

INFORMATION SHARING FOR SMALL DESIGN STUDIOS

Ubiquitous Information Flow approaches

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Abstract. While balancing the feasibility of management as well as design quality, design offices with strong focus on design are getting smaller and more compact. Mobility and dynamic information flow are two key issues for information sharing in design studio. In this research, we discuss about these concepts of ubiquitous computing, workflow and information model on small design studio. The goal of this research is trying to use available digital equipments as a ubiquitous device for sharing information dynamically no matter where and when they are. Use such digital equipments as well as server to store information and improve human interaction to achieve better interaction between human and technology. For these issues, we analyze three components of our system—the types of information, the interactive behaviors using roles as a metaphor, and ubiquitous devices that are available for small design studio. Within this research, we propose a system call Ubiquitous Information Flow Tool (UIFO) based on Java and Web technology for testing and reifying the concepts of ubiquitous information flow.

1. Introduction

Since the development of Internet, computerized technology has had bough conveniences to people in many different aspects. It includes services from

business to business, diverse information flow, and multimedia entertainment that greatly influence modern life style. Among those, the rapidly growth of information technology are best for assisting the decision-makers of business world. In addition, to use modern technology to organize and manage amounts of information becomes more or less to use technology for information sharing in current business management trend.

The main problem faced by small design office (or often regarded as design studio) management is its complex management over construction information. A dynamic organizing and separating the information sharing within the work process is the key to solve these problems. However, the information management of studio is often manual labor-intensive under the nature of design. From previous experience, we know manual labor has had problems with overlapping information that becomes the main problem of this research.

Normally, construction cycle starts from design, developing and onto construction stages. During the construction process, people who participates the outcome of the construction are client, chief architect, designer, construction Company and applier. All the information that each specialist used has tremendous influence of construction management usage. Furthermore, information sharing is the key point in the success of this construction. For example: mass amount of documented information become difficult to classify and organize. Also, during the management construction process such information is difficult to access and update. As the bigger company, these problems can be reduced with redundancy workforce. However, as the majority of design studio is small and compact. This problem becomes worse. Also with available information, we limit our information source to small design studio with less than 10 employees.

Large amounts of labor and high budget must be implemented because of this problem. Both sides are risking information lost. Therefore, the usage of tech information will create better form of communication between human interaction environments. Also the use of this technology can present multidimensional of information to create brand new form of information sharing environment.

Currently the process of small design studio is moving toward technology but usage of information is not processing properly or missing determination. Moreover, the management of construction process needs to have simple design with great impact on communication on-site. The storage of information sharing shall be the main topic. Two main factors are mobility and dynamic information flow. With the size of studio, the information flow in a ubiquitous environment becomes an interesting and practical issue for this research.

2. Reviews

For achieving the mobility and dynamic information flow required in this research, we reviews three relevant research realms—ubiquitous computing, workflow and information modeling. Each group of research represents certain aspect of information sharing for this research. The reviews are described in the following sections.

2.1. UBIQUITOUS COMPUTING

Ubiquitous computing original proposed by (Weiser 1993) provokes a fully distributed environment that all computing devices are embedded into many small electronic devices. The main idea is to give the power of communication back to the users instead of the technologies they are using. Regarding of information sharing, with ubiquitous computing, the user can then use available devices to retrieve information or to achieve communication purpose through the same process.

For example, (Schmandt 1999) applies GPS system to locate the geographical information and tracking location. By using wearable devices to store the information at that moment, different information can be shared at the same time. Another example, (Schmandt 1999) is about how mobile phones can be used to receive and process information in the different location. (Kohtake, et al. 1999) and (Brachtl, et al. 1999) shows how inter-appliance computing can be achieved through a name InfoStick Device. And such devices and framework can allow users to search the web and store information in other ubiquitous devices. Some examples of ubiquitous devices are shown in Figure 1.



Figure 1. Ubiquitous examples

One common feature shared among them is that the distributed and ubiquitous device is an important factor for mobility and effective information sharing.

2.2. WORKFLOW

Workflow is regarded as the management of each workflow process. With different aspect, workflow researches tend to be more focus on information management issues of design construction process or integrated construction (Ekholm and Fridqvist 1997, Habraken 1994). However workflow research provides insights for the process guidelines of this research. Among those, (Drosdol, et al. 2003) integrates virtual reality with architectural workflow shows an interesting visualization tool for visualizing the workflow.

According to the characteristic of workflow process, developing a new workflow will require a defining and re-defining cycle to achieve a more flexible workflow structure. This can be applied onto the design construction process or integrated construction process shown in (Ekholm and Fridqvist 1997, Habraken 1994).

2.3. INFORMATION MODELING

Information modeling researches provide a mechanism for modeling the information flow. Basically, information model is with specific focus on some information needed. Earlier information model only concerns the relation research. Or just exchange from earlier time of Electronic Data Interchange (EDI) to the recent XML technology (Van Leeuwen and Jessurun 2001). The current approach is about construction topic information model. Among those, (Yang and Cui 2003) provides an interoperable information modeling mechanism while (Zreik, et al. 2003) focuses on the communication need of information in architectural domain.

According to different information model and classification, we then follow the concepts of (Zreik, et al. 2003) for achieving a more flexible model. The main reason is that these information models can develop a various information flow by following different types and features of information. Therefore, distributed ubiquitous behaviors can occur and be influent by each other to attain Information analysis and interactive accessibility.

2.4. REQUIREMENT

With the information classification above, we tend to research problems with several requirements. (1) Ubiquitous information devices: The ubiquitous computing of the small design studio is numerous. The information can be

often acquired from the different ubiquitous devices, such as personal digital assistants (PDA) or mobile phones. (2) Flexible workflow: In addition, in the field of computation, the knowledge configuration of the design studio needs more flexible to be any use. Therefore, this research will focus on developing a flexible of workflow concept with define/re-define process. (3) Information modeling: According to different type of information, the workflow and ubiquitous devices will then be described and implemented by features of information. Since this issue requires some practical experience for different usages of information sharing, the approach we used is to test the implementation onto a set of domain cases, according to roles and focus on computation of information flow in small design studio.

3. Research steps

In this research, we will take advantage of existing devices and communication technology, such as wireless or GPRS (general packet radio system), to communicate with users by saving essential information type in different time and places. Moreover, the process of information access is similar but the display outcome is different in the different devices. For example, we use PDA with wireless; transmit pictures to the users through PDA. Users can utilize mobile phones to get information or use PDA to view pictures. This information process will use the concept of workflow to redefine to develop new workflow. We will utilize again and combine these characters to develop a different information flow based on the information model. It can easily achieve information sharing.

Research steps used in this research are—(1) analyzing information types in a specific information flow of design (stages); (2) analyzing roles of behaviors; (3) ubiquitous devices analysis and evaluation; (4) information framework and associated techniques and its implementation. The steps of research will explain within analysis and implementation sections.

4. Analysis

The main analysis for this paper is to analyze three components of our system—the types of information, the interactive behaviors using roles as a metaphor, and ubiquitous devices that are available for small design studio.

4.1. TYPES OF INFORMATION

We start with the analysis of information types. There can simply be divided into four parts—spatial information, meta-data, control data and physical models.

4.1.1. Spatial Information

The concrete spatial information can be obtained and work as an important collection of information. The spatial information consists of five catalogues as the following:

- Words: description and explanation of auxiliary data.
- Pictures: pictures of architect structure taken actually.
- 2D/3D drawing: individual exhibition and explanation of construction documents

4.1.2. Meta-data

In the meta-data information can be obtained and find the relation of information and data. For example: it is like a data warehouse. Users can understand the contents of the warehouse. It can find the relations between the data through the explanation of contents.

4.1.3. Control data

We can get the data which part can be use and check the data in current situation. In the manageable data, it can then checks and achieve the process of synchronization.

4.1.4. Physical model

Physical model is one of frequently used information that can be reused immediately. The model itself is not digitalized so we need to use several ubiquitous devices for cording or attaining such information In addition, we can then use these devices to do real-time communication in different space.

4.2. INTERACTIVE BEHAVIORS ANALYSIS

For analysis of interactive behaviors for information sharing, we use a role-model approach. By analyzing the capabilities of behaviors, the interaction can be obtained via the interactive behaviors of roles in certain situation. In the small design studio domain, four roles are unleashed—architect, builder, client and designer (office fellow). These four roles are communicated with each other by mobile devices and via a ubiquitous environment [shown in Figure.2].

With these four roles, we assume different message, interaction or demand occurred in certain behaviors. These behaviors can be divided as following:

- Access: access the data or information from the database.
- Search: search relation data or information from the database.
- View: display result on different ubiquitous devices.
- Add: add a new data or information.
- Edit: edit an existing data or information.
- Delete: delete an exit data or information.
- Synchronous: information or data need to check and update the database.
- Authorize: according to different roles the information have different authorize in different roles of behaviors.

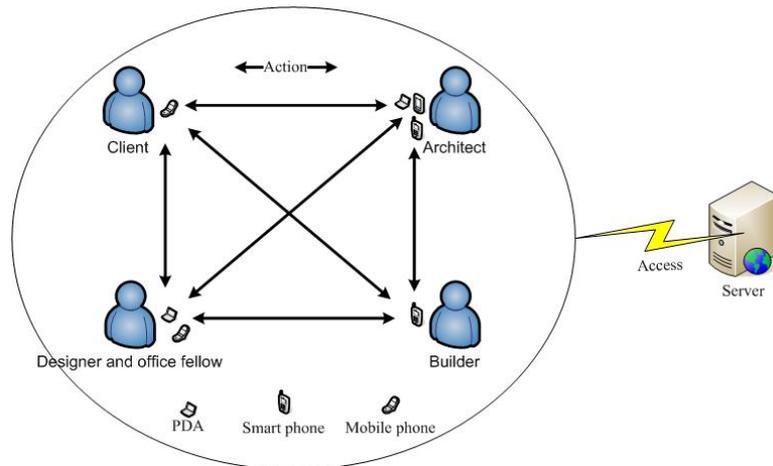


Figure 2. Different roles communicate with each other via a ubiquitous environment

4.2.1. Roles of Behaviors

With the roles defined, we then analysis the behaviors of information sharing among them. For example: we assume the architect according to the type of information and behaviors on information sharing as following:

- Evaluate feasibility of the new case: Architect need to access or search information and discuss with the client on the construction information. Thus, display relation between information is an important situation.
- Search/viewing workflow with combination of devices: Access or search using combination of different devices and have different views (PDA/PC/notebook).
- Modification of information: Through demand to add information that includes add/edit/delete of files and information flows.

- Authority of the information: Some information has different authorized issues and possible can be accessed or modified.
- Resource backup: The final result source need to backup, the backup can be asynchronous or synchronous.
- Classification of information: Organize different types of information and renew such information
- Urgent situation: when face to face communication is necessary for a urgent situation, users can access available devices such as web cam, video conference, to update/communicate the information
- Supervise the progress: Check the rule of law or check the process

Another example: we analyze the roles of designer according to the type of information and interactive behaviors as following:

- Search: Search relate information
- Different view: Use different devices for different viewing result
- Modification of visual information: According to the architect add/edit/delete pictures after making the visual checking for information relationship
- Synchronization of information: synchronization of two set of information and their modification history
- Classification of information: Organizing different types of information and updating the information
- Supervise scheduling: Supervising the working progress and check if the work is delay or not.

4.3. UBIQUITOUS DEVICES ANALYSIS

In this research, we use information types and the behaviorism demands mentioned above to analyze individual information flow. Furthermore, these actors can correspond to different ubiquitous devices and produce different outcomes. In this study, we assume different equipment features to analyze, especially the functionality, mobility, information accessibility and weights. We suppose that small design studio may use the devices, like workstation, notebook PDA and mobile phone.

- Workstation: The workstation supports the backbone power (like server role in a client/server model) for the ubiquitous computing upfront. Although it supports more functionalities and have good capacities of information, but it too weigh and not good for portability.
- Notebook: Notebook can provide ubiquitous computing with a bit of weight and size. It supports more function that can be readable and portable.

- PDA: It is a good size for a general ubiquitous device everywhere and anytime. It supports enough function and good portability to computing.
- Mobile phone: The mobile phone our life. It is good for ubiquitous computing everywhere and anytime. The mobile phone has good portability, but the function and readable is not enough.

4.4. TOWARDS A UBIQUITOUS INFORMATION FLOW

In this research, on the basis of mentioned ubiquitous devices of analysis outcome, such as shown in Figure 3. We combine different ubiquitous devices, information and roles relationship for realizing a different information flow of small design studio. We called it ubiquitous information flow (UIF) [examples are shown in Figure.3, 4].

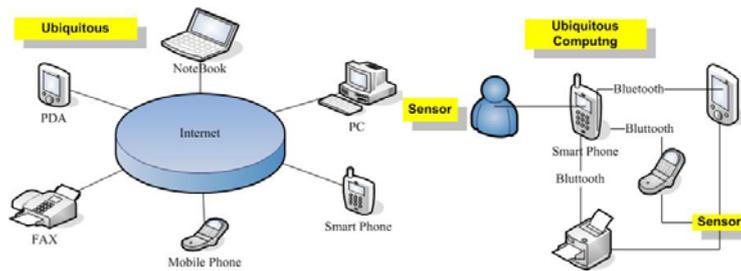


Figure 3. Ubiquitous devices and ubiquitous computing

The UIF is a cyclic process [Figure 4]. The relation came between (1) users and ubiquitous devices, (2) users and servers or (3) devices and servers. Users in different location can access and store the information in anywhere and anytime.

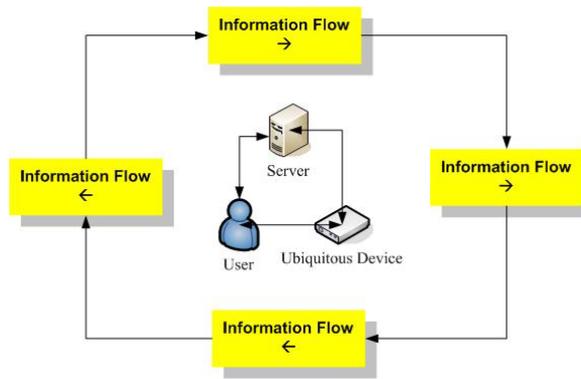


Figure 4. Ubiquitous information flow diagrams

Organizing the information-make the different types of information easier to access and search. Supervising the progress then check and visualize if the construction is following the rules and regulation. Both are synchronous. For example: architects might want to see the visual information while outside of company, they can use ubiquitous devices such as PDA or Mobile phone [Figure.5] through the network connection. Web service suits well in such network situation.

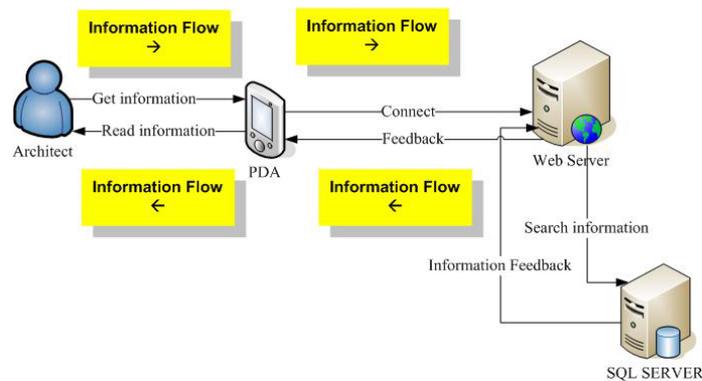


Figure 5. Information flow examples

Via Web server, available information can be sent to such ubiquitous devices for allowing architects to view. Also architects can use the computer or devices to create information then send it back through the database functionality of web server. Therefore synchronous information processes are updated. [Figure 6]

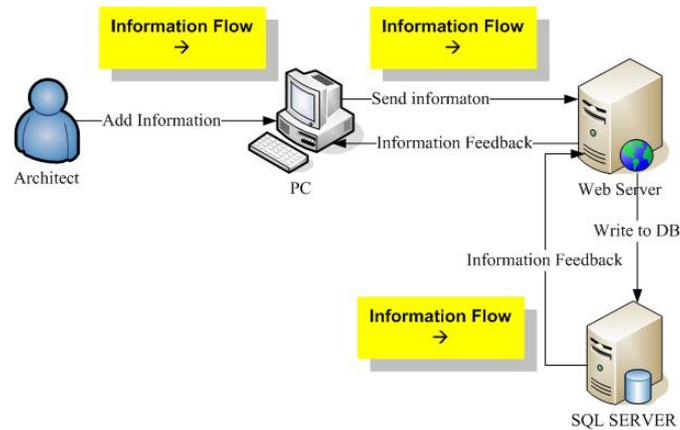


Figure 6. Information flow examples 2

According to the reviews, we use the combination of different ubiquitous devices according to the situations. The interaction between those devices are then formed and integrated into workflow. According to different roles and ubiquitous devices to store the information such demanding interaction should be different. Therefore problem could happen in the different combination of roles and information types. For example, multi-communication or multi-process over a particular information flow might need to be updated and managed at the same time. So the situation and its resolution based on UIF are important. We attain this problem by incrementally implementing the group of information flow.

5. Implementation

For organizing the information we collect these concept from review, we propose a system call Ubiquitous Information Flow Tool (UIFO) that utilizes two main research realms—ubiquitous computing and information flow. The ubiquitous devices and information flow are then integrated to do processing the information modeled by analysis above. Such, the data configuration of the small design studio will be well organized. The result of ubiquitous computing will be implemented using Bluetooth devices to connect other Bluetooth devices such as PDA or mobile phones. We use Java ME at Ubiquitous platform and Java is the programming language for the system.

The information we collect will not be limited by the textual information but also the 2D or 3D spatial information of some particular examples. For example: architect uses the mobile phone via GPRS to connect the server and obtain information from the server on the net. Therefore, the information can be various according the screen size of devices. The mobile phone while

supports more service such as email, Bluetooth, Wireless, the screen size might not suitable for spatial information. However, architects might use this service to send/control the information flow onto other users. An example of such information is shown in [Figure 7].

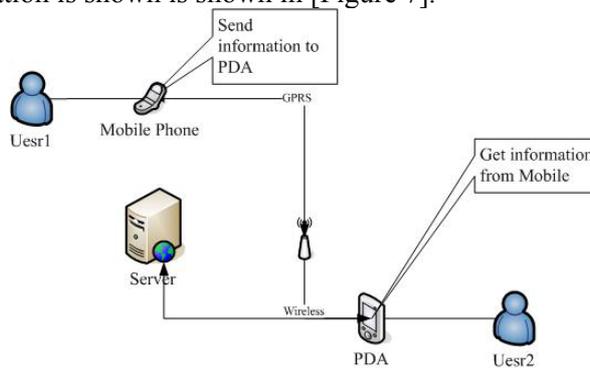


Figure 7. an example of ubiquitous information flow

Figure 8 shows that different roles can access different ubiquitous devices to connect to company server at the same time but different locations. In addition, according to the different characteristic of ubiquitous devices, users can get different information from the servers.

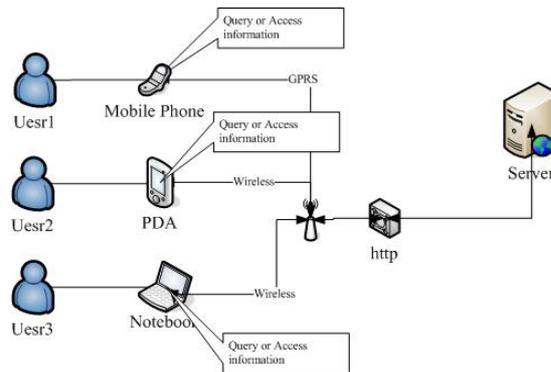


Figure 8. an example to access different aspects of information via different devices

5.1. FRAMEWORK

The configuration of UIFO System is like the relation of the client and server. Users can be through the protocol from the client to connect the server and request services from server in several routines, like Figure 9.

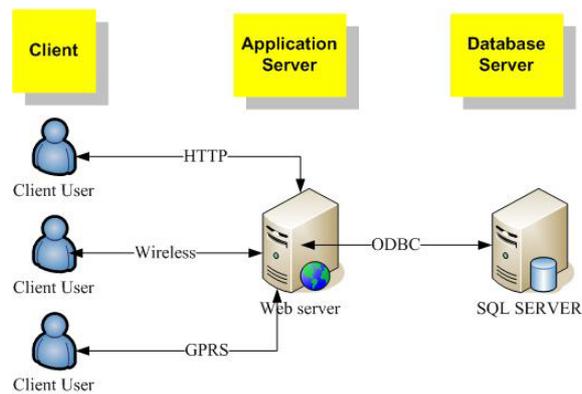


Figure 9. System framework

5.2. EVALUATION

UIFO is the combination of information modeling, concept of workflow and ubiquitous devices. The result relationship will change by following the different combination of devices. With these ubiquitous procedures, users can access the information of data model and modify the structure according to the demands of different situation they face, and finally, shared information can be updated. We use the devices to access and approach information sharing of small design studio.

In addition, several further usages of UIFO can be attained are described as following:

- Information synchronous
- Different ubiquitous devices to store and display information
- Multi-communication
- Organize information and process management
- Urgent situation and solutions

6. Conclusion and future

In this research, we develop UIFO from ubiquitous concepts in modeling information flow in small design studios. By using different ubiquitous devices such as PDA or mobile phone, the interface between users and information are redefined in sequences over different types of information required in different part of information flow. In addition, backbone of our information flow system combines the advantages of Internet as well as feasible information flow. This achieves two main characteristics of information sharing in our design problems—mobility and dynamic

information exchange. Data are analyzed and evaluated according to these criteria and provides enough feedback for the system.

Future research direction unleashed during the research process is applying ubiquitous devices onto the communication and management issues. Also, with the UIFO, the construction process can further be documented and recorded for further analysis. In addition, while more ubiquitous devices become available, the variation of dynamic information flow can be attained and examined.

In the future, because of rapidly developing technology, we are looking forward to take advantages of the integrated technology and learn from the established process. It is based on the more ubiquitous devices to let the system be more flexible.

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