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A Framework for Personalized Multi-Device Information Communicating System

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***Abstract*—**Due to the mobility of users, many information systems are now developed with the capability of supporting retrieval of information from both static and mobile users. Hence, the amount, content and format of the information retrieved will need to be tailored according to the device and the user who requested for it. Thus, this paper presents a framework for the design and implementation of such a system, which is to be developed for communicating final examination related information to the academic community at one university in Malaysia. The concept of personalization will be implemented in the system so that only highly relevant information will be delivered to the users. The personalization concept used will be based on user profiling as well as context. The system in its final state will be accessible through cell phones as well as intranet connected personal computers.

***Keywords*—**System framework, personalization, information communicating system, multi-device.

I. Introduction

IN one university in Malaysia, at the end of every semester, two to three weeks of the academic calendar will be blocked for final examination exercise. The examination unit, which is responsible for handling all matters regarding the administration of the examinations, will be generating an examination schedule a few weeks before the actual examination period starts. The schedule, among others, contains the time, date and venue for each examination. Besides, staffs who are assigned as invigilators for each examination will also be identified in the schedule. Currently, this schedule is posted on the university website for viewing by students and staff. Other than the website, all staff will also be informed via e-mails of their invigilation duties.

Few problems have been identified with the existing way of communicating the examination information. Firstly, the content of examination schedule posted is general for everyone. In other words, all information of all examinations is presented to a user, i.e., a student or a staff, even though some of the information are not relevant to him/her. Besides that, the information provided on the website is also fairly static. Even though an examination had been conducted, its information is still available on the website. This overloading of information makes it hard for users to see only the timely information related to them. As the website does not provide any means or functionalities for the users to filter the information, this leads to the possibility for some users to overlook the important information which are relevant to them. Therefore, it is not uncommon to hear missing or late cases reported during the actual examination time. Secondly, the current system also has problems in communicating last minute changes of examination's particulars such as the change of exam's venue to users. The current way of communication is by manual mean to convey the changes to students and staff. Notices will be put on notice boards around the campus and emails and phone calls will be made to the relevant staff. Unfortunately, the above methods do not guarantee the information reaches all the intended users. Again a lot of problems can be expected to happen during the examination time. Thirdly, in relation to the first and the second problems, there is no proper reminder and/or alerting functionalities to the current system to alert the users of incoming related examinations as well as changes to the examination schedule. The manual reminders through email for invigilation duties to staff also posted problems to the person in-charged at the examination unit where reminders need to be sent manually a day earlier to the respective staff has become a tedious job.

Hence, it is believed that a proper system would need to be built to cater for the above problems. The system proposed will implement the concept of personalization. The system allows students and staff to retrieve the examination schedule that is relevant to them either using desktop computers or from mobile devices. The information sent to them will be personalized and the amount sent will be based on the device that sends the request. Moreover, any changes to the schedule will be alerted to the related users immediately. The schedule shown on the university website will also be updated accordingly. Besides that, reminders will also be sent to users timely.

In this paper an overview of the design of the system will be presented. Section II provides some related works, Section III presents the system's development and implementation framework, Section IV describes the methodology and Section V concludes the paper.

II. Related Work

Personalization is a concept which has been rigorously applied in many area of research such as web interaction, e-commerce and education. For web browsing, personalized

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content displayed to users can help to control aimless surfing activity [1] as well as reduce the amount of information returned to users [2]. As for e-commerce, personalization can be seen in many parts of a user transaction. It can be in the initial stage, when a user starts browsing the site or in the middle stage when the system is looking for the most relevant products or services that suit the user. This concept is sometimes referred to as recommender systems. Zanker [3], Chung, Sundaram and Srinivasan [4] and, Deshpande and Karypis [5], are few researchers who are working in this area. Personalization can also be applied at the ending part of transactions when results are returned to users. Ranking of outputs according to user preferences is an example of such work. While, the use of personalization in the e-commerce case is more likely for the reason of capturing potential buyers and hence, increasing profits, in education, personalization is used to enhance the teaching and learning process. Researchers such as Teo and Gay [6] identified that e-learning can be made more effective if the concept of personalization is embedded into it. They suggested that a knowledge based is needed to support the materials to be presented on the e-learning. Another interesting personalization work which is related to education would be of Czyzewics [7]. She presented a personalization architecture system that was developed for a kiosk style information system for public aquaria. The interface provided at the kiosk is adapted based on a visitor's personal preferences such as languages, area of interest, text size and personalized collections management.

No matter what the domain of an application might be, personalization can be generated based on some common techniques. Among the popular techniques are those based on individual or group profile, behavior and collaborative filtering. The first technique often requires users to provide their demographic information as well as some preferences explicitly beforehand. Based on the information given by users, the application will match the information to the products or services provided. Weiß et al. [8] for example, used this technique to filter appropriate multimedia content for user viewing. Furthermore, the initial profile can also be made dynamic. For example, based on what the users have chosen from the given outputs, the profile can be updated accordingly such as the work by Ntawanga, Calitz and Barnard [9]. The second technique, i.e., behavior based, normally works by analyzing the log of transactions performed by the users previously. The information will implicitly determine the products and services to offer. Examples can be found in [10] and [11]. The third technique, which is collaborative based, uses information from others to help decide on what to presents to users. Some kind of similarity measures will be used in matching the current users with others. For example, Xue et al. [12] used the profiles of users to determine similarity. On top of the three techniques above, personalized information or services can also be determined based on context. For example, the system developed by Belleken et al. [13] suggests a suitable TV program based on user's actions and behavior in the past which have been interpreted using the Semantic web. Besides that, the suggestion also depends on the context of user viewing time of the day. Meanwhile, Panayitou, Andreou and Samaras [14] presented a recommender system for mobile devices based on the context of time of request and user experience, i.e., normal working day or vacation. According to them the different situation in which a user is in will demand for different type of information. In [15] several context-aware applications for hospital environment are discussed. An example is a "context-aware hospital bed" in which the each hospital bed is equipped with a terminal display that can be used as a normal television screen by patient or computer monitor/system by clinician who tended the patient. Another context-based information system as being discussed in [16] is regarding a contact center solution. It is an information system used by call center agents to respond to customers queries. Three main context information are needed in deciding the answer to queries: the agent, the customer and the business domain.

Besides personalization, our work shall also incorporate the concept of active database. Active database as discussed in [17] on Event-Condition-Action (ECA) rules. Whenever a change is made in the database, and this change satisfied certain condition(s), some actions will be triggered [17]. In our proposal, we implement this concept for alerting the users when there are changes made to the database. Other than the above, the concept of push-based will also be implemented in our work. Pushing of information, or rather reminders to users can be done in certain ways. For example, Wong, Henderson and Katz [18], and Armstrong et al. [19] pushed or broadcasted data to several devices on periodic basis. The latter used the concept of proxy server to identify the data that has changed. The proxy server is also responsible to manage the dissemination of those data to mobile users.

III. System Framework

The proposed system, named as PerFECS, is to be implemented based on the system architecture in Figure 1. The architecture composes of four major components which are the user terminals, i.e., fixed line terminals or cell phones, the server, the modem and the data communication network. The server will store the application software as well as the database containing the details of the examination schedule. An Ozeki server software will also be installed in the server. The software is for handling text messages sent by and to users, i.e., Short Messaging Service (SMS).

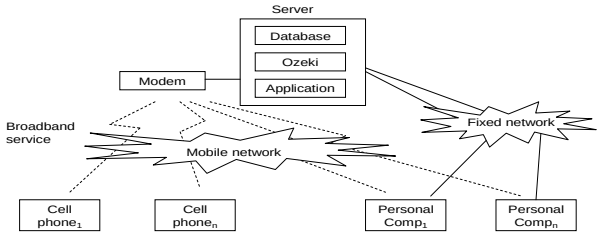

Fig. 1 Overall system architecture

From Fig. 1, requests to view examination particulars can be issued from either personal computers or cell phones. If personal computers are used, users can access the system through the current website. A front-end interface will be provided to users for interaction with the system. If on the other hand, cell phones are used, the users can either use the Short Messaging Service (SMS) method to access information or use mobile web browser on their devices. For the second approach, an interface will also be provided for users to issue commands. Depending on the device and method used to request information, different amount and format of data will be supplied. Hence, personalization of the returned information will be done here. Personalization in our work will be based on hybrid technique which composed of user profile and context. As shown in Fig. 2, the user profile component is hierarchical in nature.

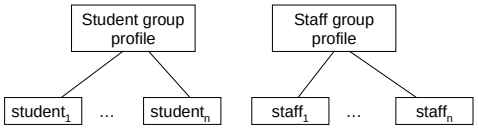

Fig. 2 User profile hierarchy

From the diagram, at the first level, users will be grouped into two major profiles: student and staff profiles. Each profile will contain the types of information often requested by the group. For example, for student profile, examination code, date, time and venue will be of utmost important. On the other hand for staff, examination code might not be that important to them, but rather, the date and time, the venue, the number of students to invigilate and the colleagues with whom they invigilate do. On top of that a secondary profile will be created for each user which is based on the answers they provided on the system registration form. For this individual profile, the information kept is more on the formatting of information rather than on content. For example, besides their personal particulars, users might also be asked to state the frequency of reminders to be sent to them, to rank the importance of information etc.

As mentioned earlier, the context when a user interacts with the system will also determine personalization. In this work, the device that a user used when requesting for information, the time and date the request is made, are the context information needed. Fig. 3 below shows how user profile and context are implemented in the system.

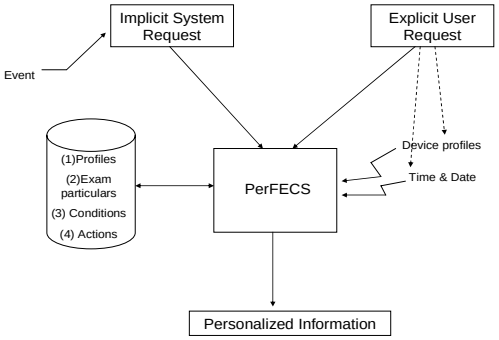

Fig. 3 Personalization implementation

Based on Fig. 3 above, implicit system request will be activated based on event, for example, a change to certain examination particular, a date etc. This event, if it satisfies certain conditions stated in the database, will trigger certain actions. These actions will be messages or alerts sent to users. ECA rules will be implemented to these processes which involves with event, condition and action. Explicit user request is a request which is formally asked by users. When a request is made, the profile of the device used and the time and date of the request will be captured. All of the data will determine the information, amount and format to be returned or disseminated to users.

IV. Methodology

The development of the proposed system shall adopt the methodology depicted in Fig. 4. There will be three major phases conducted: project initialization and feasibility studies, prototyping and, integration and implementation. Project initialization is self-explanatory. During feasibilities studies, personalization technique which is the hybrid technique based on profile and content will be formulated. Rules for the alert and messages will be sent to users based on certain event will be analyzed as well.

As for prototyping, three separate sub-systems will be developed: web based system for personal computers, web-based system for cell phones and SMS-based system for cell phones. Each of the sub-systems will be developed in modular fashion according to the functions to be supported. After each sub-system has been tested functionally, a usability test will be conducted on them. This will be followed by final integration of the three sub-systems. Again functionality and usability tests will be performed to validate the system.

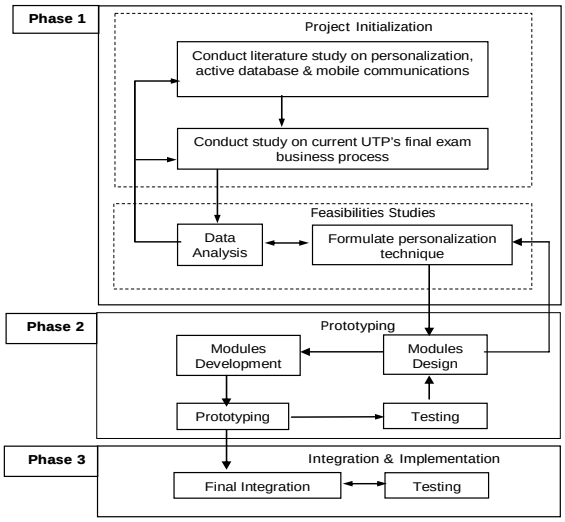

Fig. 4 PerFECS development phases

As for the tools to be used, Java language will be the main language used to develop PerFECS and XML will be the format of the database for this work.

V. Conclusion

This paper highlights the framework that will be used to develop a personalized multi-device communication system referred to as PerFECS. In PerFECS, personalization concept is to be implemented in order to communicate only relevant information to users. Our framework shows, a system which can be accessed by multiple types of devices such as the personal computers and cell phones will be developed. Personalization based on user profile and context will be used to handle multiple devices. At this point, the only limitation foreseen will be in terms of scalability of the system. Hence, proper testing will be conducted to incorporate this possible limitation. The framework proposed will be used to develop the actual system which is the next stage of our project development.

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