Chapter 101
Research Challenge of Locally Computed Ubiquitous Data Mining[1]

Aysegul Cayci
Sabanci University, Turkey

Andrea Zanda
Universitad Politecnica, Spain

João Bártolo Gomes
Universitad Politecnica, Spain

Ernestina Menasalvas
Universitad Politecnica, Spain

Santiago Eibe
Universitad Politecnica, Spain

ABSTRACT

Advances in wireless, sensor, mobile and wearable technologies present new challenges for data mining research on providing mobile applications with intelligence. Autonomy and adaptability requirements are the two most important challenges for data mining in this new environment. In this chapter, in order to encourage the researchers on this area, we analyzed the challenges of designing ubiquitous data mining services by examining the issues and problems while paying special attention to context and resource awareness. We focused on the autonomous execution of a data mining algorithm and analyzed the situational factors that influence the quality of the result. Already existing solutions in this area and future directions of research are also covered in this chapter.

INTRODUCTION

Research challenges in data mining increase as a consequence of technological and scientific advances and there is a need to lay out the emerging challenges in order to ease and expedite the research on the issues identified. Focus of extant data mining research is, on one hand, high performance data mining where research endeavours are to reduce the computational complexity of algorithms and develop parallel and distributed data mining algorithms. On the other hand, data mining methods are investigated to obtain better models for specialized areas such as genome mining or special kind of data such as spatial and temporal. Though these are still among the interested research areas and any contribution will be useful to on-going data mining, in this chapter we aim

DOI: 10.4018/978-1-4666-2455-9.ch101

to draw attention to a new data mining paradigm which is Ubiquitous Data Mining. Briefly, it refers to mining of data, which is ubiquitous in nature and collected in mobile and pervasive computing environments. Ubiquitous data mining, which is a reality today, can be predicted to be more widespread as there is a high acceptance of mobile and pervasive technologies by the masses and more advances are expected in these technologies. On the contrary, existent literature on ubiquitous data mining is lacking in quantity. Consequently, there is a need for research in this area.

Mobiles such as smartphones, PDA's and navigation devices and other devices of pervasive computing such as sensors and wearable computers constitute a new, ubiquitous computing platform. In order to take advantage of the useful data which is easily collected by mobile and pervasive devices, abundance of applications were developed in this computing platform in a very short time. Data mining is offered as a service to variety of applications as a way to provide intelligence for a long time and same usage, that is, intelligence through data mining, applies to applications of ubiquitous computing as well. Ubiquitous computing is basically differentiated by the following characteristics. Data acceptance capability is very flexible since ubiquitous devices sense the environment. This may result in accumulation of huge amounts of data rapidly. Ubiquitous devices have restricted resources such as battery, memory and so on, implying divergence from optimum processing conditions. Primarily these two facts and others mentioned below enforce data mining rules to be re-established for ubiquitous computing environments.

Ubiquitous data mining is employing special methods to discover useful but hidden information from the data collected by the computing devices, which are scattered in the environment. Issues of data mining on such a computing platform are: 1) mining should be performed on a resource constrained device because transferring data to a central computer is not practical/preferred due to technical reasons or unnecessary, 2) the context obtained from the environment is not constant, 3) ubiquitous devices have to react to the environment and the software running on it must be designed to be in accord, 4) flow of data is continuous, 5) privacy is more vulnerable, 6) process has to be autonomous.

Each issue listed above points to a feature that a ubiquitous data mining system should have. Due to the novel features that ubiquitous data mining service must have, there is a need for re-design of this service. A general framework that satisfies all the requirements of ubiquitous data mining for standardization would be of greater aid for further studies on that subject.

This chapter is written to motivate the research on ubiquitous data mining by especially mentioning the challenges to be dealt with on each particular subject of it. Mentioning issues to be handled and problems to be solved explains the properties of ubiquitous data mining. Related work on each of them is searched. Finally, we focus on the challenges of an algorithm running autonomously in such an environment and discuss possible solutions together with advantages and disadvantages.

ISSUES, CONTROVERSIES AND PROBLEMS OF UBIQUITOUS DATA MINING

The advances in wireless, sensor, mobile and wearable technologies affected substantially how and where data is accumulated, processed and analyzed. Data, which used to be entered to a central computer for processing from a limited number of end points, is now dominantly collected by incredible number of devices surrounding us. Ubiquitous nature of this new computing platform brings challenges to several information and computing technologies where data mining is one of them.