city centers. This unprecedented demographic change places enormous burden on cities to rethink the traditional approaches of providing health services to residents.

LITERATURE SURVEY

Abdulsalam Yassine proposes a Health care services is one of the most challenging aspects that is greatly affected by the vast influx of people to city centers. Consequently, cities around the world are investing heavily in digital transformation in an effort to provide healthier ecosystem for people. In such transformation, millions of homes are being equipped with smart devices (e.g. smart meters, sensors etc.) which generate massive volumes of fine-grained and indexical data that can be analyzed to support smart city services. In this paper, we propose a model that utilizes smart home big data as a means of learning and discovering human activity patterns for health care applications. We propose the use of frequent pattern mining, cluster analysis and prediction to measure and analyze energy usage changes sparked by occupants' behavior Since people's habits are mostly identified by everyday routines, discovering these routines allows us to recognize anomalous activities that may indicate people's difficulties in taking care for themselves, such as not preparing food or not using shower/bath. Our work addresses the need to analyze temporal energy consumption patterns at the appliance level, which is directly related to human activities. For the evaluation of the proposed mechanism, this research uses the UK Domestic Appliance Level Electricity dataset (UK-Dale) - time series data of power consumption collected from 2012 to 2015 with time resolution of six seconds for five houses with 109 appliances from Southern England. The data from smart meters are recursively mined in the quantum/data slice of 24 hours, and the results are maintained across successive mining exercises. The results of identifying human activity patterns from appliance usage are presented in details in this paper along with accuracy of short and long term predictions.

C.Chalmers, W.Hurst, was Proposes the smart meters has allowed us to monitor consumers' energy usage with a high degree of granularity. Detailed electricity usage patterns and trends can be identified to help understand daily consumer habits and routines. The challenge is to exploit these usage patterns and recognise when sudden changes in behaviour occur. This would allow detailed, around the clock, monitoring of a person's wellbeing and would be particularly useful for tracking individuals suffering from self-limiting conditions such as Alzheimer's, Parkinson's disease and clinical depression. This paper explores this idea further and presents a new approach for unobtrusively monitoring people in their homes to support independent living. The posited system uses data classification techniques to detect anomalies in behaviour through personal energy usage patterns in the home. Our results show that it was possible to obtain an overall accuracy of 99.17% with 0.989 for sensitivity, 0.995 for specificity and an overall error of 0.008 when using the VPC Neural Network classifier.

M. Shamim Hossain proposes the Smart, interactive healthcare is necessary in the modern age. Several issues, such as accurate diagnosis, low-cost modeling, low-complexity design, seamless transmission, and sufficient storage, should be addressed while developing a complete healthcare framework. In this paper, we propose a patient state recognition system for the healthcare framework. We design the system in such a way that it provides good recognition accuracy, provides low-cost modeling, and is scalable. The system takes two main types of input, video and audio, which are captured in a multisensory environment. Speech and video input are processed separately during feature extraction and modeling; these two input modalities are merged at score level, where the scores are obtained from the models of different patients' states.

For the experiments, 100 people were recruited to mimic a patient's states of normal, pain, and tensed. The experimental results show that the proposed system can achieve an average 98.2 % recognition accuracy.

Michael Mackay proposes smart meters have allowed us to monitor consumers' energy usage with a high degree of granularity. Detailed electricity usage patterns and trends can be identified to help understand daily consumer habits and routines. The challenge is to exploit these usage patterns and recognise when sudden changes in behaviour occur. This would allow detailed, around the clock, monitoring of a person's wellbeing and would be particularly useful for tracking individuals suffering from self-limiting conditions such as Alzheimer's, Parkinson's disease and clinical depression. This paper explores this idea further and presents a new approach for unobtrusively monitoring people in their homes to support independent living. The posited system uses data classification techniques to detect anomalies in behaviour through personal energy usage patterns in the home. Our results show that it was possible to obtain an overall accuracy of 99.17% with 0.989 for sensitivity, 0.995 for specificity and an overall error of 0.008 when using the VPC Neural Network classifier.

PROPOSED SYSTEM

In this paper, we propose a model that utilizes smart home big data as a means of learning and discovering human activity patterns for health care applications. We propose the use of frequent pattern mining, cluster analysis and prediction to measure and analyze energy usage changes sparked by occupants' behavior. Since people's habits are mostly identified by everyday routines, discovering these routines allows us to recognize anomalous activities that may indicate people's difficulties in taking care for themselves, such as not preparing food or not using shower/bath. Our work addresses the need to analyze temporal energy consumption patterns at the appliance level, which is directly related to human activities. For the evaluation of the proposed mechanism, this research uses the UK Domestic Appliance Level Electricity dataset (UK-Dale) - time series data of power consumption collected from 2012 to 2015 with time resolution of six seconds for five houses with 109 appliances from Southern England. The data from smart meters are recursively mined in the quantum/data slice of 24 hours, and the results are maintained across successive mining exercises. The results of identifying human activity patterns from appliance usage are presented in details in this paper along with accuracy of short and long term predictions.

ARCHITECTURE DIAGRAM

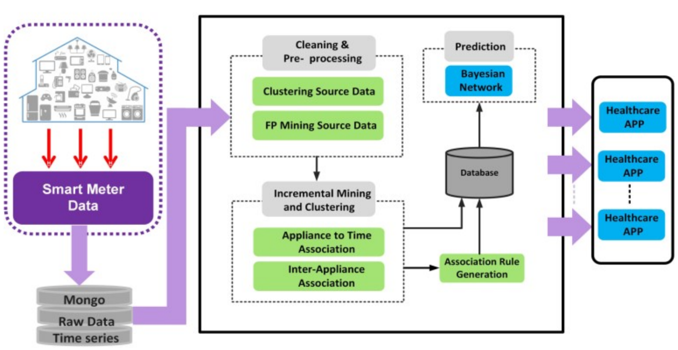

Fig. 1. Model: Mining Frequent Patterns and Activity Predictions for Health care Applications in Smart Homes

Figure (1) represents the proposed model. It starts by cleaning and preparing the data and then applying frequent pattern mining for discovering appliance-to-appliance associations, i.e., determining which appliances are operating together. Then, it uses cluster analysis to determine applianceto- time associations. With these two processes, the system is able to extract the pattern of appliance usage which is then used as input to the Bayesian network for short-term and long-term activities prediction. The output of the system is utilized by specific health care applications depending on the intended use. For example, a health care provider might only interested in knowing activities related to cognitive impairment where tracking the sequence of daily activities is crucial for reminding the patient when abnormal behavior is detected. Next subsection explains such processes and briefly outlines the theoretical background. We propose a human activity pattern mining model based on appliance usage variations in smart homes. The model which utilizes FP-growth for pattern recognition and k-means clustering algorithms is capable of identifying appliance-to-appliance and appliance-to-time associations through incremental mining of energy consumption data. This is not only important to determine activity routines, but also, when utilized by health care application, is capable of detecting sudden changes of human activities that require attention by a health provider. We apply a Bayesian network for activity prediction based on individual and multiple appliance usage. This is significant for health applications that incorporate reminders for patients to perform certain activities based on historical data. For added accuracy of the system, the prediction model integrates probabilities of appliance-to-appliance and appliance-to time associations, thus recognizing activities that occur in certain patterns more accurately.

ADVANTAGES

• Protect people's privacy from being shared .
• To understand and predict their activities that could indicate health issues.

CONCLUSION

In this paper, we presented a model for recognizing human activities patterns from low resolution smart meters data. Occupants' habits and behavior follow a pattern that could be used in health applications to track the wellbeing of individuals living alone or those with self-limiting conditions. Most of these activities can be learned from appliance-to appliance and appliance-to-time associations. We presented incremental frequent mining and prediction model based on Bayesian network. In our current work, through experiments, we found that 24-hour period was optimal for data mining, but we built the model to operate on any quantum of time. From the experiment results we have demonstrated the applicability of the proposed model to correctly detect multiple appliance usage and make short and long term prediction at high accuracy.

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