CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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Diploma Thesis

Analysis of open source web content management systems

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DIPLOMA THESIS ASSIGNMENT

B.Sc. Taisir Obad, MSc.

Informatics

Thesis title

Analysis of open source web content management systems

Objectives of thesis

The main objective of the thesis is to create an online web presentation based on analysis of chosen content management systems.
Partial objectives of the thesis are such as:
- to create literature overview of the relevant theories,
- to analyse main open source content management systems,
- to compare different approaches to design and implementation of web presentation.

Methodology

The methodology of the thesis is based on study and analysis of specialized information sources. For own solution, open source CMS will be used. Approaches of design and implementation methods will be evaluated by Multiple Attribute Decision Making model with a finite number of alternatives. Based on a synthesis of theoretical knowledge and the results of own solutions the conclusion of the thesis will be formulated.

The proposed extent of the thesis

60 – 80 pages

Keywords

CMS, applications, MODX, Plugins, PHP, WordPress, Joomla, Drupal.

Recommended information sources

Brandenborg, Thomas. "Content management system for managing publishing content objects." U.S. Patent Application No. 10/735,713.

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Understanding Content Management A CM Domain White Paper By Bob Boiko

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Declaration

I declare that I have worked on my diploma thesis titled " Analysis of open source web content management systems " by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on ……... ……

Taisir Ali Obad

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Souhrn

Cílem diplomové práce je analyzovat a vyhodnotit systémy open source webového managementu (WCMS) založené na metodách návrhu a implementace. Tyto metody byly vyhodnoceny pomocí rozhodovacích bodů (MADM) a kritéria byla vybrána podle norem kvality ISO / IEC 25010 a mnoha funkcí z obchodních perspektiv webových stránek. Pro analýzu, porovnání a vyhodnocení byly vybrány čtyři systémy pro správu obsahu (CMS) (Modx, Drupal, Joomla a WordPress), které jsou dnes populární. Na základě výsledků výzkumu byl WordPress označen jako nejvhodnější CMS.

Dílčím cílem práce je srovnání různých návrhových přístupů, implementace webové prezentace pomocí CMS a praxe manuálního kódování. První webová stránka byla vytvořena pomocí vybraného CMS a v posledních částech byla vytvořena druhá webová stránka manuálním kódováním (HTML5, CSS3, JavaScript a PHP) pro analýzu detailů, a výsledky byly shrnuty. Webové stránky byly hostovány na skutečné doméně poskytované poskytovatelem webhostingu. Tato práce pokrývá hlavní oblasti návrhu a implementace webových aplikací postavených v CMS. Výzkum dospěl k závěru, že všechny čtyři CMS jsou výkonnými nástroji pro správu webových stránek. Tyto nástroje mají různé funkce a schopnosti založené na různých scénářích, díky nimž je jedna z těchto čtyř možností CMS ideální pro klíčové webové funkce.

Klíčová slova: CMS, open source, CMS srovnání, PHP, MODx, Joomla, Drupal a WordPress.

Summary

The diploma thesis primary objective is to analyse and evaluate of open source web content management systems (WCMSs) based on approaches of design and implementation methods. These methods were evaluated using decision making scoring (Multiple Attribute Decision Making - MADM) and criteria are chosen according to ISO/IEC 25010 quality standards and many features from the website's business perspectives. For the analysis, comparison and evaluation, four content management systems (CMSs) were chosen (Modx, Drupal, Joomla and WordPress) which are popular nowadays. Based on the research results, WordPress was indicated as the most suitable CMSs.

Partial objectives of the thesis are to compare different design approaches, implementation of web presentation using CMS and practices of manual coding. First website was built using the selected CMS and in the last sections, the second website was built by manual coding (HTML5, CSS3, JavaScript and PHP) to analyse the details and results were summarized. The website was hosted on a real domain supplied by the web hosting provider. This work covered major areas of design and implementation of web application built in CMS. The research concludes that all four CMSs are powerful tools to manage the websites. These tools have different functionalities and capabilities based on diverse scenarios which make one of these four CMS options a perfect fit for the key web functionalities.

Keywords**:** CMS, Open Source, CMS Comparison, PHP, MODX, Joomla, Drupal and WordPress.

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1 Introduction

The recent advancements in web technologies have rapidly changed our life in several ways. With these advancements, many companies and individuals have instigated to present and propagate themselves on the web.

Content management systems (CMS) has evolved as a valuable tool in order to manage the website to ease the dissemination of information to the visitors. It is based on the modules rather than code so anyone can handle a CMS as it does not require coding knowledge.

Nowadays, it is easy to find many content management systems available for free, open-source, easily maintainable and the usage of these systems is still increasing, and growth remains stable at recent days.

According to data from Internet Live Stats - Internet Usage (1) and Netcraft web server survey (2), there are over 1 billion websites online today. That's about one website for every seven people in the world. It is really a vast number of websites, but does this mean that every 7th people in the world used CMS?

Regarding this matter, following questions come to mind: Do we need a web content management system (WCMS)? Is the old system (manual coding) of updating a file manually and uploading it to the server good enough for today's web programmers and developers?

Based on the analysis of CMS usage, 46.9 % of the websites were created by using content management systems and 53.1 % were created without it, so from the survey's results, it is noticed that the number of sites created by using CMSs is less than the other (manual coding) which led to the need for analysis and comparison of creating the websites using CMS and hand-coding as well.

The diploma thesis demonstrates creation of a website in two ways, the first one is using CMS and the second is by using manual coding. The purpose of the site is medical tourism which provide and introduces information about health and treatment in addition to present Czech culture, sightseeing and most famous tourist places to the visitors.

2 Objectives and Methodology

2.1 Objectives

The website is very important tool for online communication today. It is a universal way how to connect with the world. This work is trying to highlight how CMS can assist to all users and developers intending to build a website and explains the challenges that are likely to be faced when using an open source CMS.

The main objective of the thesis is to create an online web presentation based on analysis of chosen content management systems.

Partial objectives of the thesis are such as the following:

Firstly, literature overview of the relevant theories will be created to describe the current web design technologies and web development processes.

Secondly, main open source content management systems will be analysed by using quality estimation methods and Multiple Attribute Decision Making (MADM) Models.

Finally, different approaches to design and implementation of web presentation will be compared in terms of design approaches, implementation of web presentation using CMS and practices of manual coding.

2.2 Methodologies

The methodology of the research is based on study and analysis of specialized information sources. Approaches of design and implementation methods will be evaluated by Multiple Attribute Decision Making model with a finite number of alternatives. The hand coded version of the website will be created with an open source CMS that will be evaluated as the best according to MADM. Based on a synthesis of theoretical knowledge and the results of own solutions the conclusion of the thesis will be formulated. The methodology of the thesis will be taken based on the following phases.

Phase 1: Identification and analysis of the last versions of selected CMSs such as such as Modx 2.5.2, Drupal 8.2.2, Joomla 3.6.5 and WordPress 4.7.1. The Evaluation and testing of the CMSs will be done using the quality standard ISO/IEC 25010.

Phase 2: Methods for the decision making will be done using Multiple Attribute Decision Making model that explicitly evaluates multiple conflicting criteria in decision making.

Phase 3: Development and creation of a website with the help of appropriate CMS by using elements of modern web design and development technique.

Phase 4: Development and creation of a website by manual coding using HTML5, CSS3, JavaScript and developer tools. All implementation and testing were done on a local computer: Sony VAIO DUO 13 SVD1321M2E. A real domain name was obtained from web hosting provider.

3 Literature Review

The literature review gives us a fair understanding of content management system, their classifications, their benefits, core functionalities, underlying technologies, communication protocols and their practical implementation.

This chapter describes general structure of client-server architecture and some fundamental knowledge of Web technology. This information is useful to understand website creation and its operation.

3.1 Internet and World Wide Web concepts

The usage of the Internet these days has become an integral part of every individual in daily life. ‘‘The Internet is a worldwide collection of networks that links millions of businesses, government agencies, educational institutions, and individuals. It was originated as ARPANET in September 1969’’ (4 p. 4). The World Wide Web (commonly known as the web) “is not synonymous with the internet but is the most prominent part of the internet that can be defined as a techno-social system to interact humans based on technological networks” (6). It is the network of pages of images, texts and sounds on the Internet which can be viewed using browser software. W3C (1) was conceived in 1990 at CERN (2), the European Particle Physics Laboratory in Geneva. It came into existence as a proposal, to allow researchers to work together effectively and efficiently at CERN. ‘‘The Internet is the interconnected network of devices (computers, mobile phones, tablets, routers, modems etc.), while the Web is the subset of the Internet that is usually reachable via the protocols HTTP (3) or HTTPS (4) and is generally seen in a browser” (5),

"Web 1.0 as a web of cognition, web 2.0 as a web of communication, web 3.0 as a web of co-operation and web 4.0 as a web of integration"(58) was introduced such as fourth generation of the web since the advent of the web. The following diagram briefly defines evolution of World Wide Web:

(1) W3C: stands for World Wide Web Consortium

(2) CERN: derived from the name Conseil Européen pour la Recherche. It is a European research organization which is one of the world's largest and most respected centres for scientific research.

(3) HTTP: stands for Hypertext Transfer Protocol is is an application protocol used to transfer data over the web.

(4) HTTPS stands for Hypertext Transfer Protocol Secure which create a secure encrypted connection between the server and the browser.

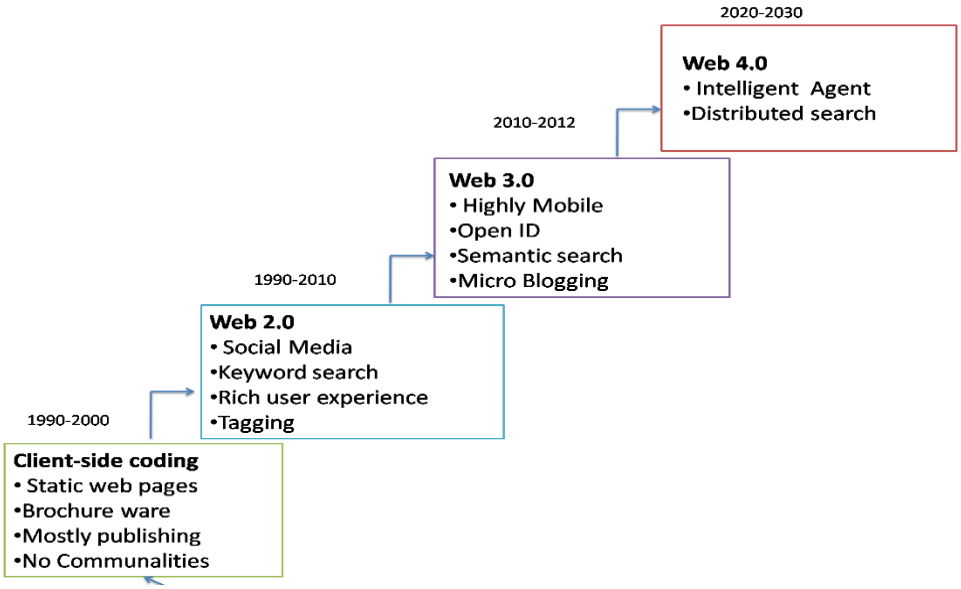

Figure 1 WEB Evolution. Source: self-authored and adapted from (WWW - Wikipedia)

3.2 Website vs. Web Application

A document which can be displayed in a web browser often called "web pages" or just "pages." (7) It is a plain text file that contains not only text, but also a set of HTML [(5)] tags that describe how the text should be formatted when a browser displays it on the screen. The tags are simple instructions that tell the Web browser how the page should look when it is displayed. Web pages also known as website which contains multiple interconnected pages from a single web address, published on at least one web server managed by its owner that can be an individual, company or an organization. “All publicly accessible websites collectively constitute the World Wide Web, while private websites, such as a company's website for its employees, are typically a part of an intranet.” (62).

Web application is the part of website. It defined as "a client–server software application in which the client (or user interface) runs in a web browser". Web application functions and tasks are much higher and complex than website. Commonly, "web applications use a combination of server-side script (ASP [(6)], PHP [(7)], etc) and client-side script (HTML, JavaScript, etc.) to develop the application." (61) We can say that website is a source of information while web application works interactively.

(5) HTML: stands for Hypertext Markup Language used for creating Web pages.
(6) ASP: stands for Active Server Pages, it is a development framework for building web pages.
(7) PHP: originally stood for Personal Home Page, but it now stands for Hypertext Preprocessor.which is a web scripting language.

3.3 Web Browser vs. Web Server

Web browser act as an interface between the user and the web server. The most popular web browsers are Google Chrome, Microsoft Edge Internet Explorer, Safari, Opera and Firefox (9) The web browser is an application software that is installed on a computer to provide access to the World Wide Web. It fetches the web pages from the server along with the necessary files like, images, flashes, videos and other files, then interprets and displays them on the screen. “Every page and resource on the Web has its own special address called a URL (8)” (9 p. 42) The browser finds the IP address of the web server and bring the web page on the user screen. Several processes done during this tow steps starting from the communications between the inputs of user interface and the rendering engine which is done by the browser engine, then displaying of the requested content on the screen which is done by Rendering Engine. The files like cache, cookies are stored in the database of the local drive of the computer where the browser is installed. The widgets on the browser like combo boxes, windows are drawn by user interface backend. Figure 2 shows the Browser components.

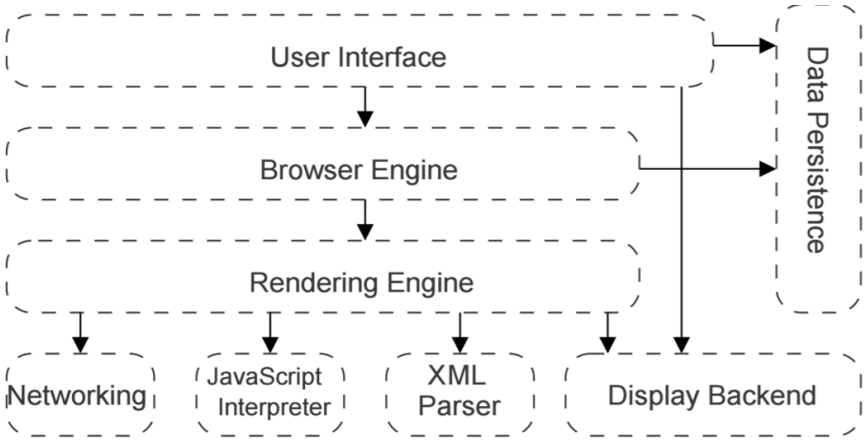

Figure 2 Browser components. Source (10)

To understand how web browser works, it is necessary to know the basic concepts of the components of web browser:

- User Interface is space where interaction between users and the browser occurs.
- Browser Engine is responsible for querying and manipulating the rendering engine.
- Rendering Engine is responsible for displaying the requested content on the screen.

(8) URL: stands forUniversal Resource Locator which is a reference to a web resource.

- Networking is responsible to send various network calls. For example, sending the http requests to the server.
- JavaScript Interpreter interpret the JavaScript code presented in a web page.
- Data Persistence store various files like cache, cookies, etc.
- An XML [9] Parser designed to parses XML documents into a DOM [10] structure. This component is different from the HTML parser and is a generic, reusable component. The HTML parser on the other hand, is optimized for performance and tightly coupled with the rendering engine.'' (65)
- Display Backend subsystem provides drawing and windowing primitives, set of user interface widgets and fonts. It tied closely with the operating system (10).

Web server is a piece of computer software that can respond to a browser's request for a page, and deliver the page to the web browser through the Internet. ''It allows to handle Hypertext Transfer Protocol transactions. Web servers are also called "HTTP servers." […] There are many server software options out there, but the two most popular are Apache (open source software) and Microsoft Internet Information Services (IIS).'' (9 p. 40) Every day, there are millions of web servers delivering pages to the browsers through the Internet. Figure 3 shows the tope web server for December 2016. Based on Netcraft survey which received responses from more than million sites and web-facing computers (2).

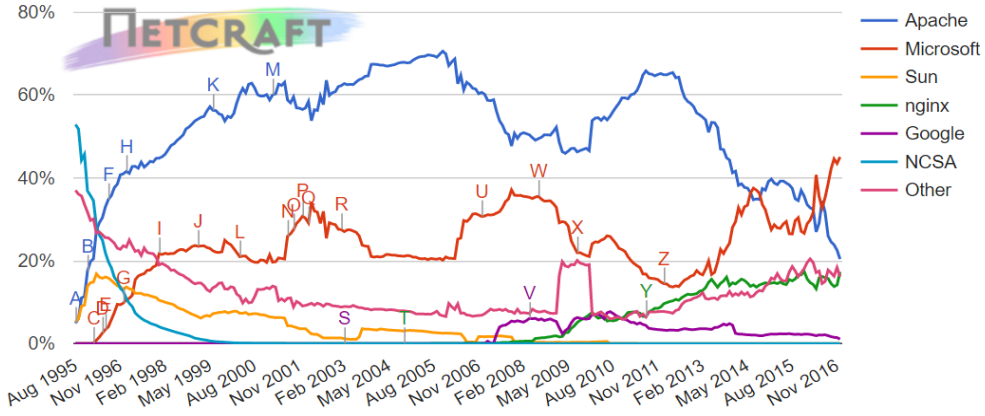

Figure 3 Web server market share of all sites, source (2)

In order to store the page in the server, it is needed to pay rent on the space pages that live in this server which can be displayed and viewed by anyone over the world. The owner is called ''host'', and the rent is usually called the hosting charges.

(9) XML stands for EXtensible Markup Language which designed to store and transport data.
(10) Document Object Model (DOM) is a programming API for HTML and XML documents.

3.4 Web design vs. web development.

Web design is a similar process of creation a web page's appearance that encompasses myriad skills and disciplines in the production and maintenance of websites that all have to work together such as sitemap and wireframe creation, webpage graphic and typography design, webpage layout, content production, interface design, authoring, including standardised code and proprietary software, UED [11], SEO [12], RWD [13] and many other aspects of design process (12). Web designing deals with the customer-facing such as division of the page, the color, the location and shape styles etc. Web designers use various programing languages and tools such as HTML, CSS, JavaScript and Adobe Photoshop or any graphical program to create the layout and other visual elements of the website.

Web development governs all the code that is responsible for determining how the website will display. It can be split into two categories, front-end and back-end. The architecture for the web development refers to building website and deploying on the web. It requires use of scripting languages both at the server end as well as at client end. Figure 4 shows web development scripting languages.

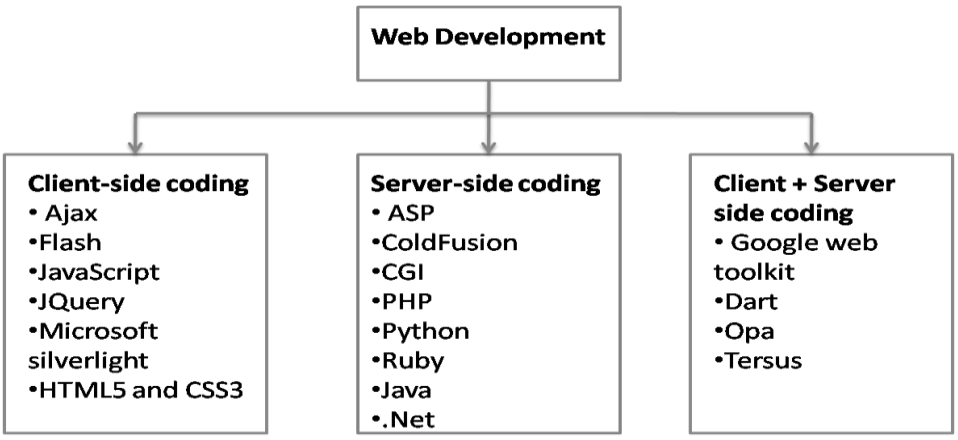

Figure 4 web development scripting languages. Source: (11)

Web development may include web engineering, web content development, client-side/server-side scripting and e-commerce development. Before developing a website, should keep several aspects in mind like the website content, hosting, ways to make it interactive, website load, search engine friendly in addition to answer the following:

- How to code it and to secure the code frequently?

(11) UED: stands for User experience design which is the process of enhancing user satisfaction with a product

(12) SEO: stands for Search Engine Optimization

(13) RWD: stands for Responsive web design which is an approach to makes web pages render well on a variety of devices

- Will the web site design display well in different browsers?
- Will the navigation menus be easy to use?
- How easily will visitors find vital details specific to the web site?
- How effectively the style sheets be used on your web sites? (11)

3.5 Web architecture

One of the trends in the design and planning of websites is the website architecture which include technical, aesthetic and functional criteria. Web Architecture focuses on the foundation technologies and principles which help to design technologies "by providing guidance and articulating the issues around some specific choices" (13) and sustain the Web, "including client and server site architecture" (11). " As in traditional architecture, the focus is on the user and on user requirements"(14). The server and client speak the standardized language of the World Wide Web. The website is modelled as a set of services that are provided by servers and a set of clients that use these services. Everything user see, click, and interact with on a website is the work of front-end web development while the communication between server, application, and database is the work of back-end. For more details, next sections will explain the client-side scripting and server-side scripting and the difference between them. Figure 5 shows client/server-side scripting processes.

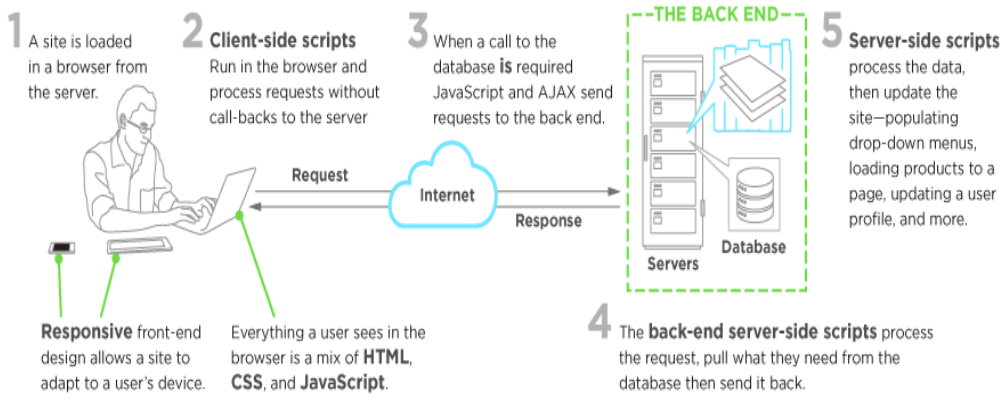

Figure 5 Client/server-side scripting processes. Source (17)

3.5.1 Client-side Scripting

It is computer programming executed by the user's web browser. The processing takes place on the end users computer. This type of computer programming enabling web pages to be scripted. Client-side scripts are often embedded within an HTML document

which provide response to questions and queries without interventions from the server. HTML supplies documents' content and structure, CSS provides presentation, while JavaScript controls browsers actions which is used in combination with other Web constructs to make Web pages more dynamic and more responsive. The combination of HTML, JavaScript, CSS and the DOM [14] is commonly referred to as Dynamic HTML (DHTML) which controls the dynamic behaviour of a Web application within the browser. The client-side execution context runs JavaScript code, which has access to the page's HTML tree and contents through the DOM (27) which constructed as a tree of objects. The browser provided features and APIs [15] as well to enable navigation of the page, remote communication, interacting with the client device, and storing information at the client side. Client-side frameworks and scripting languages provide a remote service for the web applications, such as software registration, content delivery as well as giving developers the possibility to write code that can be executed by the browser (18) using the newest technology.

3.5.2 Server – side Scripting

Server-side Scripting is written code that runs on the server, using languages supported by the server. The current most popular are Java, PHP, C#, ASP, Python and Ruby that consider as a technique used in web development, that involves embedding scripts, which results in a user's (client's) request to the server website being handled by a script running server-side, before the server responds to the client's request. The client only ever sees the final HTML generated by the script and not the script itself. Scripts often finish running in several milliseconds. Most web servers can run many scripts simultaneously with a minimal performance hit. The obvious situations to use server-side scripting may fall into three categories, the first one is for creating a web-interface for interfacing with the databases. the second is for controlling or monitoring external hardware. and the third one is for content management systems for creating a web site to setup a system for uploading and storing the contents and generate the web pages on the database (28).

(14) DOM: stand for Document Object Model
(15) API: stands for Application program interface

3.6 Information Architecture

‘‘The structural design of shared information environments and the combination of organization, labelling, search, and navigation systems within web sites and intranets.” (19 p. 4). It is the Tasks and exercises that balance the needs and goals of the business organization, site and intended audience, to deliver a roadmap on how a website’s information should be presented. Information includes: content, navigation and labelling. It is important to understand the business goals behind the web site, who the intended audience is and how they will interact with the information on the site, in addition to organizing the information and creating a structure for the site to support the information. We need to be aware of ‘‘the nature and volume of content that exists […] also we must learn about the needs and information-seeking behaviours’’ (19 p 47). Valuable information architecture design is informed by three areas: content, context and user. Figure 6 shows the infamous three circles of information architecture

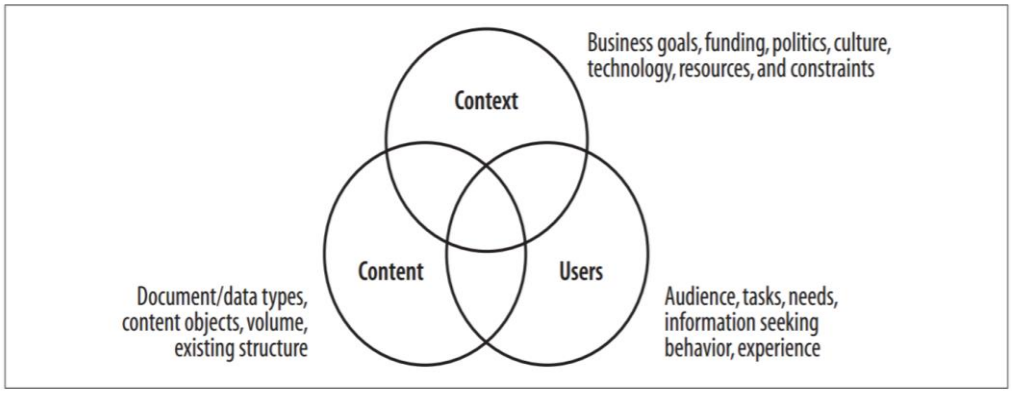

Figure 6 The infamous three circles of information architecture source (19 p.47)

3.7 Web coding conventions

Coding conventions are defined as "a set of guidelines for a specific programming language that recommend programming style, practices, and methods for each aspect of a program written in that language" (16). Getting the syntax right, and making sure that the code runs. Because the code won’t be read only by the author but also by other programmers in the future, so when writing the code, should also consider the following:

- Making the code easy to read
- Adding comments
- Module header comments
- Choosing speaking names
- Keeping clear and consistent interfaces

- Using files to group functions (15 p. 7-24)

3.8 Web development Technologies and Languages

3.8.1 HTML

Short for Hypertext Mark-up Language, HTML is an application conforming to International Standard ISO 8879 which started as a small application of SGML [(16)]. It is the authoring language used to create documents that describe web pages (Static Web Page). First developed by Tim Berners-Lee in 1990. HTML elements are the building blocks of HTML pages. With HTML constructs, images, lists, tables and other objects for presenting text, such as interactive forms, may be embedded into the rendered page document. (10 p. 58-61) An element comes with two important properties, attributes and content.

HTML tags are keywords surrounded by angle brackets like <html>, The first tag in a pair is the start tag (opening tags), the second tag is the end tag (closing tags).

HTML5 was published on October 2014 and HTML 5.1 was published on 21 June 2016, it is the last versions come with new features such as is capable of handling inaccurate syntax, using new structures such as drag, drop and much more. (20)

3.8.2 CSS

The web design today is unthinkable without Cascading Style Sheets (CSS). CSS is used to control the style and layout of web pages. It is a style sheet language used for describing the presentation of a document written in a mark-up language. CSS3 is the latest standard for CSS and aims at extending CSS2.1. ‘‘It brings a lot of long-awaited novelties, like rounded corners, shadows, gradients, transitions or animations, as well as new layouts like multi-columns, flexible box or grid layouts’’ (21).

3.8.3 JavaScript

A recent w3techs survey (64) shows that close to 94 % of the top 10 million websites of the Web use JavaScript. JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities. (22)

SGML :(16) stands for standard Generalized Markup Language

Though JavaScript and ECMAScript [17] are often used synonymously, JavaScript is much more than just what is defined in ECMA [18] Indeed, a complete JavaScript implementation is made up of the following three distinct parts (see Figure 7): The Core (ECMAScript) The Document Object Model (DOM) The Browser Object Model (BOM) (23 p. 3).

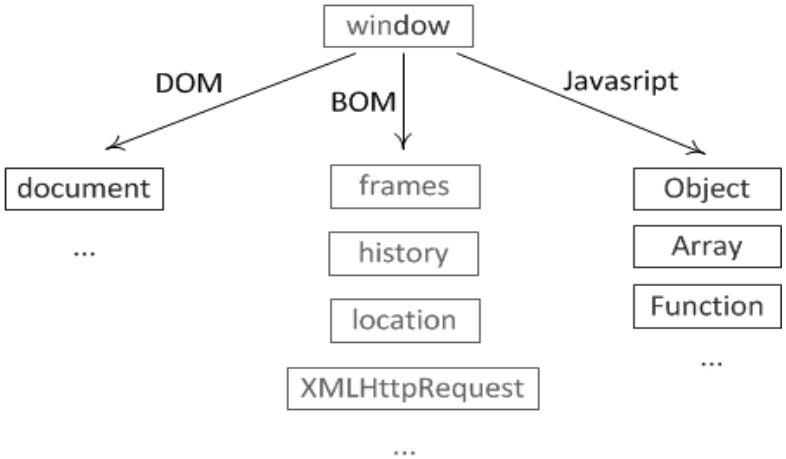

Figure 7 JavaScript. Source (24)

3.8.4 JavaScript Library (jQuery, React)

- jQuery: A fast, small, JS, cross-platform JavaScript library designed to simplify the client-side scripting of HTML and to streamlines how JavaScript behaves across different browsers. (31)
- React (sometimes styled React.js) is a JavaScript library for building user interfaces. It is maintained by Facebook, Instagram and a community of individual developers and corporations. (32)

3.8.5 Web Framework (Bootstrap)

- Bootstrap: A mobile-first framework for creating web and user interface components which uses HTML, CSS, and JavaScript to facilitate rapid responsive app development.

(17) ECMAScript is a scripting languages.
(18) ECMA standards for European Computer Manufacturer's

3.8.6 AJAX

In recent years, web developers have begun to make major investments in AJAX which stands for Asynchronous JavaScript and XML. It is an important front-end web technology that lets JavaScript communicate with a web server. Jerry Lee Ford defined AJAX as ‘‘a collection of web development technologies that can be used to create web applications that provide levels of responsiveness previously unheard of.” (63) As a result, when combined with high-speed internet connections, AJAX can be used to develop web applications that behave and respond like desktop applications. It considers as a way for JavaScript to request data from a server without refreshing the page or blocking the application.

3.8.7 Database

A database is an organized collection of data (25), it is a separate application to store a collection of data, so that it can be easily accessed, managed and updated. Data stored in tables that are associated by shared attributes (keys). Database is the collection of schemas, tables, queries, reports, views, and other objects.

3.8.7.1 Database Management Systems (DBMS)

A database management system "is system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data" (26).

Each data management system uses a database model to sort logically managed data. These forms (or species) are the first and most crucial step in how databases are implemented and how they handle and manage information.

3.8.7.2 Relational Database Management Systems (RDBMS)

A relational database management system is a program that lets to create, update, and administer a relational database. An important feature of relational systems is that a single database can be spread across several tables. Most commercial RDBMS's use the Structured Query Language (SQL) to access the database.

3.8.7.3 MySQL

MySQL is the most popular Open Source Relational SQL database management system and one of the best RDBMS being used for developing web-based software

applications. It is portable and runs on commercial operating systems (such as Mac OS X, HP-UX and Windows) and on hardware all the way up to enterprise servers.

3.9 Introduction of Web content management system

Nowadays, we know that how we can create our own documents and publish it on the web. But if we go back fifteen or more years, the only way one could create a website was by understanding 'HTML'. This meant that if we wanted to build a website then we needed someone with technical skills to develop it by manual coding or with the help of web Developing tool such as Dreamweaver or MS FrontPage. Also, once they had written it, one still needed someone with technical skills to change it, as changes involved reading HTML code to determine where to add content (33). CMS is a software package which stands for Content Management System. It is a term which can have several meanings and is not endorsed with a fixed definition. These meanings of WCMS are quite different depending on the website scenarios which provide description of the website and how the CMS will be used, project objectives and outcomes which need to be achieved. To define WCMS, firstly, a definition of the content management system (CMS) should be provided. Website consists of two main parts, the design and the programming. Design is the shape of the interface, the design of the component and color for the pages etc. and programming manages the site content and organizes the mechanisms of how the work will be done, this is the primary partition of any site. This chapter aims to give an overview of WCMS and its instruments. It will explain WCMS based theory which supports making of the website. It includes the basic concept and general-purpose of Web CMSs.

- **Content**

Content is the information directed towards the end-users. It can define as "data produced through editorial process and ultimately intended for human consumption via publication" [...] It is the content we create for a specific purpose" (34 p. 8-10). The content on the World Wide Web consists of HTML, XML, and other documents. ''Users need to be able to find content before they can use it—findability precedes'' (19 p. 239).

- **Content Management**

''For as long as humans have been creating content, we've been searching for solutions to manage it.'' (5p. 34) Management is the act or manner of managing, handling, direction a series of process or steps taken in order to achieve a storing the content in the sit. The content may take the form of text (such as electronic documents), multimedia files (such

as audio or video files), or any other file type that follows a content lifecycle requiring management. This content is stored in the CMS, sitting in a database. Content management, is a set of processes consists of the following basic roles and responsibilities:

- Responsibility for creating and editing content.
- Responsibility for releasing the content for use.
- Responsibility for managing access permissions to folders and files.
- Responsibility for tuning the content message and the style of delivery, including translation and localization. (35).

- **Content Management System**

CMS comes with purpose of simplifying web publishing and separating the site content from the site design. Usually we called the programming site as (content management system) and using the term (CMS) to denote it, and sometimes add a word (Web) at the beginning to indicate that it is special for the Internet sites and not any other content. So, we can use the term WCMS which is a system responsible for the management of the site in all its aspects that provides a simple interface for an average user to be able to manage both site and content, and to use the tools and programming languages and frameworks such as PHP, Asp.net or other programming languages. The design tools are used to other languages such as HTML and CSS for the preparation and processing of storefront exterior shape.

Deane Barker defined Content Management System as "a software package that provides some level of automation to the tasks required to effectively manage content [...] A CMS allows editors to create additional content, edit existing content, perform editorial processes on content, and ultimately make that content available to other people to consume it." (34 p.1). Other definition of CMS ''is a software system that provides website authoring, collaboration, and administration tools designed to allow users with little knowledge of web programming languages or mark-up languages to create and manage website content with relative ease. A robust Web Content Management System provides the foundation for collaboration, offering users the ability to manage documents and output for multiple author editing and participation.'' (36). CMS can be ''extended, it means that it can be added new features and functions'' (45). It means CMS is a dynamic system. CMS Provides the user to do the following:

- Manage page content (add/edit/delete/activate)
- Upload files, images and media to a site library

- Control the design of the site (templates, stylesheets, skins)
- Set up user access and notifications
- Define search engine keywords and other page meta information
- Advanced functionality, in the form of galleries, widgets, plugins, or some way to add new features (37)

- **Content Management System categories**

Nowadays there are hundreds of CMSs, because of the continued dramatic growth in content management systems (CMSs), it is importantly, to Know understand exactly the various categories of CMS tools and what they do. Sean Mooney and Peter Baenziger describe the major categories of CMS (66) as the following: CMSs can be categorized into the following categories

- Document management systems: used to track, manage and store documents. Often includes version control.
- Groupware: designed to help for managing collaborative projects involving a common task to achieve special goals in groups or teams. Can include mailing lists, calendars, contact lists and group-based content access control.
- Forums: to discussion thread management and to allow visitors to communicate with each other by posting messages.
- e-Commerce: Management of online sales and customers.
- e-Learning: Management of curriculum materials and courses, often called learning management systems (LMS)
- Image galleries: Management of image galleries
- Wikis Collaboratively developed webpages and related content
- Portals: Traditional CMS tools that manage basic web portals, and often support some of the features above. Open Source vs. Closed Source

open source defined as a software that its source code made ‘‘available with a license in which the copyright holder provides the rights’’ (38 p,4) to distribute the software to anyone and for any purpose (39). It doesn't involve any fees to use the platform and it is created and maintained by a community of developers who support the open source concept. The source code is visible for all users and it can be modified for the own needs. In terms of CMS, open source CMS applications are flexible and can fit the needs of many businesses,

but it can be ‘‘vulnerable to security issues’’ (40), especially if plug-ins and modules are not updated.

A closed source means "computer programs whose source code is not published"(41). The source code is not shared with the public for anyone to look at or change, in terms of CMS, close source software is more expensive to use, and this type of software is proprietary, so it has high security and users can receive ongoing, personalized support to help troubleshoot any problems

3.9.1 How CMSs work?

A CMS used to manage content, including web content, images, audio files, etc used for storing, controlling, versioning and publishing websites. Figure 8 show how CMS works.

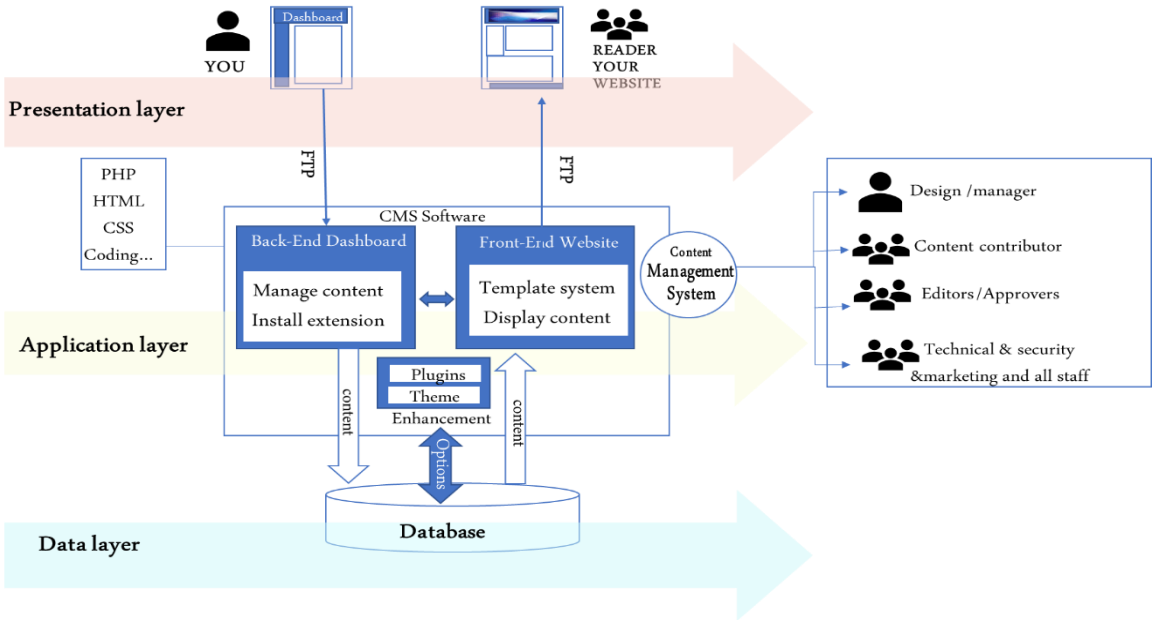

Figure 8 How CMS works? source author and adopted from source (42)

User send request to the server with the domain name of the CMS through the internet. Server send the CMS Backend interface to the user which will be running on in the user computer (Web browser). User insert the content, update or delete and manage the website through admin panel and store the data on the database. The final webpage will be published on the internet as front-end interface.

3.10 The Web Design and Development Process

Designing and development of a truly interactive website is a time taking process. Several steps for explanation the web design and development process, the basic approach, and the details of these concepts will be presented throughout the remaining chapters.

3.10.1 Information Gathering

The first step in designing a successful web site is to gather information. Many things need to be taken into consideration when the look and feel of the site is created.

This first step is the most important one, as it involves a solid understanding of the company it is created for. It involves a good understanding of what the business goals and how the web can be utilized to help to achieve those goals. It is also important to start asking a lot of questions to understand the business and functional requirements needed for the web site. Purpose, goals, Target audience, and content is certain things to be considered. (42)

- Purpose: What is the purpose of the site? Dose user want to provide information, promote a service, sell a product?
- Goals**:** What is the goal by building this web site?
- Target Audience**:** Target audience is the intended audience or readership that will help to reach the goals.
- Content**:** What kind of information will the target audience be looking for on the site?

3.10.2 Planning

Web plan fit the needs and situation. Design a sitemap is crucial step in the planning process, it is a list of all the topics the website is supposed to cover, as well as the likely placement – or navigation – for each area of content. The sitemap acts as a guide throughout the web design process. (44)

3.10.3 Design

Design, is the practice of planning and projecting ideas and experiences with visual and textual content. During designing stage, these elements should be considered:

- The Business process while designing website layout.
- Fonts, color scheme and graphics used, and usability.

- SEO Friendly Architecture and Overall Look and feel.

3.10.4 Development

This step requires a lot of involvement and it is time consuming part of the website building process. Development involves creation and coding of all webpages, programming site functionalities and its features, hosting account setup and site deployment. Many things must be taken into consideration such as, what development technology will be used, and does it contain all required functionalities? in addition to the proper internal linking, navigation and so on.

3.10.5 Testing and Delivery

Testing is process of validating and verifying that the website meets the business and technical requirements that guided its design and development. It is the next step after the development. Web design and development experts check all the customization and functionalities so, they check all the images, videos, visual effects, internal linking and content of website. After doing proper quality analysis, the site will be deliver to the client.

3.10.6 Maintenance of Website

Websites are living, breathing entities and need constant care and maintenance. Update old content, making changes to the backend and fixing broken links. Improve and upgrade features. Sites must be updated regularly to keep the content fresh and up-to-date. Also, some functions may be improved upon by advances in types of coding, so those get replaced and retested.

3.11 Multiple Criteria Decision-Making Methods.

Multiple attribute decision making (MADM) is an important part of modern decision science, it is one of the most common and popular research fields in the theory of decision science. (46) "It can be quite difficult for decision makers to make the "best" choice"(47 p. 7). Figure 9 shows the concepts of MADM.

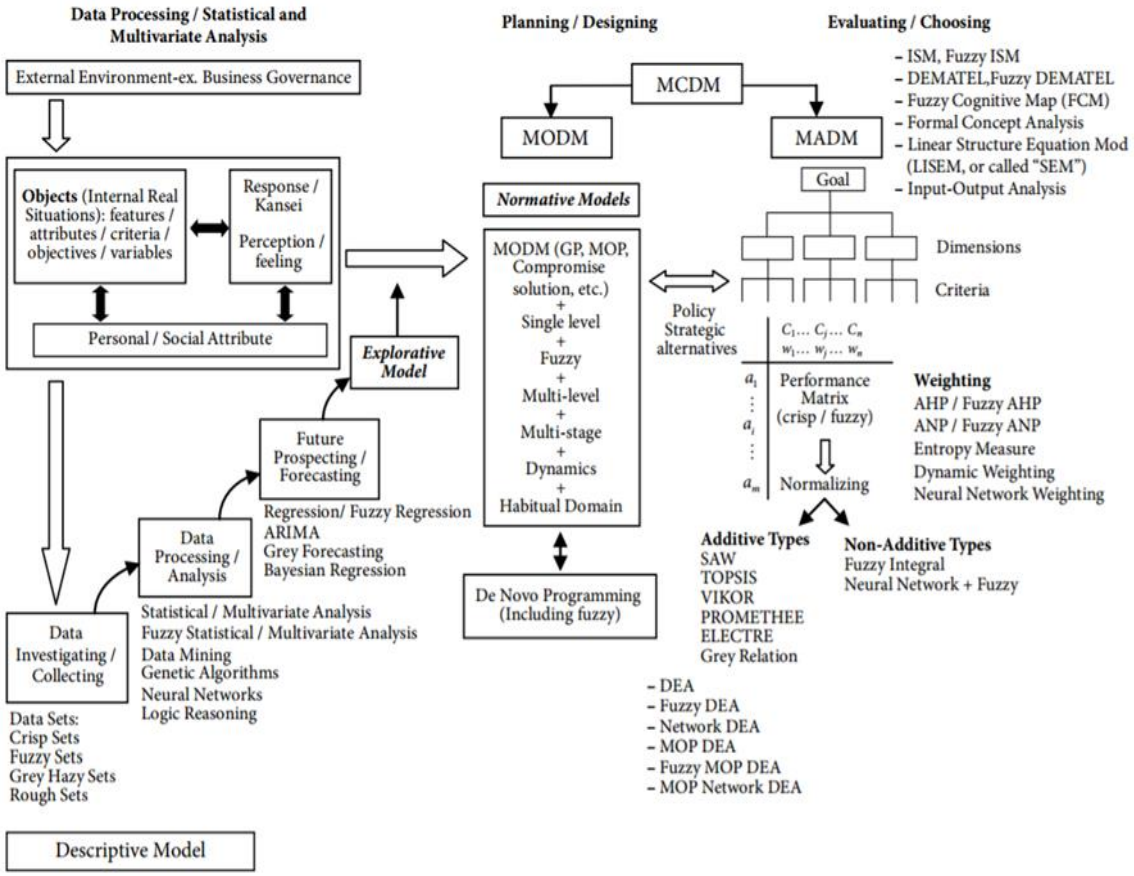

Figure 9 The basic concepts of multiple attribute decision making. Source (48 p. 674)

The super class of models is called multi-criteria decision making or(MCDM). According to many authors. MCDM is divided into Multi-Objective Decision Making or (MODM) and Multi-Attribute Decision Making or (MADM).

3.11.1 Alternatives

Alternatives represent the different choices of action available to the decision maker. Usually, the set of alternatives are assumed to be finite, ranging from several to hundreds. They are supposed to be screened, prioritized and eventually ranked.

3.11.2 Multiple attributes

Each MADM problem is associated with multiple attributes. Attributes are also referred to as "goals" or "decision. The attributes are a tool to evaluate alternatives. Each alternative can be described according to several attributes. Figure 10 shows the hierarchical of the attributes and Alternatives.

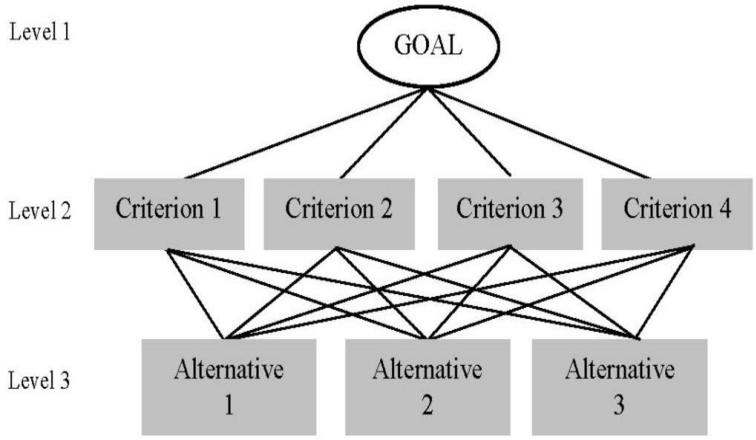

Figure 10 hierarchical of MADM source (49)

MADM is having a structure consisting of multiple levels. Some attributes are major attributes. Each major attribute may be associated with several sub-attributes. Similarly, each sub-attribute may be associated with several sub-sub-attributes and so on. (50)

3.11.3 Decision weights and matrix

Most of the MADM methods require that the attributes be assigned weights of importance. Usually, these weights are normalized to add up to one. (50 p.2)

An MADM problem can be easily expressed in matrix format. ‘‘A decision matrix A is an (M × N) matrix in which element aij indicates the performance of alternative Ai when it is evaluated in terms of decision criterion Cj, (for i =1,2, 3..., M, and j = 1,2, 3..., N)’ (50 p.3), figure 11 shows decision matrix.

	Criteria				
	C_1	C_2	C_3	...	C_N
Alt.	W_1	W_2	W_3	...	W_N
A_1	a_{11}	a_{12}	a_{13}	...	a_{1N}
A_2	a_{21}	a_{22}	a_{23}	...	a_{2N}
A_3	a_{31}	a_{32}	a_{33}	...	a_{3N}
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
A_M	a_{M1}	a_{M2}	a_{M3}	...	a_{MN}

Figure 11 Decision Matrix source (50 p. 2)

4 Practical Part

After providing an overview of the web content management systems and understanding all aspects related to the theoretical part, the practical part of the research was done based on the study and analysis of specialized information sources. For own solution, an open source CMS was used. Approaches of design and implementation methods were evaluated. Based on the analysis of the chosen content management systems, Business website was created which contains main characteristics of the modern design and its principles. Creating The site explained the steps and facilities that used by the chosen CMS to manage the content. As an extension of practical analysis, another website was created by using manual coding to compare different approaches to design and implementation of web presentation. This comparison illustrated other aspects as an analytical destination and the importance of using the content management systems for non-developer and developers as well.

The first part of the research is to choose four CMS to make general comprehensive analysis then choose one of them to create the business site. Choosing a content management system can be tricky without a clearly defined set of requirements and needs. So, the choice of the CMSs was done by decision-making and the method of scoring to compare a variety of CMSs and for this reason we need to incorporate Multi Attribute Decision Making (MCDM) Models to choose a suitable CMSs. Authored divided the practical part to many parts:

In the first part, there is the description and analysis CMSs that was considered.

In the second part, there is the definition of decision-making methods, process and classification which was used for selection of the optimal CMS.

In the third part, there is the presentation of the development process and the modern design requirements of the website by using the selected CMS.

In fourth part, there is the presentation of the of the website by designing and developing the website using developer tools and there is comparison between using CMS and manual coding.

In last part, there is conclusions and recommendations.

4.1 Analysis and Description

In this chapter, we describe and evaluate different open source web content management systems (WCMSs) based on many criteria from the perspective of site owner.

Four WCMS (Modx, Drupal, Joomla and WordPress) were taken for a detailed consideration. One of them was chosen for building the website.

All CMSs which were chosen are modern software, but their roots and development go back to many years. Appendix 1 shows the generations and versions of the chosen CMSs, WordPress 4.7.3 was released in March 2017. Author used the latest versions such as Modx 2.5.2 Drupal 8.2.2, Joomla 3.6.5 and WordPress 4.7.1. These are three widely used CMSs.

Depending on the year of release, we can see that Drupal is older than the other CMSs which was released in 2001 by Dries Buytaert, WordPress was released by Matt Mullenweg in 2003, Modx was released in 2004 by Raymond Irving and Ryan Thrash and the initial release of Joomla was introduced in August 17, 2005.

4.1.1 Web content management systems descriptions

Modx, Drupal, Joomla and WordPress all of them are an online, open source website development tools. They are available to the public for use and/or modification, so basic functions can be continuously enhanced with an ever-expanding array of add-ons, contributed from their respective communities.

Modx, Drupal, Joomla and WordPress, all of them are basically meant to do the same thing – to help for creation and managing the website. Although all of them have a lot in common, but they still have their own pros, cons and characteristics. Table1 shows the characteristics of Modx, Drupal, Joomla and WordPress.

Table 1 - Characteristics of Modx, Drupal, Joomla and WordPress! CMS. Source: author

CMS / Category	Modx	Drupal	Joomla	WordPress
Developer(s)	MODX LLC	The Drupal Project Team	The Joomla Project Team	WordPress Foundation
Initial release	2004; 12 years ago	May 18, 2000; 16 years ago	August 17, 2005; 11 years ago	May 27, 2003; 13 years ago
Written in	PHP	PHP, using Symfony	PHP	PHP
Operating system	Cross-platform	Unix-like, Windows	Cross-platform	Unix-like, Windows
Type	Content Management System	Content management framework, Content management system, Community and Blog software	Content management Framework, Content management system	Blog software, Content Management System, Content Management Framework

License	GPL	GPLv2	GNU General Public License	GNU GPLv2+ Proprietary (for web hosting)
Website	modx.com	www.drupal.org	www.joomla.org	wordpress.org

For more details, a more thorough description is following further.

4.1.1.1 MODX

MODX is an open source platform which allows for full segregation of plain HTML, standards compliant CSS and JavaScript, and PHP snippets. Originally written by Raymond. Irving and Ryan Thrash in 2004. Modx can be installed under IIS, Apache, Lighttpd, Hiawatha, Cherokee, nginx, and Zeus web servers. Modx is written in the PHP programming language, and supports MySQL and Microsoft SQL Server as the database. It is licensed under the GPL [(19)]. Modx 2.5.2 is last version and the expected version MODX 3 is currently in the planning stages. Table2 shows new features of Modx 2.5.2

Table 2 - new features of Modx 2.5.2

New Features	**Description**
Improved Accessibility & Usability	accessibility, including increased screen reader and keyboard navigation on the login screen.
New Base Template	More visual default template. For first time installers, the base template provides an educational experience and the ability to see what happens when you edit the title or content of the standard page.
Backend management system	Drag/drop Boards and Categories to arrange and manage user groups and members. Moderate, edit and view posts by users.
Speed	Cut down the time the parser spent processing MODX tags in certain cases. This speed improvement is rumoured to be able of cutting down parsing time anywhere from a few to 15%, so definitely worth upgrading for if the site is complex.
Moderation	Global Moderators, Report Post to Moderator, ACL-based Moderator Permissions, Recycle Bin support, Spam Box support and Admin Groups
Ajax library	Supports any Ajax library, including jQuery, MooTools, ExtJS, and Prototype

(19) GPL: stands for General Public License

4.1.1.2 Drupal

Drupal Written in PHP, using Symphony Dries Buytaert is the Drupal founder and president Drupal Association, he helps support and grow the Drupal community with the Drupal Association. Drupal used AMP [20] architecture and runs on any computing platform that supports both a web server capable of running PHP and a database to store content and configuration. Drupal 8 is the last version Drupal CMS which allows the editors to manage applications and create content separately for web or application. Table 3 shows the new features comes with this version:

Table 3 - new features comes with Drupal version

New Features	**Description**
New theme engine	Create functional Drupal websites using new theming engine called TWIG, which is PHP-based, flexible, fast, and secure.
Multilingual	Multilingual support, the admin interface has built-in translations. Possibility to create pages with language-based Views filtering and block visibility. Translation updates from the community are automatically facilitated.
Mobile first	All the built-in themes with an admin theme are responsive that adapts to different screen sizes.
Purely a building tool.	The Configuration API, able to focus exclusively on the task of packaging up configuration.
Support for accessibility	Improvements, which provide control for rich Internet applications. Bells and whistles like better font sizes, tweaked colour contrasts, jQuery UI's autocomplete, and modal dialogs.
Automatic packaging.	Features analyses your site and automatically packages up site configuration into a set of features.
New fields	There are five completely new field types in the Drupal 8 core: Date, Email, Link, Reference and Telephone.

4.1.1.3 Joomla

Joomla is a platform based on PHP and MySQL which was created in 2005 by a team of open source developers. Joomla! 3.6 now let's to create a category on the fly for articles, contacts, newsfeeds and banners. Version 3.6.4 is last version which released to address two critical security issues ''High Priority - Core: Account Creation, Elevated Privileges and High Priority''. Table4 shows the new features which come with Joomla 3.6

[20] AMP: Apache, MySQL, PHP architecture

Table 4 - The new features which come with

New Features	Description
Show all menu items	Quick overview of what is displayed on the website. Organise, list and filter all existing menu items on one page
Extension details	Better overview of extension details in Systeminfo for better debugging/support
Menu type ACL	Easily check which provide Access control for managing menu types
Content Category	Uploading picture to the contact in contact category list page. Add new categories without leaving the item editor
Improved UX	Speed up workflow through administrative UX improvements
	For developer
Subform field	New field type offers new possibilities for developers
Database queries	Build more complex database queries with new database query classes
CodeMirror	Latest version of CodeMirror supported
Reverse Caching Support	Supports reverse caching proxies like Varnish or an NGINX caching proxy. These help to provide increased speed, more performance and as a result better ranking in search engines.

4.1.1.4 WordPress

WordPress is web publishing software. It is initially designed as a blogging platform but has gradually enhanced and became most popular content management system. WordPress is built on PHP and MySQL and licensed under the GPL [(21).]

It is free to anyone who wants to download it and use it to create a website. It is also open to anyone who wants to create extensions and templates. It is being developed by a growing WordPress community.

WordPress 4.7 is the last major release of the year 2016 which brings some exciting new improvements and several bug fixes. A new WordPress 4.7.3 update is from the 6th March 2017. Table 5 show the main WordPress characteristics and new fetchers of WordPress 4.7.1

Table 5 - new fetchers of WordPress 4.7.1

New Features	Description
Default Theme	The new default themes "Twenty Seventeen" is more oriented to Business Websites instead of blogging, and came up with some of the starter content to help new user's setup their WordPress websites. This content is responsive with mobile-first approach to design.
Video Headers Support	Possibility to upload and use the own videos in mp4 format, or using YouTube and Vimeo videos.

(21) Stands for: General Public License

Admin Language Control for Users	WordPress make updated in the dashboard languages so, user can add multiple languages to the dashboard
PDF	Uploading PDFs to the media library will generate thumbnail images, so user can easily distinguish between all the documents.
Custom CSS	WordPress web Development company considers it as the main benefit which provide using theme customizer directly to add the custom CSS to the themes.
Improvements in the Editor	The paragraph & heading selector menu will appear in the top bar. For an easy access, users will have keyboard shortcuts in Tooltips and drop-down menus
For developers	
Locale Switching	If the content of your website is displayed in a different locale than the one set in admin area, then WordPress will show the toolbar in the language of the content page.
Post type templates	Just like the custom page templates, post type templates are featured which allow developers to integrate the templates of their choice considering different post types.

4.1.2 Popularity and usage

According to W3Techs survey (January 2017) 53.1 % of the websites use none of the content management systems. Modx is used by less than 0.1 %, Drupal by 2.2 % Joomla! by 3.3 %, WordPress is used by 27.5 %, of all the websites. But a content management system market share of WordPress is 60.7 %, of Joomla! is 7.6 %, of Drupal is 5.1 %. For more detail figure below show the Popularity and usage. Table6 shows analysis regarding which are the most popular CMS

Table 6 - Analysis regarding which are the most popular CMS, source: author, 2017

Features	**Modx**	**Drupal**	**Joomla**	**WordPress**
Market share	less than 0.1%	4.80%	7.20%	58.40%
Downloads	Less than Million	25 Million	75 Million	160 Million
Number of websites	Less than Million	1.1 Million	2.8 Million	75 Million

WordPress has a large community than the other CMSs, because it has user-friendly features and it is extremely easy to install. A user only needs about 5 minutes to install it. It has vast amounts of functionality that is accessible to the huge majority of WordPress.org users.

-

4.1.3 CMSs comparison

Modx, Drupal, Joomla and WordPress each of them are software tools that allow to create, edit, and publish content, and in order to select the best suited CMS and fully benefit from it, it is necessary to focus in the purpose of the web project and the evaluation which involves collecting and analysing information about a software's characteristics and outcomes.

To evaluate the desirable attributes and the features of the CMSs we need decision-making method which involves making preference decisions (such as evaluation and selection) using many criteria. Author choose many criteria to evaluate from the perspective of the website owner which involve seven feathers and quality requirements. Figure12 shows the criteria of the evaluation of chosen content management systems.

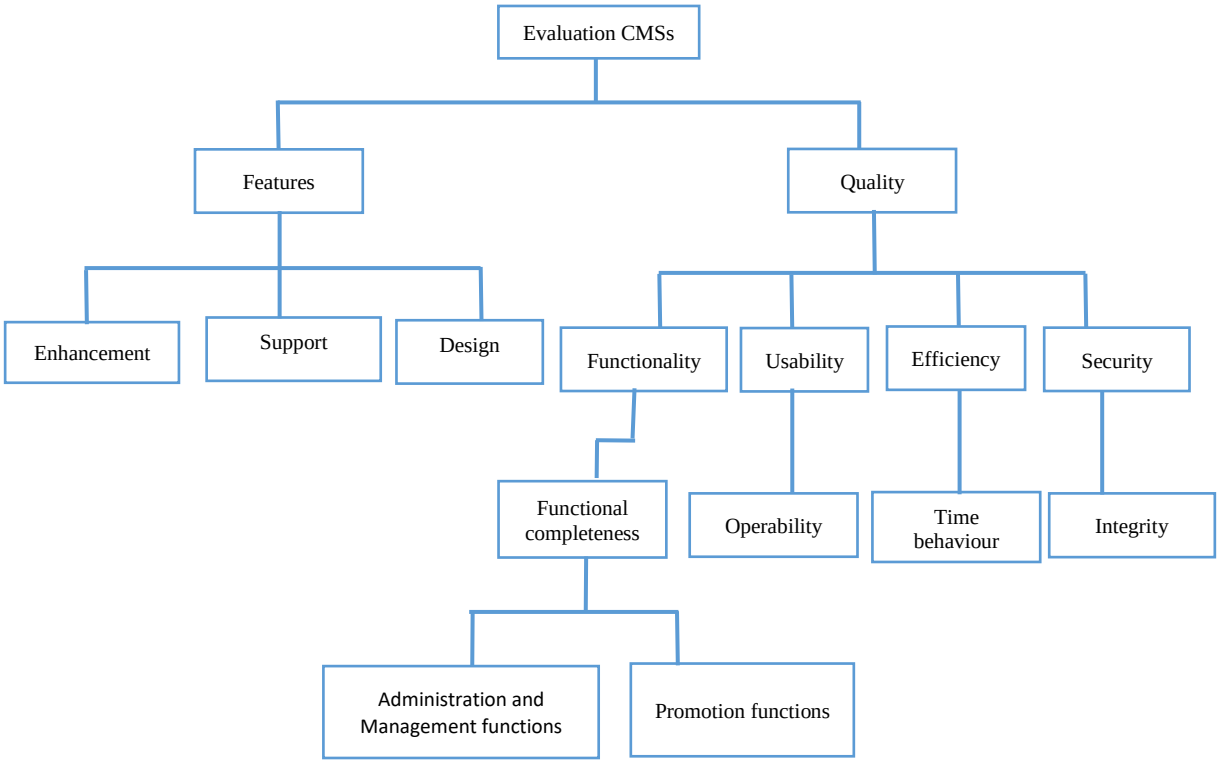

Figure 12 The criteria of the evaluation of chosen CMSs, source author, 2017

Features

Features are distinctive attributes that distinguishes one CMS from the other, author test the features. For the results, were applied the following scores.

4 points: the best result

3 points: better than average

2 points: less than average

1 point: the worst

The maximum is four points

4.1.3.1 Enhancement

Themes, plugins and another enhancement provide a lot of flexibility when it comes to designing the website. Modx has more than 500 themes and about 3K free plugins, Joomla has more than 1000 themes and about 4K free plugins, Drupal has more than 2000 themes and about 26K free plugin, WordPress has more than 3000 themes and has the most plugins of all CMS platforms about 44k making it extremely popular. All CMS provide social extension which expand the site with additional information which attract more visitors. The results of the number of themes and plugins calculate as the following: 4: means the best results, 3: means middle results, 2: the results lower than the mean, 1: the worst. All the forth CMSs have high results in supporting the social media extensions.

Table 7 shows the enhancement and extension in the CMSs

Table 7 - Enhancement and extension in the CMSs, source author,2017

Features	**Modx**	**Drupal**	**Joomla**	**WordPress**
Free themes	1	3	2	4
Free plugins	1	3	2	4
Social media extensions	4	4	4	4
Total	6	10	8	12
Score	2	3	3	4

To get the results author used the following relation: proximate score = Σ (X)/i which i=3

Author divided results by i to get results in form of 4 points.

4.1.3.2 Support

Support refers to functionality that is provided for the CMSs end users which provide technical and personal assistance. The criteria of the support features which was examined was taken from the report of CMS-Matrices (51).

All four CMSs provide commercially available document for the site and support purchased from a commercial organization with trained staff members.

All four CMSs have online help which integrates context-sensitive help system built in to the CMS.

All four CMSs provide administrative services also have certified hosting partner program and application service provider.

All four CMSs provide available forum or message board which is available for the system. They provide conference for this system where it's users can get together, discuss ideas and get training. Table 8 shows support rest results

Table 8 - Support rest results, source author,2017

Criteria	Modx	Drupal	Joomla	WordPress
Online Help	Yes	Yes	Yes	Yes
Commercial Manuals	Yes	Yes	Yes	Yes
Commercial Support	Yes	Yes	Yes	Yes
Commercial Training	Yes	Yes	Yes	Yes
Developer Community	Yes	Yes	Yes	Yes
Pluggable API	Yes	Yes	Yes	Yes
Professional Hosting	Yes	Yes	Yes	Yes
Professional Services	Yes	Yes	Yes	Yes
Public Forum	Yes	Yes	Yes	Yes
Public Mailing List	Yes	Yes	Yes	Yes
Test Framework	Yes	Yes	No	Yes
Third-Party Developers	Yes	Yes	Yes	Yes
Users Conference	Yes	Yes	No	Yes
Total	12	12	10	12
Score	4	4	3	4

Yes, means the CMS achieves this feature.

To get the results author used the following relation: proximate score = Σ (X)/i

When result is Yes, X = 1. i=3

Author divided result by i to get result in form of 4 points.

4.1.3.3 Design

Accessibility standards help for planning and managing Web Accessibility and aim to provide users of all abilities and disabilities access to the same information and features at minimal efforts on their parts. Modx and Drupal compliance with accessibility standards (Web Content Accessibility Guidelines, Section 508. Joomla and WordPress compliance to the Web Accessibility Initiative (WAI).

All four CMSs compliance with new versions of XHTML and CSS. Users can get a different theme for the homepage and every page on the site.

All four CMSs provide the modern website design elements such as ‘‘background videos’’ which focus on enticing the visitor from the moment they land on your page. And ‘‘Card design’’ which allows users visitor to understand the key points about user business without ever having to read a single line of text.

Table9 show the evaluating for the four CMSs depend on the design features and modern design requirements which help user to design the website effectively. The criteria of the design features which was examined by author was taken from the report of the content management system features (52). Table 9 shows the evaluating for the four CMSs depend on the design features

Table 9 The evaluation depends on the design features, source author, 2017

CRITERIA	MODX	DRUPAL	JOOMLA	WORDPRESS
Accessibility WAI (22), WCGA (23), Section 508	4	4	4	4
XHTML and CSS compliant	4	4	4	4
Auto-generated menu	4	4	4	4
Every page can have different theme	3	4	4	4
Design protected from content editors and editor enhancements	3	3	3	4
Multiple content areas on one page	4	4	4	4
Semi-Flat design	4	4	4	4
Card design, themes with background videos and tools for modern design	3	3	3	4
Total	29	30	30	32
Score	4	4	4	4

To get the results author used the following relation: proximate score = Σ (X)/i, i=8. Author divided result by i to get result in form of 4 points.

Quality

Autor described and evaluated the quality of the CMSs according to the quality standard ISO/IEC 25010 which is an international standard for the evaluation of software.

A software quality model provides a taxonomy of software quality factors and it is used for describing the quality factors of a single software product or system (e.g., content management system). The software quality model and their metrics provide a taxonomy of software quality factors and it is used in many contexts. for instance, during the development software or when selecting and evaluate a complex system.

(22) WAI: stands for Web Accessibility Initiative which is a technical specification that specifies how to increase the accessibility of web pages

(23) WCAG: Web Content Accessibility Guidelines are part of a series of web accessibility guidelines

Author identifies 4 main quality characteristics, namely:

- Functionality
- Usability
- Efficiency
- Portability

These characteristics are broken down into sub-characteristics which used for comparison depend on method of scoring.

The result will be calculated based on the following:

4 points: the best result

3 points: better than average

2 points: less than average

1 point: the worst

4.1.3.4 Functionality

At the heart of every practical design, whether it a website, product, or any kind of software systems, there is a function, which is the characteristic and tasks that the item is expected to perform. This characteristic is concerned with what the software does to fulfil needs. ISO/IEC 25010 quality standards defined functionality as ‘‘the degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions’’ (53). Suitability and security

4.1.3.4.1 Functional completeness

Belonging to the ISO/IEC 25010 Suitability sub-characteristic, refers to the appropriateness (to specification) of the functions of the software and their implementations.

In this study, we analyse and evaluate the suitability and accuracy of the chosen content management systems with the administration and management functions and Promotion of search engines optimization, survey and polls. The chosen CMSs functions are being compared on a range of following criteria.

□e□ – Function is available, and it is counted as 1.

□□ – Function is not available, and it is counted as 0.

Administration and Management functions

Table 10 shows the management functions author tested from the CMSs dashboards and sites.

Table 10 - The management functions test, source author,2017

CRITERIA	MODX	DRUPAL	JOOMLA	WORDPRESS
Asset Management	Yes	Yes	Yes	Yes
Content Scheduling	Yes	Yes	Yes	Yes
Inline Administration	Yes	Yes	Yes	Yes
Online Administration	Yes	Yes	Yes	Yes
Responsive dashboard	Yes	Yes	Yes	Yes
UTF-8	Yes	Yes	Yes	Yes
Localization of interface and Multilanguage	Yes	Yes	Yes	Yes
Trash	Yes	No	Yes	Yes
Media Manager	Yes	Yes	Yes	Yes
Web-based Style/Template Management	Yes	Yes	Yes	Yes
Web-based Translation Management	Yes	Yes	Yes	Yes
Advertising Management	Yes	Yes	Yes	Yes
Total	12	11	12	12
Total in 4 credits	4	3.6	4	4
Score	4	4	4	4

The research results indicate that Modx, Drupal, Joomla and WordPress each of them have high functionality administration. For assets management perspective, all chosen CMSs have central repository for uploading images and other files, so they can be reused through-out the site. The system allows the content to be automatically added or removed from a site based upon date in all the chosen CMSs which provide Content Scheduling. For metadata provides information to help manage a resource, such as when and how it was created, file type and other technical information. In Drupal, there is no trash system to allow administrators or publishers to recover content that has been removed from the site. Note that this is not the same as recovering items from a versioning archive. This function is supported in all other CMSs. All of them has a web-based interface for adding styles and templates to the system for design, layout control and manage the translation languages on the web interface.

Yes, means the CMS achieves this feature.

To get the results author follows this relation: $\Sigma (X)/i$,

when result is Yes, $X = 1$

when result is No, $X = 0$,

which i =3, author divided result by i to get result in form of 4 points.

4.1.3.4.2 Promotion

- Search Engine Optimization

Modx, Drupal, Joomla and WordPress come ready to embrace search engines which are software fetches or retrieves data, files and information. The search results are generally presented in a line of results.

SEO", is a key consideration when building a website. Better search ranking means more visitors, so it to understand which CMS is more adaptable and friendly for successful SEO optimisation.

SEO capabilities were examined of selected CMSs using website SEO scoring checker and SEO check tool which tests sites for search optimization, and Google / Bing webmaster. The results

All four CMSs support Search Engine Friendly URL and include SEO settings for home page, page title, specify page description, keywords, author of the document, last modified, content types, media files, sliders and many more.

Modx provides a complete control of all metadata and URL structure for Search Engine Optimization (SEO) purposes. It has basic installation package which supports user-friendly URLs, tags and the file robots.txt is configured

SEO-Generator is a SEO extension for Joomla, which can control all types of metadata manually and automatically. The handling of the metadata in Joomla is not so easy to generates keywords and description for each article by pulling text from the title.

WordPress provides powerful plugins for SEO. WordPress provides SEO Super Comments Plugin features which was not supported in old versions. After activating this feature and setting up a WordPress template to output your new SEO comments pages, Google will have access to all the users' comments and index them in their own.

Drupal SEO Tools module seamlessly integrates a sophisticated all-in-one suite of search engine reporting, analysis and optimization tools into the website. Appendix 3 shows the SEO test results.

- Survey and polls

Features like quizzes, polls and surveys are interest, and become one of the means of competition between the various CMSs

The Polls module allows user to create, edit and publish polls and provides with detailed real-time reports on the website.

Modx comes with polls module 3.0.0 which allows for polls to be created, updated and deleted so the user able to create questions and answers and even link them into a category for multiple poll support.

Drupal 8 has an extension CMS polling survey and comes with new features. Poll module allows user site to capture votes on different topics in the form of multiple choice questions.

Joomla extends an advanced Survey and Polling Tool. With this survey extension, user will easily create any surveys or polls right from the front-end, collect data and analyse survey results.

WordPress new versions support survey and poll unlike previous versions. Survey and poll tested with Internet Explorer, Chrome, Firefox, Opera and Safari. Works well with tablets and mobiles, the survey always fit to the device screen to get the best visual display for the visitors.

All four CMSs have the same amount of supporting surveys and polls. And the conclusive results for Promotion show in table 11.

Table 11- Promotion results, source: author, 2017

CRITERIA	MODX	DRUPAL	JOOMLA	WORDPRESS
Search engine optimization	3	2	3	3
Surveys and polls	4	4	4	4
Total	7	6	7	7
Changing to 4-point scoring	3.5	3	3.5	3.5
final score	4	3	4	4

To get the results author follows this relation: Σ (X)/i

X is the total, i =2, author divided result by i to get result in form of 4 points.

4.1.3.5 Usability

To test the usability, the author conducted a test using all the chosen content management system to check if the website meets the requirements, and to check the main elements, menu structure, mobile-first, the requirements and installation, see Appendix 2.

Web Content Dashboard is a control panel of the system and it is the first screen user can see when log into the administration area of the content management system. The main idea of the dashboard is to view information about an active CMS website. CMS give user a place to manage the sites and view the draft posts check out and moderate latest comments.

4.1.3.5.1 Modx 2.5.2 dashboard and UI

MODX dashboard link is in the top-left of the screen. It contains an unlimited number of "widgets", which are boxes that show various content on the Dashboard. Widgets can be arranged in any order, and can be either a file, a MODX Snippet, or straight HTML.

MODX 2.5 manager comes with more mobile friendly. The design is beautiful and the color composition is attractive. Figure13 shows Modx 2.5.2 dashboard.

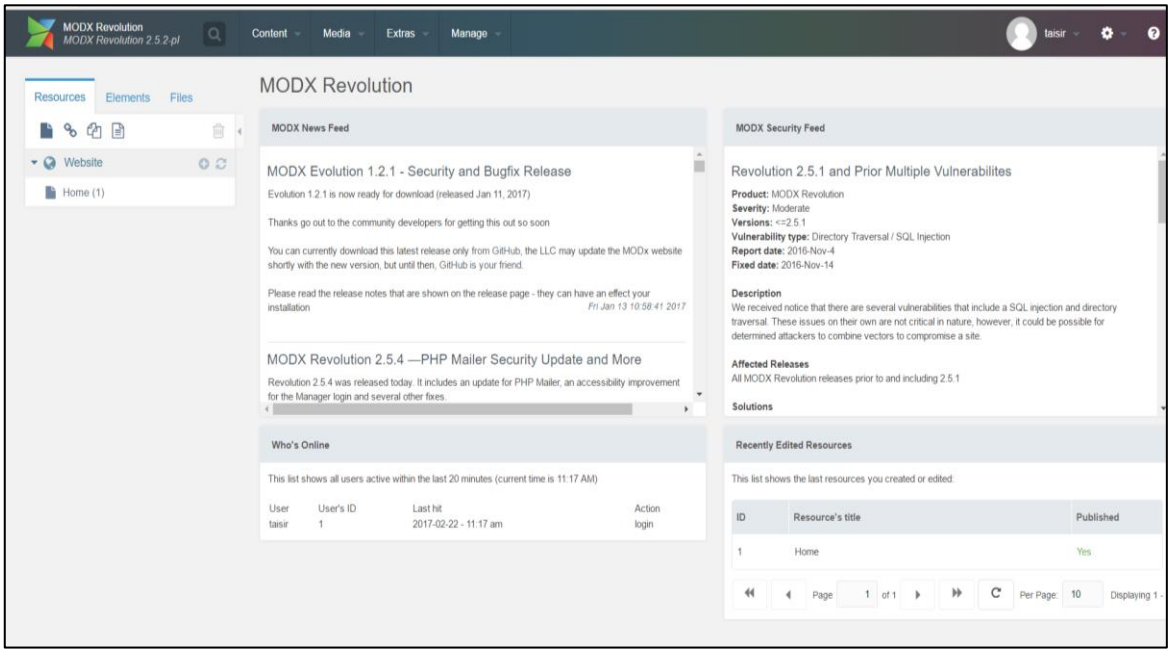

Figure 13 Modx 2.5 dashboard source: author, 2017

4.1.3.5.2 Drupal 8.2.2 dashboard and UI

Drupal 8 comes with "mobile-first " improvements which does not exist in the older versions of Drupal. In Drupal dashboard, users can add and remove items from the dashboard, or can disable the dashboard completely.

Users can add widgets to their pages and arrange them through drag and drop interface. Figure 14 shows Drupal 8.2.2 dashboard.

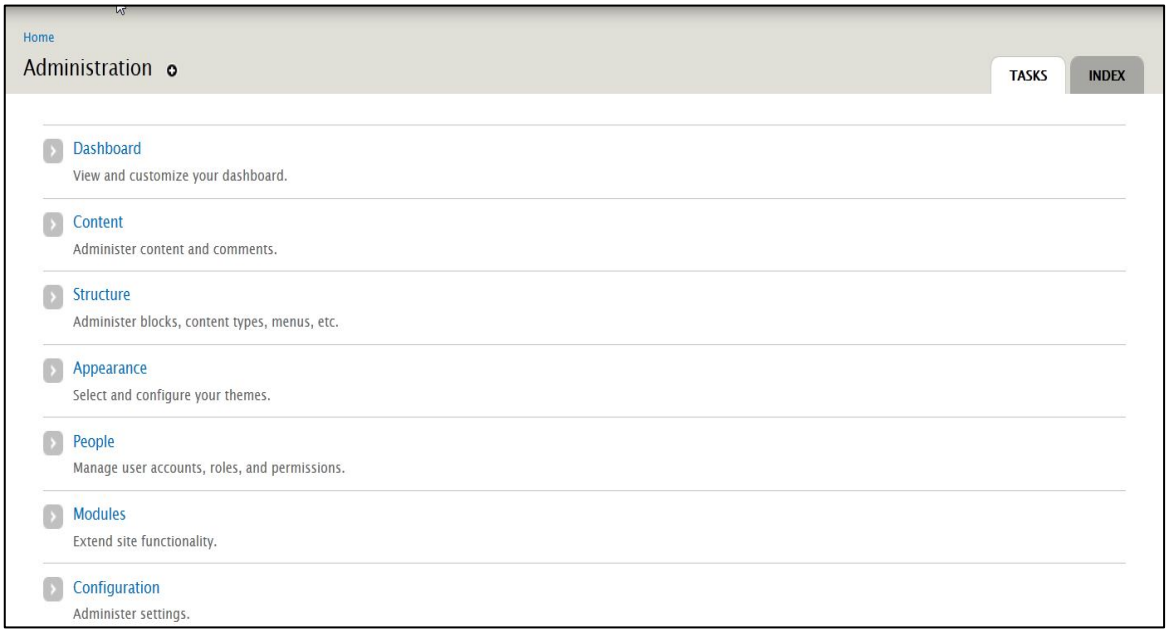

Figure 14 Drupal 8.2.2 dashboard and UI source: author, 2017

4.1.3.5.3 Joomla 3.6.5 dashboard and UI

Joomla 3.6.5 comes with the 'Perfect Dashboard' which improves the efficiency and performance. One of the important feature of Joomla 3.6 is to show all menu items: Organise, list and filter all existing menu items on one page. New versions of Joomla come with mobile friendly user interface. Figure 15 show the Joomla dash board 3.6

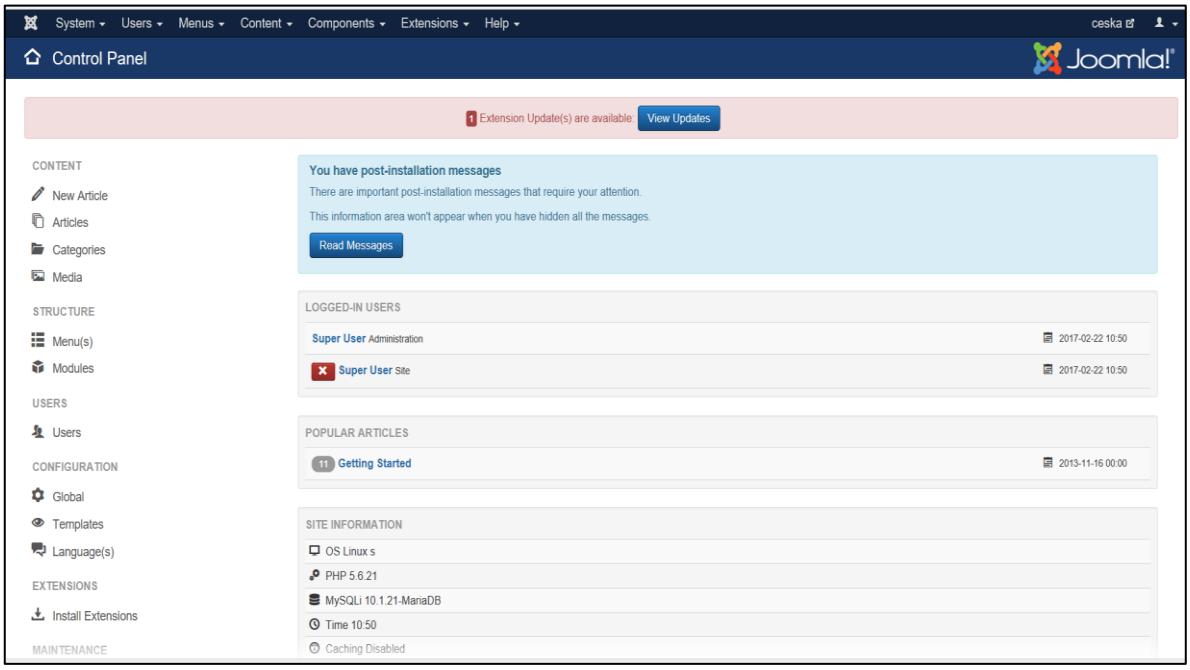

Figure 15 Joomla 3.6.5 dashboard and UI source: author, 2017

4.1.3.5.4 WordPress 4.7.1 dashboard and UI

The User Interface of WordPress is the best among another CMS. It is easy to use and ease to learn. The dashboard area is built up of many different widgets. Each widget can be enabled or disabled. All new versions are updated automatically from the dashboard. Code editor available in WordPress and it can be a security liability. User can edit the theme and plugin files with the features of code editor. Figure 16 shows WordPress 4.7.1 dashboard

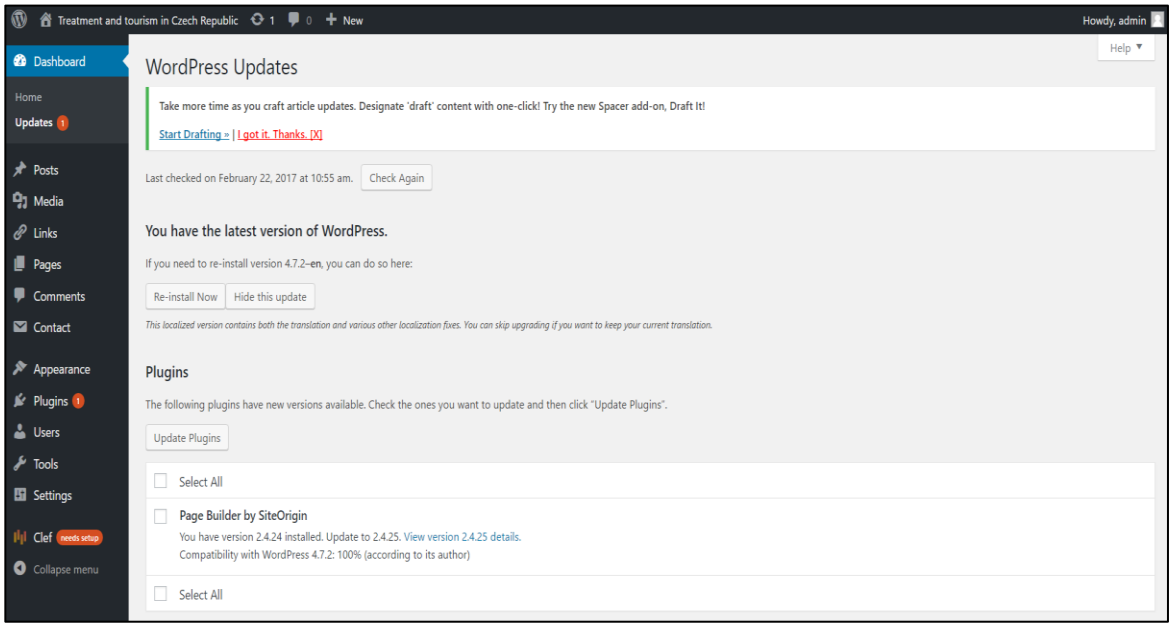

Figure 16 WordPress 4.7.1 dashboard and UI, source: author, 2017

4.1.3.5.5 Operability

Operability is the ability to use an equipment of the system and how to make it easy to control and operate. it is one of the usability attribute that bear the effort needed for usability and other individual assessment of such use by a stated or implied set of users. To clearly identify the usability of a system special test was conducted. Table 12 shows the operability test.

Table 12 - Operability test, source: author, 2017

Task	Modx	Drupal	Joomla	WordPress
Adding title and go to welcome screen	18 minutes 20 seconds	14 minutes 30 seconds	14 minutes 6 seconds	7 minutes 40 seconds
Install and insert themes	5 minutes 50 seconds	6 minutes 30 seconds	4 minutes 40 sec	3 minutes 2 seconds
Adding text and image	19 minutes 11 seconds	24 minutes 11 seconds	21min 44 seconds	18 min 20 seconds
Adding menu and items	28 minutes 9 seconds	16 minutes 8 seconds	31 min 4 seconds	17 min 33 seconds
install plugin	8 minutes 15 seconds	10 minutes 41 seconds	9 min 16 seconds	6 min 50 seconds

Best results were for the less time of operability and the results were calculated in the following manner:

4 points: the best result

3 points: better than average

2 points: less than average

1 point: the worst

Table 13 shows the results.

Table 13 - Operability results, source: author, 2017

Operability				
	Modx	Drupal	Joomla	WordPress
Total task	78 minutes 55 seconds	71 minutes	80 minutes 4 seconds	53 minutes 2 seconds
Score	2	2	1	4

WordPress showed the best operability results according to the results of the test which means that users friendliness in this system better than in others. Modx, Drupal and Joomla! demonstrated middle results but better than the average, which means that the new versions of these CMSs were less complicated.

4.1.3.6 Efficiency

Efficiency is defined as ‘‘the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions’’ per ISO/IEC 25010 quality standards. The CMS should deliver efficiency and provide staff with the information which users need, when they need it. Author examined the efficiency using technical tool to test the time behaviour of the chosen content management systems.

4.1.3.6.1 Time behaviour

ISO/IEC 25010 quality standards defined the time behaviour as “the capability of the software product to provide appropriate response and processing times and throughput rates when performing its function, under stated conditions” for the request time (53). The test was done in the local hardware device Sony VAIO DUO 13 SVD1321M2E using Chrome browser at real connection speeds and using website's performance testing tool (54). Test included multi-step transactions, video capture, content blocking and charts. the results were providing rich diagnostic information including resource loading waterfall charts and page

speed optimization checks, see Appendix 4, Appendix 5, Appendix 6. Table 14 shows test results.

Table 14 - Time behaviour test results, source: author, 2017.

Criteria in milliseconds (Ms)	Modx	Drupal	Joomla	WordPress
CPU Busy Time	4300	5010	5100	7600
Visually Complete	2600	2350	2300	2800
Last Visual change	2600	2410	2300	2800
Load time (online)	2300	2350	3800	5900
Load time (fully loaded)	2300	2350	3800	5900
Dome content loaded	600	550	1200	2000
Speed Index	2300	2200	2000	2440
Time and first Byte	100	50	60	150
Load time Result, sec	2.9	2.1	2.1	3.4
Score	3	4	4	2

Joomla and Drupal the best results, Modx has result higher than the average, WordPress has the result lower than the average. Best results are for the less time of operability and the results was calculated like the following manner:

4 points: the best result

3 points: better than average

2 points: less than average

1 point: the worst

4.1.3.7 Security

Security is a very important factor when choosing a CMS for the website. Almost websites on the internet can be vulnerable to security threats. Security has been added as a characteristic, rather than a sub-characteristic of functionality and it define as define as ‘‘degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization’’ (55).

Security during authentication was checked against different vulnerabilities and security issues. In terms of vulnerability, Modx is the best of the group in this area: it has very few reported security vulnerabilities, and it is immune to SQL injection attacks. On the other hand, WordPress has the highest number of vulnerability, WordPress discovered a

severe content injection (privilege escalation) vulnerability affecting the REST API [24]. This vulnerability allows an unauthenticated user to modify the content of any post or page within a WordPress site. Table15 show the number of vulnerability reports had been recorded at the US Government's, National Institute of Standards and Technology, National Vulnerability Database.

Table 15 - Vulnerability test results, source: author, 2017

CMS	REPORTED VULNERABILITIES	MOST RECENT AS OF FEB 19, 2017
Modx 2.5.2	14	Dec 24, 2016
WordPress 4.7.1	1,187	Feb 10, 2017
Drupal 8.2.2	1000	Dec 30, 2016
Joomla 3.6.5	844	Jan 23, 2017

For authentication and other security issues, fowling results were found:

In terms of authentication all four CMSs, for registration of users need to authenticate by supplying either a local username and password including OTP [25] via short message service, phone call, email, quick response code and other.

Modx, provides strong authentication and NTLM authentication which is a suite of Microsoft security protocols that provides authentication, integrity, and confidentiality to users.

WordPress site requires username and password for authentication. Two-factor authentication and Simple Firewall is offered through WordPress via free plugins for adding more secure for the users' site.

Drupal make possibility to authenticate users from any source.

In Joomla, authentication class allows users to log into user site and provides an interface for the Joomla authentication system.

In terms of the other security issue:

In all four CMSs, Audit Trail Report (51) shows the date and time that every page was created or modified. In addition to the date and time, the name of the user who made the entry or modification is also listed, along with the type of action performed. Only the admin user can view this report. All of them has Security Audit Log which has the most comprehensive logging and the best coverage of the changes.

(24) REST API stands for Representational state transfer - application program interface which has many underlying characteristics and governs the behavior of clients and servers

(25) OTP stands for one-time password

Modx, Drupal, Joomla and WordPress, each of them provide:

- Email verification: the system sends an activation key to users to make sure they've entered a valid email address.
- Login History: storing information about who logged and when? What IP address they came from? also including the dates, times and user agent information.
- SSL [(26)] compatible: the system uses Sockets Layer protocol authentication certificate which is a standard security technology for establishing an encrypted link between a server and a client. Table16 show the result as the fowling:

Table 16 - Security test results, source: author, 2017

CRITERIA	Modx	Drupal	Joomla	WordPress
LDAP [(27)] Authentication	4	4	4	4
NTLM [(28)] Authentication	4	0	0	0
Pluggable Authentication	4	4	4	4
Audit Trail	4	4	4	4
Email verification	4	4	4	4
SSL compatible	4	4	4	4
Login History	4	4	4	4
Less variability	4	1	1	1
Total point	32	25	25	25
Score	4	3	3	3

To get the results author follows this relation: $\Sigma (X)/i$, which i =8
The result was divided by i to get in form of 4 points.

4.2 Multiple Attribute Decision Making

To analysis the content management systems multiple attribute decision making model (MADM) was used with set number of alternative approaches. MCDM approaches and techniques are considered to introduce categorization of decision making techniques and describe some techniques to know about the differences from each other. Multi-Attribute Decision Making is the most well-known branch of decision making which helps to evaluate trade-offs when there are more than three criteria and it helps to make optimal decisions. The main purpose of the (MADM) model is to solve the problem that needs evaluation, selection and

(26) SSL: stands for Secure Sockets Layer which is a protocol creates a secure connection between a client and server.
(27) LDAP: stands for Lightweight Directory Access Protocol
(28) NTLM stands for Windows Network LAN Manager

ranking alternatives among many finite and infinite alternatives. MADM trying to estimate the attributes in order to address them and reach the decision-making process.

The decision-making steps can be summarized in five steps depending on methodology of methods and applications (64).

- The first step is to identify the problem and collect the data.
- The second step is to build a hierarchical system.
- The third step is to identify the suitable model for decision making.
- The fourth step is the relative weights
- The fifth step was to determine the best alternative

4.2.1 Data collection

Data collection and analysis were done in the first chapter in the practical part to identify and recognize the problem. Table 17 shows the results from the comparison.

Table 17 - Results from the comparison, source: author, 2017

Results from the comparison					
Criteria		MODX	DRUPAL	JOOMLA	WordPress
Functionality	Administration and Management	4	4	4	4
	Promotion	3	2	3	3
Usability	Operability	2	2	1	4
Efficiency	time behaviour	3	4	4	2
Security	Integrity	4	3	3	3
Features	Enhancement	2	3	3	4
	Design	4	4	4	4
	Support	4	4	3	4

4.2.2 Hierarchical system

The goal is to choose among the competing alternatives A1, A2, A3 and A4 (Modx, Drupal, Joomla and WordPress based on a ranking score when judged individually against criteria C1, C2, C3, … and C8. Figure 17 shows the hierarchical system using MADM

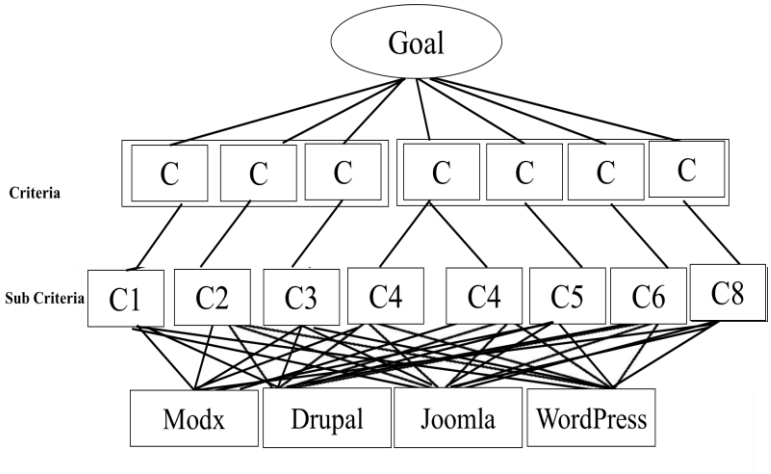

Figure 17 Hierarchical system using MADM, source: author, 2017

C1: refers to the administration and management-functionality
C2: refers to the promotion-functionality

C3: refers to the usability-operability

C4: refer to the efficiency-time behaviour

C5: refer to the security-integrity

C6: refers to the enhancement-features

C7: refers to the design-features

C8: refers to the support-features

4.2.3 Weighted sum model (WSM)

In decision theory, ‘‘the weighted sum model (WSM) is the best known and simplest multi-attribute decision analysis for evaluating several alternatives in terms of many decision criteria’’ (56). If there are alternatives and criteria, then the best alternative is the one that satisfies the following expression:

$$\text{WSM} = \max \sum_{j=1}^{N} AijWj \quad \text{for i =1, 2, 3, ..., M}$$

N is the number of decision criteria,

Aij is the actual value of the ith alternative in terms of the jth criterion,

Wj is the weight of the criterion.

4.2.4 Weights Selection Criteria

The fourth step is the relative weights, the weights were selected as the following:

W1= 0.10 W2= 0.10, W3=0.20, W4=0.20, W5=0.20, W6=0.10, W7=0.05, W8=0.05.
The summation of all weights is equal to 1. To get the performance score, the author processed the score to be in 10 points for the all alternatives, so the author multiplied all score by 2.5 to get the result in 10 points. Table 18 show the decision array for the alternatives.

Table 18 - The decision array for the alternative, source: author, 2017

	W1 0.10 C1	W2 0.10 C2	W3 0.20 C3	W4 0.20 C4	W5 0.20 C5	W6 0.10 C6	W7 0.05 C7	W8 0.05 C8
Modx	10	8	5	8	10	5	10	10
Drupal	10	5	5	10	8	8	10	10
Joomla	10	8	3	10	8	8	10	8
WordPress	10	8	10	5	8	10	10	10

4.2.5 Evaluating alternatives

To determine the best alternative, the alternatives were estimated depending on WSM model. Table 19 show the results

Table 19 - Conclusive results using MADM, source: author, 2017

Criteria / Alternatives	C1	C2	C3	C4	C5	C6	C7	C8	**Total**
Modx	1.0	0.8	1.0	1.5	2.0	0.5	0.5	0.5	7.8
Drupal	1.0	0.5	1.0	2.0	1.5	0.8	0.5	0.5	7.8
Joomla	1.0	0.8	0.5	2.0	1.5	0.8	0.5	0.4	7.4
WordPress	1.0	0.8	2.0	1.0	1.5	1.0	0.5	0.5	8.3

From the table, we can see that WordPress has the highest results, which make it the suitable system to create the project.

4.3 Development Process

The aim of this part of the thesis is to create a modern web presentation in deferent ways, the first is by using the selected content management system and the second manually using programming language. The purposes of all of them is the same so, the content and presentation requirements are also the same. By using agile software development, the analysis of the requirements was defined as sentences in document, to capture what will be needed. That led to get early results with high quality.

4.3.1 Requirements analysis

Gathering the requirements and doing the analysis process of the site content was the first step. We can consider creating the tow website as two independent projects and we can notice that there is common requirements and specific requirements for each of them.

The common requirements include the following:

1- Determining the goal of creating the project and gather accurate information which include:

- Clients: People who are interested in physical therapy treatment methods or who come to the Czech Republic as patients or as tourists from all over the world.
- Type of Site: Medical-Tourism website.
- Purpose of site: The purpose of the project was to created website to showcase Czech Republic for the people who going to visit Czech Republic for medical tourism. It is medical site with purpose of health, treatment, spas and rehabilitation in addition to show the visitors Czech civilization, archaeological and most famous tourist places.

2- Choosing name for the site and preferably small, symbolic and expressive for ease of trading and browsing. The name was Treatment and Tourism in Czech Republic" with short name "TCZ".

3- Determine the budget for site information server costs. The hosting and name server was using free hosting in addition for using free development programming language environment, text editor and CMS which are free and affordable.

4- Determine the Permissions of the administration users of the site.

5- Develop a list of the contents of the site and its relationship.

5. Determine the requirements for modern web design which include:

- Responsive Design.
- SEO
- Large and responsive hero images.
- Background Videos.
- Semi-Flat Design
- Hamburger Menu
- Card Design
- Feature Videos
- More and brighter color

- Site map
- More focus on animation
- Unique layouts
- Adding social media Icon

After initial requirement analysis, design process and conceptual wireframe was needed to be presented.

4.3.2 Design Process

This section was focused on layout and appeal which was done in several stages to ensure that the design merges well with the content, elements and color schemes. Various methods and techniques of designing process were used to create a visual representation of the site ideas such as wireframes, calligraphy, visual arts, page layout to reach the result. For that was using graphic design tools and software which used to graphic design, multimedia development, stylized image development, technical illustration and general image editing. A list of software and tools was used to design the media and frameworks as following:

1- Open-source GUI prototyping tool version 3.0.4 for creating wireframes design.
2- Adobe Photoshop CS6 used for editing images and color as well as merge layers.
3- Easy GIF Animator 6.1 to create and edit animated GIF images banners, buttons.
4- Corel Video Studio Ultimate software, version X10 10.5.0.57 for producing videos.
5- Adobe Flash CS6 was used for creating simple Flash Animation for the interface.
6- Summitsoft Logo Design Studio to design and print the logo in high resolution.
7- Hex Color Finder tool which used to grab RGB color and define the color code.

4.3.2.1 Main Interface wireframe:

The best way of giving idea is to create some skeletal wireframes. Using wireframe is important to be done before the designing, it is simple black and white layouts that outline the specific size and placement of page elements and site features. It helps to simplify the process of the implementing because we can see the trivial skeleton or layout of what we are doing. An open-source GUI prototyping tool version 3.0.4 was installed and used to create the wireframe. Wireframes were created for all pages and for the microsite as well, the wireframe for the micro site was the same for the WordPress project and the manual coding

project as well, the other were different depend on the technology used in all of them. See the interface wireframe in Appendix 8 to Appendix 16.

4.4 Website development using the chosen CMS.

Based on analysis of content management systems, website development using the selected CMS was done. The purpose of this project is to design and develop website for medical tourism.

After analysing all top open-source web content management systems, author created the website based on the purpose and the analysis results from the last chapter.

4.4.1 Planning

Planning the website ahead of time will give it clear direction as well as prevent missed deadlines and backtracking. Define the target audiences, set goals and budget in addition to create sitemap was done last chapter during the analysis process. That led to get early results with high quality.

4.4.2 Requirements and tools:

A variety of tools and requirements that needed to build the website and manage the content, here are the basic tools that have been used for building WordPress website:

- WordPress Files [https://wordpress.org/download/]
- Domain Name [Taisir.esy.es]
- Web Hosting [Hostinger - https://www.hostinger.ph/ & XAMPP]
- FTP Client [FileZilla]
- Editor [Sublime Text - https://www.sublimetext.com/]
- Browser [Google Chrome]
- WordPress Codex [https://codex.wordpress.org/]

Installing WordPress is a very simple process and takes less than five minutes to complete. See WordPress installing process diagram Appendix 2. All WordPress files were installed on "Hostinger Web Hosting" which offer two ways for installation files (manually or Auto-install). Was chosen free Domain Name with extension esy.es and was used ‘‘FileZilla’’ software for transferring files over the Internet.

To modify, extend, or contribute to WordPress website was used online WordPress Codex which offers guidelines and a big resource that details every template tag and every function that WordPress uses.

4.4.3 **Website back-end**

The various pages that control the site's options and settings are referred to as the Administration Screens which is the admin area where most work gets done i.e. creation of additional content, user management, site configuration options and regular maintenance tasks. WordPress system provides possibility for rearranging sections and displaying back-end elements according to user requirements, so it helps to increase the usability by re-arranging them as necessary. Latest version of WordPress 7.4.1 was installed which come with drag and drop page builder that allow to create, edit, and customize the site layout without writing any code. The update for the last version is from the Dashboard > Updates menu, and to manually enable automatic updates for major releases or development purposes, was added the following line of code to wp-config.php file: Define ('WP_AUTO_UPDATE_CORE', true); This enabled all core updates. Keeping the site updated help to enhance security, add new features, fix bugs in addition to improve functionality and performance.

4.4.4 Database

To create databases, store and get data, WordPress uses MySQL as its database management system. All information of creation the database was stored in Hostinger control panel. To make a backup in addition to access the database files on the account was used FTP [(29)] program (FileZilla) that helps to download WordPress files from Hostenger web host to the local computer (XAMPP) .It helps to download and upload all the WordPress files from Hostenger web host to the local computer (XAMPP) and vice versa. It also used during the development to get all database information of WordPress from configuration file "wp-config.php" that holds the database information. All the settings, list of all the registered users, Posts, pages, Categories, tags, links and relations between them have been stored in WordPress database tables. However, there was need to add new database tables to store medical spas information, types of therapeutic programs, prices, contacts, addresses in

(29) FTP: stands for File Transfer Protocol used to transfer fils.

addition to store some plugins in WordPress database. WordPress has an excellent database structure that accommodate any data. From the phpMyAdmin, new table was created called "tczapadb" and from the admin folder, PHP file was also created and called "tczdbtables.php". The written code is processed by the PHP module and installed on the web server. The pre-processor generates output to be displayed on the front-end page. To provide an interface with the WordPress database, was used wpdb class, which contains a set of functions used to interact with a database. Figure 18 shows the part of code which display

```
<?php /* This code displays the data in show page@ Medical tourism TCZ
*/?>
<?php /* Template Name: Display data */ ?>
<?php get_header(); ?>
<div class = "wrap">
 <div id="primary" class= "content-area">
<table border="1">
    <tr>
     <th>Medical Spas name</th>
     <th>Medical Spas description</th>
     <th>The prices </th>
     <th>City</th>
    </tr>
      <?php global $wpdb;
        $result = $wpdb->get_results( "SELECT * FROM tczspadb");
        foreach ( $result as $print )   { ?>
          <tr>
                  <td><?php echo $print->name; ?> </td>
                  <td> <?php echo $print->description ; ?> </td>
                  <td><?php echo $print->prices; ?> </td>
                  <td><?php echo $print->citz; ?> </td>
          </tr>
            <?php }?>
```

Figure 18 Display data from WordPress database table

data from the database table.

4.4.5 Security

There are many types of malware and other threat can attack the website, so it should be enhanced by applying security checkpoints and techniques at initial stages of the building and development as well as throughout the website development lifecycle. This section shows the most important WordPress security tools and ways which have been used to secure and protect the website:

- Encrypting login and connection to the control panel, this encryption process is done by the Chap protocol plugin to generate secure password authentication system without any server configuration.

- Prevention of a brute-force attack which is a cryptoanalytic attack that can, be used against any encrypted data. To prevent this attack was used Login LockDown plugin which records the IP address and timestamp of every failed login attempt. If more than a certain number of attempts are detected within a brief period from the same IP range, then the login function is disabled for all requests from that range.
- Protecting the admin area from unauthorized access using a Website Application Firewall, this was activating by adding the Sucuri Firewall API key into the plugin.
- Displaying the WordPress version. Many WordPress templates insert the WordPress code into the meta tag, having this information publicly available makes it easy for attackers to exploit known vulnerabilities on a particular version. To remove this problem, have been login to the control panel> Templates> Editor Then into functions.php was add the code: remove_action ('wp_head', 'wp_generator').
- Changing the default admin username, as this can be a security measure to help prevent unauthorized access to your WordPress admin dashboard.
- Using Two Step Verification to WordPress Login Screen which asks to enter a verification code generated by the Google Authenticator app on the user phone.

4.4.6 **Website template development**

The website template consists of a small set of dynamic web pages, that present Website' users with a front page, as well as functionalities for searching. The user interface for the configuration of the website is an aspect that should be addressed by the target CMS system). Home web-page presents a welcome message, search box, menu and header with video header theme. For the structure view for these web-page (see Appendix 8 - wireframe responsive design templet. Appendix 9 to Appendix 12 – wireframe pages).

4.4.6.1 Theme Template

Author selected the default theme called "Twenty Seventeen" (57) which released in December 2016. It's a blog-centric theme with a heavy focus on the front page, mobile first design, and accessibility. The Percentage diagram for of the selected theme download per a day (see the appendix 7d). Figure 19 shows the detailed of the theme.

```
/* Theme Name: Twenty Seventeen
   Theme URI:https://wordpress.org/themes/twentyseventeen/
   Author: the WordPress team
   Author URI: https://wordpress.org/
   Version: 1.0
   License: GNU General Public License v2 or later
   License URI: http://www.gnu.org/licenses/gpl-2.0.html
   Text Domain: twentyseventeen
   Tags: one-column, two-columns, right-sidebar, flexible-         header,
accessibility-ready, custom-colors, custom-    header, custom-menu, custom-
logo, editor-style,        featured-images, footer-widgets, post-formats,
rtl-   language-support, sticky-post, theme-options,  threaded-comments,
```

Figure 19 the detailed of Twenty Seventeen theme

4.4.6.2 Child Theme

In order to create a specific edit to the appearance of the WordPress theme, the child theme was created, which we can define it as ‘‘theme that inherits the functionality and styling of another theme, called the parent theme"[41]. Child Theme is collection of CSS style rules, HTML structure elements, videos, images, and PHP logic that fetches the website’s contents from the database using the WordPress API. It recommended way of modifying an existing theme without losing the ability to upgrade that theme. Conceptual model diagram was used by using ConceptDraw modelling software to represent abstract ideas and to understand the different kinds of information for creation the child theme. The diagram defines theoretical entities, objects and the relationships between them. Figure 17 shows the conceptual view of WordPress child theme.

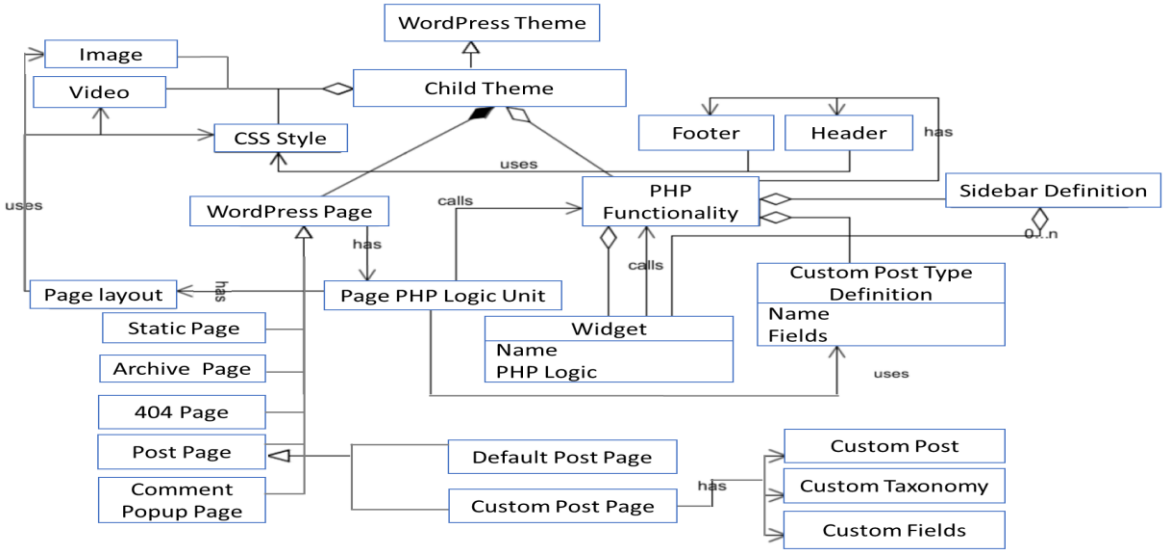

Figure 20 Conceptual view of WordPress Child Theme, source: author, 2017

Child-Theme directory was created and placed in wp-content/themes. Figure 21 shows the Child-Theme details.

```
/*
Theme Name: Creation Twenty Seventeen Child Theme
Theme URI: https://wordpress.org/themes/twentyseventeen/
Template: twenty seventeen
Author: Taisir Obad
Author URI: http://taisir.esy.es/
Description: Child Theme brings the site to life with header video and large
responsive image. It is provided with custom widget, custom post type, custom
taxonomy with a focus on business sites, it features multiple sections on the
front page as well as navigation and social menus, a logo, and more.
Version: 1.1.1490512818
*/
```

Figure 21 the Child-Theme details.

The information of the Child Theme was presented in the details of the original theme, the enqueue of the parent and child theme stylesheets was done by adding a wp_enqueue_scripts action and using wp_enqueue_style() in the child theme's functions.php and for that was created a functions.php in the child theme directory, see figure 22.

```
<?php
add_action ('wp_enqueue_scripts', 'my_theme_enqueue_styles');
function my_theme_enqueue_styles () {
    wp_enqueue_style ('parent-style', get_template_directory_uri ().
'/style.css');
}?>
```

Figure 22 The information of the Child Theme in the original theme

4.4.7 Creating an advanced content type.

Set up the structural elements when creating the website was one of the important things which was done in the first stages. By default, WordPress comes with post and pages as the main content types. However, there are many cases in which these types just aren't enough. WordPress provides a handful of built-in custom content types, that makes it easier to display that content in exactly the way that fit users' needs.

This section displays custom post types, custom fields, and custom taxonomies that have been created manually to the dashboard of WordPress, although using plugins is easier and faster. The reason for creating them manually goes back to that all the custom types will disappear when the plugin is deactivated in addition to some problems which may happened during the update of the version. Author used the advanced settings to customize every

aspect, starting from creation custom post type then associate custom taxonomies for each of them finally integrated control over custom fields display for different post types.

The following is a further explanation of how each of them was created and added to the dashboard.

4.4.7.1 Custom Post Types

To store content which doesn't fit into any standard fields or categories (such as posts, pages, attachments, navigation menu items and revisions) was created custom post types (CPTs). It looks and acts differently from a regular post. For this template was developed gender specific custom post types. It called "Medical Information, Spas, Rehabilitation Centres, News, Events and Portfolios". Functions to add and register each custom post was written via the register_post_type() function. This function defines a new post type by its labels and other specifics. Figure 23 shows the part of the code that was added to functions.php file for Medical Spa custom post:

```
       add_action( 'init', 'create_events' );
       function create_Spas() {
         $labels = array(
           'name' => _x('Spas', 'post type general name'),
           'singular_name' => _x('Spa', 'post type singular name'),
           'add_new' => _x('Add New', ' Spa '),
           'add_new_item' => __('Add New Spa'),
           'edit_item' => __('Edit Spa'),
           'new_item' => __('New Spa'),
           'view_item' => __('View Spa'),
           'search_items' => __('Search Spa'),
           'not_found' =>  __('No Spas'found'),
       'not_found_in_trash' => __('No Spas found in Trash'),
           'parent_item_colon' => ''  );
         $supports = array('title', 'editor', 'custom-fields', 'revisions',
'excerpt');
         register_post_type( ' Spas ',
           array(
             'labels' => $labels,
             'public' => true,
             'supports' => $supports));}
```

Figure 23 the part of the for Medical Spa custom post

That code explained the way of adding custom post type that has same function with different names and job assigned to each content type. After displaying each CPTs to the front end and to the widget, author associated them with a custom taxonomy.

4.4.7.2 Custom Taxonomy

This section explains custom taxonomies that were manually created hierarchically with "register_taxonomy()" function, which has two required arguments. The first is slug name of the custom taxonomy that helps make WordPress post titles into URLs and the second is custom post types that author wanted the taxonomy to apply to. For all custom type have been registered custom taxonomy which behaves similar to the custom post type as a category behaves to the default post. Custom posts have been grouping together using taxonomy mechanism according to various characteristics and then assign those groups names. Seven taxonomies have been created with following names "Medical Spa, Rehabilitation Centre, City, Accommodation, Event, News, Search". Figure 24 shows customs post type front-end.

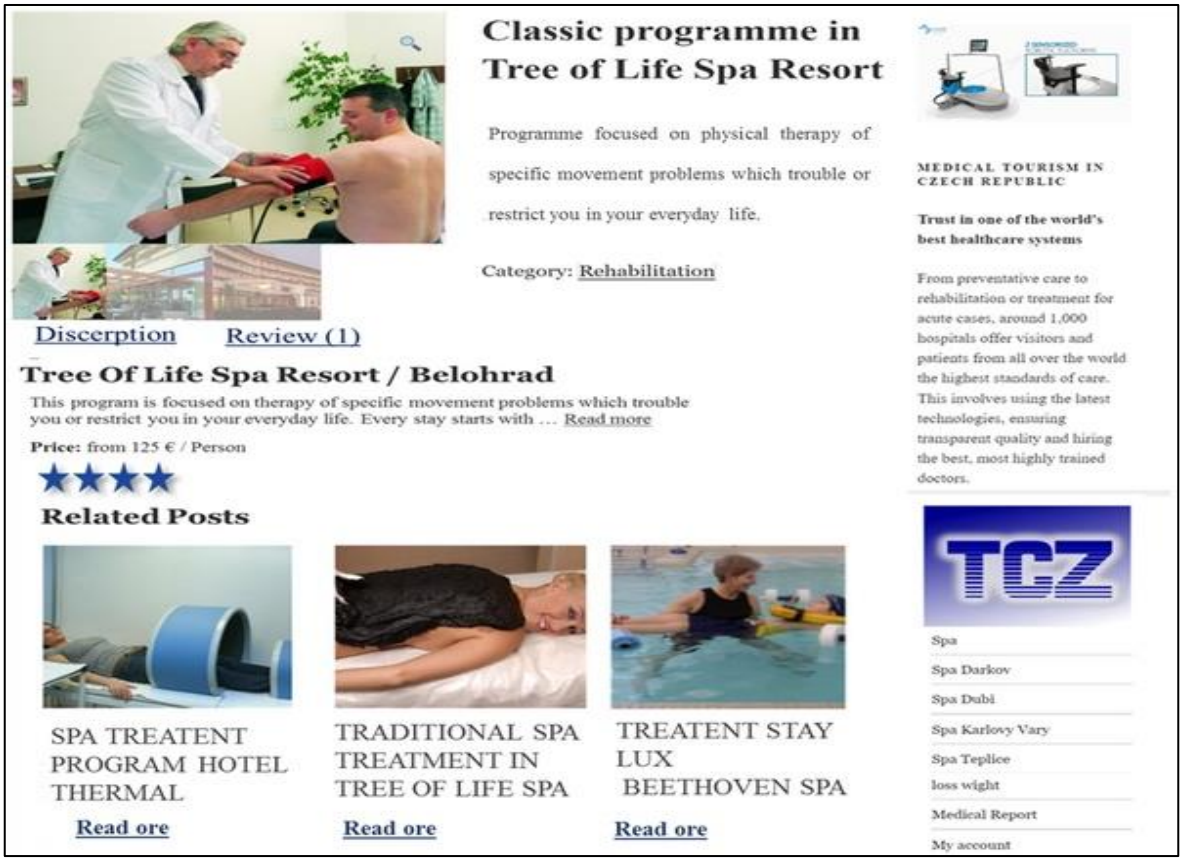

Figure 24 customs post type front-end.

4.4.7.3 Custom fields.

During the working of developing and customizing the theme, was needed more than the standard fields which appears in WordPress by default. That led to adding of custom fields manually from the WordPress dashboard. They have been added after starting to create a custom post type. The custom field section has user interface elements that allow to input data into WordPress. From custom fields meta box was provided field name and slug which was be used as key when display the custom field. This option was used to track and store additional information and properties about the website services and their custom posts. It was stored in WordPress database using certain functions. This information known as meta-data. For all custom post was developed group of custom fields. Figure 25 shows the output of custom post type, custom fields and custom taxonomy in the back-end.

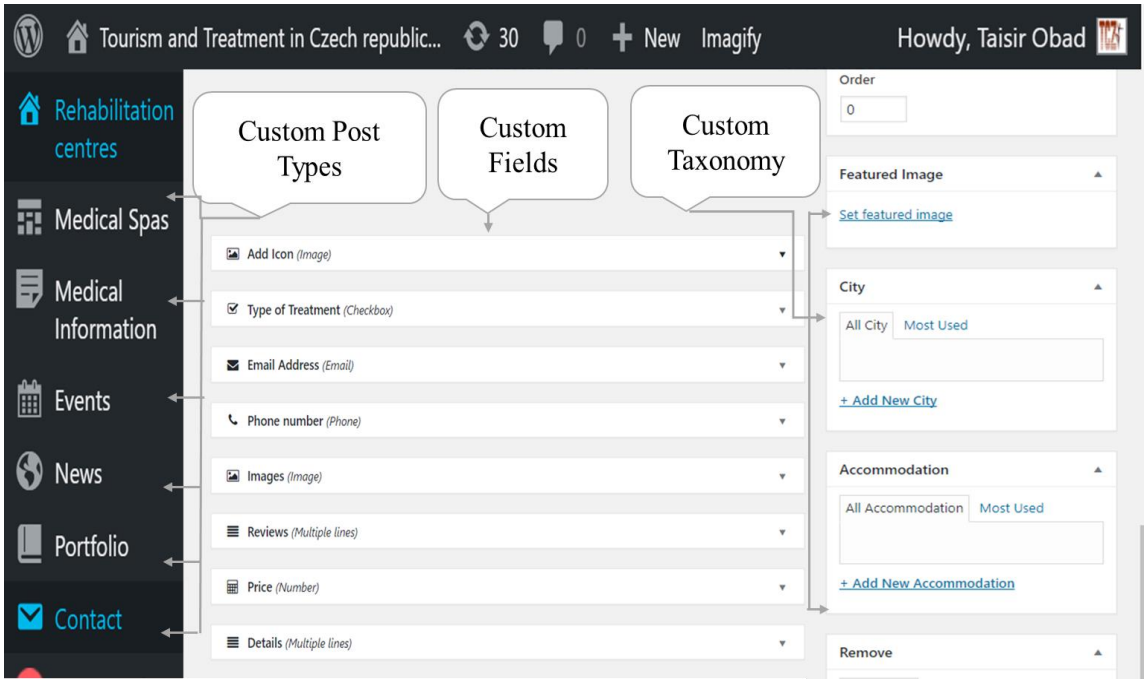

Figure 25 shows the output of custom post type in the back-end. source: author, 2017

4.4.7.4 Custom widget

This section explains custom widget, a small block that performs a specific function that placed in the footer and sidebar. Custom widget that was created which contain pieces of code added to widget areas and display it in the interface. The first step of creation widget was to register and load the widget using wpb_load_widget() function inside function.php file, then create the widget. After adding the specific code for custom widgets, appeared

directly in Appearance> Widgets page> List of available widgets. The widget used to display list of specific links with content in the post sidebar. In addition to the custom widget, another widget was added from the default widget to add social media buttons, search textbox, list posts, list pages, calendar and recent comment..

4.4.7.5 Custom footer area

The selected them had only two footer widgets so, to customize three-footer widgets was needed to edit three files "functions.php, footer.php and style.css" by adding specific code. and that was done in several steps starting from registering third footer column in widget section, that was by adding the part of the code, see figure 26.

```
register_sidebar( array(
              'name'          => __( 'Footer 3', 'twentyseventeen' ),
              'id'            => 'sidebar-4',
              'description'   => __( 'Add widgets here to appear in your
footer.', 'twentyseventeen' ),
              'before_widget' => '<section id="%1$s" class="widget %2$s">',
              'after_widget'  => '</section>',
              'before_title'  => '<h2 class="widget-title">',
              'after_title'   => '</h2>',) );
```

Figure 26 registering footer column in WordPress file

Second step was adding widgets to footer which required creation a folder named “childtheme-template. Inside that folder was created another folder called “childtheme-footer” and inside was created a file named “childtheme-footer.php”. Register_sidebar() function was added to that file to register custom footer widget, see figure 27:

```
<?php
if ( is_active_sidebar( 'sidebar-2' ) || is_active_sidebar( 'sidebar-3' ) ||
     is_active_sidebar( 'sidebar-4' ) ) : ?>
<aside class="widget-area" role="complementary">
              <?php
              if ( is_active_sidebar( 'sidebar-2' ) ) { ?>
                     <div class="widget-column footer-widget-1">
                            <?php dynamic_sidebar( 'sidebar-2' ); ?></div>
              <?php {
if ( is_active_sidebar( 'sidebar-3' ) ) { ?>
                     <div class="widget-column footer-widget-2">
                            <?php dynamic_sidebar( 'sidebar-3' ); ?>
                     </div>
              <?php }
              if ( is_active_sidebar( 'sidebar-4' ) ) { ?>
                     <div class="widget-column footer-widget-3">
                            <?php dynamic_sidebar( 'sidebar-4' ); ?>
                     </div> <?php } ?>
       </aside><!-- .widget-area -->
<?php endif; ?>
```

Figure 27 register custom footer widget

4.4.7.6 Custom CSS

WordPress 4.7 comes with additional CSS feature in the "Customizer" to provide users an access to better theme customization via custom CSS. Therefore, this feature helped to customize the theme styles more efficiently by writing code into Additional CSS tab "Appearance > Customize > Additional CSS". Some colors, text styles, footer styles fonts, text, backgrounds, margins, layout and other styles have been added to define styles. for the web pages.

4.4.8 Elements of modern web design and development.

4.4.8.1 Responsive Design

Responsive web design is a front-end development process aimed allowing webpages to be viewed in response to the size of the screen. This approach offers the same support to a variety of devices for a single website.

WordPress provides responsive design automatically without any plugins or coding, that makes web pages render well on a variety of devices and screen sizes (desktops, tablets, and phones). Theme features, widget area, template layouts, menu positions and more was supported with WordPress theme template. Figure 28 shows the responsive design layout

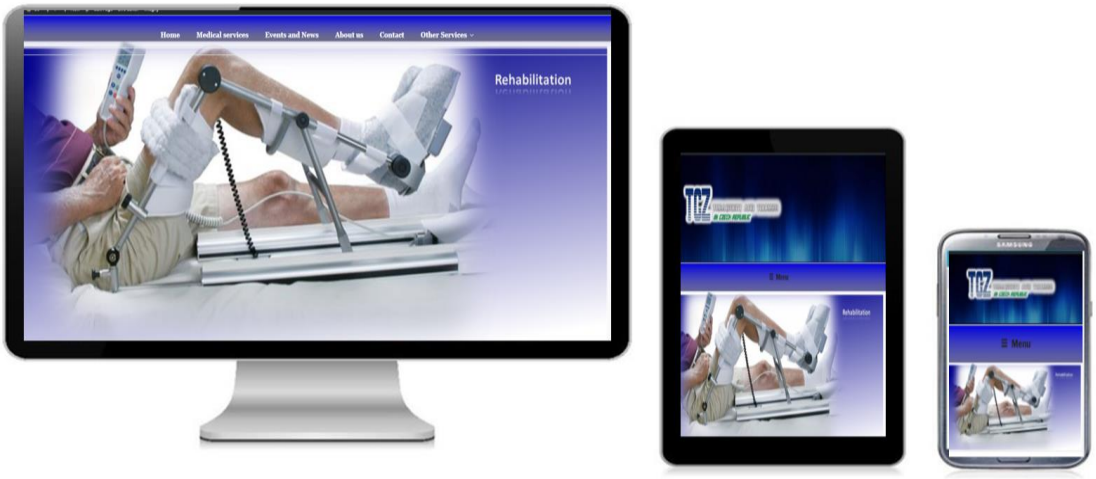

Figure 28 responsive design layout, source: author, 2017, source: author, 2017

4.4.8.2 Video background

Background Video was used that automatically play in the background. Using Background video reduce the amount of other content that is needed to explain the business. Adding a video background to the website is easy in WordPress by choosing the source for the video and converting the video to the proper size and format. The video presents a short

film that summarizes the information and elements of the site attractively. The video was designed and produced via Corel Video Studio Ultimate software, version X10 10.5.0.57 Figure 29 shows the video background for the header of the web presentation.

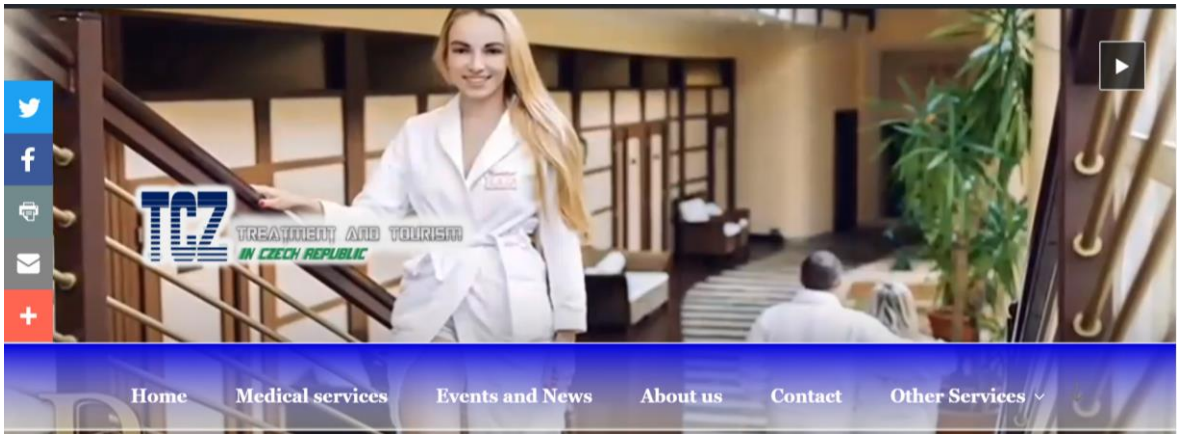

Figure 29 Video Background, source: author, 2017

- **Parallax website with Large images**

Parallax design starts with an implication of dynamic effects, it is an advanced technique provides features for scrolling process that affects the graphical interfaces on the website, so that involves the web page's background moving at slower rate to the foreground. Parallax scoring is a way to increase the user interaction with the site to show a set of events that draws the user and joins the site. The work with that techniques means to involve the visual and functional work of the user together, while using the site and move down or up. This technique encouraging visitors to scroll through the entire page and direct visitors to calls actions. The author customized the child theme and enabled the Parallax feature. Asymmetrical scrolling encourages longer page visit time trough stimulate users with diverse levels of depth and a sense of animation, as well as increase of call-to-action clicks. Large images were used to create a strong visual experience that encourages visitors to scroll down to read more. Author used Adobe Photoshop CS6 to design Large images for the site.

- **Unique and Large Typography**

To indicate subtle hints about the website large typography and different fonts were used.

4.4.8.3 Live Chat

For chat was used "Tidio Live Chat" plugin which allows to easily communicate with the visitors. It is designed specifically for the WordPress community. Install "Tidio Live Chat" on the website, was by adding short code before the closing tag in head of the page.

```
<script src="//code.tidio.co/ihmbcwcbj3jzgiip1nyfqhy85zyc1nx5.js">

</script>
```

Live chat provides keeping track of who visits the website in addition to provide the website by “offline messages form" for the visitors to send an email, when the chat is offline and contact the visitor via email when they leave the chat. Figure 30 shows the live chat part.

Figure 30 Live chat, source: author, 2017

- **Responsive Navigation Menu**

Responsive navigation menu was created using WordPress built-in menu editor and was adding CSS code to the menu to provide animation, background image in addition to change border colour, fonts, font sizes, text alignment. The menu appears in the right side with ability to import and export options in a click of a button. For Adding menu, the codex is as the following:

```
<?php wp_nav_menu( array( 'theme_location' => 'header-menu' )

 ); ?>

wp_nav_menu( array( 'theme_location' => 'extra-menu', 'container_class'
=> 'my_extra_menu_class' ) );
```

- **Contact Form**

Multiple contact forms were mange using Contact Form 7 plugin and styled using CSS styling that customize the form and the mail contents flexibly with simple Markup. The form supports Ajax-powered submitting, CAPTCHA [30], Kismet spam filtering and so on. See the contact form Appendix 21.

- **PDF Previews**

Thumbnail previews for PDF files was generated from which imported from the media library "Media > Add New document". Figure 31 shows PDF previews.

(30) CAPTCHA stands for Automated Public Turing test to tell Computers and Humans, it is test used to determine whether or not the user is human

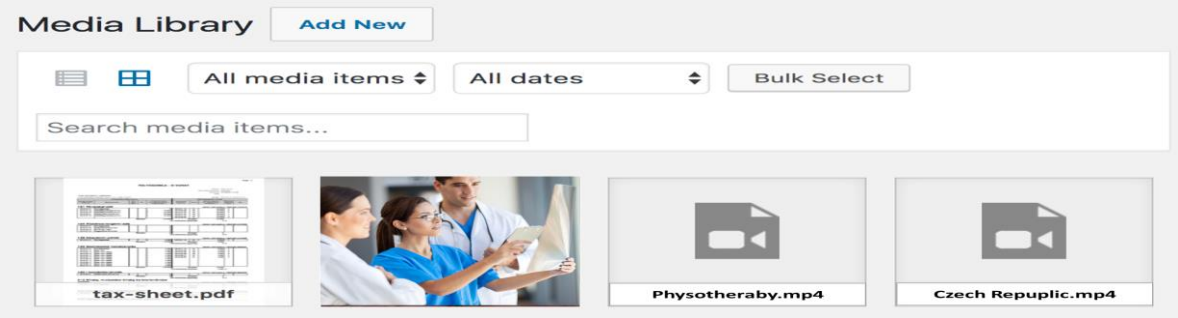

Figure 31 PDF Previews, source: author, 2017

This feature creates an image for the first page of PDF document during upload. This image is stored in different sizes and is displayed in media library, media upload popup, and attachment pages.

4.4.8.4 Embedding Map

Map is important to Display locations and routes on the website, using was adding Google Maps that allows visitors to display maps on the web page and offers satellite imagery, street maps, 360° panoramic views of streets, business locations, contact information, and driving directions. Figure 32 shows the map of the website in addition to other widgets.

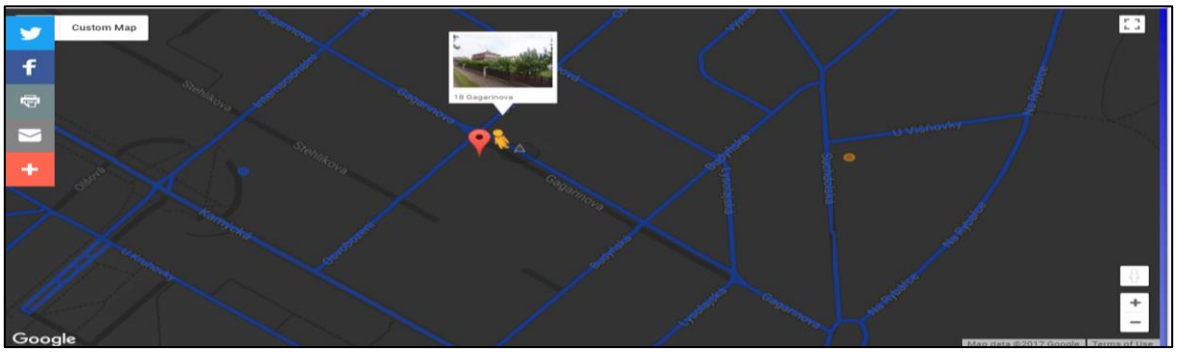

Figure 32 Google map of the WordPress website, source: author, 2017

4.4.9 Post formats implementation.

To customize post's presentation of the theme was used a piece of meta information known as Post Format feature which provides a standardized list of formats as well as allows theme developers to define visual representation of the posts. Child Themes inherit the post formats defined by the parent theme so, several post formats are available such as Image, Gallery, Video, Chat, Audio, Aside, Status, Quote and Link. It is not possible for themes or plugins to introduce custom post formats to WordPress' built in feature, however it can be just creating the own setup instead via custom taxonomies see figure. To check the format

for a post, and change its presentation was used get_post_format() function in single.php file which returns the post format for the current post in the loop. these functions used as an argument for get_template_part() function which allows to include content parts specific to a post format. Each of the formats lends itself to a certain type of “style”, as dictated by modern usage, however it was needed to style, design and edit layout of a particular post format to be displayed as the fit way. Figure 33 shows video post formats

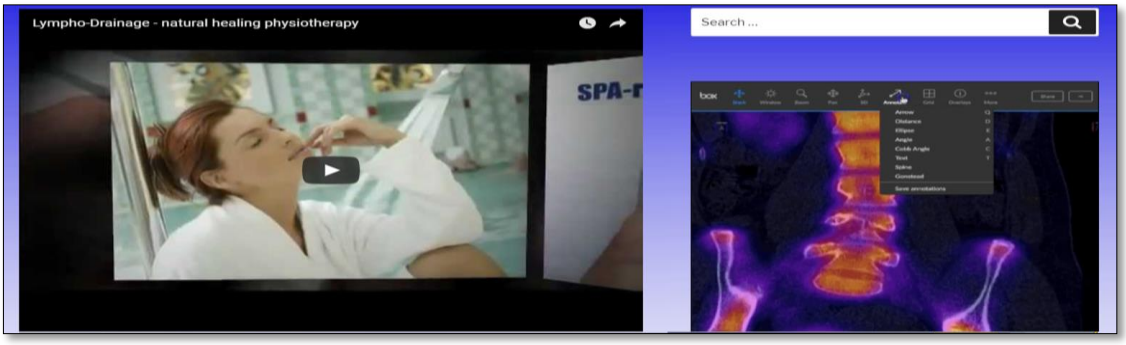

Figure 33 Post format - video, source: author, 2017

Multiple animation such as Fade Up, Flip X, Zoom and Rotate was added to deferent posts using CSS3 animations.

4.4.10 SEO

To optimize the websites for search engines was using a set of rules and processes known as SEO "search engine optimization" that affecting the online visibility of a web page in a web search engine's. Search engines use crawlers to organize and index information on the web and to make those crawlers to see the site content was using XML sitemap plugin which works, essentially, as a table of contents for the website, allowing the crawler to get the essentials and index the site accordingly. Was created XML sitemap which was submitted using Google Search Console connected to the website. Sitemap allows to quickly and seamlessly index the site, helping to boost the rankings. One of the important steps has been done is optimizing WordPress Robots.txt file for SEO by adding the instructions to the file and transfer it through FTP to the web server, see Appendix 27. Other steps have been done to change the ‘Permalink’ structure and build the content around keywords in addition to that, was using “Google AdWords Keyword Planner” tool to find the right keywords and to get group of historical statistics, competitions and keywords trend.

After adding all the processes of SEO was using social media which helps promotion, potential for links and build an audience. Vertical and horizontal line of social media buttons were added to the header and footer using WordPress widget.

The pages interface see Appendix 17 and 18 Front page interface, Appendix 19 medical services page, Appendix 20 contact page and Appendix 21 about page.

4.5 Website development using developer tools.

Previously analysed results showed that about 46.9 % of the websites created by using content management systems and 53.1 % created without it, so from the survey's results, it is noticed that the number of sites created by using CMSs is less than the other (manual-coding) which led to the need for analysis and comparison of creating the websites using CMS and hand-coding as well, that will demonstrate a deeper analysis that to know what are the main differences that distinguish CMS-driven and manual-coding websites and when developers can use each of them.

In this section we explained design and development using manual coding for the same website pursues that built using WordPress. The Next Chapters explain the strategy of the development and design process.

4.5.1 Content planning

This section explains the content planning which known as information architecture planning, this step is important to be done in the first stage by thinking about how a web site should be built and how to structure the site for optimal user experiences. Getting the website information architecture right is first step of the successful design. The purpose of the website and requirement analysis described in the third chapter.

4.5.2 Requirements and tools:

A variety of tools and requirements that needed to build the website and manage the content were defined to provide a satisfactory analysis, here are the requirements and tools that used for building the website:

- Web Hosting [Local host XAMPP]
- Editor [Sublime Text - https://www.sublimetext.com/]
- Browser [Google Chrome]
- Programing langugis:HTML5, CSS3, JavaScript and PHP

- Libraries, frameworks and modern technologies
- Content requirements which were mentioned in the chapter 3.3.1

4.5.3 Template design and development

Website development and design involve many steps, they range from gathering and preparing information then design, development, creation and ends with testing and releasing the website. Finding the right color scheme, choosing the typography, divide the layout and designing the wireframe was done as the first step. The creation started with determine the programming languages, software, tools, libraries, frameworks and new technologies that was chosen in the designing and development stages.

4.5.3.1 Design layout

This section shows the steps took for designing page layout. It is part of graphic design deals with structure of the main content of a single page as well as arrangement of visual elements on the page. The design serves as the plan or the visual presentation and appearance of the layout. The best way of giving idea was to create some skeletal wireframes. Using regular wireframe tools helped to create an innovative interface, which was built upon a new generation of interactive graphic elements. To plan the wireframe interface by using the boxes, buttons and organize their positions on the interface, an initial structure of the sections had to be defined reflecting different experiences that the user would interact with. It started by determining how the user would logically move from registration to activation. By “Open-source GUI prototyping” tool version 3.0.4, a wireframe design for the main interfaces, mobile screen, in addition to the microsite pages was created. The wireframe for the microsite pages is the same for the WordPress project and manual coding project as well. see the main interface wireframe: Appendix 13, Appendix 14 and Appendix 15.

4.5.4 Implementation

Further follows an explanation of details how the application was implemented and was already running on the local server XAMMP. For this purpose, the programming languages HTML5, CSS3, JavaScript, PHP were used in addition to the following libraries, frameworks and technologies.

4.5.4.1 Libraries

1- Normalize.css version 7.0.0. Normalize.css preserves useful defaults rather than reset tags and elements' styling, so it targets only the styles that need normalizing by making browsers render all elements more consistently and in line with modern standards. The last version of Normalize.css comes with corrected bugs and common browser inconsistencies. From the official website of the Normalize library (64), the last version of normalize.css v7.0.0 with MIT(31) license was downloaded and saved inside CSS folder>normalize.css file. This CSS file is included in the browser and is called using link script.

<link rel="stylesheet" href="CSS/noralize.css">

2- html5shiv.js is a JavaScript workaround to enable use of HTML5 semantic, sections and document level elements in IE9(32) or less. The latest version html5shiv.js v3.7.2 was licensed under a dual license system (MIT or GPL(33) version 2). Library was installed from the official website (65) which included the basic createElement() shiv technique, along with monkeypatches(34) " to enable manipulation of HTML5 elements in the DOM. It applied basic styling for them in IE6-9 , Safari 4.x and FF 3.x(35)" using document.createElement and document.createDocumentFragment functions. To call this library, the following script in the header tag after CSS scripts was called:

<!--[if lt IE 9]> <script src="js/html5shiv.min.js"></script> <!--[endif]-->

3- jQuery a JavaScript library. jQuery was installed from the official website which made HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use Application program interface that worked across a multitude of browsers. (67) jQuery file, was referenced with the HTML <script> in <body> tag (before the closing body element). Moving all JavaScript files to the end of the closing body tag, improves the performance of web pages.

4- Font Awesome Library provided scalable vector icons that could be instantly customized in terms of size, color, drop shadow, and many other settings of CSS. Version 4.7.0 was installed from the official website (68). The Library was included in the CSS folder

(31) MIT License is a permissive free software license originating at the Massachusetts Institute of Technology .
(32) IE stands for Internet Explorer.
(33) GPL: stands for General Public License which is a free, copyleft license for software
(34)MonkeyPatch: is a piece of code which extends or modifies other code at runtime (typically at startup).
(35) FF stands for Mozilla Firefox 3.

and referenced from the inside of the <head> section. All font files were installed to the font folder.

<link rel="stylesheet" href="CSS/font-awesome.min.css"/>

4.5.4.1.1 CSS frameworks (Bootstrap)

Using a CSS framework saved time needed for making CSS layouts and provided more time to focus on the functionality of the website. It helped to create multiple layouts easily, normalize code base and keep the code well documented.

Bootstrap framework had great grid system and JavaScript plugins. Bootstrap was installed and used to style every single element following a single theme. Microsite components were styled using bootstrap as well. For optimal design, the default Bootstrap style files were optimized for many elements such as: dropdowns, button groups navigation bar, breadcrumbs, labels, badges, alerts, progress bar and others.

4.5.4.2 Implementing with JavaScript, jQuery and AJAX

JavaScript provides an interaction support in web browsers. Client-side JS libraries were utilized to enhance dynamic behaviours such as interaction and animation. The interactive functionality, animations and actions that happened as a result of a user clicking, hovering, or scrolling were constructed with JavaScript and its libraries. JavaScript file was created inside “js” folder and was used for the Google Map part as well as for the filtering process and some additional features, like for example telling the end user about errors, show, hide information, and highlight specific sections of a page and check the user information. Implementation tasks such as event handling was accomplished using jQuery library that used to make writing common JavaScript tasks more concise so, many lines of JavaScript code were wrapped in a single line of code in jQuery. It used to enhance and simplify the use of JavaScript through its built-in functions for loops, recovery of HTML elements, calculations, etc. During the implementation part, jQuery was utilized to do Asynchronous JavaScript And XML (AJAX).

4.5.4.3 Implementing of PHP with MySQL

PHP is a widely-used open source general-purpose scripting language that is especially suited to server-side web development. It was used to generate the homepage. Once a visitor accessed the index page, the server executed a PHP command and sent the

outcomes of the execution to the visitor's browser. Implementing user authentication was done which consider as a security mechanism that is used to restrict unauthorized access to member-only areas and tools on the site. Login and registration was created in the first page called index.php and was needed to create a table that hold all the user data in the database.

MYSQL was selected to store and manage data in the database. A compatible version of XAMPP containing the updated version of MySQL was downloaded in Windows 10 operating system. MYSQL provides excellent security features and has powerful data encryption and decryption functions as well. To handle the administration of MySQL phpMyAdmin software tool was used that had a control panel to manage the database. For accessing databases in PHP, a connection with the database using PDO [36]. ways were created which is supported by XAMPP and is shipped with PHP 5 and later. It makes the database coding in PHP more secure, faster and portable. A part of the code see figure 34.

```
<?php  $mysql_host = 'localhost';
       $mysql_user = 'taisir';
       $mysql_password = '';
       $mysql_database = 'tczdp';
       //PDO (PHP Data Objects)
       $pdo_connect =
"mysql:host={$mysql_host};dbname={$mysql_database};charset=utf8";

       try {
              $pdo = new PDO($pdo_connect, $mysql_user, $mysql_password);
              $pdo->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);
              // to cach exception
       } catch (PDOException $texception) {
              echo "PDO Error: " . $texception->getMessage() . "\n" .
$pdo_connect;
              exit;
              if($pdo_connect)
              {echo'connected successfuly ';}} ?>
```

Figure 34 connection of the database

Back-end

The user registration system was created allowing users to create a new account by filling out a web form. This was done in several consecutive steps. First, registration information was entered by the user then checked by the registration processing. After this was done successfully, the user's information was stored into the database.

User login system was created in the login.php file. This file contained also HTML tags with input boxes. A JavaScript code detected the initial login information entered by the

(36) PDO: stands for PHP Data Objects. PDO that is a lean, consistent way to access databases.

user in the login form interface. Then the Login module checked the user's input according to the information. The user would be notified of successful login and set to login state (session), if the information was correct. The user would be notified of login failure, if the information was wrong. The session which was a secure dialogue between the web server and user would be cancelled unconditionally if the user logged out.

The control panel interface was called after successful login. Figure 35 shows the control panel interface.

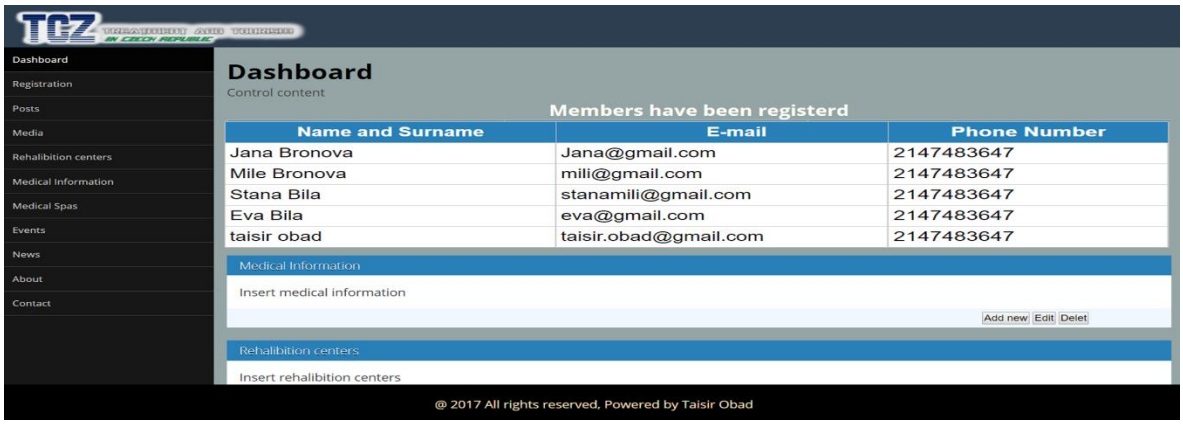

Figure 35 the control panel interface.

SEO

Inside the head tag, the title tag was inserted, the meta description and even the search engine analytics code was most likely to get its place there. Moreover, the head tag housed some other crucial tags like the meta tags, and of course the canonical link tags. The keyword phrase was added to the page title element and the main content on the page. Meta description was optimised to have a clickable useful SERP [37] snippet as well. Next step after the pages got uploaded in the hosting server, a XML sitemap was created and submitted by using Google Search Console connected to the website. A good XML site map would tell the search engine what pages are in the site, how often those pages are updated, and when they were last modified. Sitemap allows to quickly and seamlessly index the site, helping to boost the rankings. After adding all the processes of SEO, a social media was used to assist with promotion and building an audience.

Microsite

Microsite, also known as minisite, is an individual web page or a small cluster of pages which are meant to function as a discrete entity within an existing website or to

(37) SERP stands for Search Engine Results Page

complement an offline activity. The microsite's main landing page can have its own domain name or subdomain. It was used for a specific purpose to show medical news, events, videos and other purposes. Microsite was built using HTML5, JavaScript, jQuery and Ajax. It can be temporary sites and removed from the main site after the information or promotion has expired. See Appendix 16 - microsite wireframe, Appendix 25 and Appendix 26 - graphical representation pages.

4.5.4.4 Front-end design

Responsive Design

Responsive design was aimed to allow pages to be viewed on various screen sizes, in addition, offering the same support to a variety of devices. Figure 36 shows Responsive Design.

Figure 36 Responsive Design – manual coding project

Media and CSS3 elements

Different kind of media, background-gradient, Flexible Box, Multi-column, Grid and other CSS3 element were used which presented the site in a more attractive manner. Animation was added to the website that let the elements gradually change from one style to another. Transitions were also used to allow "to change property values smoothly (from one value to another), over a given duration" (59). Figure 37 shows the animation and transition for part of the interface page.

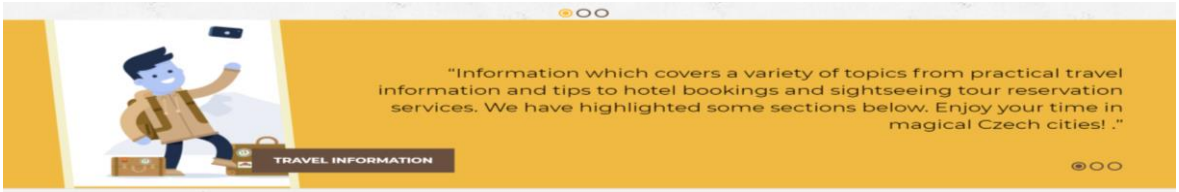

Figure 37 animation and transaction CSS3, source author, 2017

Google Maps Service

Google Maps API offers different popular technologies to display and interact with the map interface (JavaScript, Ajax, iFrame, JSON, XML, etc.). There are many different categories of Google Maps API such as JavaScript API, API for Adobe Flash and Static Google Maps API. Google Maps API was selected due to its complete and comprehensive JavaScript API, offering many methods to create maps and interact with them. It supports address resolution, zoom level setting, image size setting, adding tags and map route display. Visitors were able to view the location on the map and this service could route them to the destination based on their location. Figure 38 shows the google map.

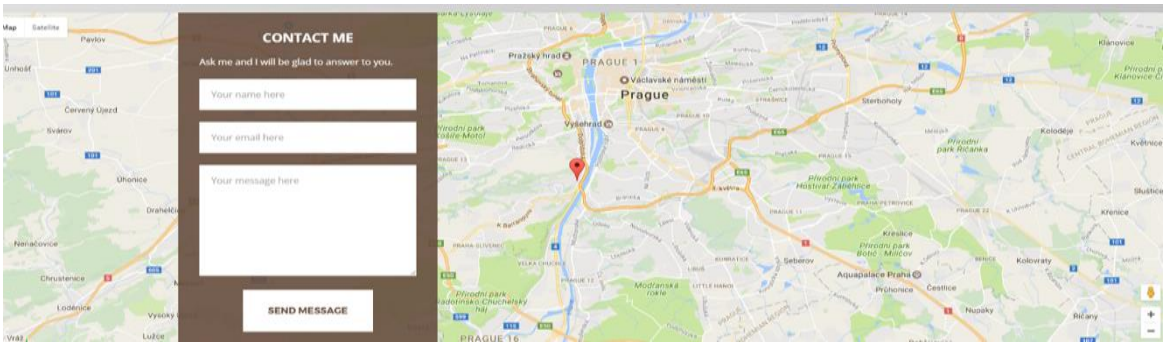

Figure 38 Website map and contact box

4.6 Testing and Release

Test techniques included the process of executing the application with the intent to verify the software is fit for use. A series of test was done during the all project stages to test the links in web pages, database connection, forms used for submitting or getting information from user in the web pages, cookie testing and so on.

After analysing all the elements of the design and development, the compatibility for different web browsers and site optimization were tested. As well as, the code validations were conducted to ensure that the website complied with current website measures. Once this was completed the website was released on a publicly accessible web server (http://taisir.esy.es/). All files were uploaded via FTP connection. Additionally, a domain was registered, as well as hosting service accounts were set up. The website user interface, Home page could be seen in Appendix 22, contact page in Appendix 24 and about page in Appendix 23

5 Results and Discussion

5.1 Discussion of the CMSs comparison results

In the previous chapter, we analysed all selected CMSs, reviewed the literature sources and we conclude the following:

All four CMSs provide high support for the users, they have online help, available document for the site, provide administrative services and so on, for supporting the users.

All four CMSs are complaint with new versions of HTML and CSS which provides the modern website design elements and allows users visitor to understand the key points about user business without ever having to read a single line of text.

The tests indicated that Joomla and Drupal have the best results in the efficiency of time behaviour. They have the highest result of CPU time, requisite time, speed index and load time.

Drupal, Joomla and WordPress have authentication but in terms of vulnerability, Modx has very few reported security vulnerabilities, and is immune to SQL injection attacks.

Based on the analysis, WordPress was selected for following reasons:

WordPress runs 27% of the entire internet and is used by fortune 500 companies like eBay, GM, and Reuters News, it is also used by over 75 million other sites of all sizes and niches, so it remained the fastest-growing CMS for the last years straight and the main reason why WordPress has grown so much in popularity is because that WordPress is easy to use and flexible enough to allow users to create fully functional websites and mobile applications with support and hundreds of free, customizable, mobile-ready designs , plugins and themes with a drag and drop page builder.

WordPress has highest number of extensions, free themes and plugins of all CMS platforms making it extremely popular.

Regarding to the usability, WordPress has efficiency of use, ease of learning and the highest results of operability.

WordPress has search engine friendly architecture. With the help of some SEO plugin so it can easily achieve the SEO goals.

5.2 Discussion of CMS and manual coding comparison

Based on the analysis of CMS usage, 46.9 % of the websites were developed by using content management systems and 53.1 % were created without using it, so it is noticed from the survey's results that the number of sites created by using CMSs are lesser than the other (manual-coding) which led to the need for comparison of creating the websites using CMS and manual-coding.

Keeping in mind this aspect, another website was built with manual hand coding to explore pros and cons manual coding over CMS based website development.

After all analysis and practical work, can be obtained a comprehensive and plain answer for the question that come to mind in the first working with this research, "with all the achievements of content management systems, such as saving time, free cost, support for users, providing modern facilities and techniques for designing without the need to learn programming. in addition to increase sites built with these systems significantly", so is it the end of the hand coding? The answer is plain and obvious. It is not the end, but it supports the manual coding. Yes, majority of users prefer seeing a beautiful and contrast website with usability and flexibility of using so they use these systems because it is easy and does not require any programming background. But in fact, what is happening is the exact opposite because from the first moment to enter the world of the designing using CMS such as WordPress in particular, the users find themselves going to learn the basics of programming languages such as HTML, CSS, JavaScript and so on. After certain time, some of them become experts in the field. The reason of that, they inevitably need to make different modifications that may not be available in the custom themes or free plugins.

As for the developers, these systems open a wider field of expertise and learning modern technology so open source systems provide various tutorials, educational sources and online support. It could be even noticed the increasing number of developers specializing in this field. They innovate, contribute to the community, and demonstrate mastery in the work they do.

Some personal websites and local business could be built easily by using manual coding

. But for the advance web applications which need full control over the control panel and automatically update, it can be recommend using CMS to manage and develop. because the complicated system, needs time, effort, experience and familiarity of using the modern technologies such as Sass [38], Node JS [39], AngularJS[40], etc., as well as it need team developer to achieve all processes.

After the analysis and results, it can be concluded that, both techniques are useful. With manual coding we are free to make any type of design and incorporate custom functionalities but on other hand it requires a lot of effort and very good knowledge of web programming languages to develop professional website. Developing website in CSM is easier and convenient and it does not require a lot technical skill, but customisation options are limited.

After discussion with many experts, developers, designers and web programmers about using manual coding vs. CMS, we can summarise it as follows:

- Anything we can do with CMS, can be done with manual hand coding pages but not everything that can be done with manual coding pages can be done with CMS.
- CMS provides professional templates which are developed by professionals from all over the world.
- CMS saves the time and gives users and clients the ability to easily update their own site.
- CMS is incredibly powerful by installing plugins, so it can add any functionality to the existing website.
- CMS provides full control and ownership, so it can make any change that is wanted, and yet without a limit on how much the site can grow.
- Finally, it can be concluded that with learning of manual coding CMS customization and more ability to work with CMS can be added. CMS provides developer with the ability to practice and edit coding because it is open source. Moreover, it provides the rights to learn from the code which can be made by many developers.

Table 20 summarizes the comparison between using manual coding and CMS which is recommended from the perspective of web design and development experts.

[38]Sass: stands for extension of CSS that enables to use variables and nested rules.
[39] Node JS that is cross-platform JavaScript runtime environment.
[40] AngularJS is a JavaScript-based open-source front-end web application framework

Table 20 Comparison Hand coding and CMS (e.x. WordPress), source: author, 2017

Features	Coding	WordPress	Description
Static website	✓		HTML/CSS website will be preferred over WordPress for building a small static website because new versions of HTML and CSS provide tools that make easier to build the website. WordPress is the option in building a statistic website which have a substantial number of pages with vast content.
Dynamic website		✓	CMS is best for a front-end developer which can help to make dynamic easily.
Easy to use		✓	In terms of ease of use, we cannot get simpler than WordPress in case of server side it is not easy to use without background in coding.
Control the website		✓	It is an easier option for website management. Update content as often as we please, make changes and post new content however we choose. Dynamic information like a photo gallery or e-commerce functionality will undoubtedly be easier to control without needing to learn any of the technical skills.
Change theme and design		✓	By using CMS, we can change the theme easily any time in one click. But for the coding we need to change all the styles of the website.
Update versions	✓		In programming languages, there is no worry of updated versions. It updates new version with new elements, attributes, and behaviours with no problem in the performance.
Cost	✓		As developer, to use any web language such as HTML, CSS, JavaScript, PHP etc. It is totally free. The code can be written in free text editors. In case design using graphical software like Photoshop or developing software environment such as MS Visual Studio for .Net or NetBeans for JAVA then we have to pay license fee to use those tools. As for the cost of CMS, some are free and other do not. The majority of plugins and themes are not free.
Time		✓	CMS is a lot quicker than coding entire websites.
Security	✓	✓	CMS offer high security, but for hand coding we can make the code more secure as the level we want depend on our skills.

6 Conclusion

The major goal of the diploma thesis was to create an online website based on analysis of selected content management systems. The research focused on the study and comparison of four CMSs (Modx 2.5.2, Drupal 8.2.2, Joomla 3.6.5 and WordPress 4.7.1).

Different techniques of design and implementation were evaluated according to the several standards. To incorporate those standards to pick a suitable CMS, a MADM Model (Multiple Attribute Decision Making) was used. The benchmark was set up according to the ISO/IEC 25010 quality standards and from a website's owner perspective. Administration and management functionality, promotion functionality, operability usability, time behaviour efficiency, integrity security, enhancement, design and support features were among selected criteria for analysis and comparison.

The second partial objective of the thesis focused on analyse of CMSs. The result said that all the four CMS all four CMSs are powerful tools for managing websites. These tools have some similar functionalities and some unique features as well based on specific business requirement and priorities, user can select any of the tool.

WordPress had the highest number of extensions, free themes and plugins out of all other CMS platforms which made it extremely popular. It had the top results in enhancements, functionality, usability, design and support. Regarding the security, Modx has good result which provide secure authentication and low inconsistency. Drupal and Joomla share the same efficient features of administration, management functionality and design. Drupal and Joomla showed superlative results in time behaviour efficiency. In the analysis, it was proved that Modx, Drupal, Joomla, and WordPress are efficient CMS and have many terrific features. Based on the results of the multiple attribute decision making, it was concluded that the suitable CMS for creating website for medical tourism in Czech Republic was WordPress.

The third partial goal was to compare different approaches to design and implementation of web presentation. The results of CMS and manual coding comparison said that, both techniques are useful and summarized that CMS support manual coding. The practical effort for designing and developing was very motivating and fruitful. The activity resulted substantial experience and an opportunity to learn more about web development and its underlying technologies. Finally, as a conclusion, the research presented analysis of CMS. the research results might be useful for whom interested in designing, developing and trying to delve into more details about CMS and trying find the right selected for their projects.

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69. jQuery Plugins. [Online] [Cited: January 14, 2017.] http://jquery.malsup.com/

8 Appendix

8.1 APPENDIX 1. The generations and versions of the chosen CMSs

Figure 39 shows The generations and versions of Modx, Drupal, Joomla and WordPress.

2017	2.5.2	8.2.6	3.6	4.7
2016	2.5	8.1.9	3.5	4.6
2015	2.4		3.4	4.1
2014	2.3	7.29	3.3.1	3.9
2013			3.0-3.2	3.8
2012	1.1		2.5	3.4 3.5
2011		7.0	1.6 1.7	
2010				3.1
2009				3.0
2008	0.9	7.32	1.5	2.8 – 2.9
2007		5.0		2.5 – 2.7
2006				2.1 -2.3
2005			1.0	
2004				1.5 2.0
2003	0.7			1.0 -1.2
2002		4.0		
2001		1.0 -3.0		

Figure 39 The generations and versions of the chosen CMSs, source author, 2017

8.2 APPENDIX 2. Requirements and installation process

The basic requirements and installation process for Modx, Drupal, Joomla and WordPress are the same.

There are two ways to install all four CMSs. A manual way or using an installation software which is installed on the hosting server and offers user-friendly interface for the management of the site and the installation of software, but the requirements for both are very similar. The author made an analysis using CRAFT.CASE business process analysis tool to simulate and define the installation process with basic requirement

Figure 40 shows simulation of CMS installation process:

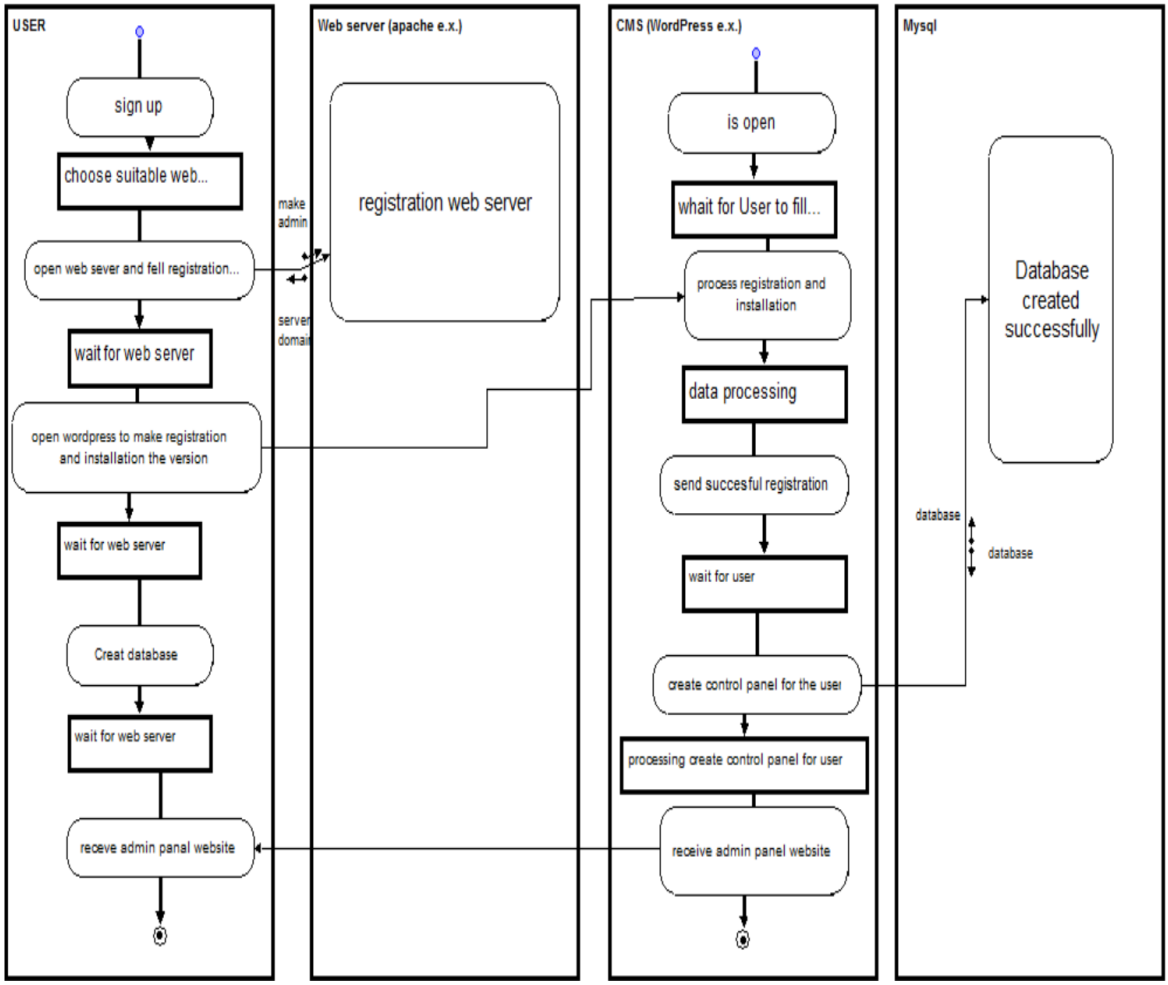

Figure 40 The generations and versions of the chosen CMSs, source author, 2017

All CMSs chosen requires an operating system, a web server and Database. The graph shows the installation process which start point tell getting the admin panel throw the following steps:

User needs server for uploading the content management system. User register in the web server.

User downloads installation package of content management system with suitable version from official web site, or using one insulation click from hosting server.

User goes through the installation process which consists of writing required site information:

Name

Password

admin e-mail

other required information.

- Content management system connects to the database.
-
- CMS present the languages list and the settings which user can select.
- User receive admin panel website to start creating the website.
- Manual installation time for WordPress is 5 minutes, and it is 10 minutes in Drupal and Joomla and 12 minutes in Modx.
- WordPress install easily in the intended environments with less installation time.

Table 21 shows the installation features. Yes, means the CMS achieves this feature.

The installation features, source author, 2017

Table 21 the installation features, source author,2017.

INSTALLATION FEATURES	MODX	DRUPAL	JOOMLA	WORDPRESS
package software	Yes	Yes	Yes	Yes
One clicks insulation availability	Yes	Yes	Yes	Yes
Install in acceptable time,	Yes	Yes	Yes	Yes
Can be installed and run in its intended environments	Yes	Yes	Yes	Yes

-

8.3 APPENDIX 3. SEO test results, source: author, 2017

Table 22 shows SEO test results for Modx, Drupal, Joomla and WordPress.

Table 22 SEO test results, source: author, 2017

CRITERIA	MODX	DRUPAL	JOOMLA	WORDPRESS
Page Title	Yes	Yes	Yes	Yes
Meta Description	Yes	Yes	Yes	Yes
Meta keywords	Yes	Yes	Yes	Yes
<h1> Headings Status	Yes	No	Yes	Yes
<h2> Headings Status	Yes	Yes	Yes	Yes
Robots.txt Test	Yes	Yes	Yes	Yes
Sitemap Test	Yes	Yes	Yes	Yes
Underscores in Links Test	Yes	No	Yes	No
SEO Friendly URL Test	No	No	Yes	No
Image Alt Test	Yes	No	Yes	No

Inline CSS Test	No	No	No	No
Favicon Test	No	No	Yes	Yes
Deprecated HTML Tags	Yes	Yes	Yes	Yes
index Tag Checker	Yes	Yes	Yes	Yes
follow Tag Checker	Yes	Yes	Yes	Yes
Domain Authority	No	No	No	No
Page Authority	No	No	No	No
WWW redirection Test	Yes	Yes	Yes	Yes
HTML Page Size Test	Yes	Yes	Yes	Yes
HTML Compression/GZIP Test	Yes	Yes	Yes	Yes
Summation of right mark	15	12	17	13
change to score point	3	2.4	3.2	2.6
final score	3	2	3	3

Yes, means the CMS achieves this feature.

To get the results author follows this relation: Σ (X)/i

when result is Yes, X = 1

when result is No, X = 0, which i =5

author divided result by i to get result in form of 4 points

8.4 APPENDIX 4. Time behaviour-load time speed.

Figure 42 shows Time behaviour-load time speed for Modx, Drupal, Joomla and WordPress.

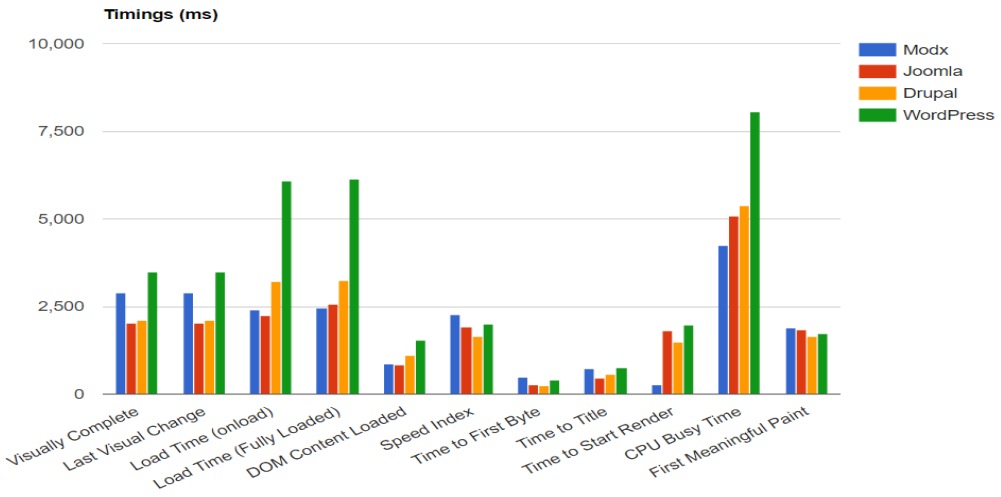

Figure 41 Time behaviour-load time speed, source author - 2017

8.5 APPENDIX 5. Time behaviour-visual process

Time behaviour-visual process, for Modx, Drupal, Joomla and WordPress.

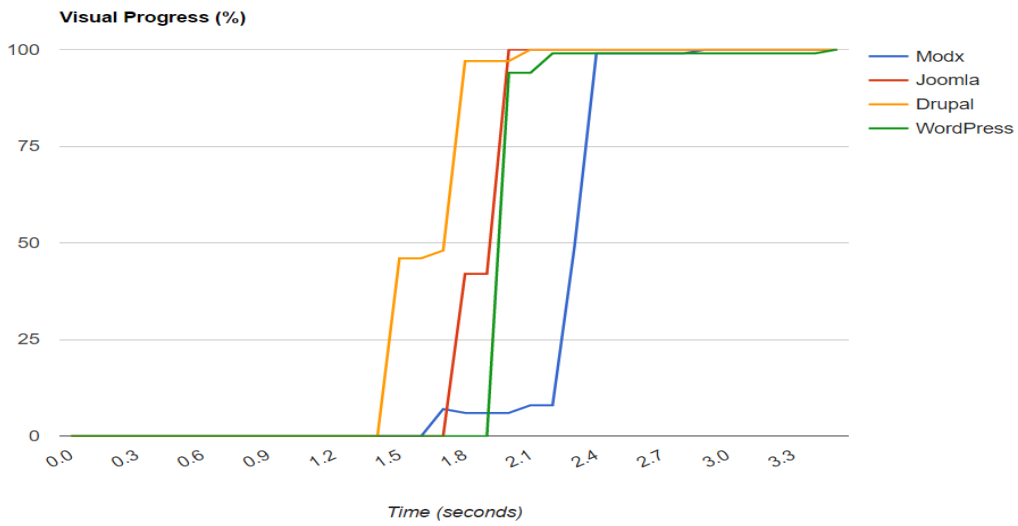

Figure 42 Time behaviour-visual process, source author - 2017

8.6 APPENDIX 6. Time behaviour-Requests

Time behaviour-Requests, for Modx, Drupal, Joomla and WordPress.

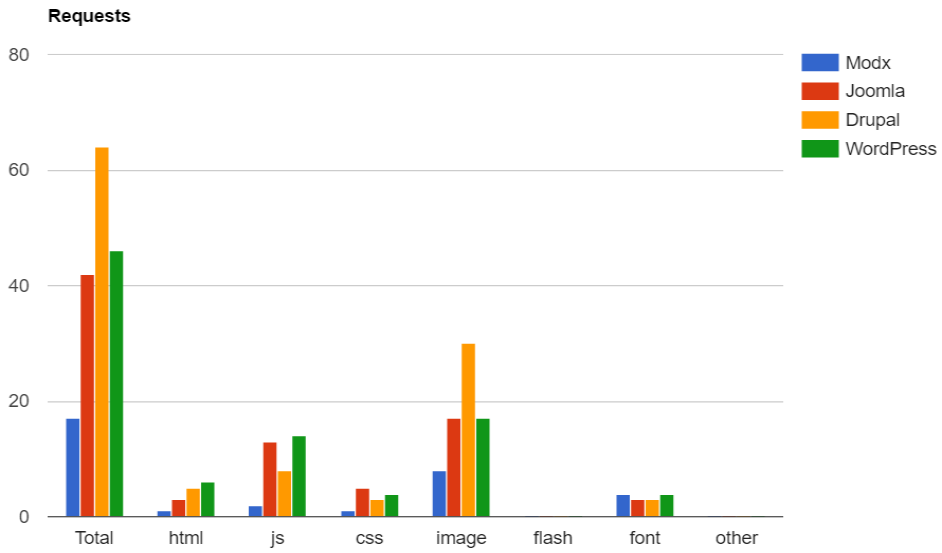

Figure 43 Time Behaviour-Requests, source author - 2017

8.7 APPENDIX 7. The download of the selected theme per a day

Twenty Seventeen is the new default theme for WordPress in 2017. Its business-oriented design highlights the new video headers, and has a front-page layout that can be created from multiple sections (57). Figure 44 shows the download of the selected theme per a day

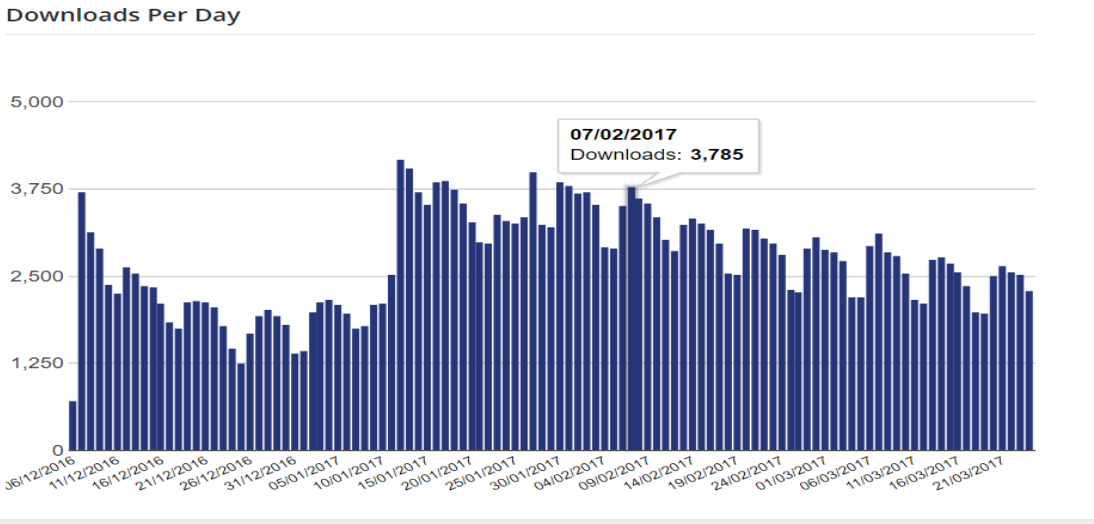

Figure 44 The download of Twenty-Seventeen theme per a day source (57)

8.8 APPENDIX 8 Wireframe responsive design templet.

Figure 45 shows Wireframe responsive design templet.

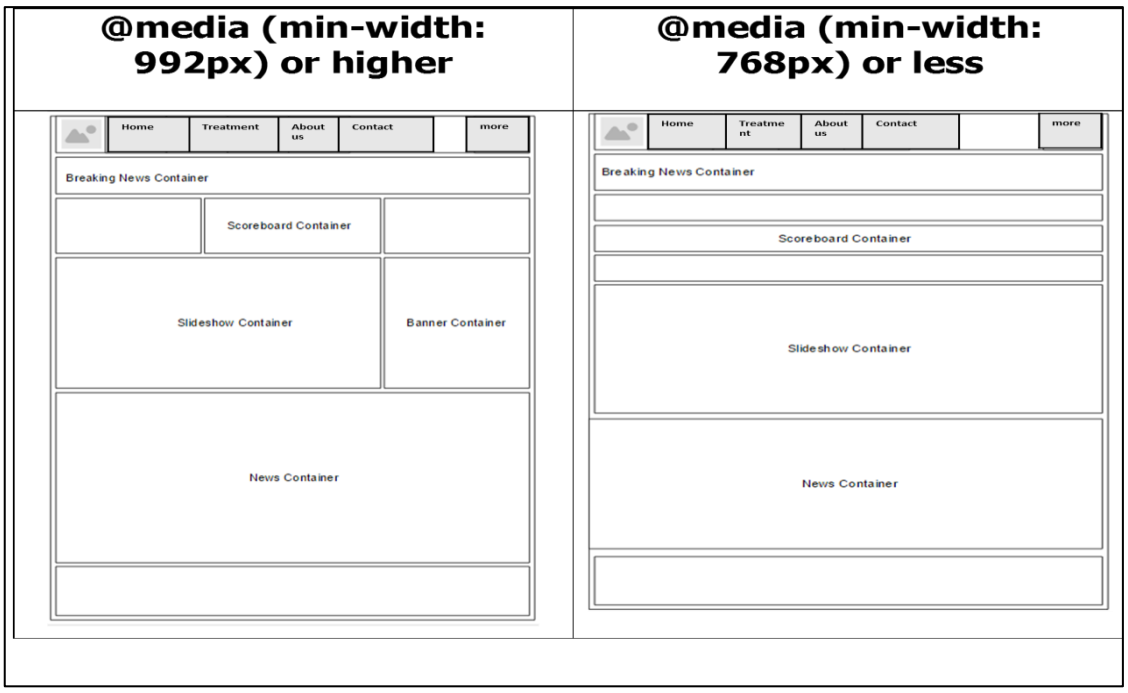

Figure 45 Wireframe responsive design templet, source author - 2017

8.9 APPENDIX 9. Wireframe for Home front page - WordPress project

Figure 46 shows Wireframe for Home front page - WordPress project

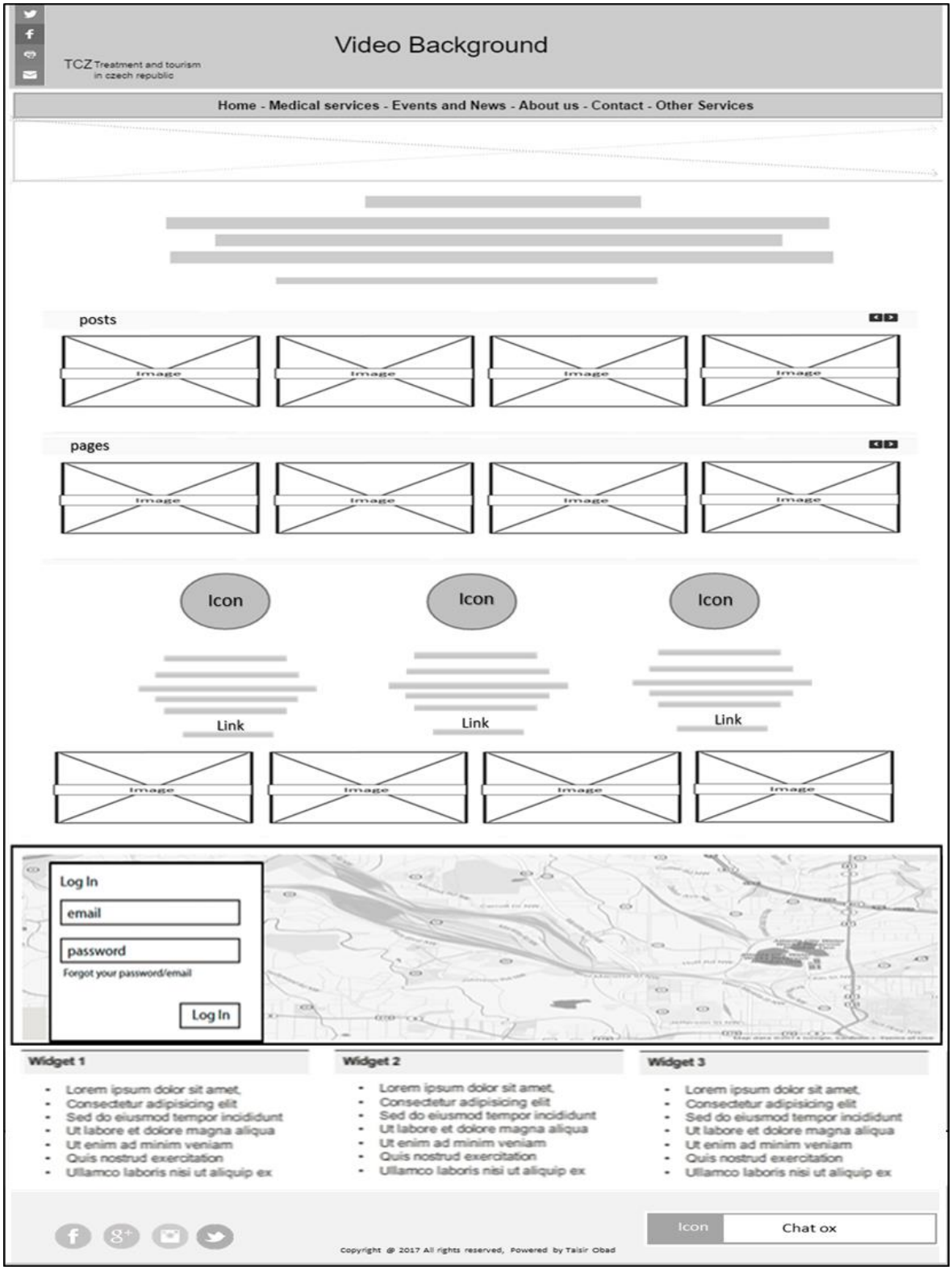

Figure 46 Wireframe for Home front page - WordPress project, source author - 2017

8.10 APPENDIX 10. Wireframe for Medical services page - WordPress project

Figure 47 shows APPENDIX 10. Wireframe for Medical services page - WordPress project

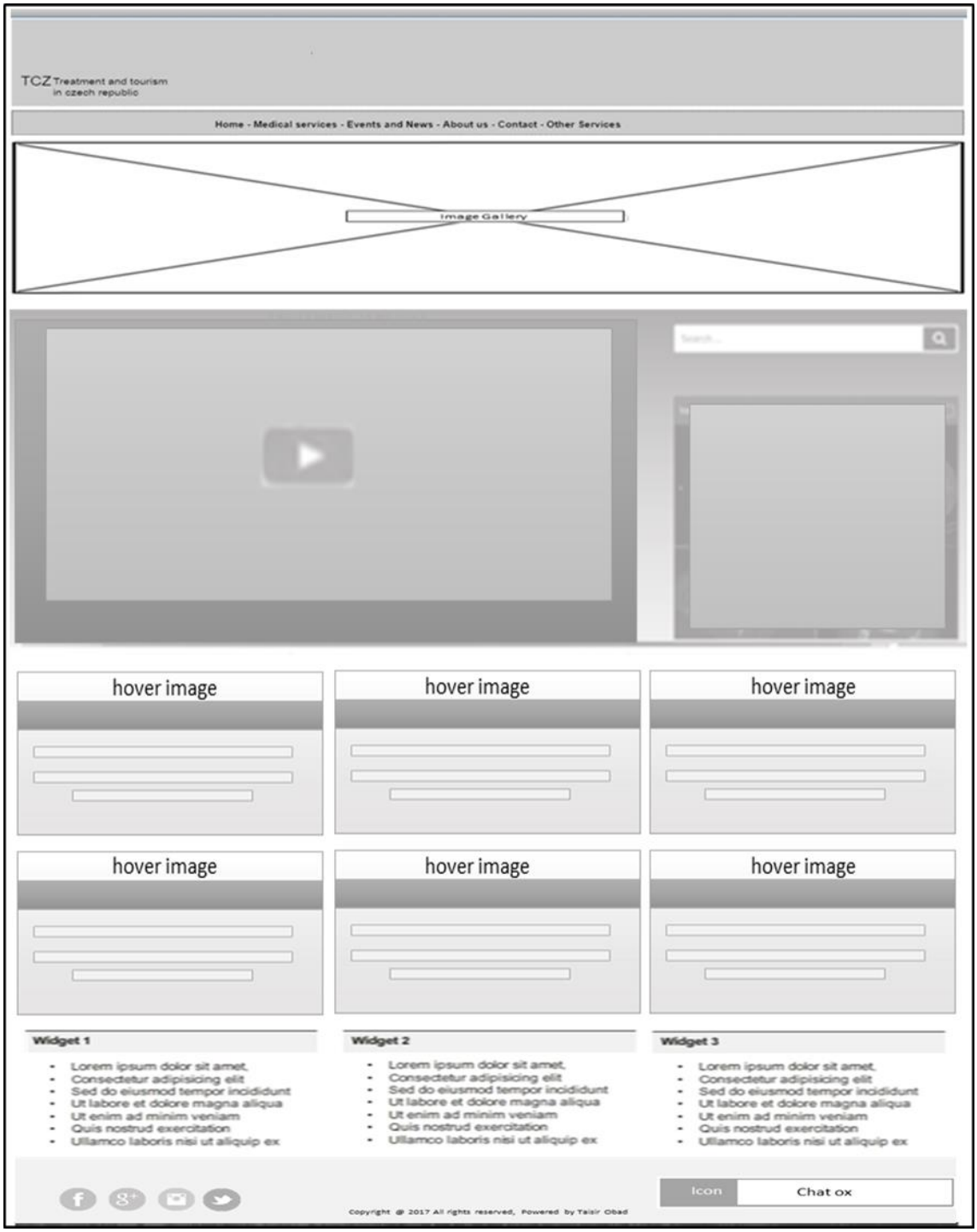

Figure 47 Wireframe for Medical services page - WordPress project, source author - 2017

8.11 APPENDIX 11. Wireframe for About page - WordPress project

Figure 48 shows Wireframe for About page - WordPress project.

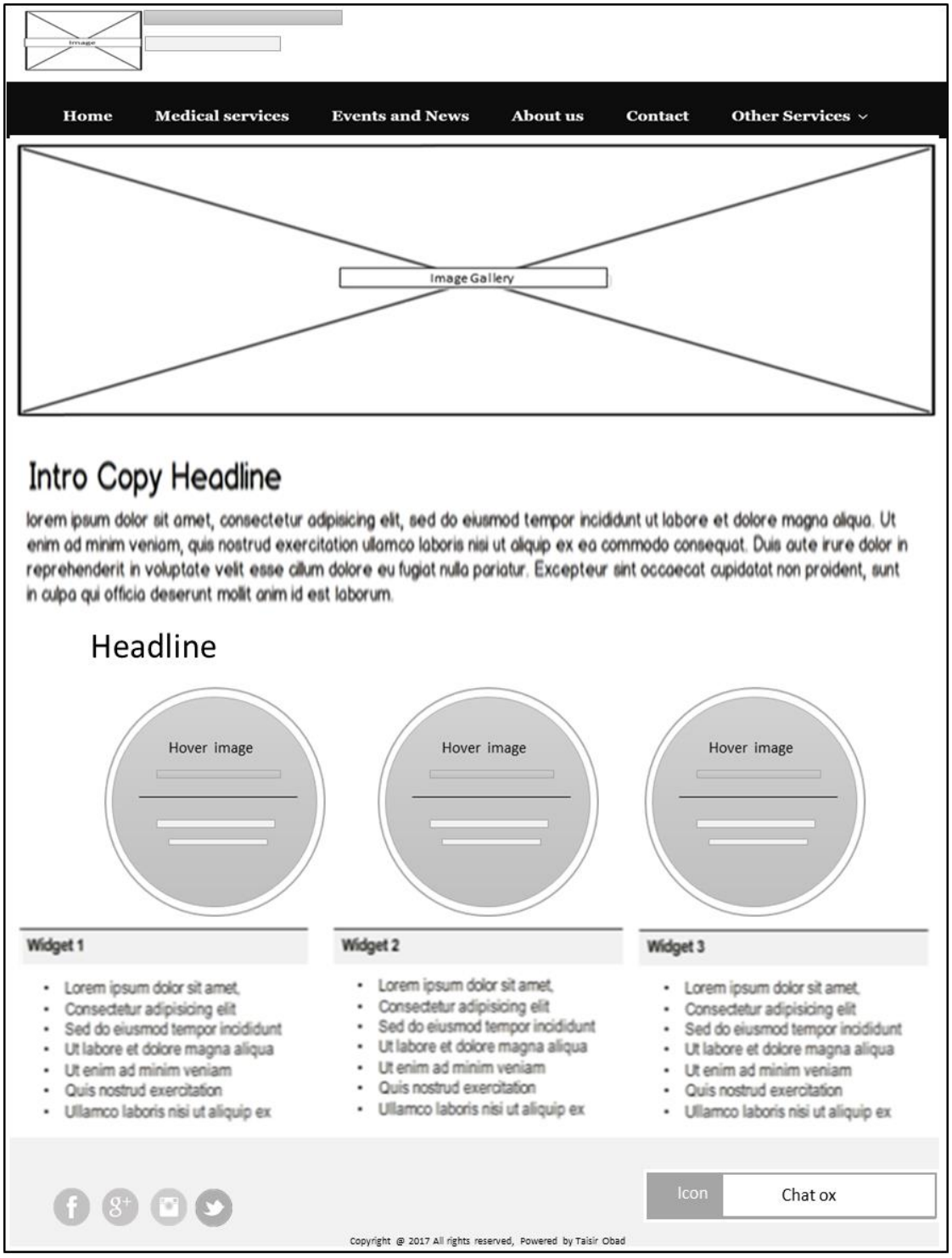

Figure 48 Wireframe for About page - WordPress project, source author - 2017

8.12 APPENDIX 12. Wireframe for Contact page - WordPress project

Figure 49 shows wireframe for Contact page - WordPress project

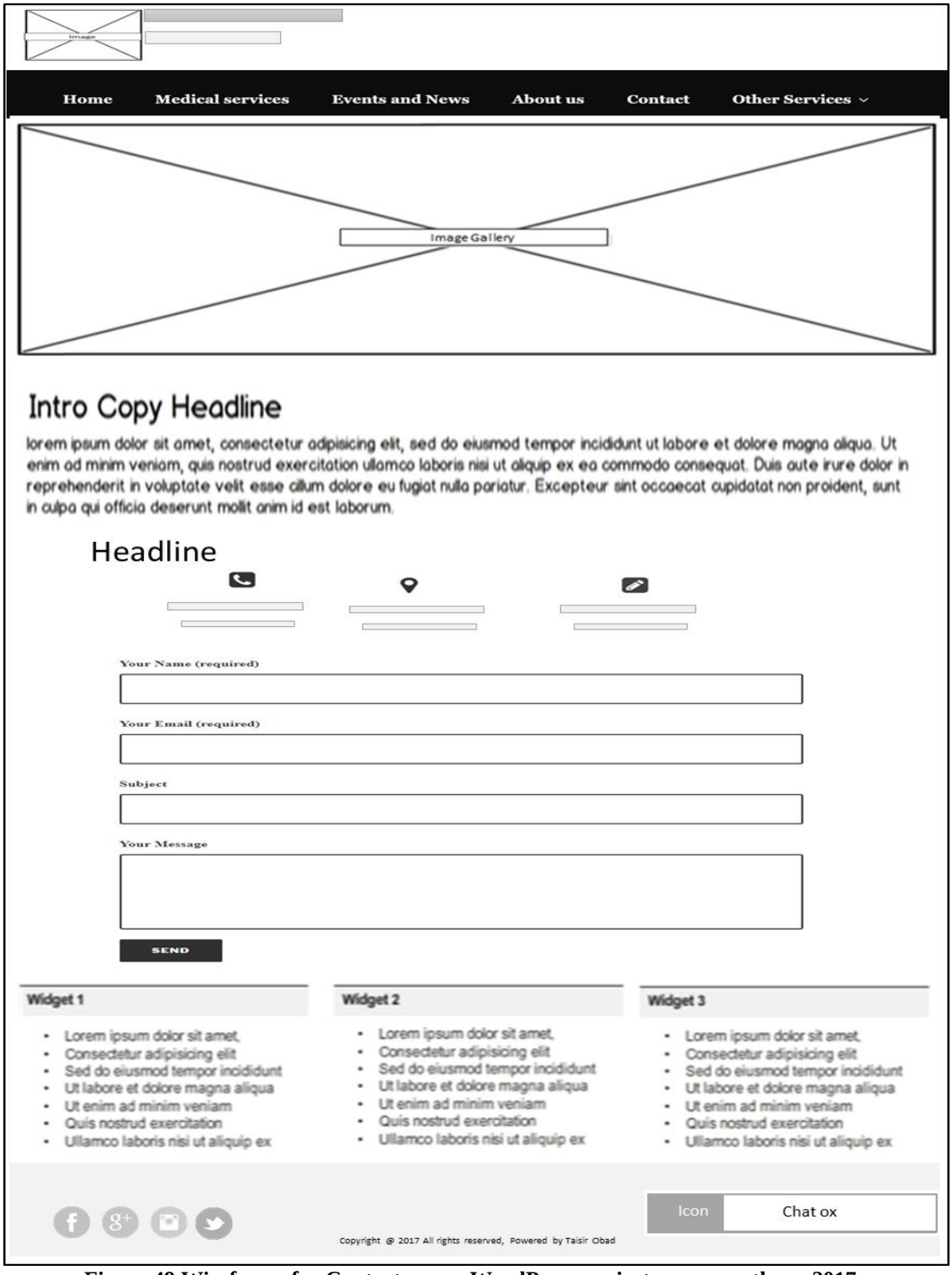

Figure 49 Wireframe for Contact page - WordPress project, source author - 2017

8.13 APPENDIX 13. Wireframe for Home - manual coding project

Figure 50 shows Wireframe for Home - manual coding project.

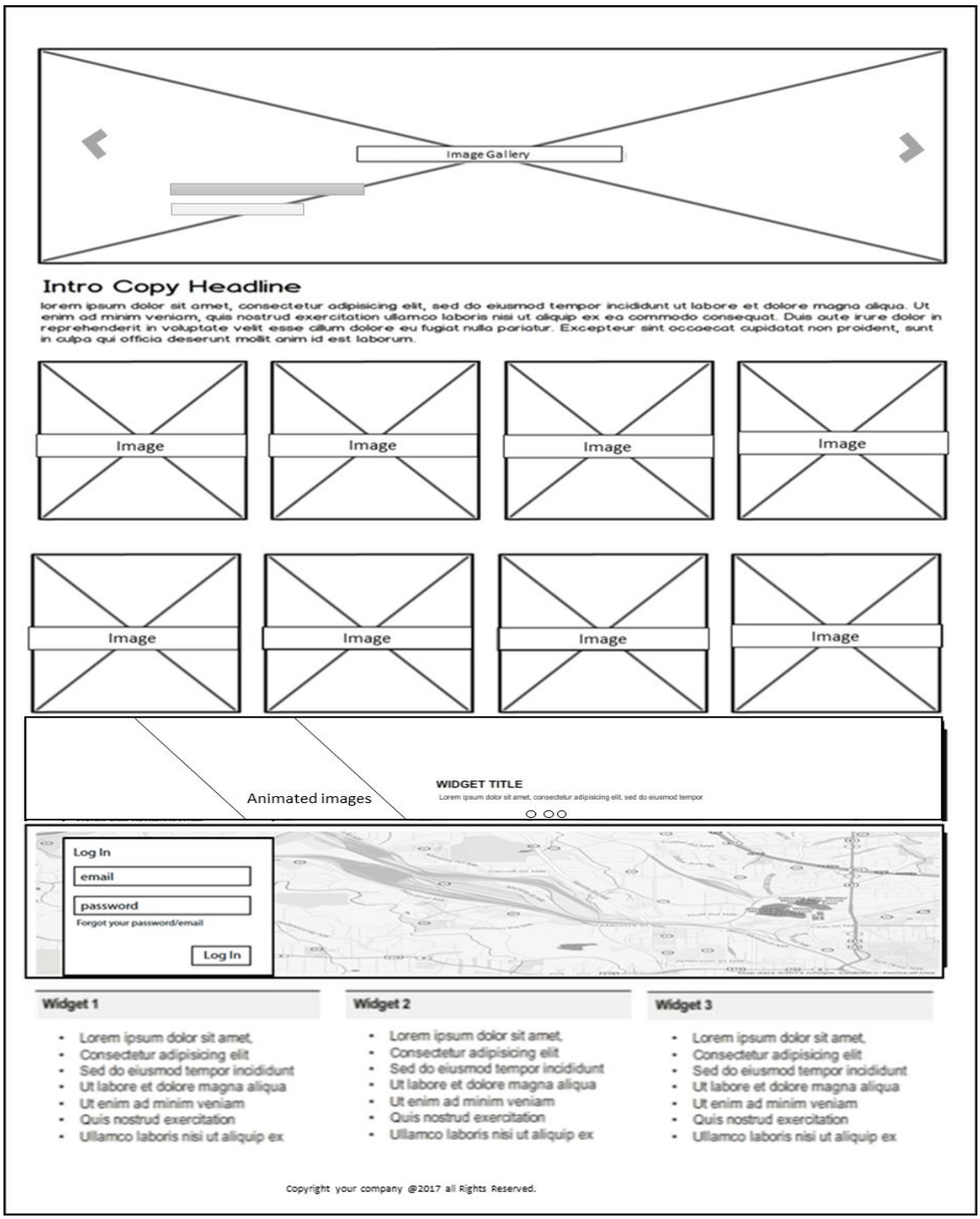

Figure 50 Wireframe for Home - manual coding project, source author - 2017

8.14 APPENDIX 14. Wireframe for contact page - manual coding project

Figure 51 shows wireframe for contact page - manual coding project

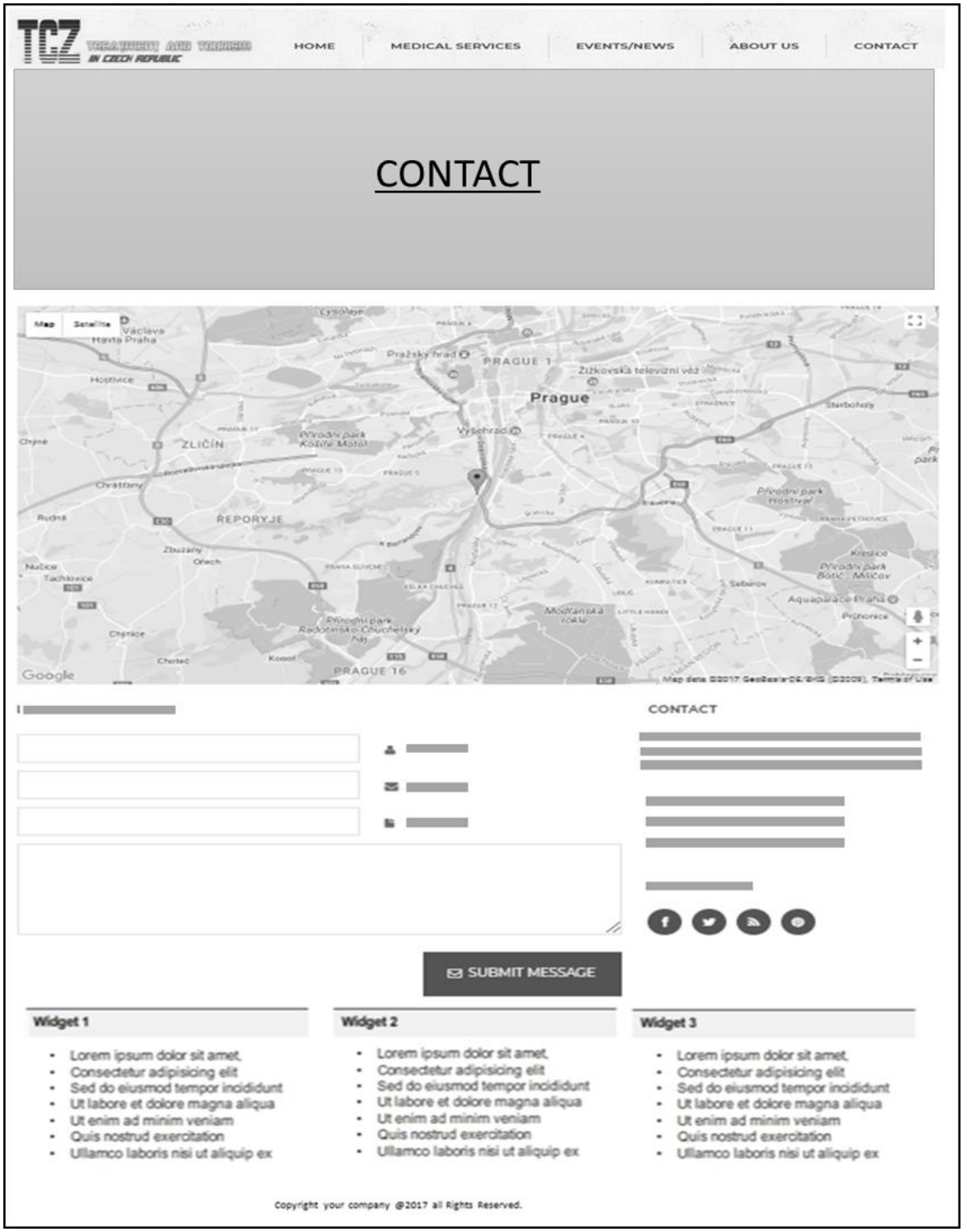

Figure 51 Wireframe for contact page - manual coding project, source author - 2017

8.15 APPENDIX 15. Wireframe for about page - manual coding project

Figure 52 shows Wireframe for about page - manual coding project.

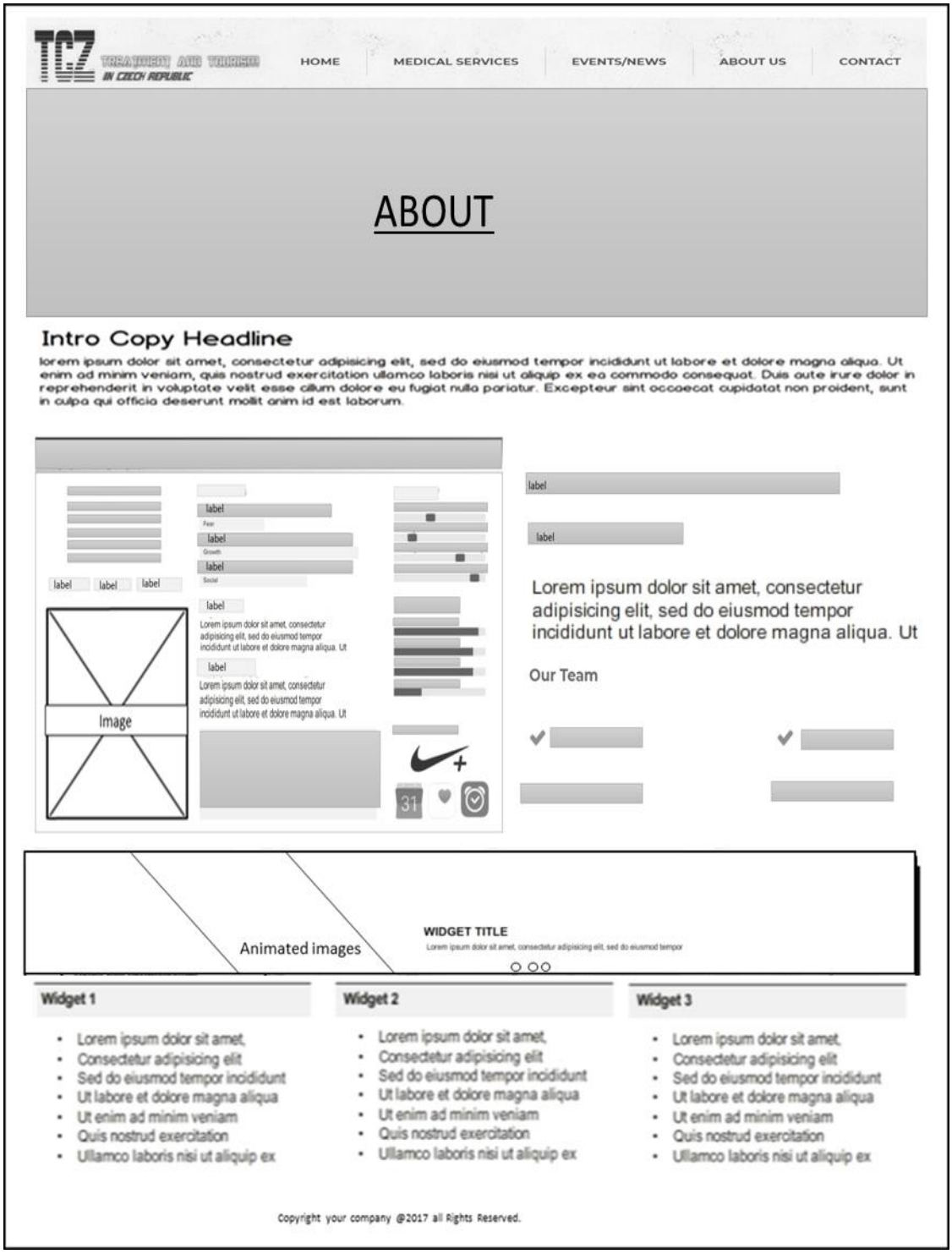

Figure 52 Wireframe for about page - manual coding project , source author - 2017

8.16 APPENDIX 16. Wireframe for the microsite.

Figure 53 shows wireframe for the microsite.

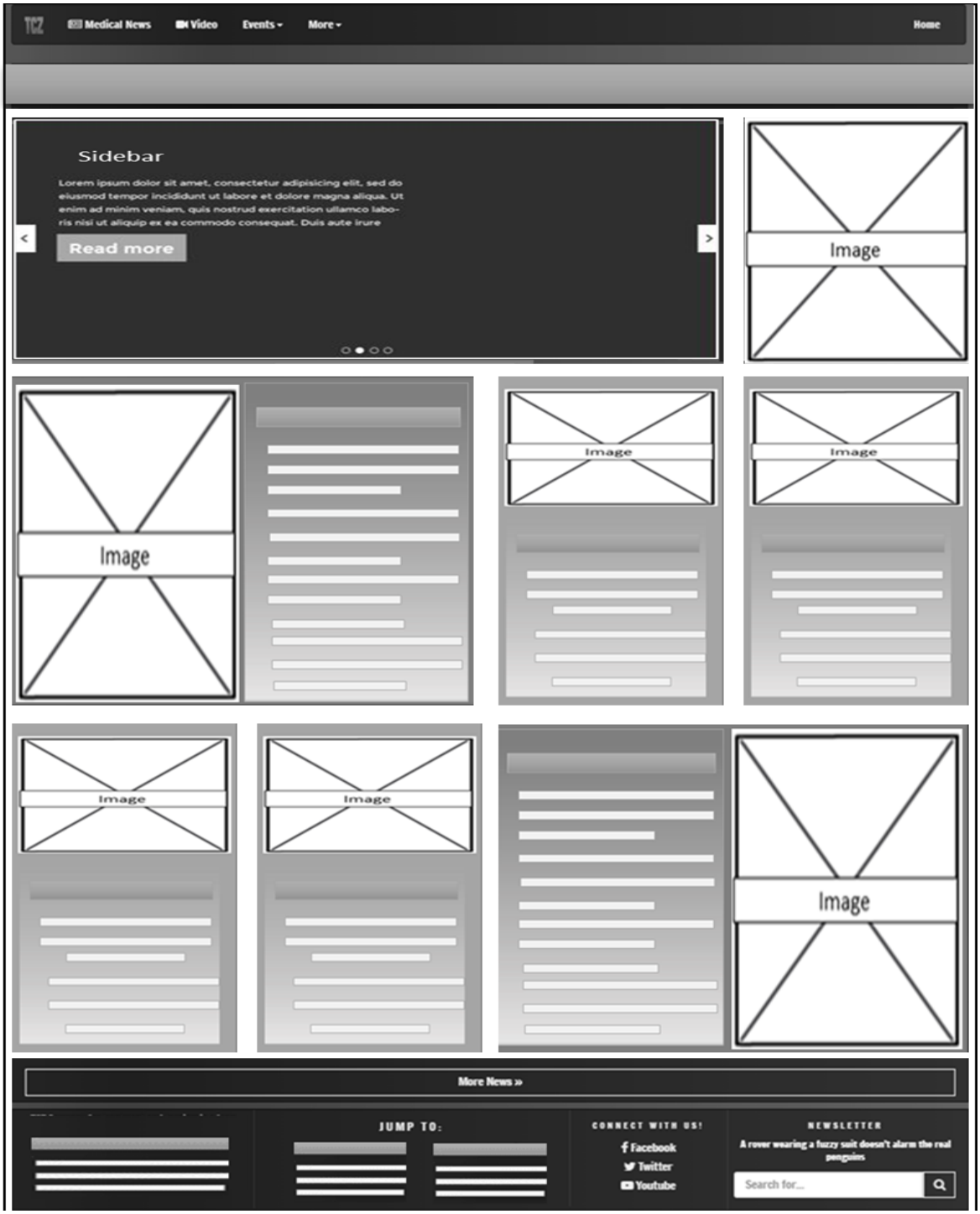

Figure 53 wireframe for the microsite, source author - 2017

8.17 APPENDIX 17. Front page interface – WordPress project, top part

Figure 54 shows Graphical representation of Front page interface – WordPress project, top part.

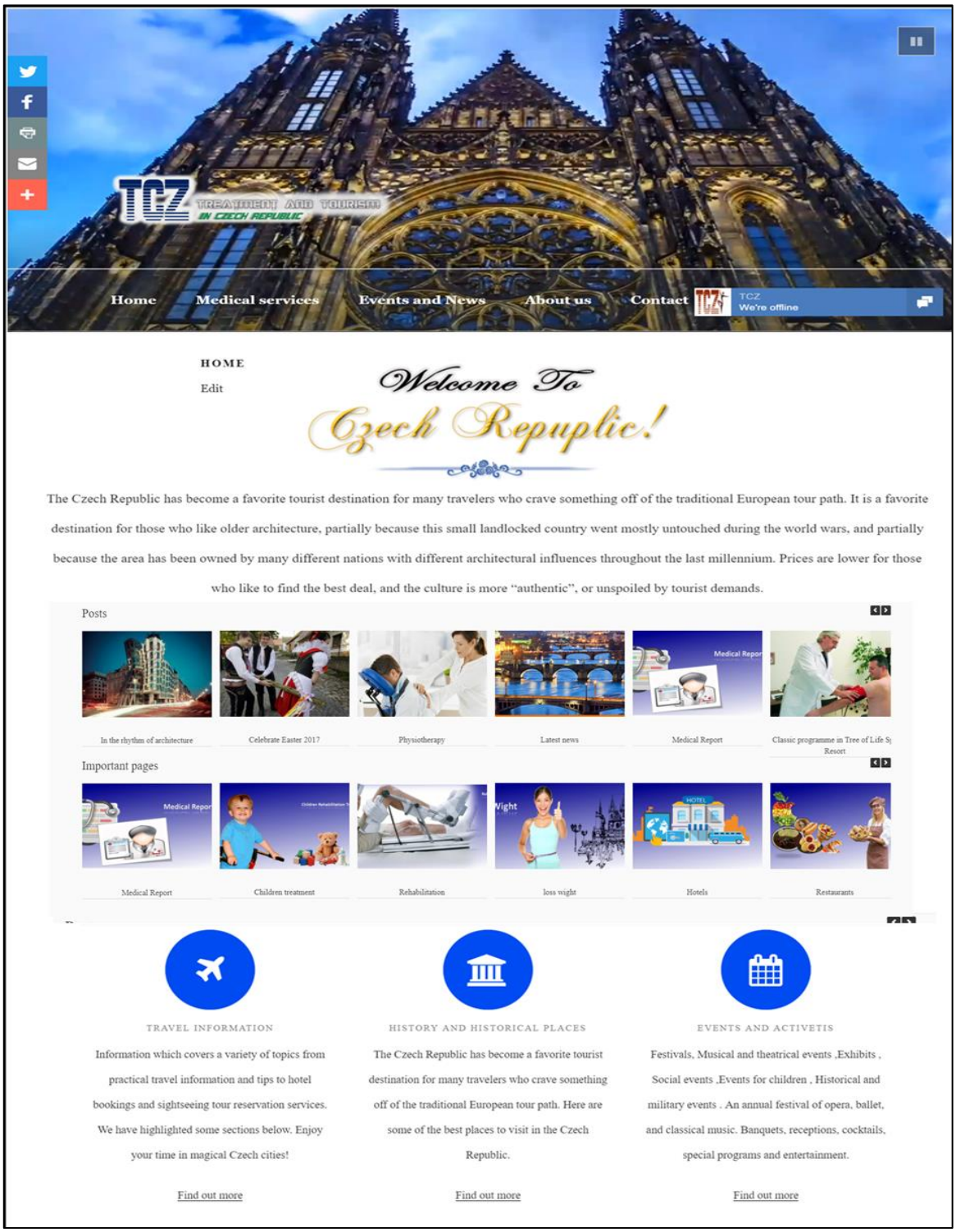

Figure 54 Front page interface – WordPress project, top part, source author - 2017

8.18 APPENDIX 18. Front page interface – WordPress project, bottom part

Figure 55 shows Graphical representation of Front page interface – WordPress project, bottom part.

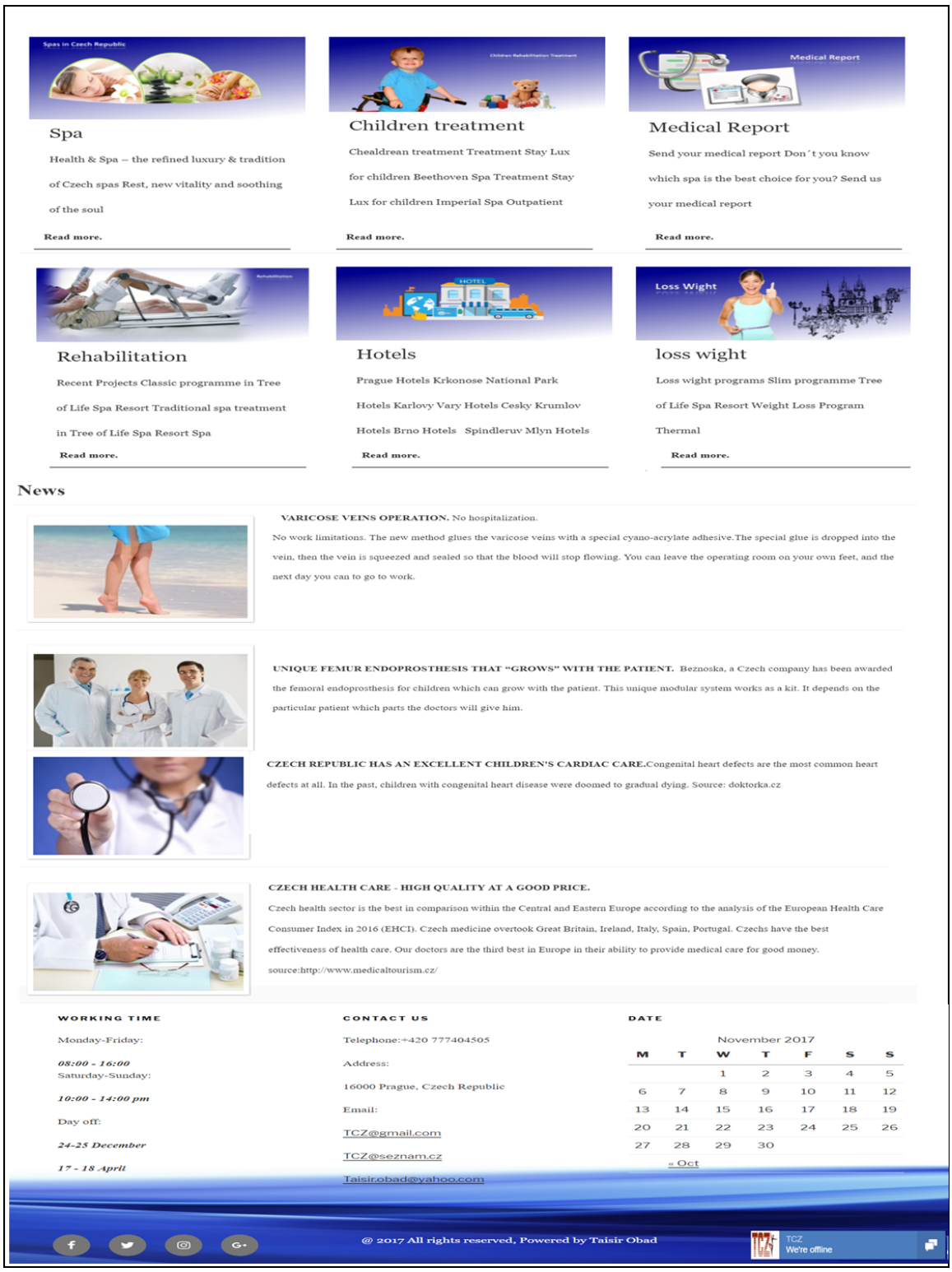

Figure 55 Front page interface – WordPress project, bottom part, source author - 2017

8.19 APPENDIX 19 Medical services page interface – WordPress project

Figure 56 shows Graphical representation of Medical services page interface – WordPress project.

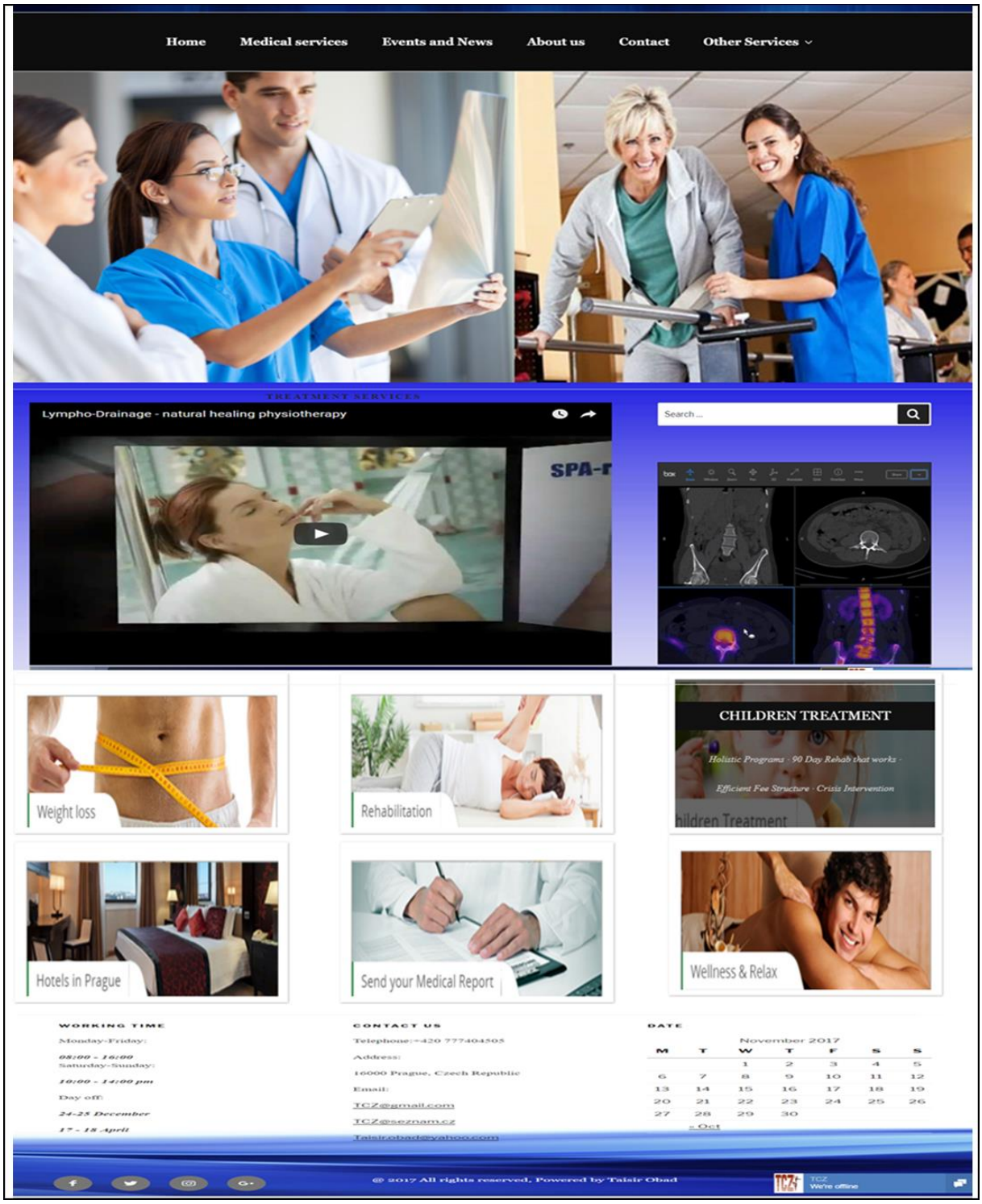

Figure 56 Medical services page interface – WordPress project, source author - 2017

8.20 APPENDIX 20. About Us page – WordPress project

Figure 57 shows Graphical representation of About Us page – WordPress project

Figure 57 About Us page – WordPress project, source author - 2017

8.21 APPENDIX 21. Contact Us – WordPress project

Figure 58 shows Graphical representation of Contact Us – WordPress project.

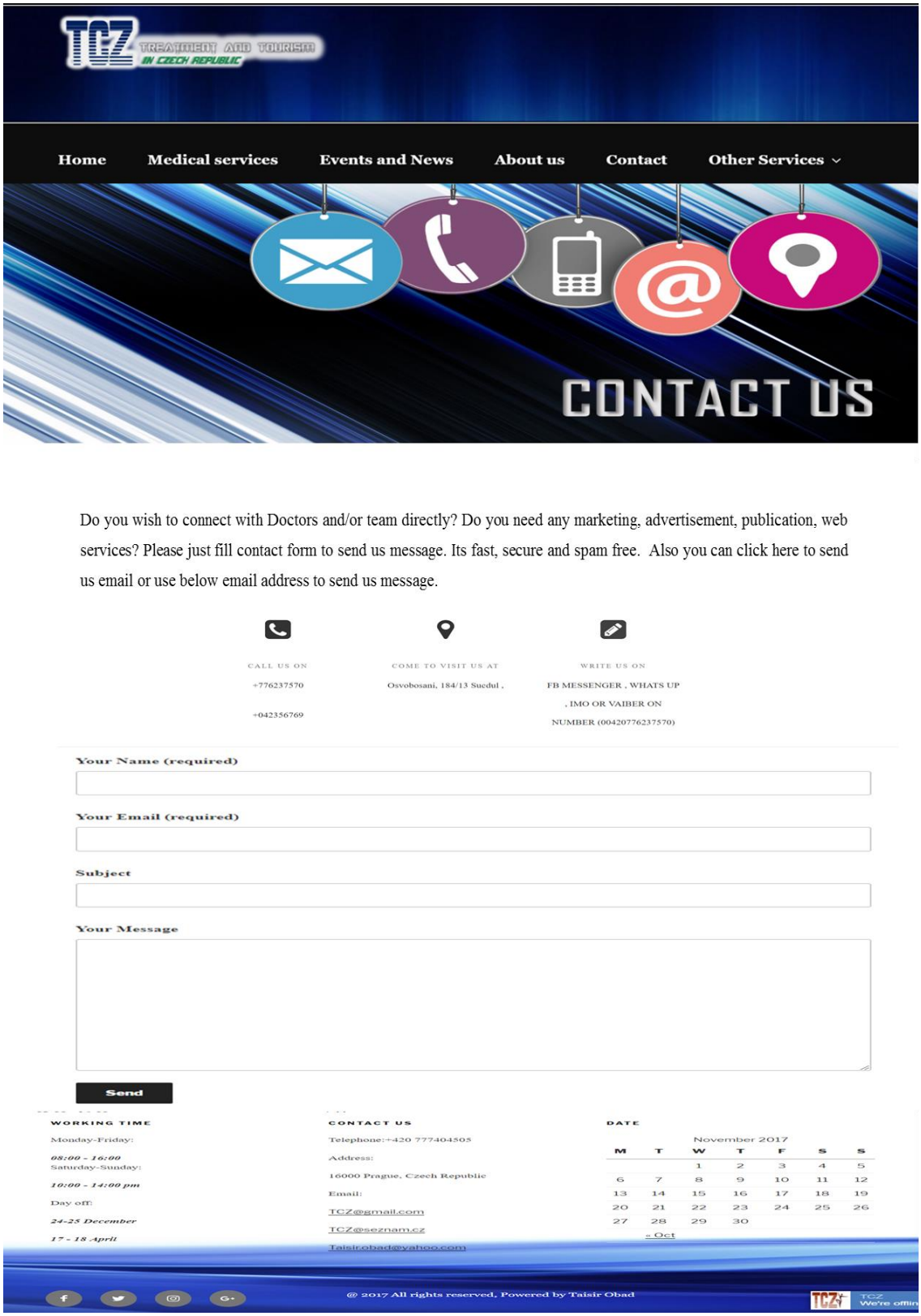

Figure 58 Contact Us – WordPress project, source author - 2017

8.22 APPENDIX 22. Front page - manual coding project

Figure 59 shows Graphical representation of Front page - manual coding project

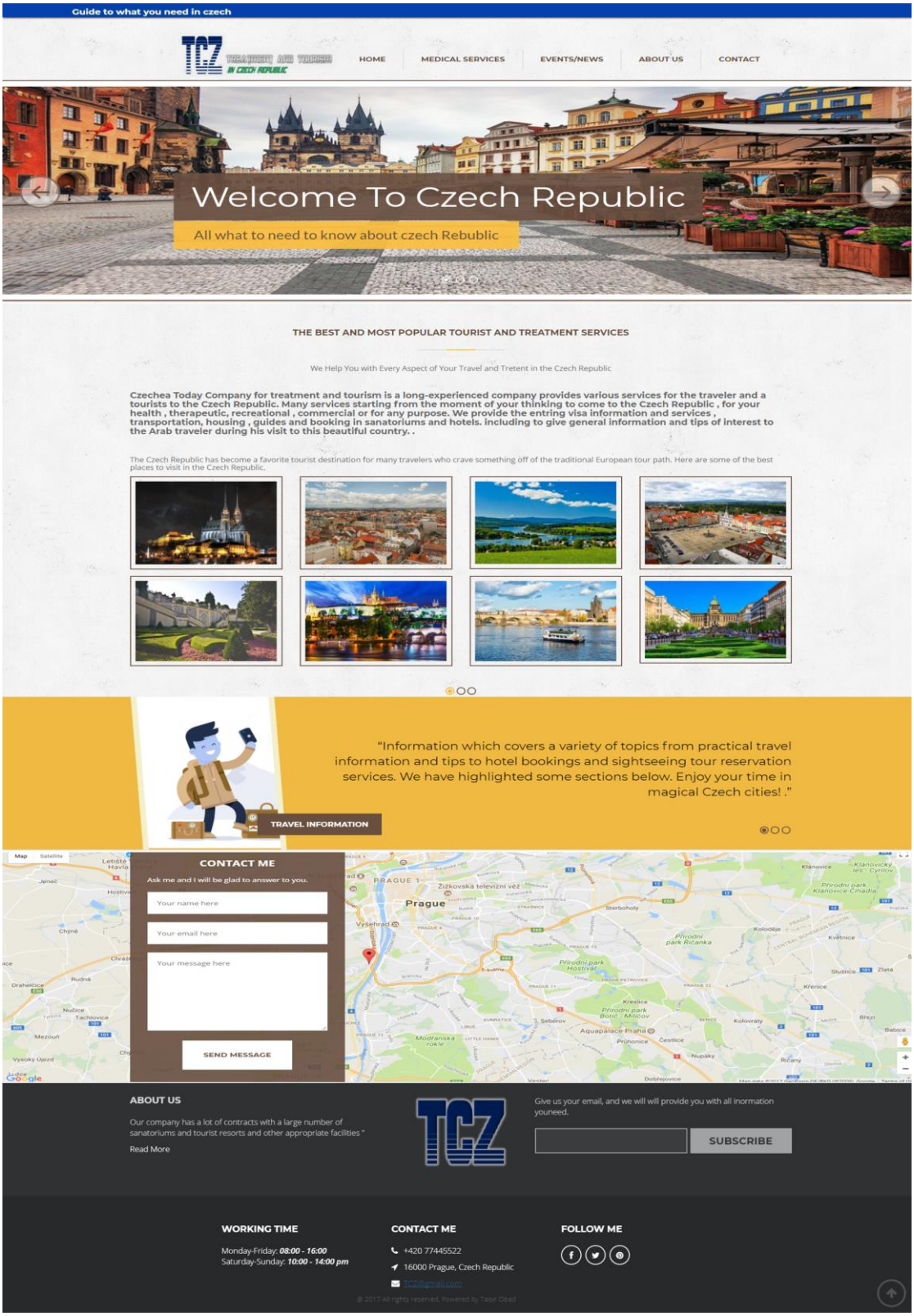

Figure 59 Front page - manual coding project, source author - 2017

8.23 APPENDIX 23. About page - manual coding project

Figure 60 shows Graphical representation of About page - manual coding project.

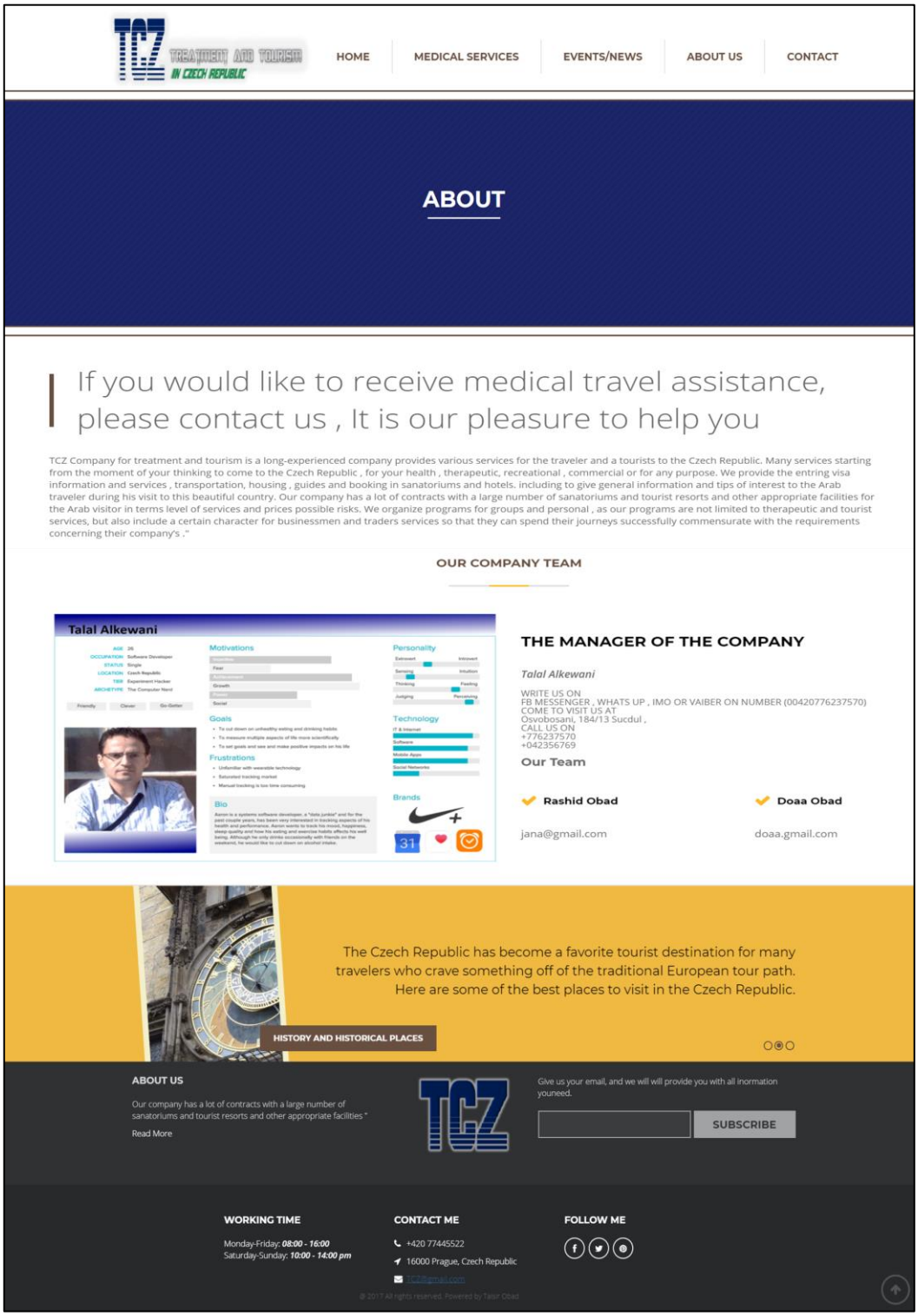

Figure 60 About page - manual coding project, source author - 2017

8.24 APPENDIX 24. Contact page - manual coding project

Figure 61 shows Graphical representation of Contact page - manual coding project.

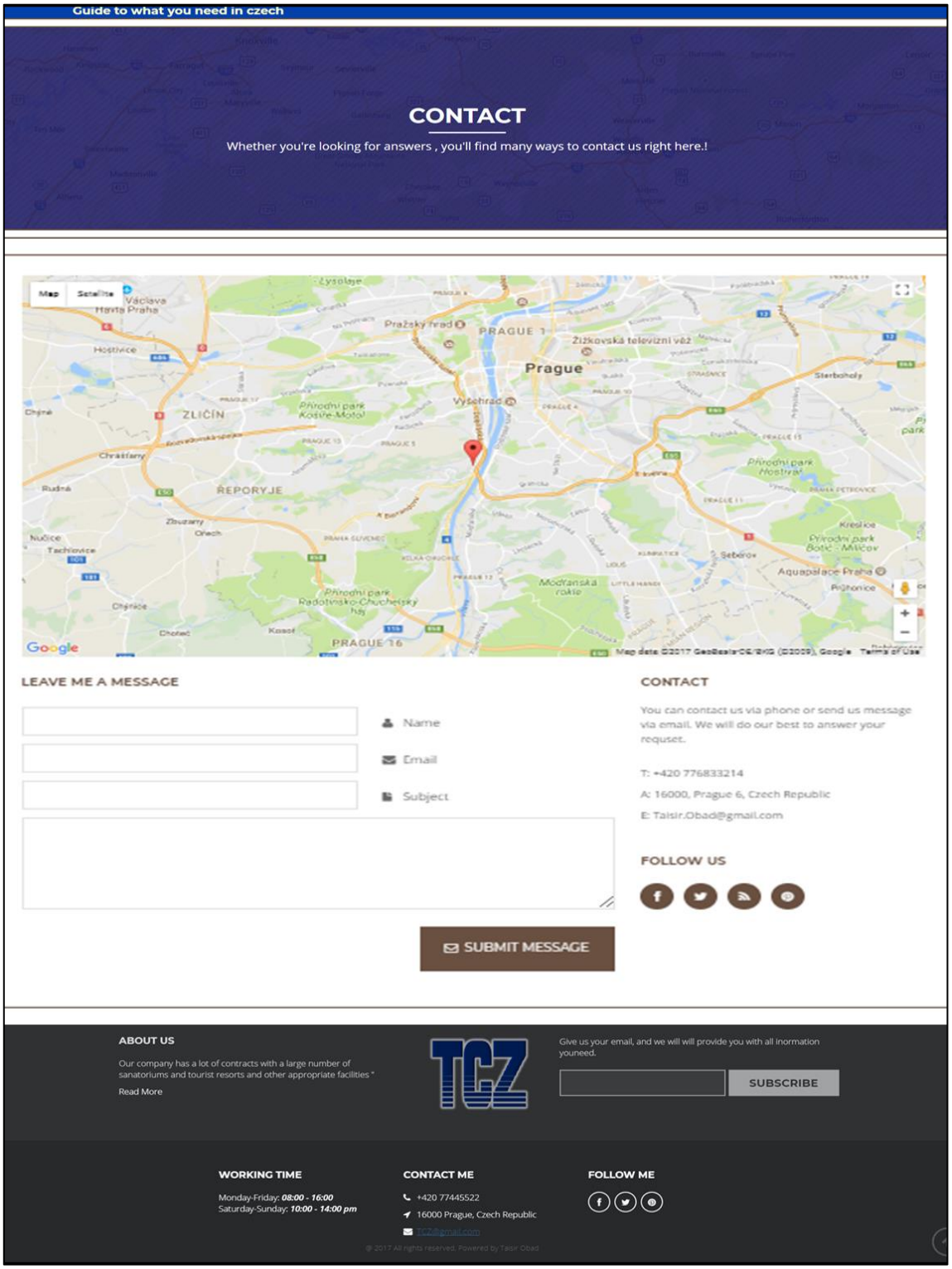

Figure 61 Contact page - manual coding project, source author - 2017

8.25 APPENDIX 25. The Microsite website – News

Figure 62 shows Graphical representation of The Microsite website – News.

Figure 62 Microsite website Interface - News, source author - 2017

8.26 APPENDIX 26. Graphical representation of The Microsite website – Videos

Figure 63 shows Graphical representation of The Microsite website – Videos

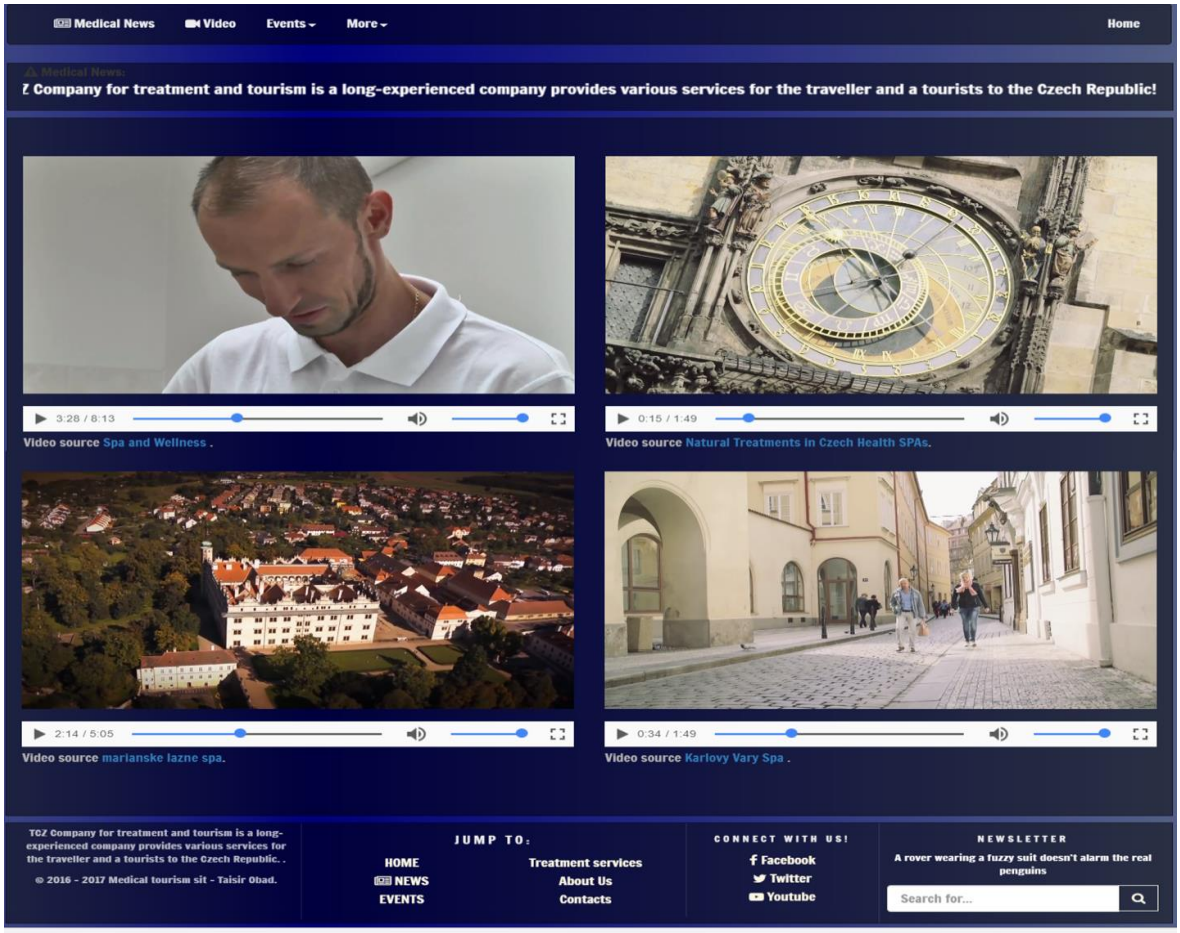

Figure 63 The Microsite website Interface – Videos, source author - 2017

8.27 APPENDIX 27 Optimizing WordPress Robots.txt file for SEO

```
User-Agent: *
Allow: /wp-admin
Allow: /wp-admin/admin-ajax.php
Allow: /wp-content/uploads/
Disallow:/wp-includes/js/
Disallow:/wp-includes/images
Disallow: /wp-content/plugins/
Disallow: /wp-login.php
Disallow: /wp-register.php
Disallow: /readme.html
Disallow: /refer/
```