



**SAVONIA**

OPINNÄYTETYÖ - AMMATTIKORKEAKOULUTUTKINTO  
TEKNIIKAN JA LIIKENTEEN ALA

# REALTIME TIMETABLE AND INTERPRETER RESERVA- TION SYSTEM

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Koulutusala Tekniikan ja liikenteen ala			
Koulutusohjelma/Tutkinto-ohjelma Tietotekniikan koulutusohjelma			
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Työn nimi Realtime Timetable and Interpreter Reservation System			
Päiväys	30 toukokuuta 2018	Sivumäärä/Liitteet	30
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<p>Tiivistelmä</p> <p>Yritykset ovat ymmärtäneet, että muuttuvan digitaalisen maailman myötä on välttämätöntä kehittää uusia menetelmiä, jotta saadaan yhteistyö asiakkaiden ja muiden yhteistyökumppaneiden kanssa toimivammaksi. Jotta liiketoiminta pystyisi kilpailemaan, on uutta teknologiaa otettava käyttöön.</p> <p>Tämä opinnäytetyö on kohdistettu Kuopion kaupungin tarpeisiin ja sen tarkoituksena on tarjota työntekijöilleen automatisoitu tulkkityöpalvelu, jotta tulkintilaaminen on helpompaa ja nopeampaa. Kohderyhmän tarpeiden mukaan lopullisen sovelluksen on oltava monipuolinen ja helppokäyttöinen.</p> <p>Näiden vaatimusten täyttämiseksi sovellus on tehty verkkosivuna, joka on ohjelmoitu PHP: llä. Myös verkkosivuston asettelu pitää skaalautua vierailevan laitteen näytönkoon mukaan, mikä mahdollistaa verkkosivun käytön erilaisilla laitteilla. Palvelun tietokanta on MySQL, jota käytetään tilauksien ja asiakkaiden tietojen tallentamiseksi. Sovelluksella on sisäänrakennetut ryhmät ja käyttöoikeustasot eri asiakkaiden, tulkkien ja super-käyttäjien käyttöoikeuksien välillä.</p> <p>Tämän opinnäytetyön tuloksena kunnan ja sairaalan työntekijät voivat tehdä tulkkityötilauksia verkossa ilman tarvetta soittaa tulkeille erikseen. Lisäksi, jos työntekijä haluaa tehdä muutoksia tilaukselle, se voidaan tehdä onnistuneen sisäänkirjautumisen jälkeen. Myös tulkit voivat hallita omaa kalenteriaan verkossa tai käyttämällä omaa mobiililaitettaan.</p>			
Avainsanat tulkkityö, varausjärjestelmä, reaaliaikainen kalenteri			

Field of Study Technology, Communication and Transport			
Degree Programme Degree Programme in Information Technology			
Author(s) Haret Hadhood			
Title of Thesis Realtime Timetable and Interpreter Reservation System			
Date	30 May 2018	Pages/Appendices	30
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Client Organisation /Partners Municipality of Kuopio			
<p>Abstract</p> <p>In an imperative world of digital innovation and engagement methods made some businesses realize how inevitable it is to adapt new methods to engage with their customers. Lack of action in an imperative world where 'everything' is being digitalized puts business at the tail in highly commoditized world. Furthermore, to stay in competition businesses must adapt newest technologies to offer their workers. Therefore, this thesis was commissioned by the municipality of Kuopio and to offer its workers a more automated approach to reserve an appointment with interpreters, without the need to contact each interpreter asking them whether they are available on certain date and time or not. According to target group's needs the final application must be simple to use and cross-platform.</p> <p>To fulfill these requirements the application is website based written in PHP. Also, the website must be responsive to different screen sizes, which makes it accessible by all devices used by the workers of the municipality. The database engine is MySQL, that is used to store reservations and client's information. The application has built-in groups and permission levels to differentiate between clients, interpreters and super admins permissions.</p> <p>As a result, municipality and hospital workers can make an interpreter reservation online without the need to call interpreter separately. Furthermore, if the worker wants to make a modification on event, it is possible to do so after successful authentication process. Also, interpreters can manage their own calendar online or by using own mobile device.</p>			
<p>Keywords</p> <p>interpreter reservation, reservation system, realtime timetable, calendar</p>			

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## 1 INTRODUCTION

In recent years digitalization of daily life activities has been increasing dramatically. We are living an era, where each task is simplified and automated for easier and more accurate results by using the available technologies.

In the past people have used different methods to communicate among each other for example posting letters via ordinary mail. This method has its well-known complications. Lately, imperative emergence of digital innovation and engagement methods made some businesses realize how inevitable it is to adapt new methods to engage with their stakeholders. Lack of action in an imperative world where 'everything' is being digitalized puts business at the tail in highly commoditized world. Businesses must have innovation strategies in order to stay in the game of competition advantages, otherwise it will lose to competitors. There is no time to waste, in an exponentially accelerating technological environment where new platforms and devices are emerging, rapidly. So, it is either keeping pace with the changes happening in the technological industry or losing for competitors. After the technological boom people started using fax as a way of communication and later mobile phones. We have been using mobile phones as the fastest way to communicate between each other (Watkins, Hjorth and Koskinen, 2012). To deal with this challenge industries must establish a better relationship with customers, an end-to-end relationship to adapt to technological changes and create a better engagement bond between service provider and customer. (Ey.com, 2014).

Recently, the municipality of Kuopio in northern-Savo has started to embrace the technological boom. They have better communication methods. They have built a system for their workers, where they can reach each other through a database that holds details about the staff. This mainly depends on Microsoft outlook services. They can look into each staff member's calendar and compare it to theirs to pick the convenient meeting time without the hassle of calling each staff member separately (Padwick, 2001). However, this remains within the municipality workers, which is not practical when they try to reach others outside the municipality database, one of which are interpreters. Due to recent development in the refugee crisis, municipality and hospital workers tend to work more often with interpreters. However, the process of getting an available interpreter is not hassle-free. When workers choose a day for a meeting from the calendar when they need an interpreter, they must call each interpreter separately to check his availability. Later, if there is no one available at the required date and time they have to look-up for another time and repeat the process.

As an interpreter working with the municipality, they could offer their own calendar online for the municipality and hospital workers. So, they can pick the convenient date and time and compare it to theirs on-the-fly without the need to call and repeat an old-styled process.

## 2 TARGET GROUP AND AIM

Our goal is simplicity. So, the creation was kept as simple as possible. Therefore, the creation of it will be based on well-known programming languages that offers a reasonable amount of documentation and security. Taking into consideration the nature of target groups of clients and their environment. The available methods of accessibility that our target group have, differs. So, the goal is to make the service available for most of the target group.

### 2.1 Target group analysis and segmentation

The target group differs in work environment, age, education (use of technological devices) and used technological devices. In order to reach most of them, then, it is advisable to take all the above-mentioned differences into consideration. For an example, an old aged worker in the municipality of Kuopio does not have skills to use technological devices or is able to adapt to changes as a young one does. Of course, there are anomalies that is what has been noticed with most workers during the work time which has lasted for more than three years. Also, some of the workers have different work environment than others. There are those who use the service from their office and those who work in the field but do not have the means to access to their desk or laptop computer.

#### 2.1.1 Age group

Taking into consideration different age of our target group is essential. Since, there are older people who are less adaptive to changes. We must offer them the service in a way they could easily adapt and use it. So, simplicity is essential with this group. Therefore, we must limit the number of pages they have to go through and clicks that are required to see the calendar and make a reservation.

#### 2.1.2 Education

People with less-knowledge in using technology tend to be less adaptive to technological changes. This group share same need of simplicity as in age group. complicated applications or websites make it harder for them to use. The service meant for this group should hold less amount of options they have to choose from. The GUI should be understandable and self-guiding with less options to choose from.

### 3 TARGET DEVICES

There are different approaches to achieve the desired platform, since the available devices on the market have grown dramatically in recent years. This growth in technology has also resulted in a different types of programming languages. It is crucial to get overall understanding of the target group and their needs, whether they have a certain fixed work point i.e. office, or they are on continuous movement i.e. in the field. Understanding the work environment will determine which type of devices should be chosen; thus, it will reduce the programming language options that should be used in order to achieve the desired platform. (Jokela and Abrahamsson, 2004)

#### 3.1 Work environment and available devices

Workers of the Municipality of Kuopio and hospital have access to desktop and/or laptop computers that are operating on windows. Also, they use mostly Nokia and Samsung smartphones as a mean of communication. Since the target devices depend mainly on android and windows operating systems, there is a long-list of programming languages that has been excluded.

#### 3.2 Android

Android is a mobile operating system that depends on Linux kernel and is being developed by Google Inc (Saha, 2008). Since 2008 Android has grown rapidly. In the 2<sup>nd</sup> quarter of 2017, Android owns 87.7% of the market share (Statista, 2017). Most of the well-known brands such as Samsung, HTC and LG rely on Android. So, these brands prefer Android due to its robust and open-source nature, meaning it has no licensing fee whatsoever (Collins, Galpin and Kappler, 2012).

Most of the apps that were initially developed to work with Android platform were written in Java. In early stages of Android, the official language was objective-c. However, later Google switched to Java to be the official development language for Android platform apps.

#### 3.3 Windows

Windows is the preferred operating system (OS) in Finland (StatCounter Global Stats, 2018). The first graphical user interface (GUI) of windows was released back in 1985 by Microsoft. Afterwards, the operating system received attention and started growing rapidly (Beal, 2016). Almost certainly, there is no department in Finland that lacks a computer that is being operated by the windows operating system. Also, internationally Windows have been dominating the market share with 88.59%. Followed by Mac operating system with 8.69% of the market share (Fig. 1) (Market Share Statistics for Internet Technologies, 2018). So, the GUI of windows is the most familiar to everyone that has used a computer.



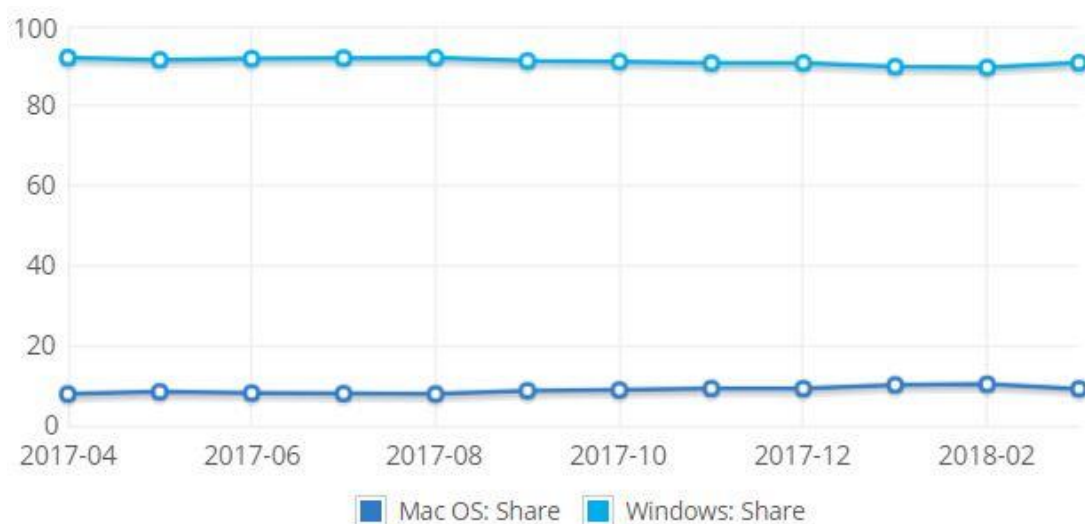


FIGURE 1. Operating systems usage statistics published in 2<sup>nd</sup> quarter 2018, where Windows (88.59%) and Mac (8.69%). (Market Share Statistics for Internet Technologies, 2018)

Recently, Microsoft had released an all-in-one operating system, Windows 10 that unifies almost all Microsoft's devices with one operating system. This means less-time will be spent on developing software that can be used by smartphones, tablets, surface, laptops and PCs that are being operated by windows 10. (RATHBONE, 2018)

#### 3.4 Programming language analysis

Choosing the right language in which the project will be executed is a matter of personal preference, resources, target audience and supporting environment (Scott, 2000).

#### 3.5 SWOT analysis

Performing SWOT analysis helps in understanding strengths, opportunities, weaknesses and threats of certain product.

	<b>Strengths</b>	<b>Opportunities</b>	<b>Weaknesses</b>	<b>Threats</b>
Native-app	<ul style="list-style-type: none"> <li>- access market-place</li> <li>- Better user-experience on smartphones</li> <li>- Use of built-in features</li> <li>- Local storage memory</li> </ul>	<ul style="list-style-type: none"> <li>- larger audience base</li> <li>- Use of IDE kit</li> </ul>	<ul style="list-style-type: none"> <li>- costs more</li> <li>- requires resources in development</li> <li>- Difficult to maintain</li> </ul>	<ul style="list-style-type: none"> <li>- Change in used platform</li> <li>- App market rules and regulations</li> </ul>

Web-app	<ul style="list-style-type: none"> <li>- common code-base</li> <li>- cross-platform</li> <li>- Easier to maintain</li> <li>- Cost-efficient</li> <li>- No need to start from scratch</li> </ul>	<ul style="list-style-type: none"> <li>- Easier to expand in future</li> <li>- Accessible from anywhere</li> <li>- Doesn't require ISTEKKI approval</li> </ul>	<ul style="list-style-type: none"> <li>- Can't use built-in features</li> <li>- Requires internet connection to work.</li> </ul>	<ul style="list-style-type: none"> <li>- Higher security threat</li> <li>- Server-side load</li> </ul>
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Since, we are targeting different environments PCs, Nokia and android smartphones, building a native app for each environment will be expensive proposition and as well as it will drain the resources. Also, such a practice will require later updates and support for each environment. However, there are situations where native apps are the only option available, such as using sensors, built-in features and local storage memory of the environment itself, which is not the case in this project. On the other hand, web-app is easier, faster to develop by sharing common code-base across multiple platforms and cost-efficient than creating a native-apps for each environment. web-apps have all the features needed to establish a calendar website that can be accessed by interpreters, workers and accountants simultaneously while they are performing different tasks. (Dua, 2018)

## 4 TOOLS AND TECHNIQUES

One of the most powerful advantages of developing web-app regarding time, recourses and cost saving is that developers doesn't have to start from scratch. There are many open-source frameworks that we can benefit from as a kick-start for us to not waste time on replication. Since, most of web-app programming consist of replicated basic tasks for each project. Thus, many developers have contributed in releasing open-source frameworks that serve different kind of needs. Using open-source frameworks that are suitable with the desired platform will help developer to reach certain state in development where, developer will implement the actual logic of the project (Figure 2). Some of these tasks are back-end and front-end, user management system, built-in UI and its functionalities and basic security precautions. Therefore, it is essential that developer scrutiny the functions that he needs to evaluate, what open-source framework he is going to implement. (Laine, 2017)

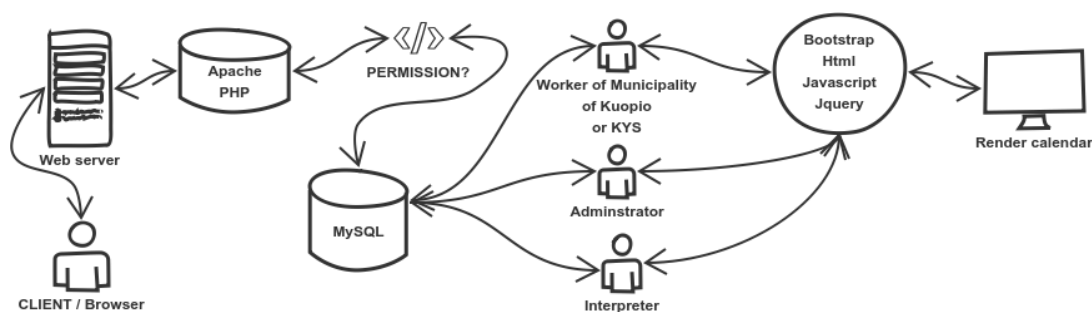


FIGURE 2. Diagram of platform logic.

It is important to keep the code as clean as possible. As open-source framework helps to avoid the hassle of writing the code of the desired platform from scratch; it could be harmful when too many or too large framework is implemented but it does not serve or support your purpose. The platform will have users, permissions, front-end, back-end; thus, UserSpice will be used which is suitable for these tasks. Bootstrap will serve as user-interface framework, because we are targeting different screen sizes such as in smartphones and PC monitors. Furthermore, the programming language in which this platform will be written in is PHP and MySQL will serve as a database engine.

### 4.1 PHP

PHP (Hypertext preprocessor) is an open-source server-side scripting language that has been and will be for years to come dominating the web. You hardly will come across a problem that doesn't have a solution online. Many web developers start with php as it is easy to code with and have

many open-source MVCs (Model, View, Controller), that can give your project a boost such as cakePHP, Zend Framework, Laravel and Yii.

## 4.2 MySQL

According to experts, world data is expected to double every two years. This thrive for data storage has caused an epic shift from storing data on files and archives in the office; to most advanced and developed data storage methods that now we call, databases ( There are different types of databases that serves different types of data we want to store. We have been using databases in our everyday tasks intentionally and unintentionally. Since, the world has started to shift from archived data on papers to digitalization, which means when we go to open new bank account our data will be stored on their databases. Also, when we send an international or domestic shipment to another person, both persons data will be stored. Furthermore, when we make a phone call to another person whether he or she were aware, these data about the phone call, such as caller phone number, duration and receiver phone number are being stored on a database. SQL (Structured Query Language) is a programming language that were developed specifically to work with relational databases such as MySQL, SQL-server, PostgreSQL, Oracle and others. MySQL database management system is one of many databases that are being used in web-development across the globe. A survey that was conducted by Stackoverflow (Stackoverflow, 2018) had shown that MySQL is the most popular database that is being used by developers (Figure 3). Since, it is one of the first new comers to the industry of web-development databases, almost every problem that might encounter developers can be found online with a solution. In Addition, MySQL have above excellent documentation and support, stable versions and low total cost of ownership (TCO). (Suhering, 2002)

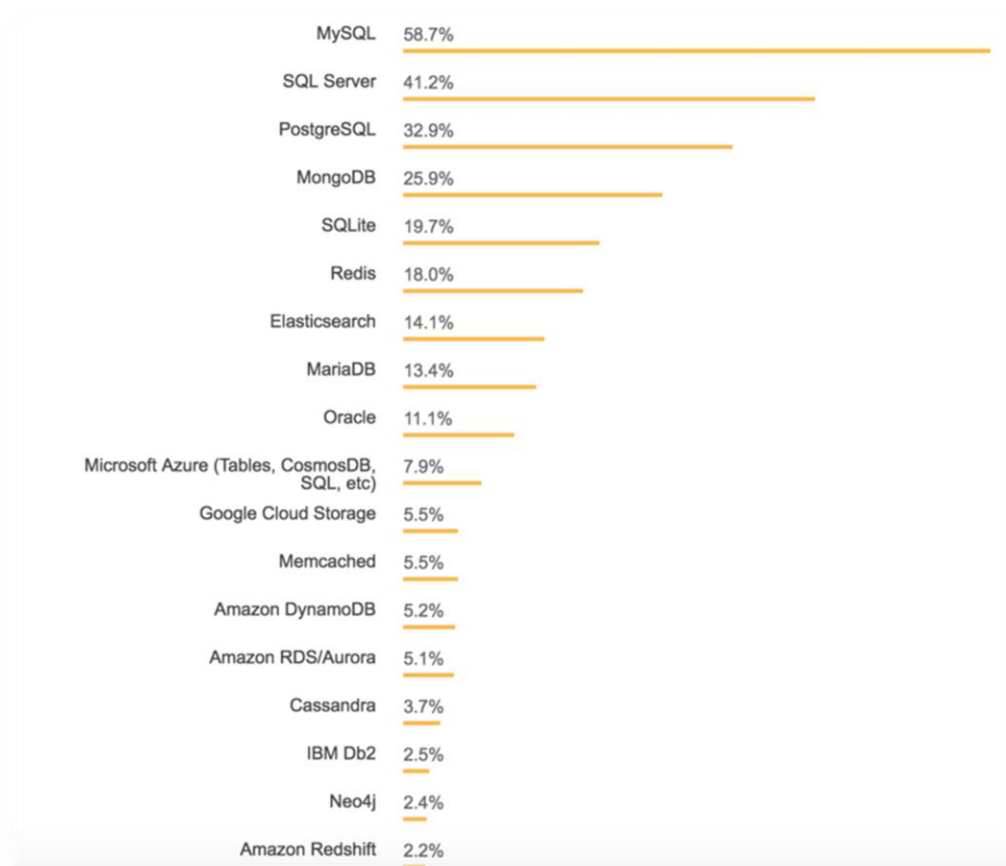


FIGURE 3. Most popular database that is being used by developers (Stackoverflow, 2018)

### 4.3 UserSpice

Initially, UserSpice were developed to serve one purpose only, which is user management. Later, it was developed to include many other features such as permissions, log history, messaging, email, social login integration, database connections and sanitization, user groups...etc. However, most of these features are about users and managing back-end. Also, what makes this framework the one-to-go for this project is that it is not time consuming and it does not interfere with the programming. Simply, it serves its goal without the need interfere or to have to rewrite rules and comply with a certain type of framework guidelines or use template engine as with most of the available frameworks. So, this tiny framework fits our platform needs with many functions that we can choose from what to use and what not. (Dan, 2018)

### 4.4 Bootstrap

Bootstrap framework was released in 2011 by Twitter team lead by Mark Otto and Jacob Thornton (Spurlock, 2013). Bootstrap is front-end framework that consist of series of less-stylesheets, which were developed to offer a nicely designed interface out of the box. Most of the web development share same structure in regard of interface design. Therefore, what made bootstrap the most successful project that targets front-end interface, is that it delivers already made interface components that are based on HTML and CSS. These components can be used in different sizes and colors and it

can be extended to use javascript that comes packed with bootstrap bundle, according to each platform needs. Now a day, using bootstrap is essential to avoid the hassle of writing CSS code from the scratch, as you can use whatever component and customize it as you need. More importantly, bootstrap offers the support for multi-device platform, which is the core idea of this platform. It is essential for our platform to work with as many devices as possible, especially PC, Windows and Android smartphones. (Cochran, 2012)

#### 4.5 JQuery and Javascript

At the early stages of web-development, websites were static and less interactive. Later, the web-development industry as other technologies had a turn-over in terms of user-experience (UI). One of the key players that played a role in giving more opportunities to developers that will eventually result in a better user-experience was JavaScript. Initially, JavaScript is a weakly-typed, multi-paradigm and Object-oriented programming language that was initially implemented in client-side web-browsers in the mid-90's (Flanagan, 1998). Later, the industry has carried on developing languages that works on enhancing user-experience. Subsequently, JavaScript was one of these languages that have changed over the time to introduce new implementations. According to usage statistics for JavaScript that were carried out in May 2017, 94,9% of the most popular websites uses JavaScript (W3Techs, 2018). The most important advantages of JavaScript are that it adds client-side behavior to HTML, which is known as Dynamic HTML (DHTML). Usually, scripts are embedded in HTML pages that interacts with Document Object Model (DOM) (Figure 4). Thus, it gives a possibility to interact with data given by the client without the need to reload the web-app.

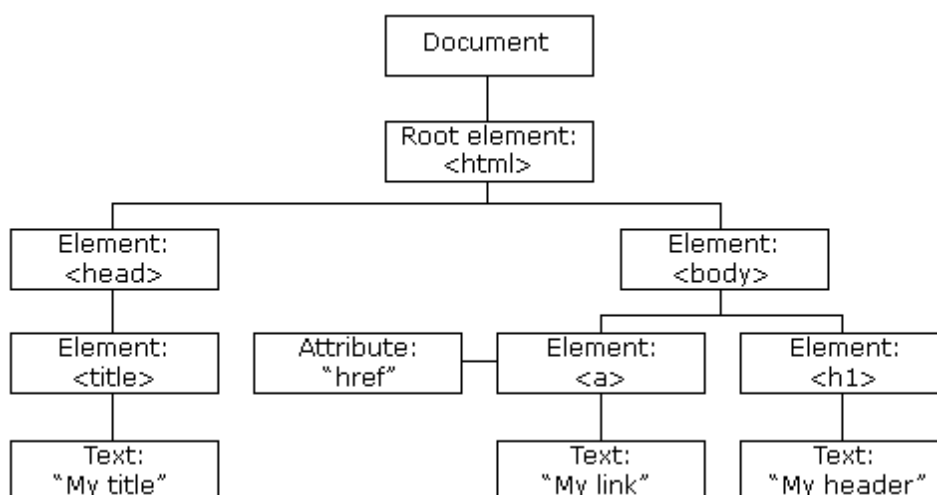


FIGURE 4. Document Object Model (DOM) elements tree, that can be accessed by JavaScript (W3Schools, 2018).

On the other hand, jQuery is not different from JavaScript. jQuery is a set of JavaScript libraries that have been designed specifically to offer most of the used JavaScript techniques in web-development. In recent years, developers started using jQuery more often, since jQuery require

less-code to be written compared to JavaScript to accomplish certain task. Furthermore, using jQuery allows to manipulate HTML documents, event-handling, Ajax, animation and most importantly its support for multitude of browsers; without the need to go through the burden of making JavaScript work as intended with our target group web-browsers.

#### 4.6 FullCalendar

Fullcalendar is highly powerful JavaScript based calendar script. The key concept of fullcalendar is to offer reliable event display system. Powered with animations and gestures and many other well documented features to control the layout of the calendar. However, it does not go beyond dragging an event from point A to point B. All other features required to make it event management system is left for developers to choose their way in doing so. Fullcalendar has no connection with any form of database whatsoever.

## 5 DEVELOPMENT PROCEDURE

The creation of websites consists of different steps. Some of these steps differ according to the programming language that is being used. The underlying infrastructure is what is going to make the code compile for the machine to understand it. To be able to start working with the php programming language and MySQL database, a Linux operating system must be installed, Apache server, PHP and MySQL or what is known as LAMP. Since, this is a development process, the web-app will be implemented on a virtual platform, WampServer. WampServer 3.1.0 comes packed with all requirements that are needed for this project to be accomplished, such as MySQL database 5.7.19, PHP 5.6.31 and Apache 2.4.27.

### 5.1 Database design

Database affects the effectiveness and efficiency of a software. So, it is impossible to overestimate the importance of database design. Usually, the first step of the database design starts with the creation of a logical data model for business information that must be stored in and accessed through the database. Then the logical design should be transformed using best practices. The transformation process consists of transforming entities into tables; attributes into columns; domains into constraints and data types; and relationships into primary and foreign keys.

Since, FullCalendar is not database dependent script, which means it doesn't have the means to communicate with database; nor the method to store and retrieve data. So, it is crucial to append it to the logical database design. Furthermore, fullcalendar should have the possibility to differentiate between different user groups and permissions. Each event that is created by client should be related to user and interpreter as shown in (Figure 5).



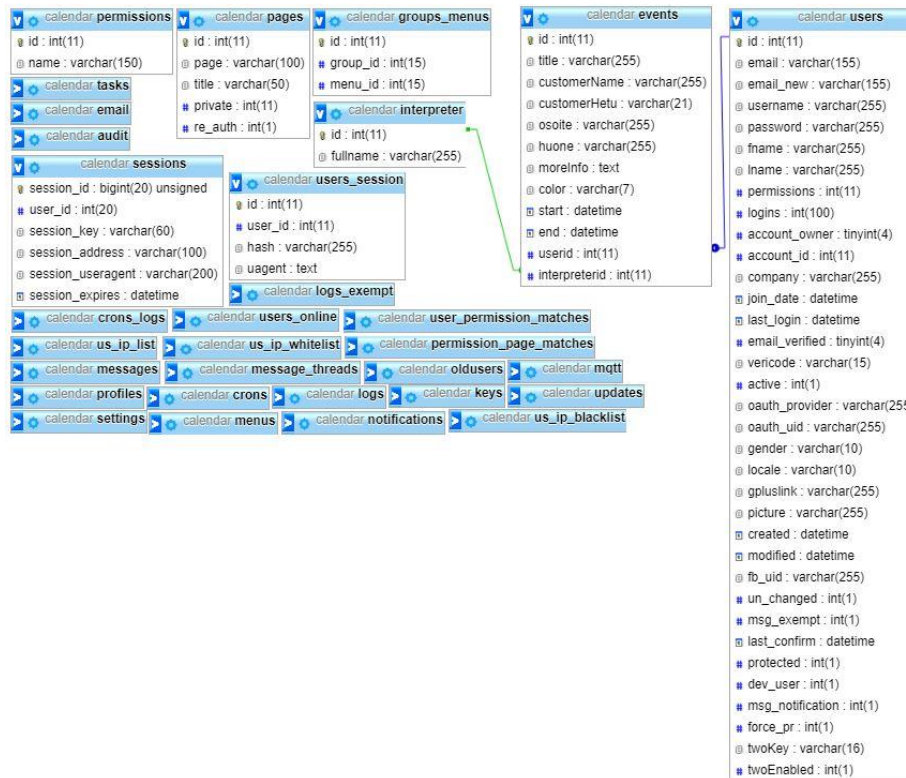


FIGURE 5. Database design schema for interpreter reservation project.

## 5.2 User registration

Every event that is being added, modified or deleted by the municipality and hospital workers should be done after successful identification. Thus, client registration is essential as first step toward using interpreters calendar. When client opens registration page the system will check whether the ip-address is banned or not, if the ip-address is on ban list, the system will throw ban message. Also, the system performs another check whether client is already logged in or not. If the client is logged in, will be redirected to homepage (figure 6).

```

function ipCheckBan(){
    $db = DB::getInstance();
    $ip = ipCheck();
    $ban = $db->query("SELECT id FROM us_ip_blacklist WHERE ip = ?",array($ip))->count();
    if($ban > 0){
        $unban = $db->query("SELECT id FROM us_ip_whitelist WHERE ip = ?",array($ip))->count();
        if($unban > 0){
            logger(0,'User','Blacklisted '.$ip.' attempted visit');
            return false;
        }else{
            return true;
        }
    }else{
        logger(0,'User','Blacklisted '.$ip.' attempted visit');
        return false;
    }
}

public function isLoggedIn()
{
    $command = $this->generateP4Command('login -s', false);
    $exitCode = $this->executeCommand($command);
    if ($exitCode) {
        $errorOutput = $this->process->getErrorOutput();
        $index = strpos($errorOutput, $this->getUser());
        if ($index === false) {
            $index = strpos($errorOutput, 'p4');
            if ($index === false) {
                return false;
            }
            throw new \Exception('p4 command not found in path: ' . $errorOutput);
        }
        throw new \Exception('Invalid user name: ' . $this->getUser());
    }

    return true;
}

```

FIGURE 6. The responsible functions that perform checking for banned ip-addresses and whether client has already logged-in.

When both conditions return false, the client can perform the registration process. To simplify it, the user does not have to submit the registration form to check whether the username is taken or not. During the registration process when the client takes the focus out of the username field, the chosen name will be stored into a variable and compared to the stored data in the database using Ajax. If the username is not taken, the client will see an indicator show that he can use this username. Otherwise, an alert will appear, informing the client that this username is already taken.

Password should match with password regulations that were assigned by website admin. These regulations can be changed from application settings, by website admin only. There are two validators that should be passed, for the password to be valid. First validator is when the user chooses password that match with safety regulations and second validator is when both password match.

## Register

**Username:** ✓ This username is not taken.

Haret\_Hadhood

**First Name\***

Haret

**Last Name\***

Hadhood

**Email Address\***

haret.hadhood@uef.fi

**Choose a Password\* (Between 6 and 30 characters)**

.....

**Confirm Password\***

.....

**Passwords Should...**

- ✓ Be between 6 and 30 characters
- ✓ Be typed correctly twice

[Show Passwords](#)

**Registration User Terms and Conditions**

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Check box to agree to terms

[+ Register](#)

FIGURE 7. Registration page where all fields are filled appropriately, except for confirm password field.

After submission the form will check whether all required fields were filled appropriately and pass the data to be stored into database.

### 5.3 Calendar

The calendar is the core of this project. Since, the logic of this web application is to offer workers the ability to reserve an interpreter; and modify, delete their reservations. Our goal is to offer clients and interpreters as well, the ability to do everything they need regarding reservations from one page with ease and efficiency. Municipality of Kuopio and hospital workers can browse each interpreter calendar separately; and the ability to view all interpreters timetable in one calendar to see who is available for the desired period; where, they can modify and delete their own reservations; In addition, insertion of new events to interpreter's calendar. Subsequently, interpreters can view their own calendar, with full-control over-it. These actions can be made without the need for client to reload a single page, to achieve highest efficiency and effectiveness, regarding user experience (UX). Most of the logic of this system is built behind the scenes. Mostly, actions made by clients are handled by jQuery. Thence, it communicates with the server to get the information from and into database, through php functions.

Below is a detailed description for the proposed calendar (Figure. 8).

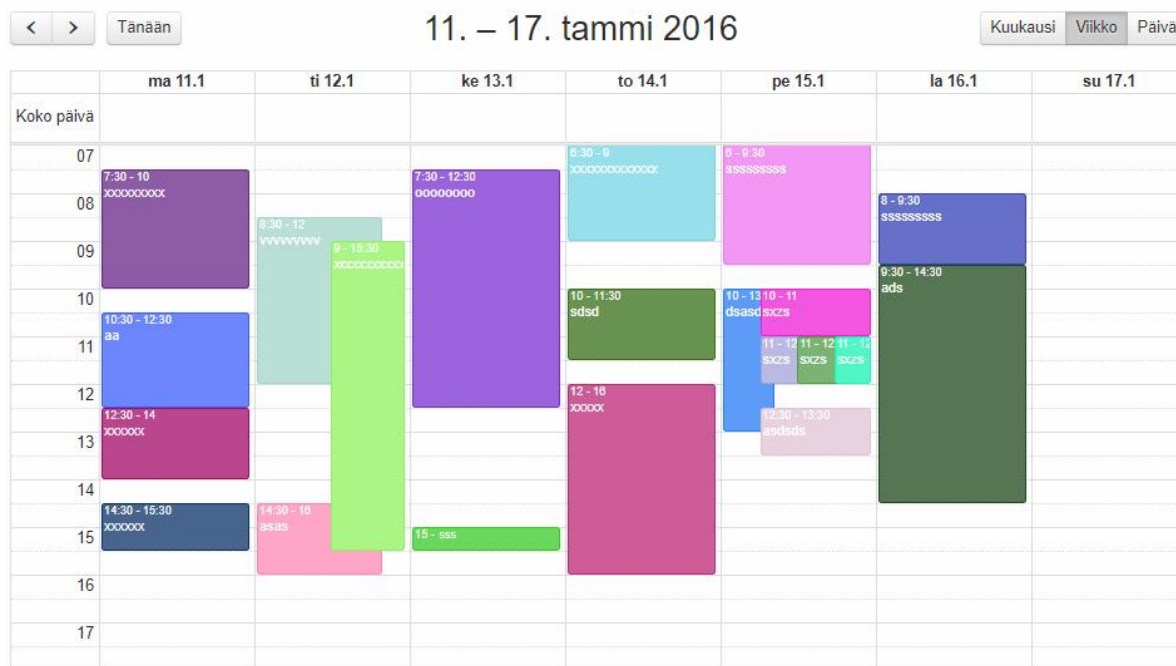


FIGURE 8. detailed description for the proposed calendar

Recently, The EU general data protection regulation (GDPR) has made huge shifting in terms of data protection and client privacy after long time of debate (Eugdpr.org, 2018). The regulation has been approved in 14<sup>th</sup> of April 2016 and will be enforced in 25<sup>th</sup> of May 2018, replacing the old deprecated regulation that were set in 1995. This change in regulation is tremendously important, especially since the calendar deals with customers information. Furthermore, the clients are officials and they must work according to these regulations. Therefore, customers information should be protected and no other than client who has reserved the interpretation and the interpreter could see customers information. Also, highly sensitive data such as customers social ID will not be stored in database which will provide more security for client's sensitive information.

### 5.3.1 Insertion of an event

The insertion of an event is possible when the client has logged-in and certified by the site admin as a valid worker of the municipality or hospital. Otherwise, the client will not be able to create an event into the interpreters' calendar. This process helps to prevent any outsider who does not belong to the target group from sabotaging or spamming the system.

The client has the option to browse the calendar to find the convenient time for a reservation. If the interpreter happens to be booked on the exact required time, then it is not possible for the client to add an event over an existing one. The calendar offers selectable functionality offered by jQuery, which means that the client can select a multiple row as each row of the table represents 30 minutes. Afterwards a popup menu will appear where the client should fill out the form. After clicking on reserve then the data will be sent to the database to be stored without the need for reloading the page (Figure 9).

The image shows a web application interface for creating an appointment. A modal window titled 'Ajanvaraus' is open over a calendar. The modal contains the following fields and controls:

- Valitse Tulkki:** A dropdown menu with 'Haret Hadhood' selected.
- Aihe:** A text input field containing 'Tapaamisen aihe'.
- Asiakkaan nimi:** A text input field containing 'Asiakkaan Nimi'.
- Osoite:** A text input field containing 'Osoite'.
- Huone:** A text input field containing 'Huone'.
- Lisää tietoja:** A text input field containing 'Lisää tietoja'.
- Start date:** A date and time input field showing '2016-01-12 09:00:00'.
- End date:** A date and time input field showing '2016-01-12 10:00:00'.
- Buttons:** An orange 'Sulje' button and a red 'Varaa aika' button.

The background shows a calendar grid with time slots from 07 to 17. Some slots are occupied by colored event blocks, such as a purple block from 12:30 to 13:00 and a blue block from 14:30 to 15:00.

FIGURE 9. view of event creation into interpreter calendar.

### 5.3.2 Modifying an event

Clients have the option to access to modify any event, that was created by them. Also, interpreters can modify all events in their own calendar. Super admin has access to all calendars. Modification is possible in three different ways, date, time and information update. Date-time modification is when client want to change only the date and time, this happens by dragging the event from one place and dropping it in another one. Similarly, on the bottom of the event-widget, it is possible to resize the event by dragging it to the desired length, where each row represents 30 minutes (figure 10). Usually, this is used when user wants to increase or decrease event's period, on the fly.

On the other hand, it is possible to double-click on an event to show a pop-up modal that is being populated with events details, in a similar way to the one shown in (figure 9). These details can be modified by client himself, interpreter and super admins. Both types are done without the need for the page to reload, using ajax.

```

export function drag(startDate, endDate, debug) {

  startDate = $.fullCalendar.moment.parseZone(startDate)
  endDate = $.fullCalendar.moment.parseZone(endDate)

  var startRect = computeSpanRects(
    startDate,
    startDate.clone().add({ minutes: 30 }) // hardcoded 30 minute slot
  )[0]
  var endRect = computeSpanRects(
    endDate,
    endDate.clone().add({ minutes: 30 }) // hardcoded 30 minute slot
  )[0]

  return EventDragUtils.drag(
    startRect,
    endRect,
    debug
  )
}

```

FIGURE 10. The responsible function for event insertion.

#### 5.4 Groups and permissions

Since the core concept of the calendar is to work with workers of the municipality and hospital; interpreters and super admins. Clients cannot do what interpreters can, in terms of permissions. Therefore, it is essential to implement built-in groups access policy; where each group could be granted or do denied from accessing certain area of the system. Furthermore, groups system helps to differentiate between clients on the back-end of the system.

We have implemented four different groups admin, interpreter, accountant and client with the possibility to expand, to (group)<sup>n</sup>. Each group has its own accessibility permission depends on its needs, evaluated by super admins. A group can inherit multiple groups permissions and in addition to that its own permissions. For example, group A has access to user profile, report generation where group B has access to user profile only. Subsequently, group C can have any of the group mentioned above as one of its sub-groups, for demonstration purposes, group A belongs to group C. Therefore, group C will have access to user profile and report generation, in addition it could have its own permissions that will not be inherited by any other group especially group A, if not specified otherwise (figure 11).

The image shows two side-by-side panels from the Haret Hadhood application. The left panel, titled 'Muokkaa rooli', is for editing a role. It includes a header with 'Haret Hadhood' and a menu icon. Below the title are two buttons: 'Päivitä rooli' (blue) and 'Peru' (orange). The main content is divided into three columns: 'Roolin tiedot - testi vaiheessa' (Role info - test phase) with fields for ID (3) and Name (Interpreter); 'Kuka kuuluu tähän?' (Who belongs here?) with checkboxes for 'Poista' (admin, interpreter) and 'Lisää' (user); and 'Mihin pääsee - ominaisuudet' (Where can you access - features) with a list of PHP files under 'Remove Access From This Level' and 'Lisää ominaisuudet' (Add features). The right panel, titled 'Tee rooli', is for creating a new role. It has a header with 'Haret Hadhood' and a 'Roolin nimi:' input field, followed by a 'Lisää uusi rooli' button. Below is a list of roles: 'User', 'Administrator', 'Interpreter', and 'kirjanpitaja'.

FIGURE 11. View of group creation and permissions.

## 5.5 Layout

Web-design isn't something that could be taken easily. Websites layout affects user interaction with content. Before starting to develop a certain layout, it is advisable to think thoroughly about the content. Since, the layouts role is to give smooth experience for clients and make content visible according to its importance. It doesn't matter how well back-end of an application is done, since the front-end is badly designed. So, badly designed website agitates users and result in complicating content understanding. Choosing bootstrap to serve as front-end framework enhance user experience and navigation flow, since most of the elements were thoroughly tested and enhanced to offer a better user experience. However, it is up to us to choose how content will be displayed and what colors to choose.

The core idea is about calendar and reservations. So, we tried to minimize all possible distractions by creating only one calendar that all groups could interact with, according to each groups permission. Furthermore, the system mainly consists of one page, which is the calendar page. The main view of the calendar contains all interpreter's calendars, each interpreter has random color. Random colors for each interpreter make it easier for clients to distinguish between interpreters; also, it makes the overall look of the layout more versatile.

Since, clients have different setups, which means each client could have different screen resolution. Thus, the web-app is responsive and could be viewed on large and small screens.

## 5.6 Managing malicious activities

One of the most devastating activities are malicious activities. As malicious activities could harm the system in a way that could be irreversible. Therefore, security precautions are never over estimated. Surely, there are multiple levels of security that should be taken into consideration, starting from the physical address of the servers ending with clients' environments. There are a few tools provided that could help super admins to follow malicious activities by unknown sources to prevent them by blacklisting their IP-addresses. The framework has a built-in log which could be wisely used, in preventing such activities (Figure 12). The super admin has the power to follow which page and how many times it was visited by a certain registered or un-registered client. Also, it offers a filter that could be used to follow certain client activity; the possibility to follow certain page visitors; and actions that were taken by clients.

The screenshot displays the Haret Hadhood web application interface. The main content area shows a log of events with columns for time (pvm), type (tyyppi), user (kayttaja), and a note (HUOM). The log entries include actions like 'Added 1 page(s) to Permission #3', 'Deleted 1 user(s) from Permission #3', and 'User logged in'. On the right side, there are two filter panels: 'Kayttaja suodatin' (User filter) and 'Tyyppi suodatin' (Type filter). Below these is the 'Logs Manager' section, which includes a table with columns for Log Type, Count, Exempted?, and Mapper Function. The table lists various log types such as User, Permission Manager, Admin Verification, Setting Change, Permissions Manager, and User Manager. At the bottom, there is a 'View Security Events' section with a note about security breaches and buttons for 'Clear All Logs' and 'Ban Selected IPs'. Below this is another table with columns for Event ID, User, Page, Timestamp, and IP, showing specific security events.

Log Type	Count	Exempted?	Mapper Function
User	136	No	Map
Permission Manager	9	No	Map
Admin Verification	3	No	Map
Setting Change	3	No	Map
Permissions Manager	2	No	Map
User Manager	2	No	Map

Event ID	User	Page	Timestamp	IP
1	Haret Hadhood	users/message.php	2017-02-20 19:31:13	::1
2	IP last used by Haret Hadhood	users/admin_backup.php	2017-08-14 20:32:22	::1
3	IP last used by Haret Hadhood	users/admin.php	2017-09-16 20:53:58	::1
4	Unknown IP	users/admin.php	2017-10-09 18:41:11	192.168.0.222 (banned)
5	Sample User	users/update.php	2017-12-03 06:58:52	::1

FIGURE 12. Logs view and blacklist functionality.



### 5.6.1 Cross-Site Request Forgery (CSRF) attack

A study conducted by CDNetworks shows that cross-site request forgery is the most widely used technique in cyber-attacks. CSRF happens when malicious web app, email, blog or software requires client's browser to perform unwanted tasks. When clients log-in they get randomly generated session token, which gives the client authorization to access the platform. Subsequently, client's session token is bound to client's browser, which the attacker uses to perform certain unwanted tasks after clicking on malicious links. In general, the severity of the attack varies, from client to another. Since, the website depends on groups, where each group has different level of permissions. Therefore, if the victim were worker from the municipality of Kuopio or the hospital, the attacker can perform any task client can. On the other hand, if the victim were super admin, the severity of the attack is relatively higher. Taking into consideration this website is reservation based, the severity of the attack might be devastating. Specially, when an attacker performs unwanted reservations on interpreter's calendar, which leads to raise in cost for the municipality and the hospital; since they are obligated to pay for the time they have reserved. Eventually, this leads to losing trust in the service among work community. So, protecting the service from CSRF is highly important.

To protect the service from any possible CSRF attack, a unique CSRF-token was created which is generated cryptographically in server-side and bound to the session when client enters a page that contains forms, which eventually will be sent to the server to perform certain task. Subsequently, after the submission of the form the server will check whether this token was issued to this session or not (figure 13). Also, another layer of protection was added by comparing the origin of the referrer, which will reveal whether we are dealing with cross-site origin or not.

```
class Token {
    public static function generate(){
        return Session::put(Config::get('session/token_name'), md5(uniqid()));
    }

    public static function check($token){
        $tokenName = Config::get('session/token_name');

        if (Session::exists($tokenName) && $token === Session::get($tokenName)) {
            Session::delete($tokenName);
            return true;
        }
        return false;
    }
}
```

FIGURE 13. Token class for CSRF-protection.

## 5.6.2 SQL-injection

SQL-injection refers to an unwanted act performed by an attacker to inject the database (WILLIAM, HALFOND and ALESSANDRO, 2006). Unfortunately, MySQL injection is wide-spread across the world wide web. Applications with minimum defense methods against MySQL injection or no defense at all, are vulnerable to identity spoofing, temperment with existent data or repudiation issues, such as making reservations on behalf of work community; or deleting existing reservations. Thus, SQL-injection exposes the application to the most severe form of data manipulation and puts data confidentiality at grave risk, eventually even data-loss. SQL-injections happen by injecting code into query that will be executed by database directly. To avoid such practice, we are using prepared statements, PHP data object; parametrized queries; and stored procedures. Also, another layer of protection the MySQL server user is not attached to any other database on the same server.

## 5.6.3 Cross-site scripting (XSS)

Cross-site scripting is another form of malicious behavior, performed by an attacker to execute malicious code behind trusted website. The malicious code is sent to the client browser in any form that browser can execute, specially segmented JavaScript or flash. Usually, this kind of attack steals session data or any other data retained by the browser and store it on third-party server for the attacker to use the session, which compromise victims account. Also, XSS might be used to install trojan horses into victim's computer. The severity of the attack varies from the annoyance of advertisement, unwanted content, revealing end files or even compromise super admin account. We have implemented validation methods that validates every input made by client to verify its authenticity.

## 5.7 Framework settings

Being able to configure most of the functions that comes backed with the framework, is an important approach. Since, websites go through different states of development over the years. Most of the features that comes packed with UserSpice framework are important at certain point of development, in which website goes through. Therefore, it is important that these features could be disabled, enabled or even modified to serve certain task depending on the current needs of the website.

### 5.7.1 Enforced TLS-connectivity

Enforcing transport layer security (TLS) is always a wise decision. Specially, when dealing with highly sensitive data. Transport layer security prevents criminals from spying on client's data by creating secure connection that safeguards any sensitive data being sent between two parties under TLS-

connectivity. The connection between two computer applications is encrypted. Thus, all data transmitted are complicated for attacker to intercept.

### 5.7.2 Restriction of usernames

It is possible to choose from the settings whether to restrict username to certain type or to give complete freedom to the client to choose. The framework comes with possibility to auto assign username to their first and last name; if the username already exists, then by default the system will choose their first name and last initial; in case this option also exists then the email address will be chosen as their username since it is unique. However, this functionality is partially practical. For the sake of simplicity, we have modified on this setting to include two options only, the client has the freedom to choose their username; or restricting it to their email address only.

### 5.7.3 Enforcing password reset

In case of security breach, it is important to include password reset for all clients. The database table users have a column named force-pr, which is assigned to false by default. This function will change the value to "true", which will enforce clients to reset their password in next login and change the value to false. This gives additional security layer for the system.

### 5.7.4 Keeping spammers away

BOTs are crawling the web to archive the content for later inclusion, in a search engine. However, there are malicious BOTs which try to publish uncensored content, which eventually will create masses of unwanted data. Since, no one can add anything to the database without registration, it is important to ensure no BOTs are allowed to register. ReCAPTCHA is a service offered by google to distinguish between humans and BOTs, by doing risk analysis and adaptive CAPTCHAs. The framework offers a setting from which reCAPTCHA could be disabled or enabled.

## 6 SUMMARY

Digitalization is an important tool to help workers and customers in an end-to-end relationship, mostly using automated processes to smooth the flow of work. The municipality of Kuopio has decided to deploy a new innovative and partly-automated model for its work community to be able to work with third-parties, calendar wise. This project was meant to serve urging needs for the hospital and municipality of Kuopio workers to coordinate their calendar reservations with third-parties, from which are interpreters. Thus, this project was carried out using PHP, MySQL and jQuery according to target groups, work environment and resources limitations.

The main goal for this project was to offer a functional, cross-platform and most importantly easy to use service that workers of the hospital and municipality of Kuopio can use to register their own account from which they can create a reservation to interpreter's calendar, safely. In case of change in schedules workers can modify their reservations. Furthermore, interpreters can fully control their calendars by modifying or even deleting an event. Mostly, frameworks were relied on to give a boost in the development. Furthermore, due to limited resources and short time of development, Userspace was chosen as framework for the project, because of its small footprint and most of the kick-start functionalities that are needed for this project to be functional and ready for demonstration were already built-in. During development process the municipality workers were achieved and the required changes were made along with the development process to address their needs.

Since, the development of this project was carried out locally, we had to evaluate user-experience. Thus, created a website ([kuopiontulkki.fi](http://kuopiontulkki.fi)), from which customers can access to review and give their feedback. Eventually, users were satisfied from their experience using large screen devices, specially desktops. However, the fullcalendar framework wasn't easy to use on smaller screens such as mobiles. It would be a better approach to create native application for each mobile platform; in addition, to web-app service.

In general, the project was successful as a proto-type, that should be refined before publishing it officially. Investing in this project and creating native applications for mobile platforms is advised, due to simple fact that the idea of this project doesn't necessarily address interpreter's reservations. Any work environment could benefit from this project where they need to interact with certain people's calendar with permissions for different groups. Also, interpreter service companies could benefit, as they have the same old-style strategy used by municipality of Kuopio, where they must contact each interpreter, separately.

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