

Implementation of a Web-Based Multi-User Task Management System in a Civil Engineering Construction Project

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Abstract

This paper presents work on applying web-based groupware or computer-supported cooperative workflow-management techniques in a civil engineering project that includes a multi-user task management system. The technique assists individuals in working together in groups to enhance the productivity of an organization and explores how information technologies can enhance efficiency among engineers with the information they need to share. This technique has enormous potential in civil engineering, mainly in the field of construction management, which provides workflow control and a notification mechanism. Groupware and workflow are significant in all the applications and have been demonstrated efficiently at the construction site by sharing information among designers, consultants, and contractors who are working in parallel with the client. This is an encouraging tool for assisting engineers in sharing and managing knowledge.

In coordinating with consultants, contractors, vendors, and clients via the management of assigned objectives, it is necessary to focus on multipurpose management software. The entire work effort, from strategic goals, to project and task management, to individual performance, is important for effective coordination. A communication platform for consultants for enhancing their ability to view and impact client requirements and follow through on deliverables is essential for a construction project. This approach was implemented to provide task management to utilize the flow of information between the client, consultants and contractors effectively by relying on computer-assisted software engineering technology.

A method is proposed for developing workflow-based applications in a cohesive and consistent way. Several tasks required external services and the creation of subtasks; few tasks were finished within the workgroup without creating subtasks. Comprehensive research was undertaken to handle inner and outer tasks and to accomplish "sender" and "receiver" functions. A task-notification system is the core requirement for a workflow management system, which is described briefly along with a demonstration of the concept of multilevel task assignment.

Keywords

Groupware, Project Task-Management, Workflow Management, Notification System, Civil Engineering.

1. Introduction

Groupware technology facilitates the accomplishment of group tasks effectively. The technology is web based and has been used to communicate, manage or coordinate, relying on modern computing networks

such as email, newsgroups, videophones or chat rooms. Generally, the impact of most research results in the field of construction shows that information technology (IT) has not had a significant impact on the industry, as noted by some authors (Amor et al. 2002). Hypertext is a web-based system for linking text documents to each other. Engineering large industrial construction projects is usually a complex task with several cooperating actors (Robert and Dirk 2000). Whenever multiple people author and link documents, the system becomes groupware, constantly evolving and responding to others' work. Most sophisticated groupware applications use intranet methods, which include a mechanism for sharing resources within the network. A pilot project on applying groupware computer-supported cooperative work and workflow-management techniques in civil engineering projects that include the Electronic Document Management System (EDMS) has been implemented (Jadid and Idrees 2005). Construction respondents are heavy users of critical path analysis for planning and control, resource scheduling for planning, and earned value analysis for control. The number of activities in a typical project and the use of software for *all* active projects were the key determinants of the usage of specific analytical techniques. (Matthew et al 2001).

2. Selected Construction Site

The new King Faisal University (KFU) campus is on a coastal road opposite the existing campus, with an approximate area of 2,000,000 m². The total building area at the completion of the contract will be about 570,000 m². The new campus will accommodate male and female students in two distinct areas. Each area will carry its own educational facilities, public services, and housing. The construction site is divided into eight main areas, as shown in Fig. 1.

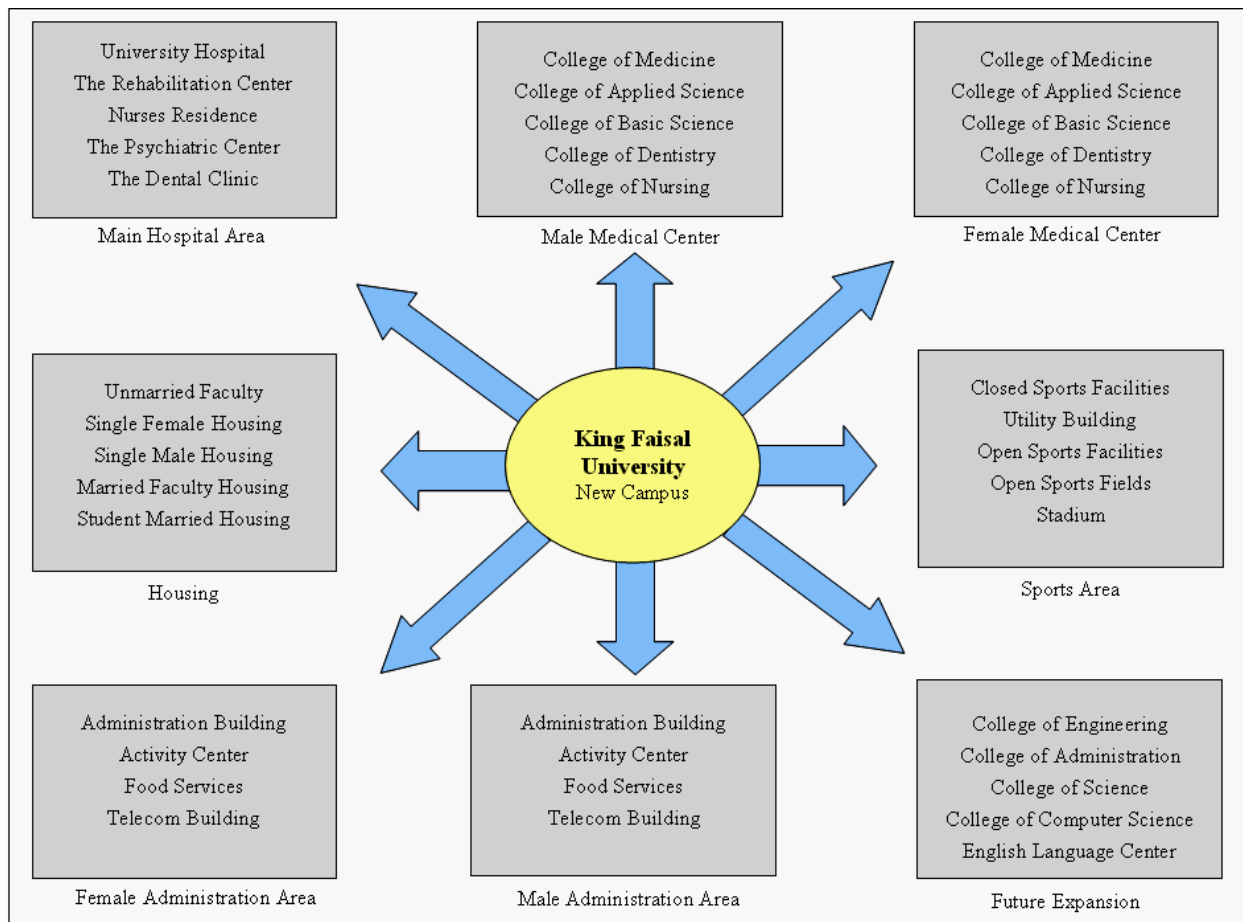


Figure 1: Colleges and Facilities within the Eight Main Areas of the Construction Site

3. Task-Management in a Civil Engineering Project

The conceptual approach was implemented in the construction project of the KFU campus. The objective was to improve the project participants' access to view their tasks in a secure manner and to supervise effective flow of information among consultants, project and planning departments, supervisors and engineers. The system utilizes the flow of information among the client, consultants and contractors effectively toward achieving the following services.

- Track and manage team, or individual tasks.
- Set assignments, priorities and due date.
- Email notifications of new task assignments.
- New assignments shown as special items on the individual's to-do list.
- Individuals and/or teams update status and resolutions.

In a multi-user task management system, each user acts as a task receiver or a task sender. These functions are described in Figures 2 and 3. The receiver and the sender must identify the task. In this project the first character of the task identification (task ID) is used to recognise internal and external tasks. If a user receives a task, and the task ID begins with the letter "N", the task is new, and the task cycle has not yet started. The program displays all finished and pending tasks that can be identified by colour. Once a task is finished, the colour changes from green to grey, as shown in case 1 of Fig. 2.

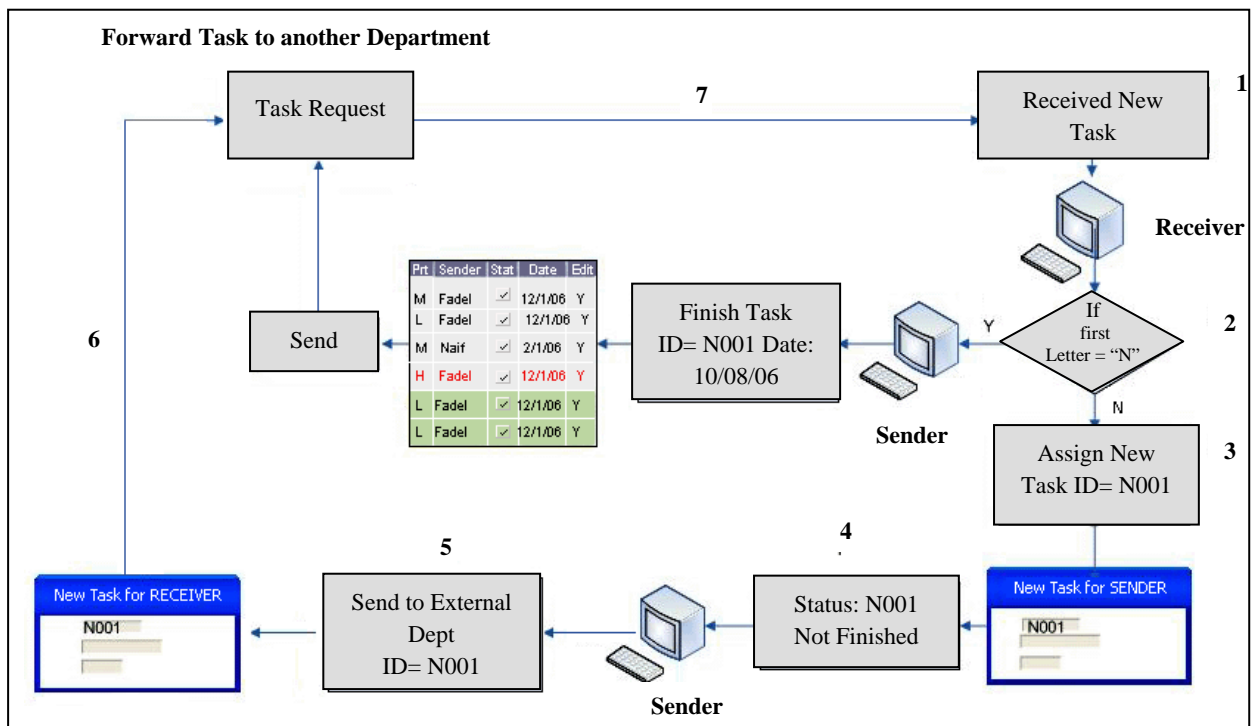


Figure 2: (Case 1) - Receiver's Function in a Task Cycle

If a task id starts with the letter "F", the task is to be forwarded to an external department. A new task is then created—for example, F001, as shown in case 2 (Fig. 2). Once the task is finished, a notification is sent to the requester that the assigned task has been finished.

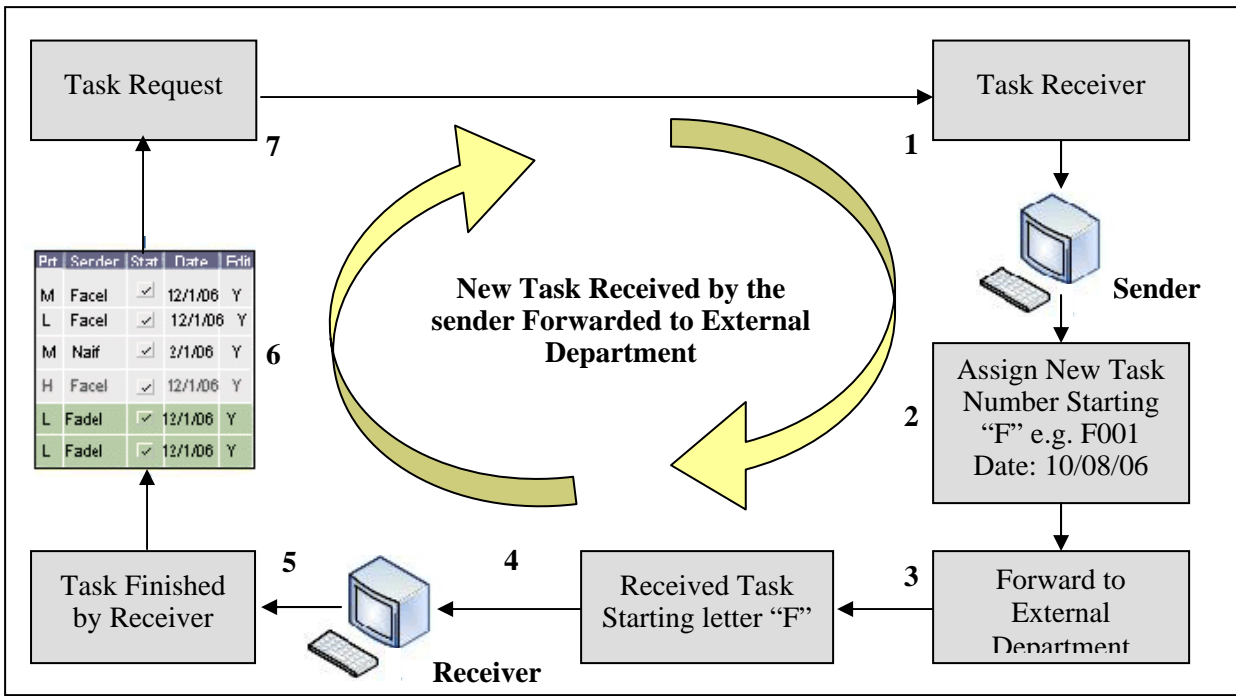


Figure 3: (Case 2) - Sender's Function in a Task Cycle

3.1 Workflow in a Construction Project

In a civil engineering project, human knowledge, judgment or experience is essential, and tasks should be assigned to the appropriate members of an organization through workflow systems.

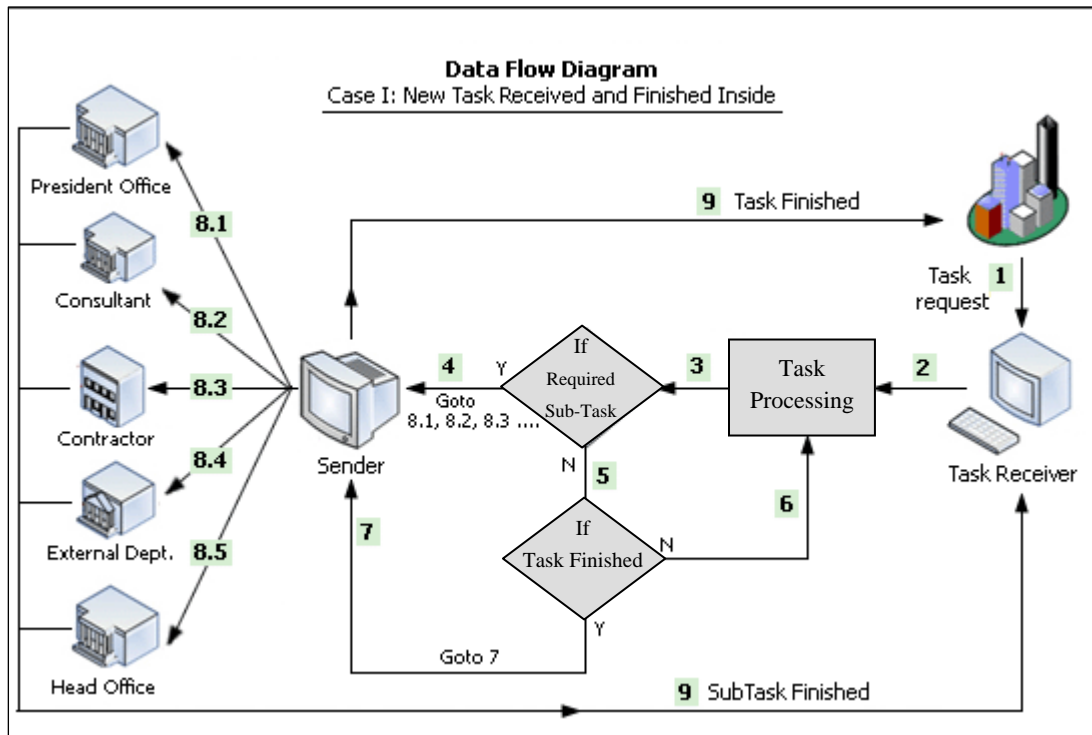


Figure 4: Workflow in a Civil Engineering Project.

The objective in the area of inter-organizational workflow management is to support the automation of business-to-business operations. This section describes the data flow in a civil engineering project for task processing. Figure 4 shows how a new task request is received and forwarded for processing.

The Ace-flow project developed techniques for flexible inter-organizational workflow management i.e., specification and execution of global workflows (crossing enterprise boundaries) in a workflow federation formed by the collection of autonomous workflow systems (Kradolfer, 1999). In a typical construction engineering project, consultants, contractors and client are the main entities of the workflow system. The work request flows within the group members or to a different group. If the task is finished without any external processing, no subtask is required, and the task is sent back to the requester to complete the cycle. In another case, tasks may require external processing by members of another group; therefore, subtasks are created to provide a relation key to its parent task, creating a link between the parent task and subtasks. In this example, subtasks 8.1 to 8.5 were created to complete one cycle. Components of a workflow can be defined by three parameters.

- Input description.
- Transformation rules and algorithms.
- Output description.

3.2 Multi-User Tasks-Management Model

The work carried out describes the conceptual development and implementation of a multi-user task-management model, including attention to the selection of appropriate mechanisms for task assignment. Federico and Roberto in 2000 described WF-ATOMS, a framework for the specification and management of workflows, the proposed engine was integrated in a multi-user and distributed task-management system. Fig. 5 shows a model of a task-management system. In this model, clients send requests to a centralised database, which has a task-control unit for assigning the task to the appropriate user or group.

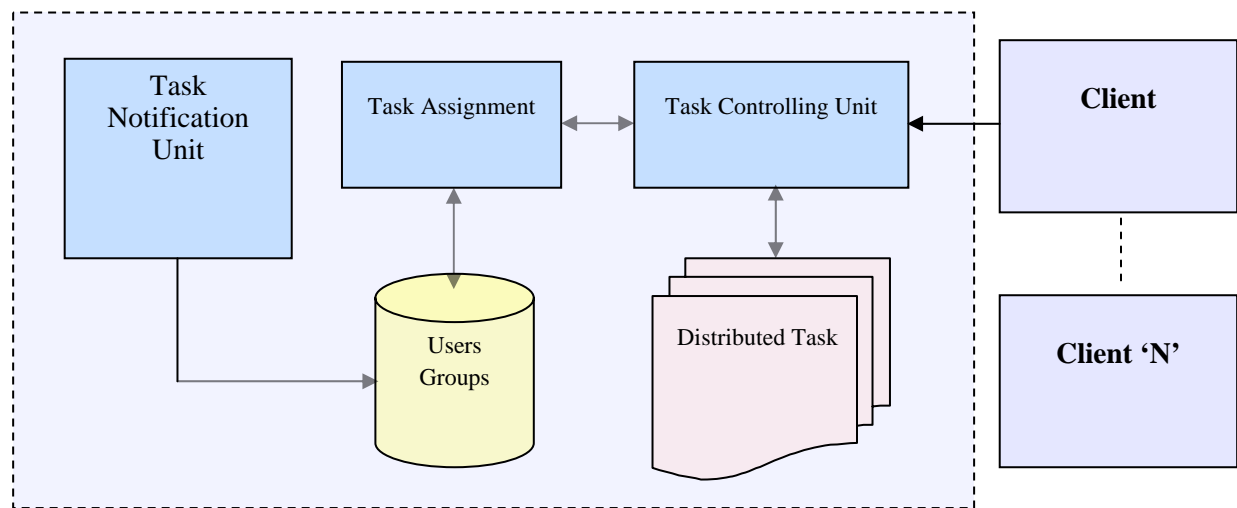


Figure 5: Task-Management Model.

This diagram describes the concept of viewing the status of the task assigned, using the hyperlink technique as shown in Fig. 6; “X to Y” represents the tasks assigned to the User “Y” by the sender “X”. Every member shares a single application with multiple abilities to view individual tasks and the status of assigned tasks in an instant.

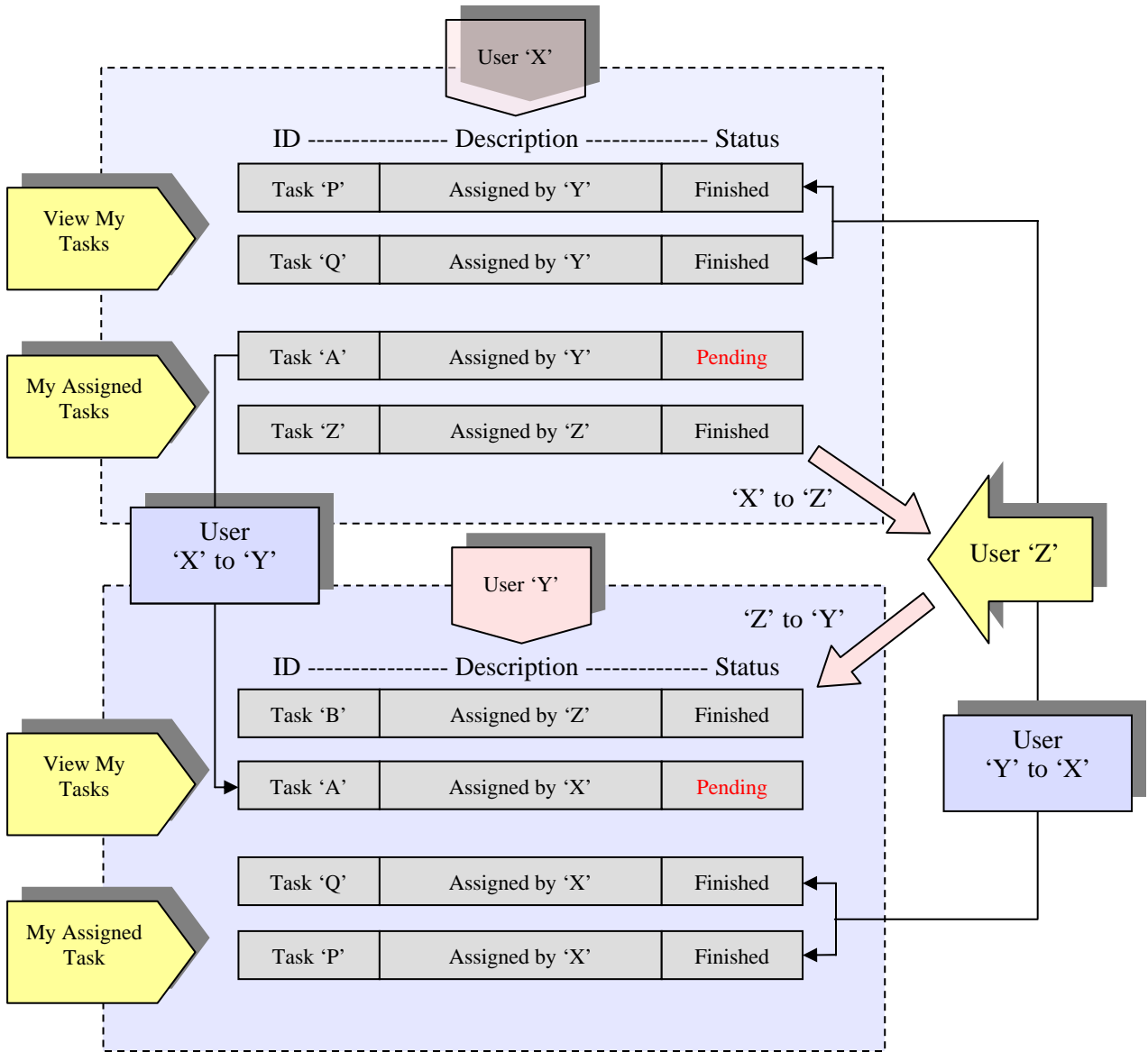


Figure 6: Hyperlink Method for Assigning Tasks.

A conceptual diagram for a multi-user task-management system is shown in Fig 7. This demonstrates the concept of multiple levels for assigning tasks within a group. “User A” views the status of his assigned task, and the tasks assigned to him by “User B” and “User C” can be sorted and grouped according to “Assigner” and “Project”. The notification information is stored and processed periodically through a script file and sent to an appropriate user.

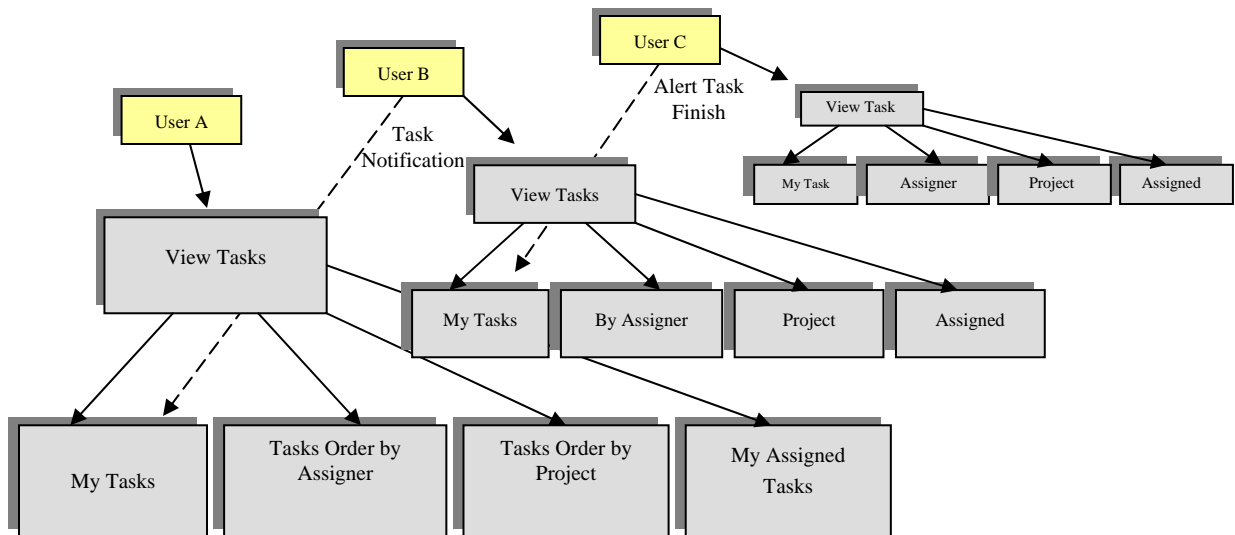


Figure 7: Conceptual diagram for Multi-User Task Assignment.

3.3 Master and Subtask Relationship

Defining a master-detail relationship requires the same type of data for linking columns together. Fig. 8 shows such relationships between data in the master data set that has INT (integer) type, and the detailed data set with the same characteristic INT type (tbl_clients, tbl_projects, tbl_tasks, tbs_employees). Here, “project id” and “client id” are set to the primary key.

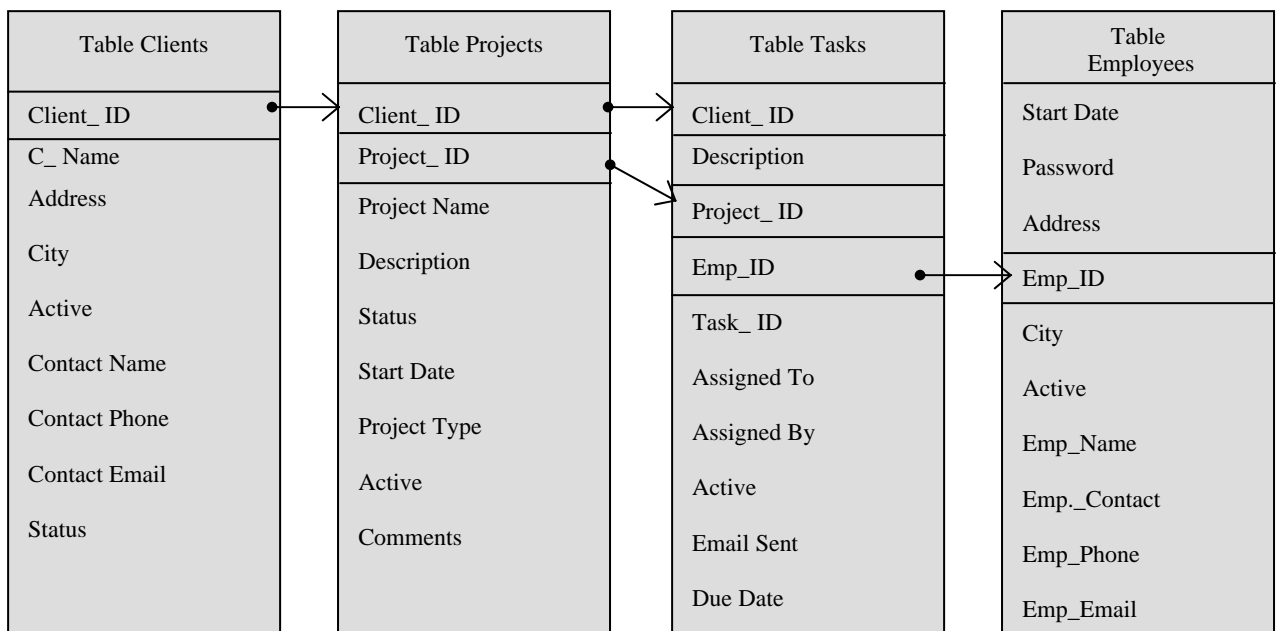


Figure 8: Table Relationship

Master-task and subtask relationships are shown in Fig. 9. Task N-1123 is a master task, with three subtasks assigned to a user. The master task can be finished once all the subtasks are finished.

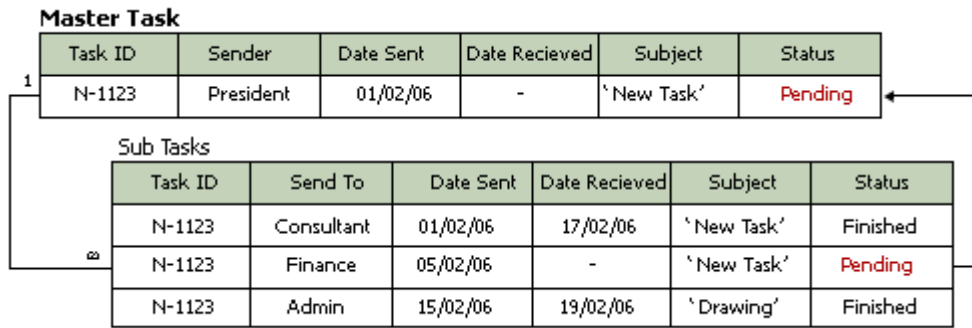


Figure 9: Master-task and Subtask Relationship.

4. Rules for Consideration

If the received task has no ID number, the receiver identifies the task as a new master task and opens a new task for the sender—for example, M-01, M-02. If there is a need to create subtasks, a new task is opened—for example, S-01-M-01, S-02-M-01. Thus the ID is divided into two parts: the last part indicates the master task—for example, S-01 and S-02 are two subtasks for master task M-001. If a user, as a sender, identifies a task as internal, he can create a new task, starting with the letter "I"—for example, I-01, I-02, which, upon completion, the receiver will finish. This relationship is shown in Fig. 10.

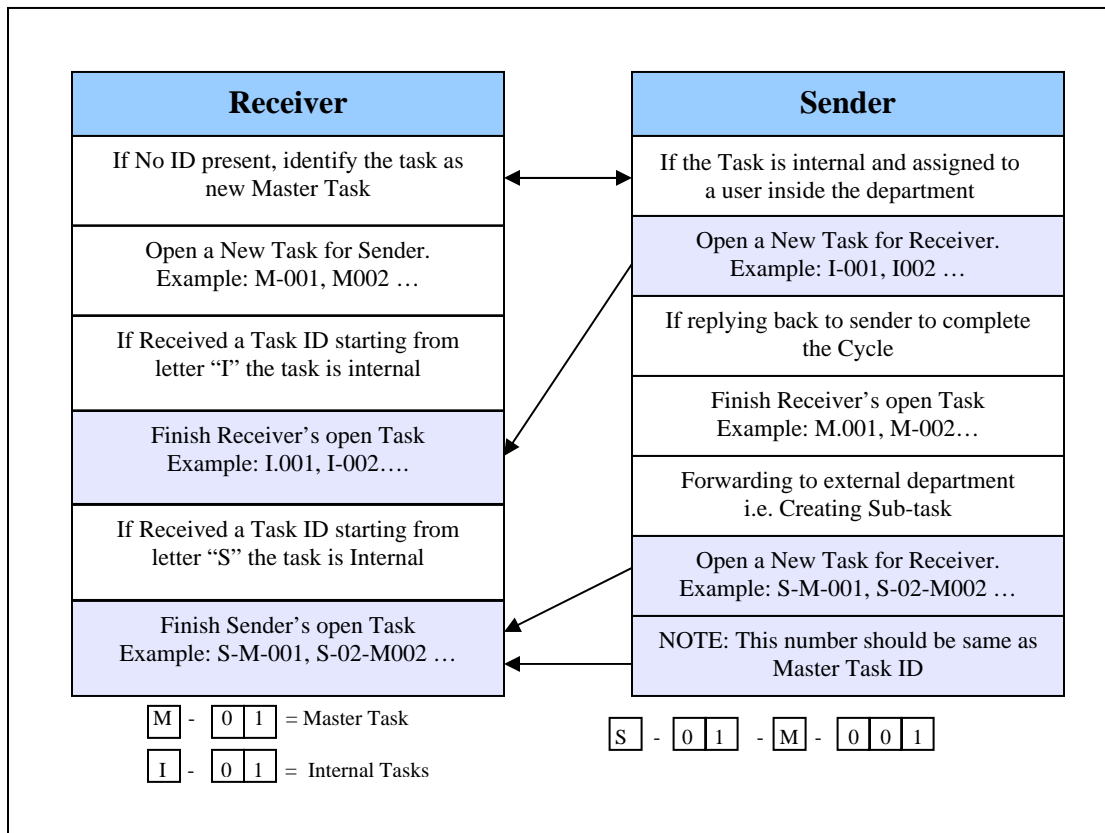


Figure 10: Rules for Sender and Receiver.

5. Implementation

A Microsoft® Active Server Pages (ASP) and SQL server running on the windows operating system were used in the implementation phase of this research project. The project and planning-department engineers were asked to fill in a registration form to create their account; they logged in and checked the daily tasks assigned to them by other members.

The first tool used in the design process is the requirements tool. It assists designers in analyzing and gathering user requirements to help with the elaboration of a design model (Norman 1986). In a sophisticated management system the task is assigned to single or selective members within the groupware, and task notification enhances the productivity of the system.

5.1 Task-Notification System

Notification systems are used to inform users of valuable information in an efficient manner without unnecessary interruption to their primary task (Fabian et al. 2004). The implementation for email notification used Windows Scheduler services for executing the Visual Basic Script (VBS) File periodically to trigger the emails and send them to the members. A JMAIL component with an Active Data Object (ADO) connection reads from the table and sends email to the user in consideration of the task due date and the reminder date, as shown in Fig. 11. Successfully adapting task modeling to model notification tasks shows promise in benefiting the requirements analysis of notification system design and promoting reuse (Cyril et al. 2005).

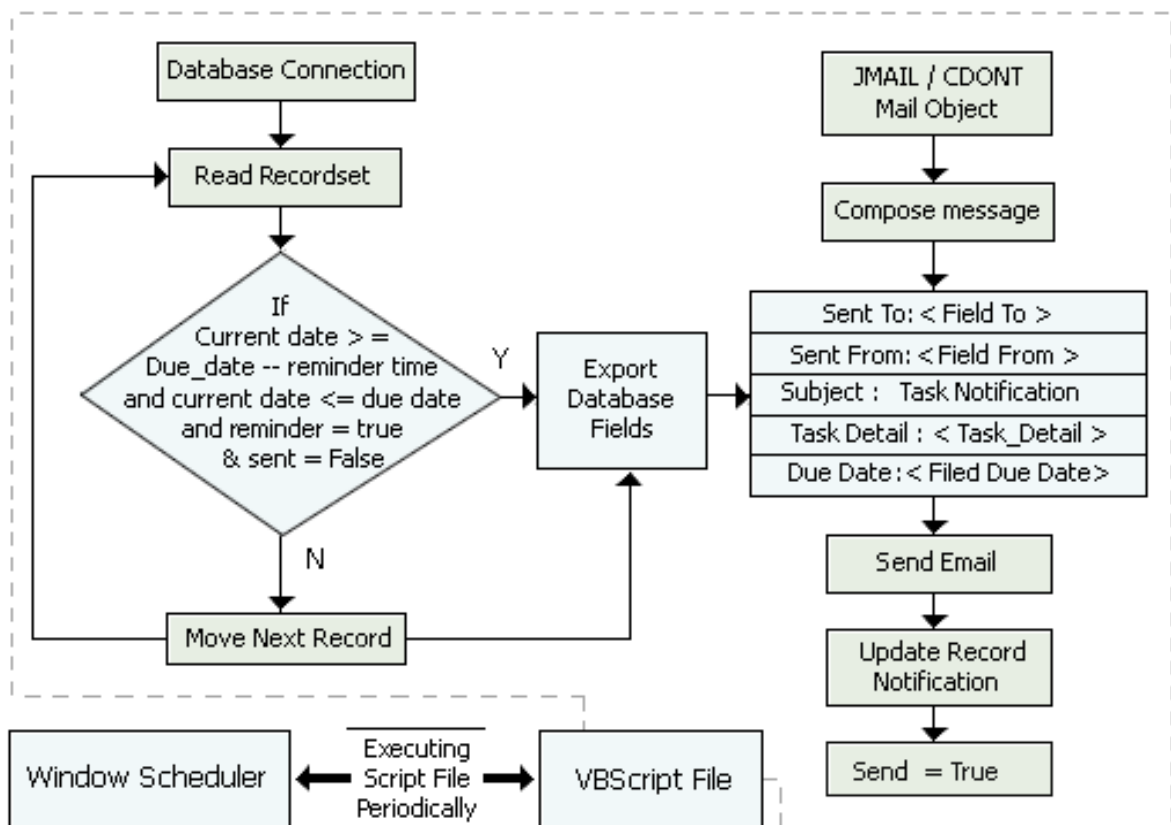


Fig. 11: Email Notification

Notification systems are interfaces specifically designed to support user access to additional digital information from sources secondary to current activities. (McCrickard and Chewar 2003).

At a glance, the users view their active tasks, finished tasks and tasks on hold, as shown in Fig. 12. Users assign a task by filling in a form. The task ID is automatically generated, whereas the project name, assignment and reminder have to be supplied by the task originator. The task is stored in the database for viewing by the receiver, and sending a notification reminder of a script file is periodically executed on an IIS (Internet Information Server), triggering emails after filtering the records and appropriate information.

The screenshot displays the 'My Assigned Task' section of the KFU Intranet. The main window shows a table of tasks with the following data:

Status	Expr-date	Priority	Assign For	Assign By	Details	ID	Receiving
edit	16/02/2006	low	Naif	Fadil	Consult on extract no 11 for establishment of Research Center for medical studies and research	2887	16/02/2006
edit	16/02/2006	low	Naif	Fadil	Consult report on extract no 17 for establishment proje	2888	16/02/2006
edit	16/02/2006	Mid	Naif	Fadil	Report no 6 for supervision on administration building		
edit	16/02/2006	low	Naif	Fadil	Inspection rooms for univesty city infra-structure for univesty city phase 2		
edit	16/02/2006	low	Naif	Fadil	Report no 7 for supervision on administration building		
edit	17/02/2006	Mid	Naif	Fadil	3 attachments of contract assets which signed with company to establish administration building		
edit	18/02/2006	Mid	Naif	Fadil	Report no 5 for supervision on administration building		
edit	18/02/2006	low	Naif	Fadil	Consult report on extract no 18 for establishment proje		
edit	28/03/2006	low	Naif	Fadil	Inspection rooms for univesty city infra-structure for univesty city first phase		
edit	28/02/2006	low	Naif	Fadil	Consult report on extract no 14 for establishment proje		
edit	09/03/2006	low	Naif	Fadil	Report no 6 for supervision on administration building		

The 'New Task' form is open, showing the following fields:

- Issued-no : 42
- Project : Select Project
- Remarks : Inspection rooms for univesty city infrastructure for univesty city first phase
- Priority : High
- Assigned For : Naif
- Assigned By : Fadil
- Date Assign : 11/02/2006
- Due Date : 18/02/2006
- Notify Task : 2 Days Before

Figure 12: Web-based Task Management in the Civil Engineering Project.

6. Conclusions

This paper introduces the use of web-based groupware and multi-user task management, and explores their use for a construction project. The principal advantages of the system are presented in context with respect to the relation of the subtask to the parent task, objects and transaction. Groupware is effective in the construction process in terms of the task-management system in which tasks have originated from different sources or from within the office. It has been observed in engineering construction that task monitoring and management for a large project are essential for a successful project. Groupware and workflow are significant in all the applications, but a construction site requires more planning as it deals with more entities such as contractors, designers and consultants who are working in parallel in a project by creating better

coordination among these entities. This paper demonstrates the beneficial use of groupware and task-management technology at the construction site. The results of this research show that users are able to communicate through the interface and understand the processes of an intranet task-management system.

Acknowledgement

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