

**KEMI-TORNIO UNIVERSITY OF APPLIED
SCIENCES**

Web-based touch screen information panel for KTUAS

Asfaw, Hana Kebede

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ABSTRACT

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The aim of this research work is to design a prototype web based application for touch screen information panel, which can be used in Kemi-Tornio University of Applied Sciences. Today, touch screen panel technologies are used for variety of services. The objective of this research work is to provide organized and easy accessible information on touch screen panel. To accomplish the objective of the research, constructive research methodology was used to provide a solution for KTUAS information system. Conducting interviews helped me understand the user requirements.

In my research work I analyzed touch screen technologies and their characteristics. Touch screen panel applications can be programmed by using a high level of programming language for example, C++, Java or using HTML in combination with web browser. In my research work I used Java programming language and MySQL database to design and implement the prototype web based application. Unified Modelling Language was used to design the visual diagram. The user interface was designed by Java swing and AWT applications. MySQL database and Java project were connected by JDBC driver.

The outcome of this thesis work can be used by KTUAS for further implementation and research. The output contains a prototype user interface which is connected with MySQL database. An analysis of touch screen technology and user requirements are also included in the research work.

Key words: Java, MySQL, JDBC, KTUAS

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1 INTRODUCTION

This thesis work emphasizes the design and implementation of a prototype web based application for touch screen panel. The touch screen information panel provides information for KTUAS branches. “Information is a data that are processed to be useful; provides answers to who, what, where and when questions” (Ackoff 1989, 3-9 cited in Bellinger & Castro & Milles 2004). Today information is accessible in an easy and flexible manner by using touch screen panels.

Touch screen panels are input devices with a touch sensitive transparent panel which can sense a finger, hand or stylus (WEBOPEDIA™ 2012). The information will be useful to provide organized information for KTUAS educational environment. Touch screen technologies can be found in peoples’ everyday lives in a different style and place, for example in public areas, in shopping malls, in museums, at airports, etc. Touch screen technology is implemented on different devices to provide a fast and easy user interface.

1.1 Motivation and background

I intend to design a prototype web based application for touch screen panel. The idea was emerged from a business project which was instructed by Okuogume (2010) and I became more interested to implement the idea in practice. The information panel is planned to replace the traditional notice board in Kemi-Tornio University Applied Sciences (henceforth KTUAS). KTUAS provides education for Finnish, exchange and international degree students. There are different kinds of notice boards inside the University environment, which have scattered and unorganized information all over the board. I observed these notice boards which were found in KTUAS and the information content was difficult for me to get specific information out of the pinned papers. During my observation, I recognized different kinds of information, for example information for international degree students, police working hour’s information and re-exam date concerning Finnish and international degree students in a different place. This information was very scattered and unorganized. The papers on the notice board have a tendency to tear easily and look unattractive. I observed also the information board which was found around the University library and student secretary office and it had

also different gymnasium advertisements and maps. It would be easier for Finnish and international degree students to get information in an organized form of manner.

Information is a backbone tool to support the ongoing education system in KTUAS. Being part of this educational system motivated me more to focus and plan to develop a solution. Students, staff and visitors of KTUAS are the beneficiaries because they get information timely and in an organized manner through the information panel.

Beyond providing organized information I aim to design and implement a prototype web based application for touch screen panel which provides easily accessible information by touching the screen interface. In the early 1990's computing and the Internet revolutionized education. Now there is a new revolution going on, which is offering touch screen technology as a means of communicating digital information for educators. (protouch 2010.) Touch refers to the way user interacts directly with a computer using a finger and it is more suitable than a mouse click (Microsoft 2012). Touch screen technology inspires me because it is a developing technology and will bring increasing impact to people's daily lives. People are exposed to the new technology in one or another way, for example people use touch screen phone and they know how it is simple and interesting. KTUAS also using different touch screen devices to support the education flow.

1.2 Objective

The main objective of my research work is to design and implement a prototype web application for touch screen panels. The panel will be used as an information centre inside KTUAS building. This information panel provides different kinds of easy accessible information. Users can access information about KTUAS and related information in an organized manner. For example, students do not have enough knowledge on some urgent and important cases unless they check their e-mail or the KTUAS website. Students have to login in to the University website to view information. To overcome this problem, the information panel will be placed in front to give a quick reference for those students. Guests also have a difficulty in finding classes and office rooms when they visit KTUAS branch offices. Therefore, guests can view class room numbers from the touch screen panel. Moreover, the touch screen panel

provides beneficial information for staff members, for example meeting and class timetables.

1.3 Structure of the thesis

This thesis is divided in to six chapters. Chapter two discusses the research topics and questions, research methodology, research techniques, theoretical framework and expected result of the research project. Chapter three focuses on the literature review which is related to touch screen technologies and characteristics. This chapter also analyses the user interface design with Java programming language and connection between MySQL database and the Java application.

Chapter four discusses the requirement analysis of the research project and also it includes the user interface design and UML diagrams to visualize the functionality of the system. Chapter five describes the development phases of Java application and the implementation of the prototype database. In this chapter, I also described the functionality of the prototype user interface. Chapter six includes conclusions and discussions of the research result, limitations and challenges of the research project and directions for further research.

2 RESEARCH TOPIC, QUESTIONS AND METHODOLOGY

This chapter focuses on discussing the research topic and questions. Further, the expected outcome and the theoretical framework of the research work are included in this chapter.

2.1 Topic description

My research topic focuses on the designing of a prototype web based application for touch screen information panel for KTUAS. Information is useful for people's daily lives, to increase their knowledge and wisdom. Moreover, information is widely spread via the use of the Internet throughout the world. Today information is accessible through touch screen panels and monitors. Touch screen technologies are becoming increasingly familiar to the world and most people are using this touch screen because it is simple and easy to use. The main reason for designing this web based application is to provide organized, clear and easy accessible information for the students, guests and staff members. There are three fundamental research questions to be answered in this research.

1. How does touch screen information panel work?

Touch screen computers use different technologies than standard computers. I will identify how touch screen computer works and its difference from other standard computers. Moreover, this research question provides a basic knowledge on touch screen panel technology.

2. How information can be gathered and organized?

One of the objectives of the research work is to provide organized information for KTUAS. Therefore, user requirements should be gathered to provide information in an organized form of manner. There are different kinds of users in KTUAS educational environment, for example students, staff and guests who can benefit from the information panel. To design the functionality of the prototype system, UML was used in my research work.

3. How can a web application and user interface be developed for KTUAS information system?

Usability of the planned information system is the important concept of this research work to satisfy the intended users by providing quick and easy accessible information. The plan for designing and implementing the prototype user interface will be manage by Java swing and AWT applications. This research question provides a basic knowledge on MySQL database connectivity and Java application.

2.2 Research methodology

Blaxter, Hughes and Tight (2008, 62) state that research is a systematic study to find answers to a problem or phenomenon through scientific method. Methodology usually refers to the approach or theory that supports the research by producing broadly different data (Blaxter & Hughes & Tight 2008, 58).

Constructive research is the research method used in my research work. Constructive research method was chosen because it is appropriate to complete the research work successfully, to design and develop a solution for a practical problem. Constructive research method provides solutions for practically relevant problems. Järvinen (2001, 88) suggests that constructive research builds a new innovation based on the existing or new research knowledge. In my research process finding a practically relevant problem was my first step, which is unorganized information in KTUAS educational environment. Conducting interviews and my study experience in KTUAS helped me understand the topic and problem. After understanding the problem, I offered an innovative solution to design and implement a prototype web based application for touch screen panel.

2.3 Research techniques

Information and data were gathered by primary and secondary sources. The primary data were gathered by interviewing students and staff members. Conducting the interview is very essential to acquire the requirements of the user and to implement the functionality of the system. The secondary sources are printed materials and reliable

Internet sources. Primary and secondary sources of information were organized and analyzed, to obtain relevant information from all findings. Information was analyzed by qualitative and quantitative research methods because it helped me to get background information. I used more of qualitative research because I gathered non-numeric data which collected and gathered from the primary and secondary sources. By definition, qualitative research is concerned with collecting and analyzing information in non-numerical form of research (Blaxter et al. 2008, 64).

The research technique used in my research work is interview. An interview is defined to be a discussion between an interviewer and respondent with the purpose of gaining certain information from the respondent (Järvinen 2001, 130). Interviews are a very useful technique for my research work. The interviewees are students who are the target of the research and who gain from the research work. The main reason why I chose interviews as my research technique is because all students are part of the KTUAS educational environment and it was easy to meet them face to face and to conduct the interview. I wrote down the information during the interviews and discuss the requirements with staff members. The interviews were held in KTUAS environment by making appointments with students and staff members. The interviewees were selected by using a sample from KTUAS students. The interviews group includes Finnish exchange and international degree students. The interviews results are discussed in chapter four of this research work.

Moreover, to make my research successful, I gathered literatures which consist of books, articles, journals and Internet sources. These reading materials assisted in designing and implementing my idea in practice.

2.4 Theoretical framework

Theoretical framework is an organized models or ideas that direct the research to determine a specific viewpoint (Thesis Notes 2012). In my thesis work I used unified modelling language (henceforth UML). UML is a standardized model for modelling object orientated program which is accepted by object management group (henceforth OMG) standard setting organization. UML diagrams are used for designing and visualizing the web based touch screen information system. The diagrams are also used

to design and structure the system in order to meet the requirement. The Meta-Object Facility specification is the foundation of OMG's industry standard environment. Therefore, MOF was used as a standard to define and validate UML diagrams. (OMG, Inc. 2011.) During designing the UML diagrams of the web based application of KTUAS information system, MOF was used as a standard to be able to verify and define the UML diagrams standards and validate the diagrams requirement specification.

Moreover, I will use heuristic rule to design the user interface. The heuristic rule will guide me to design a good user interface and usability. Usability heuristics are the general principles for user interface design (Nielsen 2005).

2.5 Expected research outcome

I will expect a valuable research outcome when the prototype information panel is implemented in practice. The main objective is to satisfy students, staff members of KTUAS and guests. Moreover, the process of my thesis work enhanced my research and analysis ability, and improved my system designing and programming skill. The expected outcome of this research work is the availability of touch screen information panel in all branches of KTUAS. The list below shows the benefits of KTUAS touch screen information panel.

- the user will be motivated to use the system because of the user friendly environment;
- the user will get access to the information in an organized manner and users can find information clearly;
- the user will be able to view information within one or two touches;
- the user will be able to access information easily.

3 TOUCH SCREEN PANEL

In my thesis work I designed a web application for touch screen panel. First I will explain how the touch screen panel works and its technology. This touch screen panel is designed to provide all sorts of services and information in the KTUAS educational environment. “A touch screen is a unique type of visual display device that allows the user to interact physically with the computer or other electronic device by touching the screen” (Sharrieff 2012). Hardware and software aspects make touch screen panels differ from the ordinary panels (Živanov & Rakić & Hajduković 2008, 43).

3.1 Hardware and software characteristics

Živanov, Rakić and Hajduković (2008, 43) state that standard personal computers use the keyboard and mouse for interaction with users, from touch screen computers' point of view, the keyboard and mouse are not essential for interaction. To deal with this issue, two major approaches are used, touch-screen monitors and virtual keyboards. Touch screen panels also need a high security because mostly touch screen information panels are placed in public areas. For this reason touch screen panels are integrated with video cameras or protected by surveillance cameras to control user actions. The panels have an Internet connection with an administrator. The administrator is responsible person for updating and controlling the whole system. “Uninterruptible power supply is also a common component, allowing” touch screen panels “to end its job in a regular approach”. Usually, touch screen panel hardware placed in a “strong metal case” to protect the panel from bad weather and unnecessary usages. (Živanov et al. 2008, 43.)

From the software point of view, there is a difference in user interface between touch screen panels and ordinary panels. The difference is caused by the hardware input devices and by the target user group. The users are directed step by step in the process of using the touch panel. Mostly user interface is organized by standard screens to display only currently needed information. After successfully completing tasks on one screen, the user is directed to the next information window or page. (Živanov et al. 2008, 44.)

Screens are displayed in a full screen format. The full screen format is more attractive than a screen with toolbars and it will be done by hiding or disabling the toolbar and

taskbar of the underlying operating system. This is necessary because users must not interact with operating system directly, because it may lead the users to a different program or application. In most cases, screen elements are limited to buttons, labels, pictures and input fields. There are no scroll-bars, searching boxes or any list boxes, to provide easy accessible information. (Živanov et al. 2008, 44.) To display touch screen applications in full screen, Mozilla Firefox provides add-ons which is called R-Kiosk extension. This add-ons change the web application in full screen mode by disabling all menus and toolbars. (Heinaaro 2011).

The following lists explain the main reasons why touch screen elements have no scroll buttons (Živanov et al. 2008, 44):

- there is no input devices like mouse and keyboard;
- users have little or no technical knowledge;
- application displays only the necessary data;
- simple user interface produces less error.

Interaction with panels may start by touching the screen and by touching some of the buttons. Interaction with the system may be ended by successfully completing the necessary tasks, by cancelling the process, or by making an error. Some touch screen systems are designed to return back to the front page, if users did not interact to the system for a specific period of time. (Živanov et al. 2008, 44.)

Touch screen application is a program which users see and touch the screen, and read the information provided. Živanov et al. (2008, 43) state that the situation for transferring from one condition to the other condition may be different. The list below shows an example of different conditions which makes the user to continue or end their activities (Živanov et al. 2008, 45):

- user selects one of the available choice;
- user enters correct data or view information;
- user completes the process of using touch screen application;
- user do not have any interactions with touch screen panel for specified interval of time;

- user detects error on the touch screen panel application;
- user encounters error during communication, etc.

During touch screen panel application implementation, the conditions listed above must be checked in order to allow users to go to the next screen. All screens usually share a few common options or buttons, e.g. help, cancelling the process, going one screen back and going one screen forward. In the case of KTUAS, on the touch screen panel all information will be displayed on the front page and users can select from the option, to read and view more information. Fulfilling user requirement is one aspect of touch screen panel application. (Živanov et al. 2008, 45.)

3.2 Type of touch screen systems

There are many different types of touch screen technologies used today, and the most widely used technologies are resistive, capacitive, surface acoustic wave and infrared. (EngineersGarage 2011.)

“The resistive system consists of a normal glass panel or a touch screen sensor is a clear glass panel with a touch response surface that is covered with a conductive and a resistive metallic layer” (Kayani 2012). Resistive touch screen can respond to finger tips, finger nails, stylus and glove covered fingers. Today resistive touch screen technology is the most used technology because of its versatility, ease of integration and relative low cost. (Sharrieff 2012.) The figure below shows an example of resistive technology.

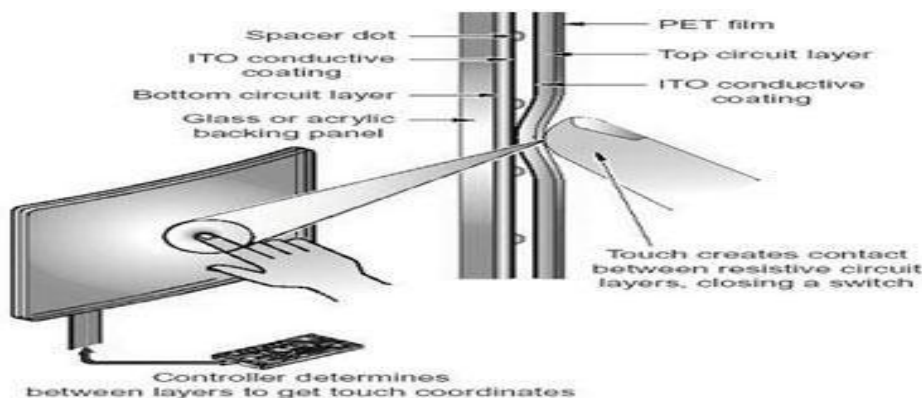


Figure 1. Example of resistive touch screen technology (EngineersGarage 2011)

“In the capacitive system, a layer that stores electrical charge placed on the glass panel of the monitor.” It is the most durable technology. Whenever the user touches the monitor, some of the charge is transferred to the user, so the charge in capacitive layer decreases. (HowStuffWorks 2012). Unlike resistive touch screen capacitive system will not work with stylus or glove covered fingers. Capacitive touch screens can serve as both input device, for receiving user demands and as an output device, for displaying imaginary (Devaney 2011). The figure below shows an example of capacitive touch screen technology.

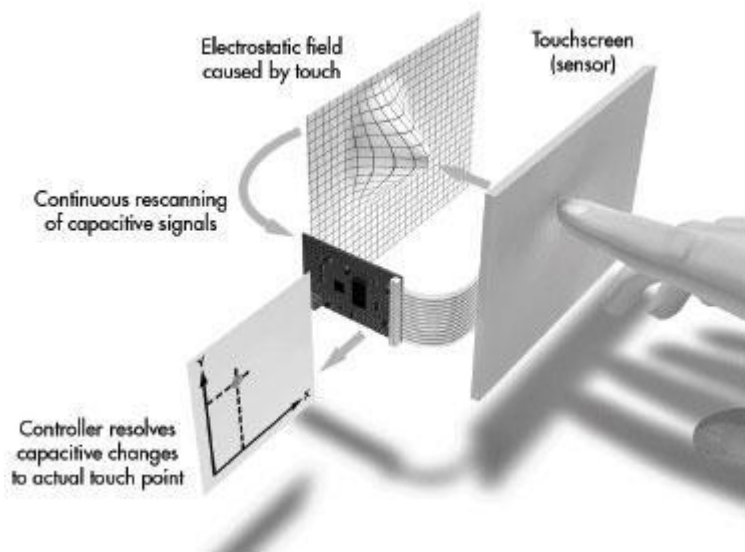


Figure 2. Example of capacitive touch screen technology (EngineersGarage 2011)

“Surface acoustic wave (SWA) system technology uses ultrasonic waves that pass over the touch screen panel.” When the panel is touched by the user, part of the wave gets absorbed. Surface acoustic wave touch screen panels are covered by small transducer which uses to send sound waves. (Kayani 2012.) The figure below shows an example of surface acoustic wave touch screen technology

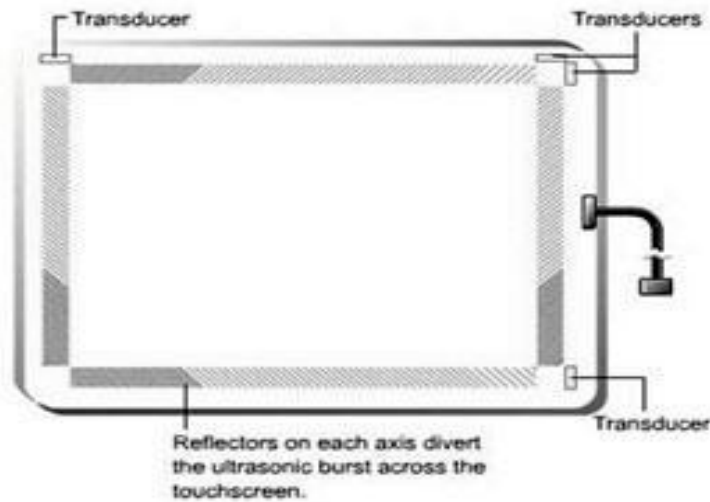


Figure 3. Example of surface acoustic wave touch screen technology (EngineersGarage 2011)

“An Infrared touch screen technology works by using focused beam of infrared light with along with sensor.” When a user touches the screen, a beam of light will be deformed to find where the touch occurred. Infrared technology could not be used in portable devices because the frame is large. (Morgan 2010.) The figure below shows an example of infrared touch screen technology.

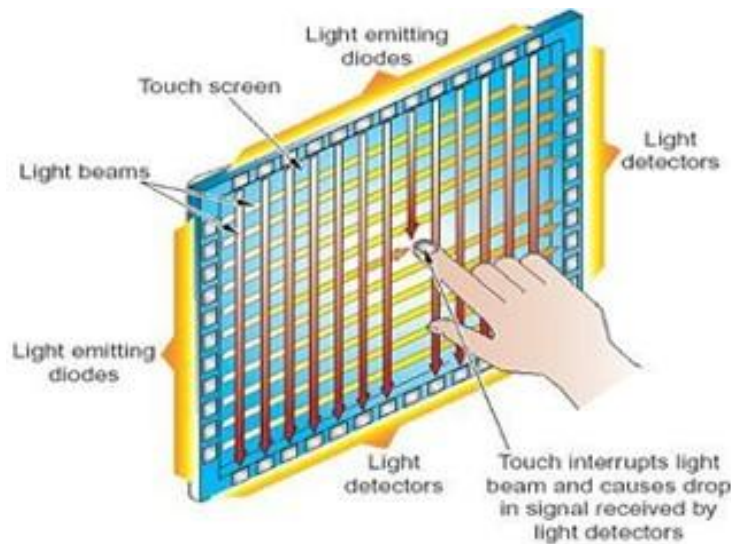


Figure 4. Example of infrared touch screen technology (Assured Systems 2012)

The table below compares the durability, operation, touch resolution and clarity of the listed above touch screen technologies. (I-TECH COMPANY)

	Resistive	Capacitive	Surface acoustic wave	Infrared
Durability	Can be damaged by sharp object	Highly durable	vulnerable to dirt and moisture	Highly durable
Operation	Finger or stylus	Finger only	Finger or soft tipped stylus	Finger or stylus
Clarity	Average	Good	Good	Good
Touch resolution	High	High	Average	High

Table 1. Comparison of touch screen technology

3.3 User interface design in Java programming

The research work intended to design and implement a web application for touch screen panel by using Java programming language. It is important to understand the basic knowledge and background of Java programming in order to be able design and implement the application. Designing a web application for touch screen panels needs more attention to provide ease and simple accessible user interface. The Java platform is an open source platform for providing and running highly interactive, dynamic and secure applets and applications. (Johnson 1998.)

I used the combination of swing Java and Abstract Window Toolkit (henceforth AWT) classes in order to design the user interface. AWT provides a platform independent collection of classes that implement a wide variety of widgets. Both AWT and swing are object orientated classes representing windows, lists, buttons, check boxes, etc. A familiar set of AWT components are available in a swing package. Component is the super class of all the widget classes and it is not shown as a direct class because it is an abstract class. (Decker & Hirshfield 2000, 73.)

The main difference between swing and AWT is that swing does not contain any platform specific code but AWT calls directly from the native window manager. In addition, AWT provides only the minimal amount of functionality necessary to create a windowing application but, swing provides a large scale application and contains more graphical components. (Loy & Eckstein & Wood & Elliott & Cole 2003, 4-5.)

Therefore, I used more of swing components for designing the user interface because of the availability of graphical components.

The user interfaces will be a blank window without events and action listeners, events turn the program flow into an event-based flow. An action event occurs, whenever an action is performed by the user. The users perform an action to see an expected result, and before the users perform an action the programme remains as it is until a click occurs (Oracle 1995).

3.4 MySQL database and Java database connectivity

A database is a structured collection of meaningful information stored over a period of time. Database management contains data storage, data manipulation, data entry and retrieval. (O'Donahue 2002.) A relational database is a set of data organized in accordance with the relational model to complete a specific purpose (Reese 2003). Relational database system uses SQL to communicate with a database. The basic units in SQL are tables, columns, and rows. Java provides a framework called Java database connection (henceforth JDBC) framework. JDBC provides a number of classes for encapsulating common objects, for sending query to the database and receiving the result. (Coffey 2010.)

JDBC includes four components JDBC application programming interface (henceforth API), JDBC driver manager, JDBC test suite and JDBC-ODBC Bridge. JDBC API executes SQL statements and retrieves results to the data source. JDBC driver manager connects Java applications to a JDBC driver. JDBC test suite and JDBC-ODBC used in specialized environments to test web applications. JDBC supports two-tier and three-tier processing models for accessing database data. In the two-tier model the Java application connects directly to the database source by JDBC driver. (Oracle 2012.) The figure below shows the architecture of two-tier model for accessing data.

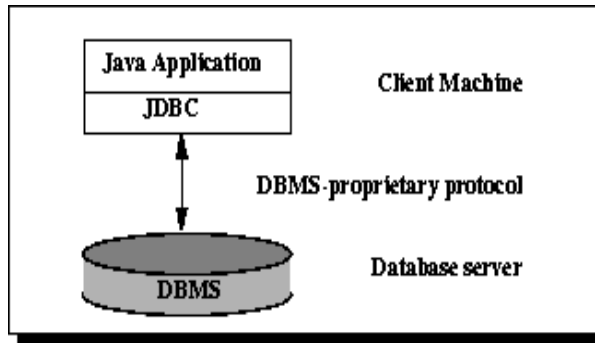


Figure 5. Two-tier architecture for accessing data (Oracle 2012)

In the three-tiers model commands send to the middle layer and the middle layer send to the data source layer. The data source processes the command and sends the result back to the middle layer, and then the middle layer sends the command to the clients. (Oracle 2012.) The three-tier models uses to separate servers, the application server and database server. The other advantage of the three-tier model is separating the business logic from the database and simplifies the deployment of client applications. (OXXUS 2003.) The figure below shows three-tiers architecture for accessing data.

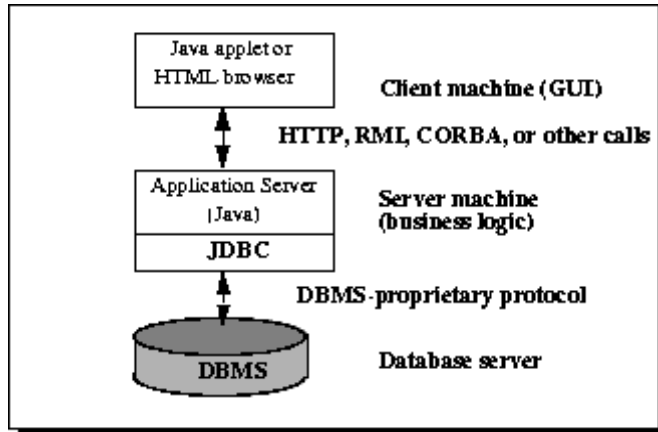


Figure 6. Three-tier architecture for accessing data

4 REQUIREMENT ANALYSIS AND FUNCTIONALITY DESIGN

This chapter focuses on the user requirement analysis and system requirement analysis. I will use UML diagrams to show the functionality of the web application. The user interface will be designed by Photoshop.

4.1 Requirement analysis and functionality design

Requirements “are the descriptions of how the system should behave, application domain information, constraints on the system’s operation or specification of a system property or attribute” (Kotonya & Sommerville 1998, 6). According to Sommerville (2001, 100), software system requirements are often classified as domain requirements, functional and non- functional requirements. In KTUAS information system, functional requirement describes how the touch screen panel should react when users touch the screen and how it should behave after one action performed. The list below shows an example of functional requirements for the touch screen information panel.

- the user shall be able to select information;
- the user shall be able to touches next button;
- the user shall be able to return back to the front page;
- the system shall limit redundant user action.

Non-functional requirements are the overall qualities or features of the system. Usability and availability are the main non-functional requirements in my research work. Usability requirements are concerned about the quality of the graphical user interface and the user interaction with the system. Availability is concerned about the availability of the information service when requested by the user. (Kotonya & Sommerville (1998, 187.)

Sommerville (2001, 100) states that domain requirement are “requirements that come from the application of the system and that reflects characteristics of the domain.” User requirement is what the user will be able to do with the product, and what kind of action the user will be able to perform with the system. User requirement should include functional and non-functional requirements to make the system understandable by the novice users. (Wiegers 2006, 5.) The other requirement in software engineering is

system requirement. According to Sommerville (2001, 109), system requirement describe user requirement more in detail form.

4.2 Data gathering and analysis

User requirement analysis is very important in the design and implementation process for understanding the user needs and expectations from the planned information panel. User requirement gathering was made by conducting an interview with students and a discussion with staff member. The interview sample was taken from business and information technology, health care, social services, and technology departments. Thirty students were interviewed from different departments. The aim of the interviews was to know what kind of information the user needs to view from the touch screen information panel. The interview questions were organized to accomplish the research objective and to get clear information about user needs and requirements. Interview responses were collected and analyzed to determine the final user requirements and needs.

To identify the requirement of staff members, a discussion was conducted with Mr. Juha Meriläinen. According to Meriläinen (February 2012), floor maps, class room numbers, staff contact information, events, notices and library information should be the most important concepts which are needed to be included on the information panel. Meriläinen (February 2012) suggested that the information panel can be used as a source of income in the future by receiving electronic advertisements from outside companies or institutions.

The sample group was selected randomly from business and culture, health care, social service and technology departments. This sample group also included first, second, third and fourth year students. This sample group was selected randomly because there is no need for special skill or experience to answer the interview questions. Since KTUAS has diversified nationalities, the sample group also included different nationalities to get diversified response. The interviews were conducted by arranging appointments with the sample group. The interviews were conducted face to face. Face to face interviews provides interactive nature of communication with the interviewees.

I visited different places to meet interviewees face to face for example IT lab Minerva building, Kemi student dormitories, social service library, nursing unit lecture rooms, Liike room in Minerva building and Kemi digipolis library. Before I start conducting the interview I explained the purpose of the interviews, to make the interviewees understand the objective of the study and the purpose of the interviews. After conducting the interviews, I analyzed the collected data by making a percentage of each interview responses. The interview questions are enclosed in the appendix.

The interviews made with KTUAS students were very important to identify their needs and requirements. Moreover, the interview helped me to identify the students' past experience on accessing information and their future expectations from the touch screen panel. KTUAS has different kinds of students, Finnish, exchange and international degree students. More than eighty percent of the exchange and international degree students encountered language problem to access educational and entertainment information and to get information on time when they join KTUAS for the first time. Since the students were new for the educational environment and some of the information was provided in the Finnish language. Less than twenty percent of students stated that they gained enough educational information during the orientation day. More than ninety percent of students said sufficient educational information was provided by KTUAS. However, they also stated that there was a lack of entertainment information for the last academic years. Sixty percent of exchange and international degree students do not use the ordinary information board because most of the information was provided in the Finnish language. However, Finnish students can be benefited from the manual information board because they can understand the language.

More than ninety percent of students supported the idea and the implementation of the touch screen information panel because they found it easy and attractive for use. The remaining of students were of the opinion that interaction with the touch screen panel will be difficult than the normal computer in use. The students use KTUAS website as their information source and business information technology students use bit.tokem.fi website as an additional information source.

The students who supported the implementation of the touch screen information panel suggested a list of information that they would like to view on the touch screen panel. For example lunch menu, staff information, upcoming entertainment programs, NEWS,

events, timetable, re-exam dates and places to visit were among their suggestion. This information needs to be accessed within a few clicks. According to the students, it would be tedious to have more than three clicks to view specific information from the touch screen panel.

4.3 UML diagrams

UML is a modelling language for visualizing, specifying, constructing and documenting a system. UML is used to design software before coding. UML is released by Object Management Group (OMG) as the industry standard modelling language. (Knoernschild 2001, 44-46.) MOF is the foundation of OMG industry standard environment where models can be exported from one application and imported into another. The latest UML specification is 2.4.1 released on August 2011(OMG Inc 2012).

UML has four different elements, i.e. views, diagrams, model elements and general mechanisms. A view represents a particular aspect of the whole system while model represents a complete system. Diagrams are the graphs that describe the contents in a view and general mechanism provide extra information about a model element. UML defines nine types of diagrams which are class, object, use case, sequence, collaboration, state chart, activity, component and deployment diagrams. (Eriksson & Penker 1998, 13-17.) In my research work, I designed use case diagram, class diagram, activity diagram and deployment diagrams to visualize the functionality of the information panel.

A use case modelling technique is used to explain what a new system should do on behalf of an actor. The primary components of the use case model are use cases, actors and the system. An actor is someone or something that interacts with the system and a use case is represents a series of actions that the system performs. There are three types of relationships between the use cases, which are extends relationship, uses relationship and grouping. This relationship shows the relationship between the fundamental elements on use case. (Eriksson & Penker 1998, 45-51.)

To identify the actor of the use-case diagram, the following questions should be answered;

- Who will use the main functionality of the system?
- Who will need support from the system?
- Who will administrate the system?
- What are the results that the system produces? (Eriksson & Penker 1998, 50.)

In my research work, there are two main actors, i.e. admin and users. User' actors include staff, students and guest users because they have the same rights. The Admin actor performs different actions than users by accessing the database and making changes to the database. The figure below illustrates a use case diagram for the KTUAS touch screen information panel.

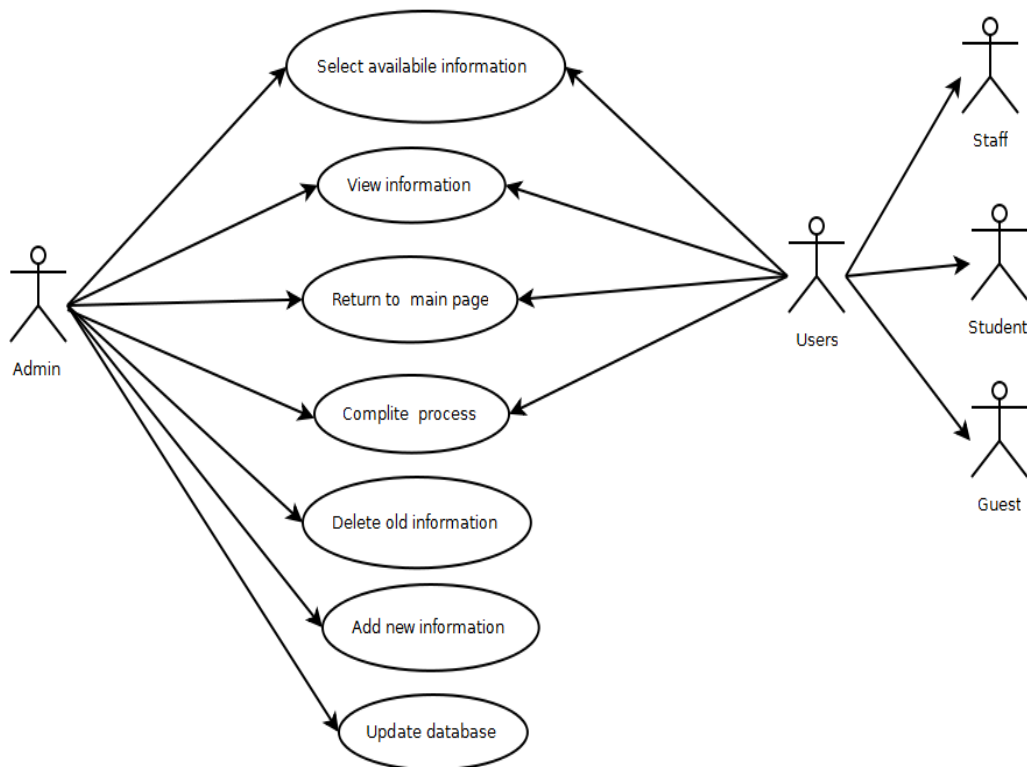


Figure 7. Use-case diagram of KTUAS information panel

A class is a plan of an object. A class has three partitions which are class name, attributes and operations. A class diagram shows the structure and behaviour of a system. (Knoernschild 2001, 126.) The first part shows the name of the class. The second part shows the attributes of the class which describes specific instances of the class and the third part shows what a class can do and what kind of “services” it offers.

Class diagrams have a relationship between classes. There are four types of relationships in a class diagram which are associations, generalizations, dependences, and refinements. (Eriksson & Penker 1998, 50.)

To identify classes in a class diagram, the following questions should be answered.

- Do we have information that should be stored and analyzed?
- Do we have external system?
- Are there devices that the system must handle?
- Do we have organizational parts? (Eriksson & Penker 1998, 50.)

The touch screen information system has four main classes which are administrator, database, graphical user interface, users and server. The graphical user interface class generalizes the sub classes of the graphical user interface classes. The figure below shows a class diagram of KTUAS information system

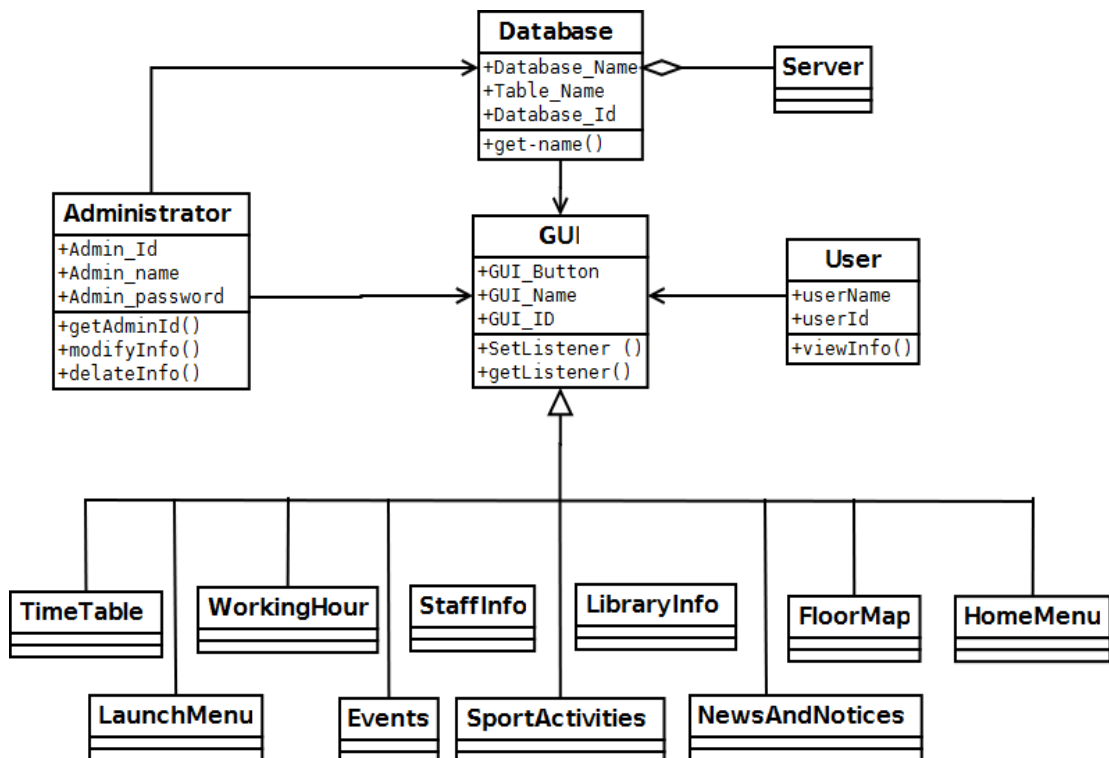


Figure 8. Class diagram of KTUAS information panel

Activity diagram shows a sequential flow of activities and it explains actions and their results. The activity diagram consists of action states, which contain a specification of an activity to be performed. (Eriksson & Penker 1998, 22.) Activity diagram uses to

show how business works in terms of workers, workflows, or generalization and object. The activity diagram consists of actions, transitions and swim lanes. An action shows that action states are performed to produce a result and a transition shows that an activity follows after one another. Swim lanes used to show explicitly where actions are performed or to show parts of an action. (Eriksson & Penker 1998, 149-153.) Activity diagram has a decision point which is signified by a diamond shape, the decision point indicates that an activity has alternative directions depending on a condition (Bennett & Skelton & Lunn 2001, 215).

In KTUAS touch screen information system activity diagram was designed to show users sequential flow of activities. A user performs the first activity by viewing the main page and clicks the necessary button to open another sub page. Users can terminate their interaction with the touch screen panel or go to the main page to view more information. The figure below shows an activity diagram of KTUAS information system.

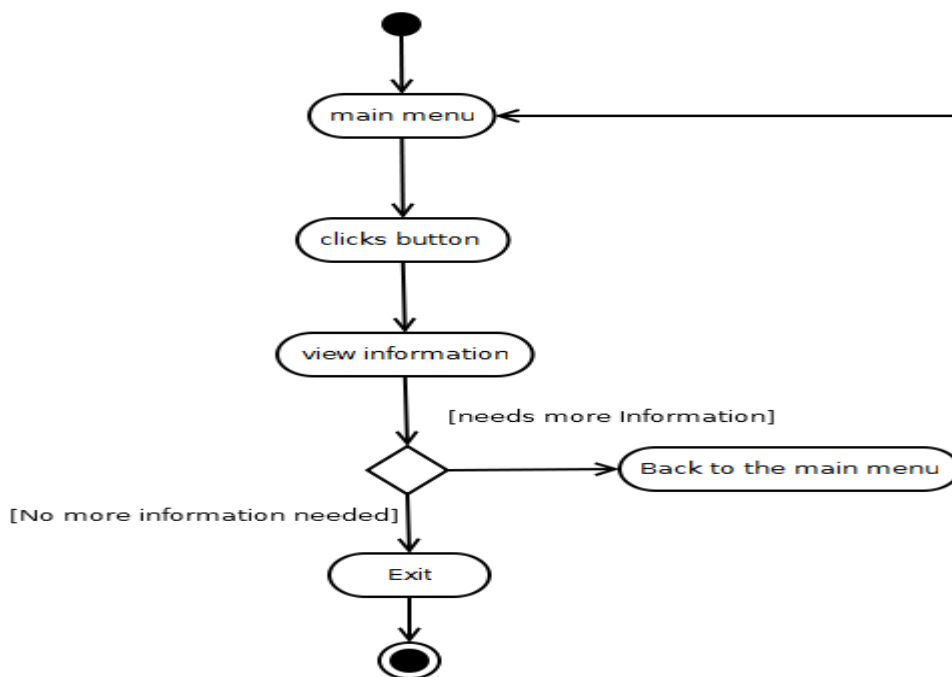


Figure 9. Activity diagram of KTUAS information system

Deployment diagram shows the run time configuration of hardware and software elements of the system. Deployment diagram uses model elements to show the application functionality. Some of the model elements are class, object, state, node, package, and component. (Eriksson & Penker 1998, 23.) The figure below illustrates

KTUAS information system deployment diagram. The diagram demonstrates the applicable functionality of the system.

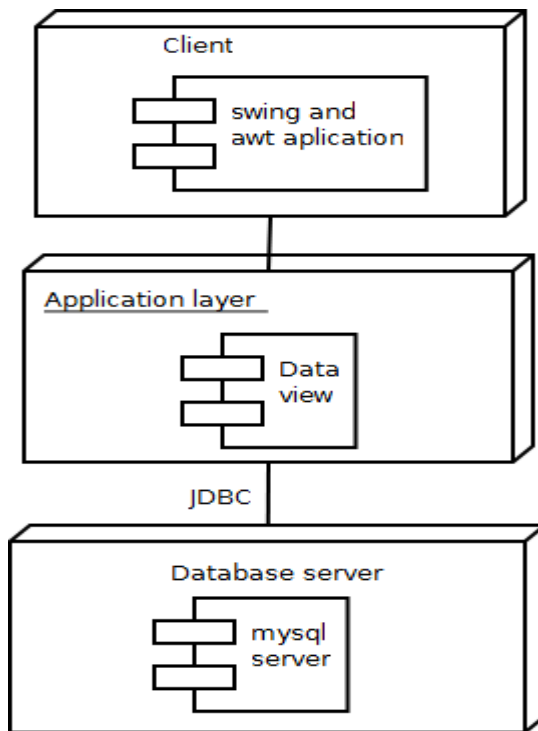


Figure 10. Deployment diagram of KTUAS information system

4.4 User interface design

Sommerville (2001, 330) states that user interface should be designed based on the physical and intellectual capability of the people who use the software. Nielson (2005) developed ten general principles for user interface design. Visibility of system status, error prevention consistency and standard are the examples of Nielson heuristics rules. KTUAS information system user interface uses familiar words and concepts based on the experience of the user. The main user interface of KTUAS information system uses touchable buttons to fit the user fingers on the touch screen panel. These buttons are designed to achieve a consistent and standard platform. To prevent errors and complexity, the users will not be able to write or search information from the touch screen panel. During the interaction between the user and the system, users touch the button to perform an action or to open sub page.

The picture and the figure below compares organized and disorganized information board. Picture 1 shows a disorganized notice board which has different kinds of

information which can fall down at any time. The information board is found in the KTUAS Minerva building Tornio branch. There are advertising papers about different services and activities. These advertisements can be implemented electronically and displayed on the planned touch screen panel and it can be a source of income in the future.



Picture 1. Disorganized notice board inside KTUAS building

The figure below shows the organized user interface of the KTUAS information panel. The information is organized according to user requirements to make information easily accessible. The information panel displays different information in an organized manner. The user only touches the button and can access the required information easily. The figure below shows an organized information panel.



Figure 11. Organized notice board

5 IMPLEMENTATION THE PROTOTYPE WEB-BASED APPLICATION

This chapter focuses on the user interface functionality and on the implementation of the prototype web-based Java application. Moreover, it explains how MySQL database is connected with the Java application.

5.1 User interface functionality

A combination of Swing and AWT Java application was used to design the user interface. The main user interface has nine buttons with image and texts. The image adds attractive value to the user interface. When user performs an action on the button, another window or page will open with detail information. The labels included on the buttons are events and notices, news, staff Info, library Info, working hours, timetable, floor map, lunch menu and sport activities. The NEWS button provides NEWS information about KTUAS educational and entertainment environment. Staff information button provides staff contact information and their availability. Working hour button provides working hours information, for example the University nurse working hours and police working hours. The lunch menu button provides lunch menu list of the different restaurants in KTUAS. The sport activities button provides detail information about the KTUAS sport activities. This will help the students to spend their spare time in different sport activities. The labels of the buttons were planned and organized based on the users' requirements and needs. The figure below shows the screenshot of the actual user interface design with buttons.



Figure 12. User interface of KTUAS screenshot

Floor map and events and notices buttons were selected to explain detail functionality of the system. For example when the users perform an action or touches floor map button another window will be opened with lists of KTUAS branch buildings. For the prototype purpose floor map of Minerva building takes as an example. The user can view the outside image of Minerva building and other branch offices, next to the image of Minerva building there is a view first floor button which shows the first floor map of Minerva building. The floor map window has three buttons on the footer of the page, home, back and next. The home button directs the user to go back to the main page. The next button directs the user to go forward and view other KTUAS building floor maps. The back button used to redirect the user to go back to the previous page. The figure below demonstrates the prototype user interface of the floor map window.

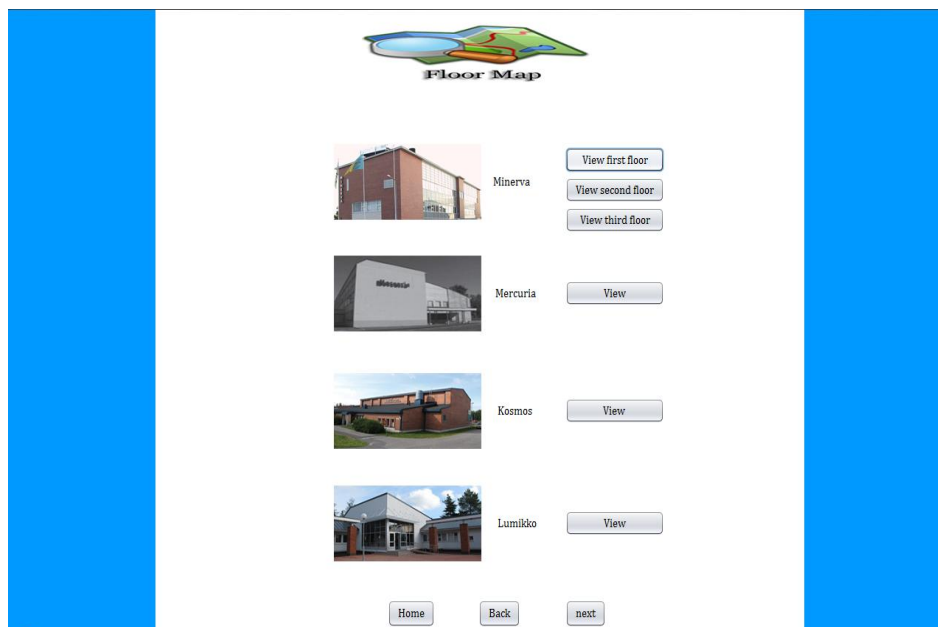


Figure 13. Floor map window

The figure below demonstrates a sample first floor map of Minerva building.

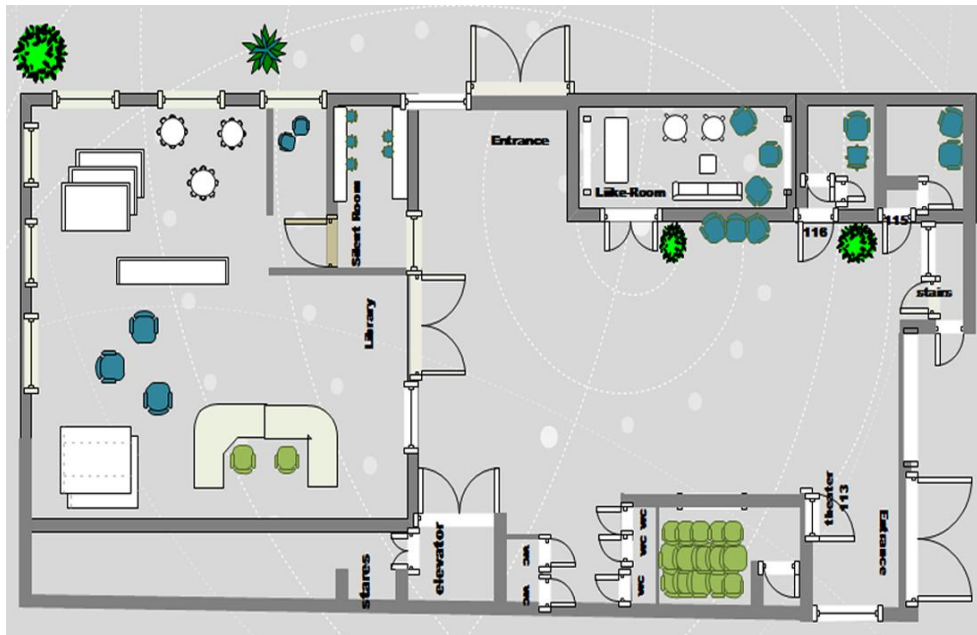


Figure 14. Sample floor map

The other example of the prototype user interface is the events and notices page. The events and notices page serves the user by providing up-to-date event schedules and notices. Lists of event information will be listed in one page and next to each event list there is a view more button. The view more button shows detail information about the events and notices. New events are displayed on the top and older events remains on the bottom part of the page. There will be an administrator who updates the events database and make changes. The figure below shows a sample events and notices window.

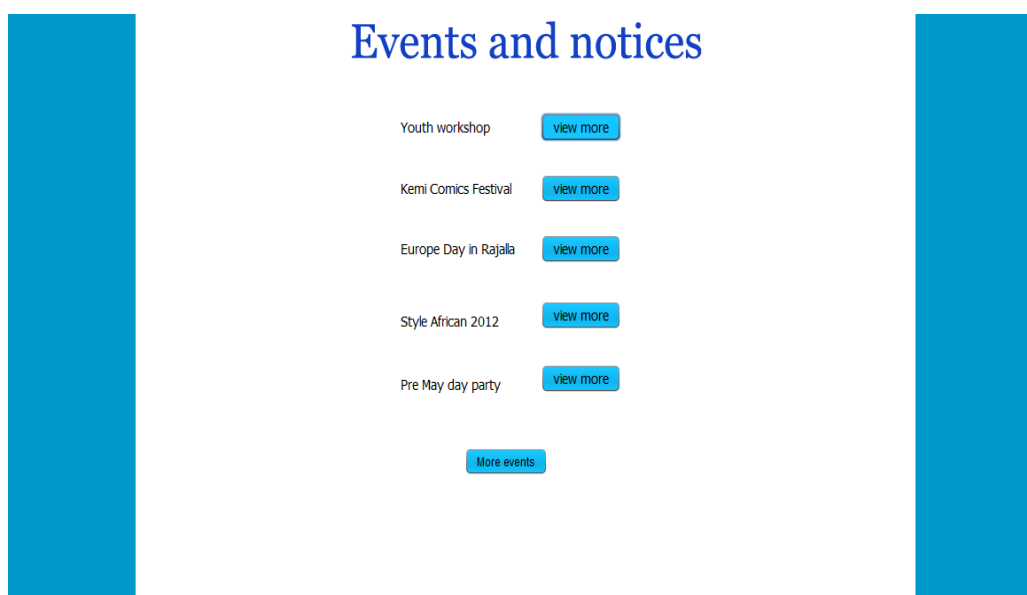


Figure 15. Events and notices main page

For example in figure 15 there is pre May Day party event on the top, next to the pre May Day party there is a view more button. When a view more button clicked users can view detail information about the events name, place, organizer of the event, time and date. The home button uses to redirect the user to the main page. The figure below shows detail information of pre May Day party window.

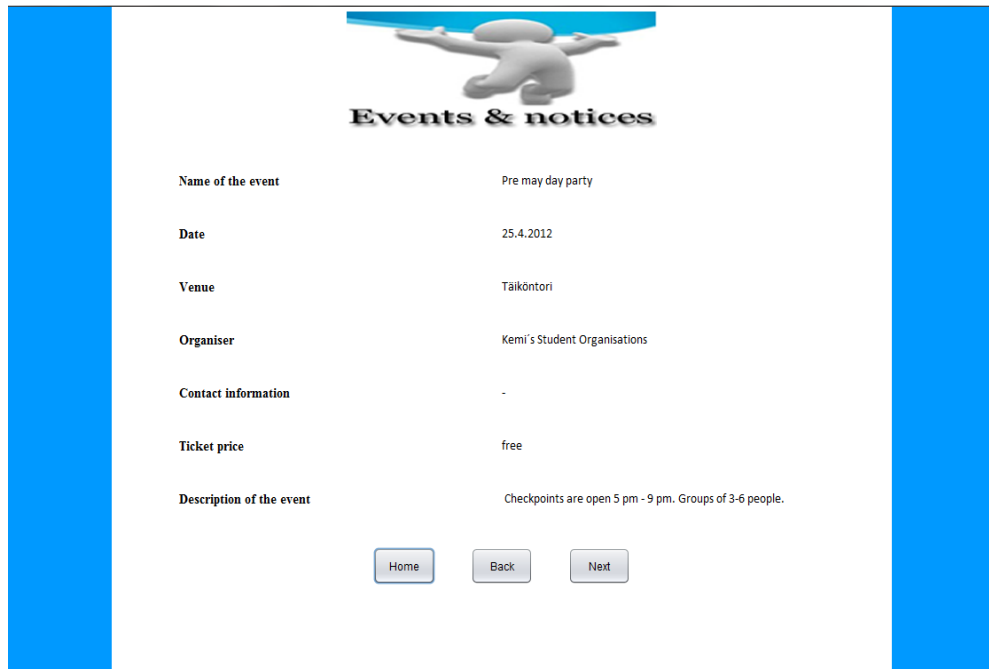


Figure 16. Events and notices sub page

5.2 Database design functionality

The database was designed on XAMPP platform because it is an open source platform with the combination of Apache HTTP server, PHP scripting language and MySQL database. In the MySQL KTUAS info system database created and a table called events. In this table, a list of event information can be stored. Users can request the stored information from the user interface page. The table has seven columns which stores data, and these columns are events name, date, venue, organizer, contact information, ticket price and description of the event.

5.3 Java database connectivity

The Java project was created on NetBeans platform because it is open source with interactive future. To establish a database connection, a JDBC driver should be added to the CLASSPATH to test the java application with the database system. The MySQL

JDBC driver is downloaded from MySQL website and extracted to find the jar file. The jar file added in the library of the main project. The figure below shows how the jar file added to the project library.

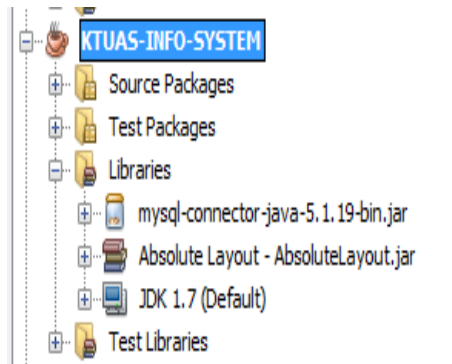


Figure 17. MySQL-connector-Java

The URL format for MySQL connection is `jdbc:mysql://localhost:3306/ktuas_info system`. The driver class name is `com.mysql.jdbc.Driver`. After the connection created it is possible to access any database and table from the NetBeans platform. Moreover, it is possible to add more delete and add data from the NetBeans platform to MySQL database. The figure below shows the JDBC connection between MySQL database and NetBeans IDE platform.

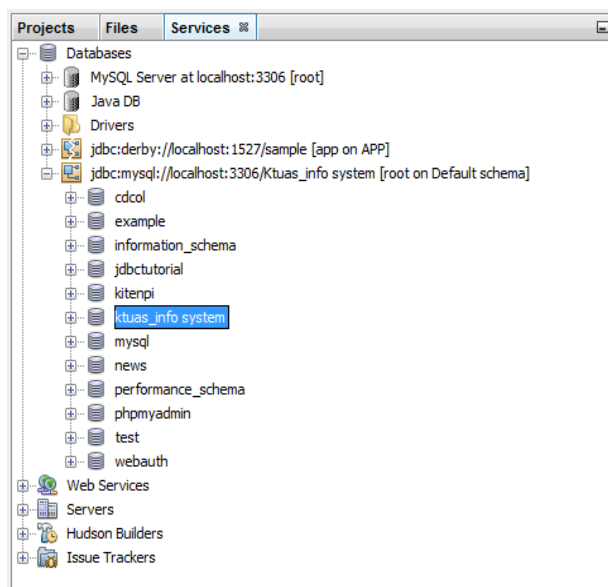


Figure 18. Sample database connection

To establish a connection with the main project, I used the code listed below. The method "con" gets the driver and establishes the connection, "PreparedStatement"

method used for communication between the Java application and the database server and “ResultSet” method executes SQL query and return the result in the ResultSet method.

```
Connection con = null;
PreparedStatement pst = null;
ResultSet rs = null;
String cs = "jdbc:mysql://localhost:3306/ktuas_info system";
String user = "root";
String password = "password";

try {
    con = DriverManager.getConnection(cs, user, password);
    String query = "select * from `ktuas_info system`.events";
    pst = con.prepareStatement(query);
    boolean isResult = pst.execute();
    do {
        rs = pst.getResultSet();

        while (rs.next()) {
            System.out.print(rs.getString(1));
        }

        isResult = pst.getMoreResults();
    } while (isResult);
} catch (SQLException ex) {
    Logger lgr = Logger.getLogger(newclass.class.getName());
    lgr.log(Level.SEVERE, ex.getMessage(), ex);
}
```

Figure 19. Sample connection code

6 DISCUSSION AND CONCLUSION

This chapter presents the result of the thesis work, limitations and challenges of the research work and future development and conclusion.

Today, touch screen technology is becoming popular and used in different kinds of devices. The objective of this research work was to design a prototype web application for touch screen panels and to provide organized information for KTUAS.

The architecture and functionality of the information system were designed by UML diagrams. The diagrams are used for visualizing the system functionality. Moreover, the Meta Object Facility is used as a standard to define the UML diagrams. Literature review and the interviews helped me to answer the research questions and to identify users and user requirements. I designed and implemented a prototype user interface based on the user requirements.

I also create a prototype database and a table in MySQL database and I established a connection between the Java project and a MySQL database. The database was used for storing different data in a table format. The stored data will be retrieved when it is requested by the user.

Further research can be applied on hardware requirements to implement the prototype web based application. Moreover, the applicability of the database on KTUAS local server can be analyzed before the implementation of the web based application. The administrator interface should be design to provide interactive interface and to make the administrative service fast and reliable. Floor map can be designed by professional designers to provide qualified floor map for the intended users. During the implementation of the web based information system the recommendation web browser is Mozilla Firefox as it discussed in hardware and software requirement chapter, it provides real kiosk add-ons which change the screen to full screen mode. The three-tier architecture is the recommended architecture for accessing data sources as mentioned briefly in chapter three. The system can be applied in different languages since KTUAS has different international degree students.

There are some limitations on designing and implementing a prototype web application for touch screen panel. Some of these limitations were the complexity of Java database connectivity and lack of literature on touch screen technology. Designing and implementing the web application is a broad concept. Therefore, I had to limit my research work on the basics of touch screen technology concept and on the designing and implementing a prototype Java application. Moreover, the time frame for the research work was tight and I had to carry out the project within limited resources, which was challenging to manage. Additionally, working with Java project and MySQL database was a new experience. Therefore, it was time consuming to understand the system and it needs high level of programming skill to implement. Due to the limitations and challenges, implementing and testing the whole system was beyond my research objective.

In conclusion, designing and implementing the prototype of web based touch screen information panel helped me to understand the technology of touch screen panel. I am able to work on MySQL database and establish a connection. Moreover, I am able to design an attractive user interface and to advance my knowledge about Java programming. The prototype web-based application can be developed and implemented in the future and users can get organized information from the touch screen panel.

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INTERVIEW QUESTIONS

The Interview used to identify problems, requirements and benefits of touch screen information panel.

1. If you are international or exchange student what was the first problem you encountered regarding accessing information?
2. What do you think about educational and entertainment information which is provided in kemi-Tornio University of Applied Sciences?
3. Do you think educational or entertainment information is provided in an organized manner?
4. Do you have enough Knowledge about Kemi-Tornio environment? Can you access current NEWS regularly?
5. Have you tried to access information on ordinary information boards around the KTUAS area? If you do, did you get specific information that you would like to know?
6. What are your information sources other than edu.token.fi website?
7. What do you think if organized touch screen information panel implemented as a source of information?
8. If the planned information panel implemented, what kind of information you would like to access in an organized form?