Visualizing the Knowledge Domain: A Review

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ABSTRACT

Nowadays, it is very challenging task to reveal the scientific knowledge due to availability of numerous research materials. The use of visualization tools to discover scientific models and their relationship is very difficult. The intellectual structures of a particular knowledge domain can be captured by visualizing the knowledge structures. This paper comprehensively explores the scope and major themes of ubiquitous multimedia computing research. To analyze the leading research themes in the said field, three visualization techniques are used which linkage the publications, citation, research projects and patents in ubiquitous computing. The scientific papers from Institute of Scientific Information (ISI) web of knowledge (CiteSeerX) are clustered for the future research direction. The results show that recent popular research trend is going towards health care.

Key Words: Ubiquitous Multimedia Computing, Institute of Scientific Information, Path Finder Network, Open Services Gateway Initiative and Peer-to-Peer.

INTRODUCTION

Wikipedia:

The idea of ubiquitous computing was introduced by Weiser with a vision to create such a computing environment which provides information to people when and where needed (Abowd & Mynalt, 2000). Weiser vision has two aspects, one is proliferation of varying devices and other is emergence of new applications that leverages off the new devices and infrastructure (Wikipedia). The challenges of ubiquitous computing are described into three themes that are development of natural interface, development of context aware applications and capturing of live experience and their flexible and universal access .
(Hansmam et al. 2003). The vision of ubiquitous computing is to have small, inexpensive, robust networked processing devices, which are distributed at all scales in our everyday life e.g. wireless technology, networked appliances (Indirect Science). It is the era of wireless technology and this environment is also described as ubiquitous computing, pervasive computing or ambient computing as these terms are used interchangeably by Xerox, IBM and Philips respectively, introducers of these terms. (Daniel, 2007). All the terms talk about decentralized intelligence .

Citeseer. IST:

It is important to note that ubiquitous computing (UC) is one of the key technologies of ambient intelligence. The vision of UC can becomes reality if there exists pervasive networks (IST, 1999). Due to rapid growth in wireless networks, UC platform not only enables the interactions among the users, applications and services through wireless but people remain connected with internet while moving. High speed connectivity can also be provided with portable devices even with low bandwidth. UC platform also provide controlled multimedia services on portable devices via internet (Law & Sunny, 2010). The services of ubiquitous multimedia computing (UMC) allows peoples to access the multimedia contents with different networks and computing devices. The research in this area is still immature as only some services are deployed like mobile audio video streaming, mobile e-learning etc.

would be traced. It would be very difficult to filter the information from very large volume of data as lot of research papers published each year. The approaches like factor analysis, path finder and context based ontology (Chan Lee, Zoob: 2007). were used to analyze research trends by taking data from ISI web of knowledge in 2008. The author co-citation analysis (ACA) is mostly done through these statistical techniques (Thomsonrecuters). The said three knowledge visualization techniques are used to inter relate the research papers in this domain.

Factor Analysis:

Factor analysis is a data reduction technique used to reduce the variables and detect the structure of relationship between the variables. Common factor model is the base of factor analysis. The presented model shows that the analysis is performed by examining the patterns of correlation between the observed measures. In this model the highly correlated measures are influenced by same factor and uncorrelated by the different factors (Howard, 2003). The term “ubiquitous computing” was queried to citeseer citation index by limiting the search to literature published in the citation data of ISI web of knowledge in 2008 (Thomsonrecuters & Childreasmercy, 2008). The citation graph of all retrieved articles has been built. The initial citation graph contains 15708 nodes that were pruned to 1506 nodes by pruning papers that were cited less than three times. Ten research trends were identified by applying factor analysis and data shows health care is the most popular area.

Path Finder Network (PFNETs):

Path Finder Network (PFNETs), this technique has significant benefit in ACA. In PFNETs , authors are represented by nodes, the explicit links between the nodes represented by weighted paths and weights are co-citation counts (Howard. 1981). The two documents have a close relationship if they cited together (Maria & Tshug, 2000). The correlation of the papers was calculated by using the Pearson correlation coefficient, which is used to calculate the degree of association between the two variables (Thomsonrecuters). The papers are highly correlated when coefficient value approaches to one. In the constructed PFNET graph the nodes which lies close to the center defines the basic concepts and which are apart are less correlated (Weiser). The correlation coefficient is inversely proportional to the distance between the nodes.

The cluster like medical informatics, context aware computing and fundamentals of ubiquitous computing represented by number 1,5,6 respectively are very close to center , shows that the papers in these components play a fundamental role in ubiquitous computing research. Figure-1 drawn from the scaling graph, highlighting the aforementioned themes relationship. In the diagram context-aware computing have six connections, foundation studies having five and medical informatics having two and double arrow shows the relationship.

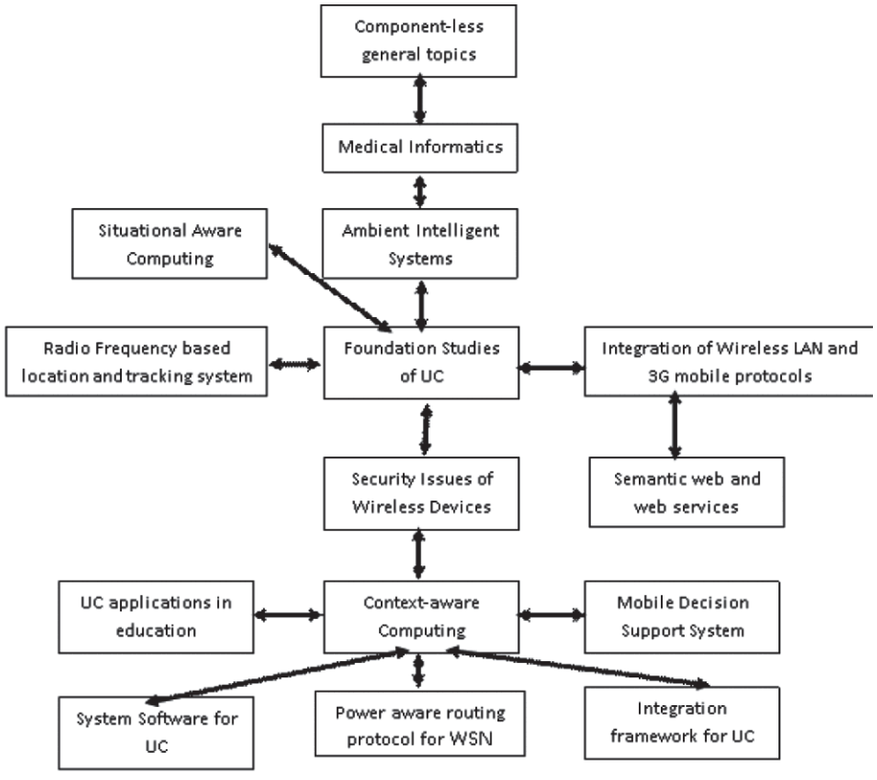

Figure 1. Relationship between main themes (Weiser).

Context Based Ontology:

Context based ontology; context aware computing is the basic theme of UC. We can describe it as location aware devices. These devices simply take the user location and provide services like call forwarding, updated maps etc. (Wikipedia). These Ontology model and concept databases were derived from the citation graph by using 209 papers. Ontology provides structure, organization and semantics. Context models can be classified into three approaches i.e, application oriented, model oriented and ontology oriented. The existing context model (model name) lacks generality and presented model address the generality but less formal.

The Concept database includes ubiquitous multimedia services and applications, intelligent context awareness for UMC, pervasive and interactive multimedia systems, UMS for human computer communication interaction, multimedia systems, architecture and applications of UMC, multimedia file system, database and retrieval for UMC, mobile multimedia systems and services for UMC, multimedia modeling and processing, emerging standards and technology for UMC, UM business model etc. Context based trend approach was drawn from ontology model and concept database. The presented ontology model shows the most context based trend in UMC is health care.

CONCLUSION

The research trends in ubiquitous computing were derived through factor analysis, PFNET and context based ontology from the published material on ISI web of knowledge of 2008 (Weiser). The results obtained from the aforementioned three techniques shows that the recent popular research area in UMC is the applications of health care. Based on Factor analysis and PFNET the power aware routing protocol in WSN is also an important research area (Weiser). On the basis of context based ontology, research in multimedia databases is also getting popularity. Furthermore factor analysis and PFNET extract the concept from ubiquitous computing while context based ontology emphasis on UMC, we can say factor analysis and PFNET have broader view than the context based ontology (Weiser).

The proposed visualization and co-citation techniques may be used for the different research domains for future research direction and to find the relationship between publications, citations, research projects and for patents (Weiser). The proposed three techniques can be used for other domains also.

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