Tampere University

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CLOUD-BASED ACCESS PORTAL FOR DESIGNER DOCUMENTATION IN SOC DEVELOPMENT

Master's Thesis
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ABSTRACT

Zaighum Sultan: Cloud-Based Access Portal for Designer Documentation in SoC Development
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Document Management System plays an important role in any organization especially when it comes to retrieving hundreds of documents. Various companies use Document Management Systems for their specified purposes like accessing and managing the documents, editing online etc. Each Document Management System functionality varies according to the required features. Keeping in mind above mentioned criteria, Documentation Technology team in our department came up with an idea to create an access portal where the Designer Team can access required documents through one access point.

Designer documentation in our department is scattered in various platforms and tools. It's hard to keep track of each document, whether it's HW, SW, Modelling, Design, or Verification related. The Access Portal front end is based on HTML, CSS, and Bootstrap. While Django Framework and Python are used to build the back end. PostgreSQL serves as a database to store the documents. Docker is used as a cloud container to run the website on our company's internal cloud UNIX server.

Keywords: Document Management System, Web Development, Web Designing, Cloud-based Documentation Access.

PREFACE

أَعُوذُ بِاللّٰهِ مِنَ الشَّيْطَانِ الرَّجِيمِ
بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيمِ

I thank Allah Almighty (JJ) for all the blessings in my life, my family, my friends, education, leisure, and top of all for great teachers.

الصلوٰۃ والسلام علیک یا رسول اللہ
وعلیٰ آلک واصحابک یا حبیب اللہ

I thank my beloved Prophet Muhammad (SAWW) for all I have and for the love that I have for Him (SAWW). I thank Panjtan Paak (AS) and Ashaba e Karam (RA) for all the love and blessings.

وَعَبْدُ الْقَادِرِ الْمَشْهُوْرُ اِسْمِیْ
وَجَدِّیْ صَاحِبُ الْعَیْنِ الْکَمَالِ

I thank Huzoor Syed Abdul Qadir Gillani Ghaus e Azam, Huzoor Aun Qutab Shah Alvi and Huzoor Abdullah Shah Golra Alvi, Huzoor Syed Shahabal Shah Shehenshah Hamdani, Huzoor Syed Shah Sharaf Qalandar Hamdani, Huzoor Syed Bahadar Shah Hamdani, Huzoor Syed Yusuf Gillani and other Aulia e Karam (RA) for everything.

ماں باپ کی نافرمانی گناہِ کبیرہ ہے۔ (صحیح بخاری ۲۶۵۳)

As mentioned above, if a person disobeys his/her parents then it's the greatest sin of all in Islam. I would like to thank my parents and grandparents for everything they did for us, all their dream wishes which they sacrificed for our future. I would specially like to thank my father Malik Zia Sultan Awan for his love, for everything he did for me. I always want to serve my parents, respect them and keep them happy. I would like to thank my beautiful wife for her love and support. I would like to thank my brothers, sisters, and cousins for their motivation, guidance and support. I would specially like to thank Malik Kashan Sultan Awan for his help and support, Malik Mudassir Sultan Awan and Malik Shahbaz Ahmed Awan for their motivation and support, and last but not the least my cute little brother Malik Zaeem Sultan Awan for his love to me.

If a person teaches me one single word, he has made me his servant for a lifetime.

Imam Ali Ibn Abu Talib (AS)

I would like to thank all my respected teachers since school life for their guidance and passion of teaching. I would like to thank my Tampere University supervisors Prof. Mikko Valkama and Associate Prof. Reza Ghabcheloo (Tenure Track) for supervising my thesis work. I would like to thank my managers and colleagues for full support and guidance throughout my thesis. I would like to thank my friends for their support especially my dearest friends Syed Hassan-uz-Zaman Gillani, Umer Hameed, Muhammad Sami Ullah Mann Jutt, and Aamir Jilani Awan and for their moral support and guidance.

Tampere, 10 October 2020

Zaighum Sultan

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LIST OF ABBREVIATIONS

5G	5th Generation Mobile Technology
ACID	Atomicity Consistency Isolation Durability
AI	Artificial Intelligence
AJAX	Asynchronous JavaScript And XML
API	Application Programming Interface
ASIC	Application-Specific Integrated Circuit
CAD	Computer Aided Design
CD	Continuous Development
CI	Continuous Integration
CMS	Content Management System
CPU	Central Processing Unit
CRUD	Create Read Update Delete
CSP	Cloud Service Provider
CSRF	Cross-site Request Forgery
CSS	Cascading Style Sheets
DB	Database
DBMS	Database Management System
DDR	Double Data Rate
DFE	Digital Front End
DMS	Document Management System
DRY	Don't Repeat Yourself
DTL	Django Template Language
ECM	Enterprise Content Management
FPGA	Field Programmable Gate Arrays
GIN	Generalized Inverted Index
GiST	Generalized Search Tree
GUI	Graphical User Interface
HR	Human Resource
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HW	Hardware
I/O	Inputs/Outputs
IP	Intellectual Property
ISO	International Organization for Standardization
JS	JavaScript
JSON	JavaScript Object Notation
L1	5G Layer 1
MATLAB	Matrix Laboratory
MEAN	MongoDB Express.JS Angular.JS and Node. JS
ML	Machine Learning
MVC	Model View Controller
MVCC	Multi-Version Concurrency Control
MVT	Model View Template
ORM	Object Relational Mapping
OS	Operating System
PDF	Portable Document Format
PHP	Hypertext Pre-processor
PWB	Printed Wire Board
R&D	Research and Development
RDBMS	Relational DBMS
REST	Representational State Transfer
RFSW	Radio-Frequency Software

RI	Referential Integrity
ROI	Return on Investment
RTL	Register Transfer Level
SaaS	Software-as-a-Service
SEO	Search Engine Optimization
SoC	System on Chip
SOP	Standard Operating Procedure
SQL	Structured Query Language
SVN	Subversion (version control system)
SW	Software
TB	Terabyte (1,024 Gigabytes)
UI	User Interface
UML	Unified Modelling Language
UNIX	Uniplexed Information and Computing System
URL	Uniform Resource Locator
UT	Unit Testing
UX	User Experience
XML	Extensible Markup Language
XML-RPC	XML-Remote Procedure Call

1 INTRODUCTION

The Chapter gives a high-level overview of HW (Hardware) designing, SW (Software) development, problem statement, and use cases. In high-level introduction, I will walk you through the overall process, what kind of documentation is included/needed to support processes and customers, the importance of documentation in designer teams, as well as the content of documents. Problem statement of the thesis and use cases which helps define the problem in detail.

1.1 Background

In our company's SoC (System on Chip) department, there are billion of documents in different branches. Some of the documents are in word format, some of the documents are stored as code comments in version control, various documents are in UNIX (Uniplexed Information and Computing System) directories, some are stored in SharePoint cloud storage. Thus, designer documentation is dispersed across many resources and platforms, because of the excessive tools and less information about where to search for the document, it is hard to access the documents. To solve this issue, we need a portal to allow anyone to access the document defined by users. This centralized access helps users to reduce their time consumption, to make them frustrate when locating the documents in various tools, and also to access the documents through a user-friendly portal.

On 16 September 2020, our company announced that it has digitalized 100% of its 5G (5th Generation mobile technology) network deployments worldwide, bringing high-quality, agility, and transparency to global customers. Our company simplifies the implementation of the network infrastructure by using digitalization, machine learning and automation, boosting both time-to-market and ROI (Return on Investment) for 5G operators.

Traditional network implementations based on paper and digital documentation combinations that can lead occasionally to errors and inefficiency. Our company enables network roll-outs to be easily and cost efficiently carried out with the aid of digital project orchestration and data inventories, to match customers' mobility needs and to aid them deliver new services to the market more quickly. This leads to a 30 % reduction in site visits and a 30% increase in the quality in installation, a 30% reduction in cycle times of 25%.

Our company facilitates easier, quicker, more effective and better service delivery by digitalizing its 5G network implementations entirely. Our company has assisted over 100 customers globally by offering transparency across all phases of a project. The industry's first digital implementation world1. Digital deployment gives CSPs (Cloud Service Providers) the ability to manage their assets securely and thoroughly by providing a digital network asset database, which can be used to remotely and virtually access sites. Moreover, deployments can be made more reliable by limiting CO2 levels by cutting truck rolls and removing paper, saving approximately 1500 trees each year.

The digital deployments of our company are constantly evolving to take advantage of the power of technologies based on AI (Artificial Intelligence) to further boost efficiencies on a wide scale. Via automated analyses of pre/post deployment of images or video content, intelligent defect recognition can use powerful ML (Machine Learning) algorithms to recognize defects in real-time. The system would also provide intelligent input on the availability of space for the location of specific equipment without the need for a site visit.

Our company has collaborated with Tampere University in Finland to create a "Center of Excellence" focused on the production of custom SoC processors for its ReefShark chipsets used in its 5G infrastructure devices. As a result of its previous decision to use 5G devices heavily focused on FPGAs (Field Programmable Gate Arrays) as opposed to ASICs (Application-Specific Integrated Circuit), the supplier lost ground in 5G-although FPGAs were considered to be more versatile, they are more costly than ASICs-and it has tried to fix the problem by switching to SoC-based products. As part of the partnership, Our company says that it will also explore areas such as machine learning, hardware development for artificial intelligence and security, as well as open source hardware-based SoCs.

1.2 Problem Statement

Designer documentation in our department is scattered in various platforms and tools. It’s hard to keep track of each document, whether it’s HW, SW, Modelling, Design, or Verification related. To solve this problem, our documentation team decided to develop a platform where everyone in our department can access the required documents in one place. Designer Document storages in our organization are mainly SharePoint, Version Control, and UNIX Directories.

1.3 Use Cases

Use cases are always a keen help which helps users understand the requirements of a project. Below are the UML (Unified Modelling Language) use cases which help us define the problem statement of our thesis in detail.

Unified Access to Documents

Designer documentation is scattered in many tools and platforms, it's hard to access the documents because of excessive tools and less information on where to look for the document. To solve this, we need a platform where everyone can access the specified document that users want to read. This unification of document access will allow users to help reduce their time consumption, their frustration of finding the document in different tools, and a user-friendly portal to access the documents.

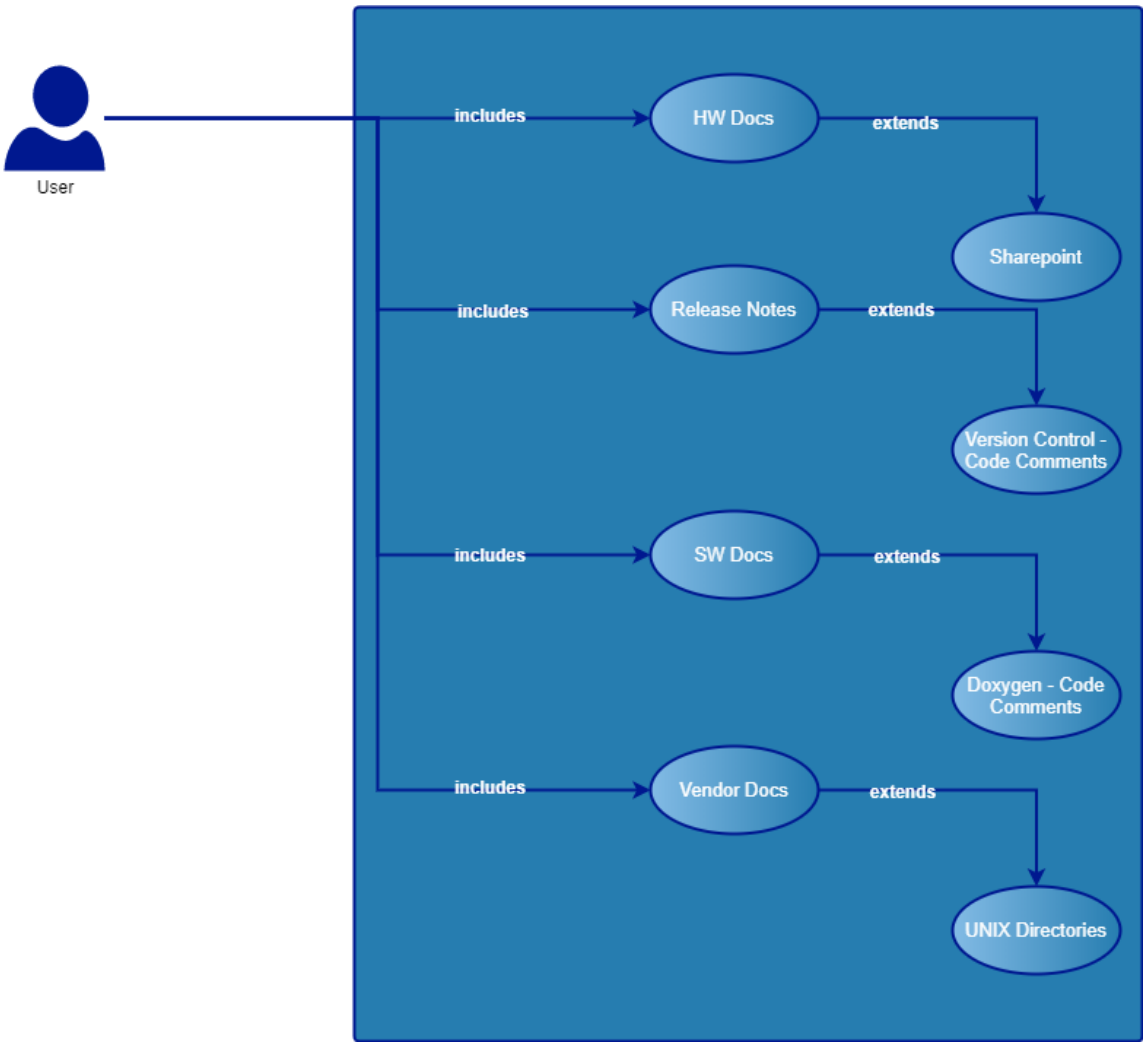

Figure 1. *UML Use Case Diagram for Unified Access to Documents*

Search Functionality

When we are defining a portal where all the documents are stored, there is a requirement for search functionality so it's easier for users to search for the specified documents. For example, imagine yourself in a situation when there are billions of documents on a portal and there is no search functionality, it will take decades to search for the document you are looking for without the search functionality.

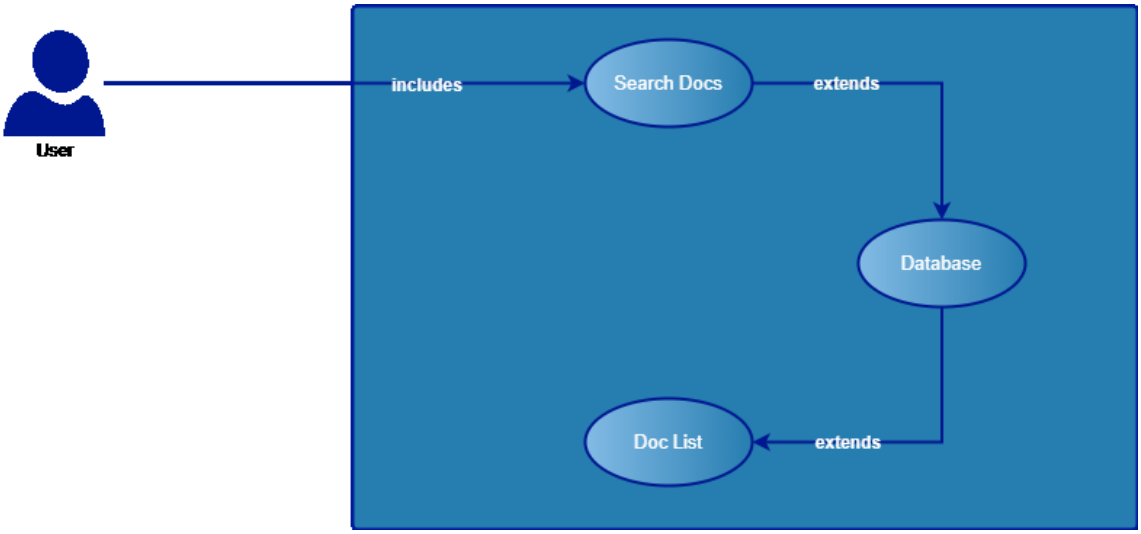

Figure 2. *UML Use Case Diagram of Search Functionality*

Document Metadata

Metadata defines the characteristics of a document. Users should always add new documents along with the metadata. Metadata makes it easier for the users to seek the required documents in areas where the users desire. For example, while searching a document, users can state the category of the document to help classify the documents for that specified category. Metadata helps the users identify key characteristics of a document.

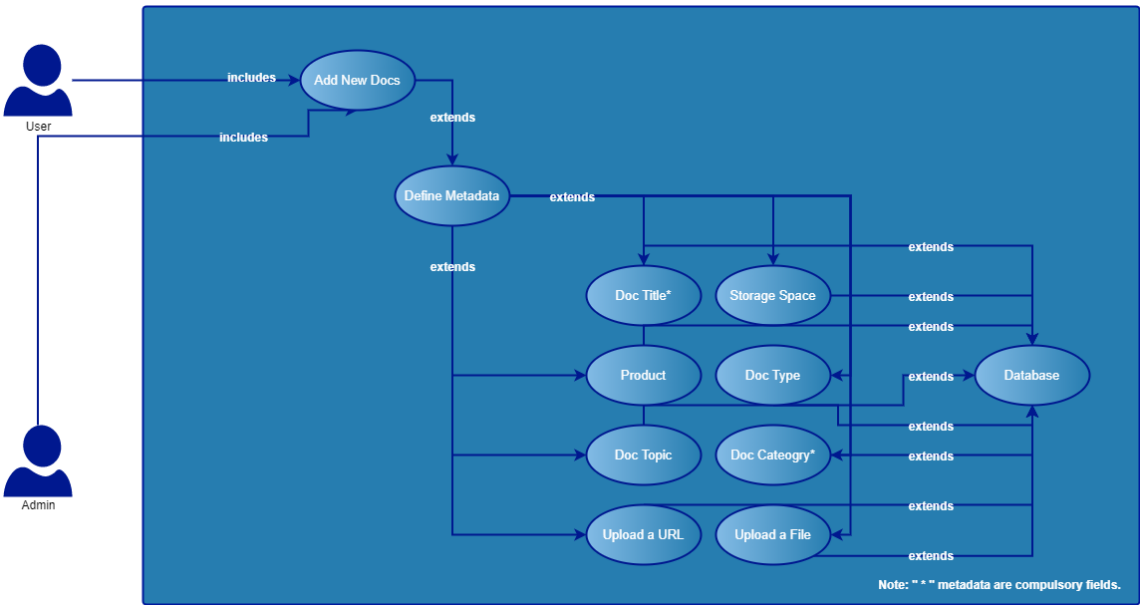

Figure 3. *UML Use Case of Defining Metadata of a new Document.*

Admin Panel

An admin panel is necessary so administrators can manage the portal. An admin panel allows certain users to manage the portal. Administrators can update, delete, and add new documents to the portal. There is a possibility to add new administrators as well from the admin panel, and many other features as per administrators' requirements.

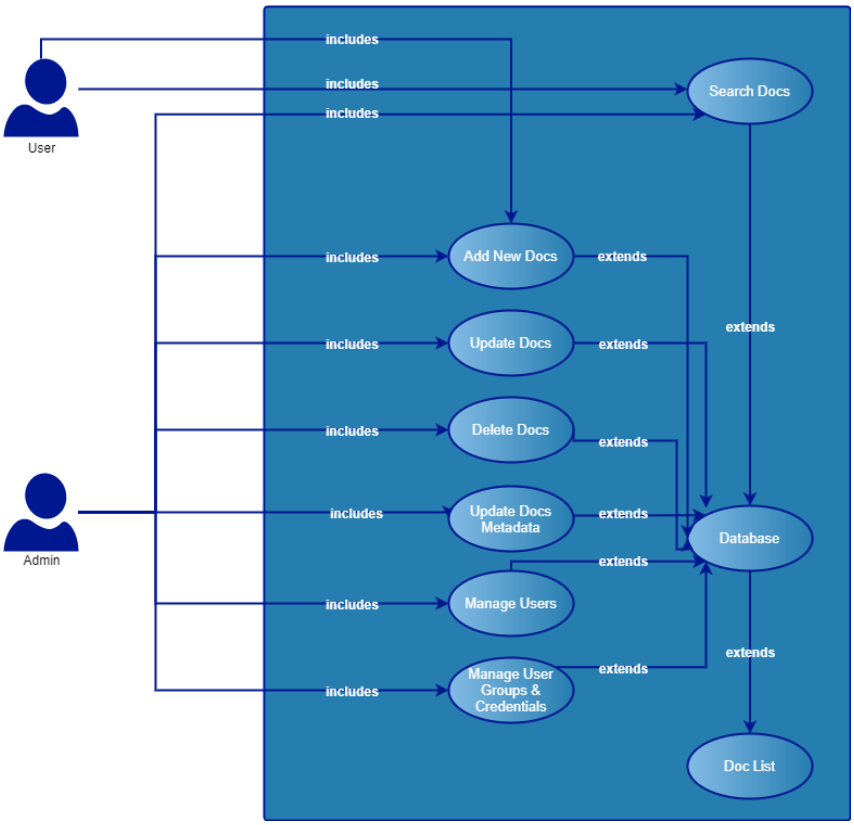

Figure 4. *UML Use Case of Admin Panel*

Cloud Integration

The Access Portal should be integrated with our UNIX server so internal users can access the portal. In development phase, Localhost is used but main implementation will be cloud-based.

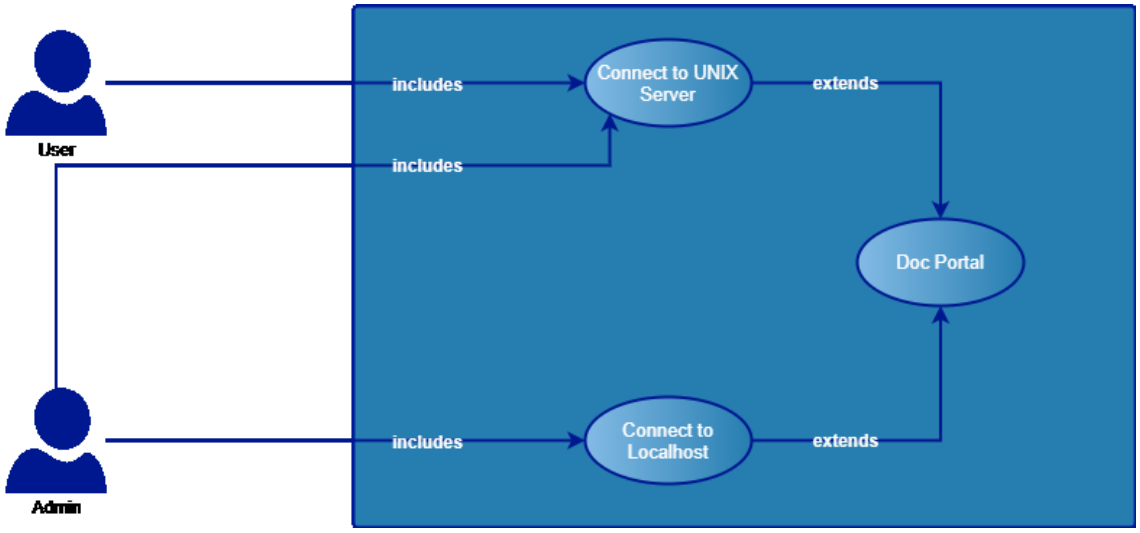

Figure 5. *UML Use Case of Cloud Integration for the Access Portal*

1.4 High Level Overview of SoC

In SoC design, various vendors provide different IPs (Intellectual Property) and sub-systems, like CPU (Central Processing Unit) and DDR (Double Data Rate). IPs may come as RTL (Register Transfer Level) code or hard macros. High Level Overview of SoC design which means that even physical layout is provided by those vendors. Typically, chips may have hundreds of I/Os (Inputs/Outputs) to connect to PWB (Printed Wire Board) that connects the chip to other chips or systems.

Chip design is usually started with architecture design. For example, MATLAB (Matrix Laboratory) is often used for high-level modelling of the system. Next, the design team writes the RTL code to correspond to the MATLAB models to check that the system performs as per the requirements.

The SoC design may contain millions of logic gates like AND gate, OR gate, flip-flops etc. and these gates are used to build, for example, multipliers, adders or shifters. There are also memory macros storing the data. In the 5G technology, both FPGA chips and ASIC chips are used.

After completing the design, the verification team verifies that everything works as expected. Prototyping is also a part of overall testing process. If developers want to simulate the chip from the top level, it would be very time-consuming. Thus, HW acceleration is used to do simulations for sub-systems.

1.5 High Level Overview of SoC SW

The SW flow consists of SW design, implementation, UT (Unit Testing), SW/HW integration, and code generation. SW team creates the SW drivers for FPGA/ASIC chips mostly using C/C++ in Linux environment. Some of the work is done in assembly language as well. As we have discussed earlier in section 1.4 that HW side is modular and divided into sub-systems and various IPs, SW designers are working on these IPs as well and providing the SW drivers.

The first internal customer is usually L1 (5G Layer 1) or RFSW (Radio-Frequency Software) and SoC SW provides the libraries/APIs (Application Programming Interface) and drivers for the customer through build system called Yocto. Currently individual APIs are made for a sub-system and on IPs level but not for the whole SoC. Result is one API to configure DFE (Digital Front End) block, one API to control the connectivity like ethernet, so one API for each IPs and sub-system.

To begin working on the API design and development, the SW team has the HW user guide, design specifications, IPs requirements, coding guidelines, SW architecture specifications (in some cases), register APIs in XML (Extensible Markup Language) format.

In SW design phase, we have source code and SW design specifications along with UT design, UT test cases/Automation test cases, XML-RPC (XML-Remote Procedure Call) test servers (helper for test frameworks like robot framework used for automation test cases) for CI (Continuous Integration)/CD (Continuous Development), Jenkins doing the build and compilation, Git/Gerrit, SVN (Subversion (version control system)), among many other tools. The end result is the SW source code (the libraries/APIs and the kernel drivers), which is provided for customers in bitbake recipes via Yocto meta-layer, eventually customer can build into their Linux image and use in their application SW.

1.6 High Level Overview of DMS

Document management is an integral part of our company's business and is a prerequisite of all processes as well as a necessity for all management systems to which our company subscribes. Key documents in our company shall be reviewed and preserved

in order to ensure successful operation and, where applicable, to provide proof of conformity, for example, with management system requirements, legal and regulatory obligations and to ensure availability in the event of legal action related to intellectual property rights, alleged product safety, security and liability issues.

All of our company's Document Management is according to Document Management SOP (Standard Operating Procedure). A DMS is far more than just cloud storage, while most DMSs hold data in the cloud. The documentation categories in our department are:

Release Documentation

Documentation which describes the content of the major/minor release (correct versions, all modules in the build etc).

Product Documentation

Documentation accompanying the product intended for users of the product.

Maintenance Documentation

Documentation describing the known errors in the product.

Current documentation tools used in our company are:

Editing

Microsoft Word which is most commonly used for writing specification and design documentation, Microsoft Excel, Microsoft Visio for diagrams.

Storage/DMS

Microsoft SharePoint which is most commonly used for R&D (Research and Development) documentation, UNIX directories for vendor documentation and confidential content, Git/Gerrit for SW including code + comments and build data, Confluence for SW release notes and build data, JIRA for test cases, follow-up, and results.

2 CURRENT STATE

The Chapter gives an overview of DMS, observe the existing state of DMS in the market, overview of various DMS tools available in the market. In addition to DMS, we will discuss what kind of tools are required for development and designing of a website. Evaluation and selection of tools, and reason why these tools are selected for the Access Portal.

Information management also relates to as DMS, use a computer program and SW for processing, handling, and recording electronic records and electronic photographs of paper-based material. Its present states are as below:

On-Premise vs Cloud

In terms of reliability and access control, users begin to assume about the pros and cons of an on-premise DMS versus cloud-based DMS. On-premise solutions allow more flexibility at end, although one of the benefits of cloud-based offerings is that much of the management is provider's responsibility. Cloud-based systems are often useful when clients cannot reach the workplace, but this involves an internet connection, unlike on-site systems that can operate offline.

Ease-of-Use

DMS are designed to facilitate a traditional paper process; functionality is one of its most significant factors. Users need to check a test of record management systems until they make a purchase decision. Look for applications for document management that has a strong search feature to quickly find and tag files within program.

Security

DMS are central to security, protection starts with the system that allows managers to setup controls and permissions on access. Therefore, as with any system that maintains business records, ensure that the user of the SW measures clearly the steps they are taking to keep documents secure. It not only covers app-specific features itself, but also covers all implementations so that the program meets all requirements and regulations for local and international safety.

2.1 Existing Document Management in the Market

DMS is a program for the processing, monitoring and storing of electronic documents such as PDFs (Portable Document Formats), word processing files and digital paper

objects. The record management platform includes record and content collection, management, collections of records, systems of distribution and systems for data collection. Furthermore, the methods used to register, archive, and maintain documents. Managing the records always save the time and money for an organization. It provides benefits including document protection, access control, centralized data, audit trails and streamlined identification and retrieval. A DMS is far more than just cloud storage, while most DMS hold data in the cloud [1].

2.1.1 M-Files

A DMS can relate as a computer device used for digital documents storage, monitoring, and recovery. M-Files allows user to quickly and effectively optimize document management so that information starts to work for user, rather than vice versa. Different organizations use the SW to analyses solutions that meet the unique demands of customers. The system is user friendly and completely scalable. M-Files is special in minimizing repositories for a more informative solution that manages content. M-files are easily to use, and all the users accepts because of the specific way M-Files organize documents and other information: not dependent on where they are placed in a folder structure. User will enhance the quality and speed of procedures with M-Files, stronger protect and monitor content, prevent conflict and loss of data, and allow staff to find, access, edit, and exchange information more easily and efficiently. User need not think about rigorous training or user susceptibility with M-Files [2].

2.1.2 Templafy

Organizations often need to keep numerous documents under control, store and organize. Templafy is a SaaS (Software-as-a-Service) system that allows workers to access all the applicable templates and material of their company from inside the SW they work in, such as Microsoft Office. Templafy also personalizes the document dynamically to each employee, thereby saving time and ensuring compliance. Nevertheless, Templafy is not a DMS, it integrates with them, because it acknowledges the value of DMS for workflows, thereby helping to drive investment. Templafy is designed to improve efficiency and ensure compliance across all stages of document work flowing. Templafy share roles that support tasks such as identifying, creating documents and managing content [3].

2.1.3 DocuWare

In the digital era, the entire world is evolving, meaning the customer no longer wants paper documents for most departments of the business, including Finance and HR (Human Resource). This is understandable why several companies rely on information taken and why the other consumers wouldn't, it has been a tried and true system for many years. DocuWare makes any individual document related function easier. Through consolidating document storage in the cloud and simplifying paper management it will take the business operations to a new phase. User can handle and exchange documents electronically, whatever their type or origin. In the cloud or on-premises. Documents are easily accessible, when and where appropriate. One fast search reveals some documents relevant to it. DocuWare is indeed a document management SW provider that provides storage and process automation capabilities, also known as ECM (Enterprise Content Management) or most commonly as document management services [4].

2.1.4 PaperTracer

PaperTracer has minimized data submission defects, saved time for their specialists and insurance claims processing data management, and decreased phone calls over insurance records. If IT is applied correctly, the local units can the ability to store and evaluate vast quantities of information, expose regularities, and improve the productivity of local management systems. This reduces the decision-making time and increases group management productivity and development. Paper Tracer enhances dataflow and collaboration. The accessibility features implemented in Paper Tracer outperformed the other programs. Paper Tracer has an incredibly fast period of deployment and training. Any organization that wants to automate the administration of its contracts getting the services of Paper Tracer is for that organization. Paper Tracer provides services for small, medium-sized, and corporate enterprises [5].

2.1.5 MasterControl

The use of a DMS allows organizations to be more effective, improve efficiency, and speed up time-to-market innovative brands. The document management SW systems from Master Control allow businesses more effective by integrating automated routing, web-based distribution, and document sharing. Master Control Document Management handles quality documentation, such as SOPs, rules, product manuals, CAD (Computer Aided Design) reports, technical change orders, and so on, and maintains compliance requirements with Regulatory requirements, ISO (International Organization for Stand-

ardization) standards of quality, and other global regulatory requirements. It offers routing, approval, approvals, monitoring, and analytics electronically. Master Control is a leading provider of SaaS, which helps companies bring their life-enhancing products to market faster. In all document-based processes, Master Control automates task evaluation, routing, planning, follow-up, monitoring, progression, review, and approval. Includes job confirmation and collaboration via email [6].

2.2 Tools and Features Required

Web development applies primarily to the activities of creating websites for intranet or internet hosting. Among other activities, the procedure of web development comprises web design, the creation of web content, the scripting client/server, and the security configuration of network. Web developers use several coding languages to do so. The languages they use depend on the types of activities they perform, and the platforms they operate on. This is one of the most readily accessible higher-paying fields because user don't need a typical university degree to apply. In general, the area of web development is broken down into the front end (user-side) and back end (server-side). Let's focus on the details.

Technology plays an immense role in our daily lives, from the simplest of applications to the most innovative developments. Web developers develops website and different kinds of SW’s that users find on the internet. What users see and use, including the visual aspect of the website, the drop-down menus and the text, front end designer puts these all components together [7]. The responsibility of front end developers is to create the set of programs to link the arrangement of different elements, make them look nice and interactive. The internet browser runs these programs.

Back end developers are experts in what is happening behind the scenes. Where the data are stored, and there would be no front end without such data. The web back end developer comprises of the server which hosts the website, an application to operate it, as well as a database containing the data. The back end developers use computer programs to ensure the smooth operation of server, client, and database together [8]. There are various options from server-side languages comparable PHP (Hypertext Pre-processor), Python, Ruby, and Java to develop an awesome website.

2.2.1 Front End

What's happening in the browser is front end, also called "client-side" programming. This is all that the customer interacts and communicates with. In addition to offering a user-

responsive user interface, front end developers review code, create and test applications. Developers are responsible as a front end developer for the layout, sound, and eventually design of the website. The position of the front end developer has improved in the past several years, so experienced front end developers might also want to suggest learning a little more intermediate to professional JS (JavaScript) expertise, as well as building up familiarity with development tools and a framework like Django or React. The front end development develops front end elements of a website these elements that the end-user or client can directly view and access [9].

It is the responsibility of front end developers to implement visual components on a webpage as well as interactive features such as navigation, buttons, or anything else that enhances overall functionality. HTML (Hypertext Markup Language), JS, and CSS (Cascading Style Sheets) are also used to ensure that a site's visual side (or client-side) operates smoothly, allowing users to communicate with it easily and comfortably. Although some developers maintain web development at the front end, others work from a web design. These front-facing elements of a website are not specific to front end developers; this is a web designer’s task. The front end developer requires this design on board and develops this into something functional using languages which are mentioned above. Web designers are concerned about design for example the website layout design [10]. Front end developers are concerned with features; the engineering that converts those designs into a live, interactive website. The front end languages are mentioned below in the table which different developers use these languages to perform front end development tasks.

WordPress

In relation to standard desktop applications, WordPress runs online (in the cloud). Its mean there is no need to install any tool in the computer, user can develop the website online. User can update WordPress website using mobile from anywhere the only requirement is an internet connection. WordPress is written in PHP and run MySQL database. WordPress is a perfect solution for both small and big websites. Creating and making WordPress permanently free, it’s development team wants to "decentralize blogging" besides designing a website-building programs that could allow anyone to have a forum and internet service [11].

Table 1. *Pros and Cons of WordPress*

Advantages	Disadvantages
WordPress is inexpensive owners of web-sites with WordPress and its free themes will cut costs. WordPress themes are free and range up to $99.	WordPress uses PHP, it is a server-side language, it has a lot of scripts as an HTML template for people who are not familiar with coding.
The WordPress plugin is simple to install, and the template feature allows the user to install very quickly.	If the database contains a corrupt file, the whole program fails, and then all the files will get corrupted.
The WordPress plugins are designed for accessibility and for SEO (Search Engine Optimization) purposes.	The script and other applications are not always protected in WordPress.
The code inside WordPress is simple and clean, which makes it much easier for search engines to peruse and index a website content.	For additional features, users need lots of plugins which creates difficulties.
Just like the smartphone, WordPress is up to date with latest technologies, trends and user requirements.	WordPress website without warning may go down.

HTML

HTML is now considered an accepted web standard has a climactic rise in world. Every new HTML-language version includes new tags and basic properties. HTML is not a programming language which means it is not capable of developing complex features. HTML allows document editing, like Microsoft Word. We use basic code structures (tags and attributes) when operating with HTML to mark up a website article. HTML files use either the extension for.htm or.html files. The new version HTML5 is the latest version, and some styling elements that have very little use and access violation are not used in HTML5. HTML5 has many new updates, the latest tags which makes a web page more attractive. CSS manages the presentation and provides colouring, and JS makes elements to perform different actions [12].

Table 2. *Pros and Cons of HTML*

Advantages	Disadvantages
A developer can easily integrate JS, jQuery, and CSS into HTML.	HTML can create only static and plain pages so if a user really needs dynamic pages then HTML is not helpful.
Every browser supports HTML Language.	Users need a lot of code to write to create a simple page.
HTML is a free, open source Markup language, users do not need to purchase a code to build a website.	In HTML safety features are not good
HTML is the friendliest to search engine. Creating websites which comply with SEO using HTML is considerably easier than any other programming language.	If a developer needs to write long code to make a webpage then it adds some difficulties.
HTML is very simple to edit, because there is no need to edit it with a special interface or framework.	HTML becomes more complex with each major release and new tags are introduced whereas others are deprecated

CSS

CSS provides different styles on a web page. HTML allows a developer to insert video, images with different formats, and other media on a webpage, CSS provide layouts designs, colours, and many styles in fonts. The main responsibility of CSS is to determine how a website will appear on frontpage which has different HTML elements. HTML as the base language, and CSS is the graphical choice. HTML and CSS both are written on a plain text using a text editor, a user can also use word processor to write the code of HTML and CSS. When the developer writes CSS code then it is inserted into HTML to make the website stylish [13].

Table 3. *Pros and Cons of CSS*

Advantages	Disadvantages
Users can write CSS to several HTML pages and then reuse the same file. For each HTML feature users can identify a style and add to as many web pages as a user wants.	It often takes longer to open an HTML file if CSS is included within it.
Webpage loads faster with CSS due to less code which makes faster download time.	CSS is easy to use and intuitive, but its syntax differs from HTML which makes hard for user to use and maintain the code.
CSS is known as one of the best coding languages for website development which means that the websites have more content than scripts.	If one browser does not support the CSS features, then some other browser can use and support these features.
The script of CSS delivers good platform independence and can also promote the updated browsers.	As it is an open text-based framework, CSS does not have the built-in protection that protects against overriding it.
CSS's developed for styles on website. User can mix up the HTML and CSS code to make a website beautiful.	CSS could get messy and complicated when a user tries to develop CSS with third-party tools.

JS

JS is a structured scripting language which is widely popular. JS is an open platform, with different frameworks and an easy syntax has made it famous for beginners. JS is among the world's most used programming languages. Despite being designed to help front end web developers build interactive elements, JS's use cases have grown rapidly and included items including web back end development, game production, and even mobile app growth. If someone is interested in any of above-mentioned things, then they might want to consider learning JS. JS would make user further attractive to employers, give user the opportunity to become an investor or a freelancer, and give even more job protection to developers [14].

Table 4. *Pros and Cons of JS*

Advantages	Disadvantages
The JS program is composed on the customer's processor instead of the web server thus it reduces latency and loading on the web server.	Although the server-side scripts often generate the same output, often different browsers perceive JS code differently.
JS tends to be very efficient as it often runs instantly inside the browser of the client.	As the JS code is visible to the user, it may be used for malicious purposes from others. Such activities can include the unauthenticated use of source code
JS is indeed on the web and is progressively getting used at back end with the introduction of Node.JS.	JS is an old scripting language that runs on the computers and other technology do the same thing in a better and easier way instead (e.g. jQuery).
The JS syntax is simple for the developers and customizable.	If a user disables the JS in the browser the entire JS code will not work.
It is the greatest advantages of JS that it is capable for supporting all modern browsers and delivering the same result.	A single code error will stop all JS code from rendering on the website.

jQuery

jQuery is a library of JS. It is very lightweight and simple to use. The responsibility of jQuery is to simplify HTML webpage navigation, management of different events, animation, and the interaction AJAX (Asynchronous JavaScript And XML) for fast website creation. jQuery provides simple techniques to a web developer. It offers a lot of built-in functions with which user can efficiently and rapidly achieve different tasks. The purpose jQuery is to promote the use of JS mostly on website. jQuery has many sections of JS code to enter and turns them into methodologies that developers can use to write a single line of code. There are many complicated issues in JS's and jQuery facilitates many these issues, such as manipulation of AJAX calls. jQuery is an application designed using the capabilities of JS [15].

Table 5. *Pros and Cons of jQuery*

Advantages	Disadvantages
The key benefit of jQuery is that it's much easier to use relative to many other JS libraries.	jQuery has an immense import collection.
jQuery repositories are easy to use because they are open source.	It is hard to learn and understand jQuery.
jQuery is simpler for a designer to understand because it uses the familiar CSS syntax.	Not every new version is consistent with the older versions.
jQuery optimizes the relationships between HTML content traversing, memory management, designing, and AJAX for rapid web creation.	Another big issue with jQuery is the many versions are out there. Some variants are getting along well with others and some are not.
jQuery provides real powerful documentation for 3rd party.	In certain instances, jQuery is slower with comparison to CSS.

Bootstrap

Bootstrap is free, open source and world-famous front end development platform which was initially developed for Twitter. A developer can create a website easily and quickly. It includes different kind of templates for typography, shapes, frames, buttons, navigation, different models, and many other automated elements which are dependent on HTML and CSS. It also supports JS modules. The word bootstrap in computers means booting, loading a program onto a machine using a much smaller original program to load into the desired program which is normally an operating system. Developers no longer handle almost all the hard work nor Bootstrap itself. Even back end developers can keep coming up with responsive front end using Bootstrap, without spending time to understand HTML and CSS. User can apply Bootstrap to a static site, a PHP site, a CMS (Content Management System)-anything. Its adaptability is the feature that helps save time and avoid wanting to make too many changes [16].

Table 6. *Pros and Cons of Bootstrap*

Advantages	Disadvantages
Bootstrap is a cohesive platform supporting significant updates of all browsers including CSS functionality.	For enterprises it's not always realistic.
Bootstrap is Portable and responsive.	Growing a business without investment will take a lot longer.
One of the key benefits of using Bootstrap is the speed of development.	The only drawback to this is that anything created with Bootstrap would look quite similar.
The Bootstrap documentation is extremely comprehensive.	Bootstrap generate different files which are always large, these files slow the things down.
Bootstrap is not merely a framework, but it is a complete methodology for the front end design quality standards.	A developer must rewrite a lot of Markup code to make design changes.

2.2.2 Back End

A server, SW, and a database comprise of the back end of a website. The architecture that drives those modules combines and enables the website's user-facing feature to work like in the first place by a back end developer. Back end developers concentrate mainly about how a website operates. Developers learn to code that works on the features and reasoning that control the program they are working on; end users cannot see the developer's work back end explicitly. The back end technology is a mixture of servers, SW, and repositories. Back end programmers' duties could include writing APIs, coding knowledge to communicate with a database, building databases, focusing on business processes and associated structure, and so much more. Instinctively the front end is another side of back end growth. The main difference is that although back end developers create the way a website works, front end programmers construct and layout the interface to decide how well the website looks for users [17].

Django Framework

Django is Python's high-level web system which helps steady and reliable sites to be quickly developed. Django intends to take care of a lot of problems about web creation, thus developers can focus on scripting the increased availability without reinventing the wheel. It is a free-to-use SW, has a vibrant and engaged group, excellent knowledge, as well as plenty of extra services that are free and affordable. Django's model uses a powerful ORM (Object Relational Mapping) layer that streamlines the handling of the database and data and speeds up the process of creation. The ORM layer allows developers to write all tables descriptions in simple python programming language and is responsible for translating them into the appropriate query language selected, along with facilitating CRUD (Create, Read, Update, Delete) activities. In fact, the programmer does not actually have to fully understand the actual SQL (Structured Query Language) or what it corresponds to, but it is worth noticing that understanding SQL will allow you to write databases easier and quicker and make your site safer as well. SQLite is useful for R&D as it can be used before needing to install additional SW straight out of the box [18].

Table 7. *Pros and Cons of Django Framework*

Advantages	Disadvantages
Django is simpler for programmers to create web applications.	Django's powerful factors make developing massive and complex.
Django is one of Python's quite popular Application frameworks. Its design principles focus heavily on reducing time spent designing web applications.	Most web frameworks boost web application performance by having each process handle many requests at a time. Unlike many other current web frameworks, however, Django does not allow individual entities to manage numerous requests concurrently.
Users can access web apps on different platforms and devices. Django makes web applications more available by promoting large operating systems such as Windows, Linux and mac OS (Operating System).	Nowadays many Python programmers choose component-based programming approach to speed creation and maintenance of web applications.

Django's built-in security techniques enable developers to create safe web applications.	Django's ORM framework allows it simpler for developers to deal with different databases and do standard operations on the database. But some of the robust features offered by other commonly used ORM systems are missing to the ORM system used against the web framework.
Django has continuously grown to allow programmers to develop stronger and more dynamic web applications.	All of Django system functionality comes with a lot of coding. It requires computation and time for the server, which presents some problems for low-end sites that can run even on very limited data.

Flask Framework

Flask is a web-based application, which implies that flask supplies you with tools, resources, and technologies to build a web app for you. Flask is a fellow of the micro-framework groups. The micro-framework typically has little or no reliance on external repositories. Flask is the platform here, while Flask is a datatype for the Python class. In other terms, if developers want to make it quick, Flask is the template used to build iterations of web apps or web applications.

Table 8. *Pros and Cons of Flask Framework*

Advantages	Disadvantages
Built-in development server and fast debugger.	Not suitable for big applications.
Integrated support for unit testing.	Full-Stack experience.
Support for secure cookies (client-side sessions)	No login or authentication.
Jinja2 templating	Migrations can be difficult.
Unicode based.	No admin sites.

So, when Flask is imported by the developer, the developer needs to build an instance of the web app Flask category. Flask is easier, and much clearer, than Django. It's a

micro-framework so you didn't notice stuff like formal credit or an abstraction layer for the database. The way to go out for a fuller structure is through Django framework [19].

Laravel Framework

Laravel is an open-source and it is a PHP platform established with the structures of built-in functionality to make web applications quicker and simpler. Developers can either routinely shape their own code or install ready-to-use packages through Composer. In addition to authentication, Laravel includes more standout features such as built-in translation support, routing requests to individual controllers, addressing sessions, and much more. The system is designed with evaluation of the MVC (Model View Controller) framework. With the support of the system the user will construct a new program. In the current context, designing customized apps in a few easy steps is a difficult challenge. With this framework such applications can efficiently generate in a short time [20].

Table 9. *Pros and Cons of Laravel Framework*

Advantages	Disadvantages
Laravel provides method of Authentication and Authorization.	Compared to Django and Ruby, Laravel is a lightweight system so it has less built-in support.
Laravel provides the highest safety standards.	PHP platforms usually have several problems with long-term support models, and Laravel is often blamed for that.
Laravel provides over the popular Swift Mailer library with a clean, simple API.	Compared to other frameworks the implementation is not as fast
To use the file cache driver, Laravel is designed to store cached items in the file system.	Public participation is not universal compared with other channels.
Laravel is designed with a view to research. Out-of-the-box support for checking with PHP Unit is provided, and the framework already has a phpunit.xml file set up.	Move to Laravel isn't easy for existing systems.

Express.JS Framework

Express is a simple non-reflective web platform, open - source JS, and managed Node.JS in runtime. Express provides a sturdy collection of features for web and mobile applications development. It enables the rapid creation of web applications based on the Node. Express is designed specifically for single-page, intra-pages, and mixed web applications. It has evolved into the traditional Node.JS server system. Express is the underside to what's recognized as the MEAN (MongoDB, Express.JS, Angular.JS and Node. JS) stack. The MEAN is open source and fully free JS SW stack to create interactive websites and web applications [21].

Table 10. *Pros and Cons of Express.JS Framework*

Advantages	Disadvantages
Express.JS is a pre-built Node.JS framework which can help developers more easily and smartly build server-side web applications.	For Express.JS, a major negative is that so many developers struggle with the always evolving API and the lack of consistency that comes with such changes.
Defining routes of the existing app are premised on URL (Uniform Resource Locator) and HTTP (Hypertext Transfer Protocol) methodologies.	Evaluated with the other programming languages, Express.JS requires a robust library structure in comparison to the other programming languages around here.
Express.JS developers can understand adaptable middleware modules for carrying out additional functional and request tasks.	If developers want to make the applications fully portable, implementation of the asynchronous programming model is a necessary requirement.
One of the most striking qualities of application development on Express.JS is the invention of REST (Representational State Transfer) API server.	Developers find out using Relational Databases with Express.JS is not a simple job.
Express.JS is a wonderful choice for developing which handle many user requests and notifications.	Express.JS has proved to be a weak heavy computing platform, as it is a Processor intensive process.

Node.JS Framework

Node. JS is free-to-use JS programming framework cross-platform which implements JS code at the external side of a website browser domain. Node is not rendered completely in JS; instead, its packages are agreed to create in C, it just executes JS. Node.JS has come up with a new paradigm of single-threaded event-driven application programming, which is done with the call-back idea. A step towards reaching the server side or back end programming is very significant with the increasing popularity of JS and it also raises hope for lots of JS developers. But now, if assume Node is powerful enough just to replace .NET, PHP or Java, it's going to be a hyperbole. But yes, the reason JS is trying to develop, developers are quite optimistic that one day Node could become the greatest web back end solution [22].

Table 11. *Pros and Cons of Node.JS Framework*

Advantages	Disadvantages
Asynchronous event-driven programming IO assists in managing simultaneous requests.	Node.JS does not really provide scalability. One CPU normally can't be enough.
NodeJS uses JS and it helps users learn quickly who are already familiarized with JS.	Relational database handling is a hassle when someone is using Node.
Use the same block of malware with server as well as client hand.	Node.JS use time a call-back, which increase the loads of nesting call-backs
Packaged Node modules have become enormous and continue to expand.	If anyone starts Node without dipping in depth of JS, developer can face theoretical issue.
Active and vibrant culture, with much code exchanged via GitHub, etc.	Node.JS doesn't work for CPU-intensive tasks. Just suitable for I/O stuff (like web servers).

2.2.3 Search Functionality

Simple to navigate pages, seamless cross-device user interface, interesting and insightful content, beautiful graphics these are essential for good website. Every bit of information on the web page contributes to the website's user-friendliness. Professionals at

the website development company also attest for its validity. The little search box appears to be just a small element of website design, but when applied correctly this basic feature can significantly improve the website quality. A search bar helps users to figure out what they are searching for. Users have trouble searching out all the sites to figure out what they're looking for. No one has the time or stamina to browse at the whole page, too. The search feature lets users locate valuable content by selecting keywords without searching the site. Given that mobile devices generate about 51.53 % of global web traffic, making your website mobile-friendly is essential. A search feature can have a huge effect on user engagement by allowing them to find out specifically what they want and need [23].

Query Based Search

The data is just as important as the value that may draw from it. Search and queries are critical elements that can discover users' sense by sharing the exact details user wants at the right time. Many commercial web pages don't reveal their search records, so it's hard to get information about what users are looking for on the web. The absence of high-level querying tools available to enable the collection of information over the web. Query languages have long been an integral part of DBMSs (Database Management Systems), with SQL being the main DBMS query language. These query languages not only provide a structured way to access the data contained in a database but also mask user-specific information of the data model. Since the web is often perceived as a vast database that holds enormous data stores, some domain-oriented query systems were created [24].

Table 12. *Pros and Cons of Query Based Search*

Advantages	Disadvantages
Query search is very simple in the way that systems find words wherever they exist.	Query searches often fail to show relevant materials which do not explicitly use the term search.
If the users understand specifically what they are searching for, the approach is effective.	The issue is that words sometimes have various meanings, and many search queries produce irrelevant outputs.

It's also a useful method if the user's search intent is to get an outline of the subject or get fast answers.	Users may miss the necessary details.
These are the words used by people in the real world to find certain pages by organic and paid searching.	Users sometimes maintain vastly structured queries that need further improvement.
In search marketing strategies consumers can obtain new words to pursue.	Various other types the problem, keyword searches are becoming more difficult Identifying possible causal relations when users decide to go further than clustering.

Postgres Search

Postgres is an open-source relational database that operates on the Linux platform and works in the database management framework with objects as a relational element. It utilizes SQL to access the data in database tables and is thus also called as Postgres. Most of this database's popular features include, it's very stable and efficient, the recovery process is seamless, and maintenance requires less expense and manual energy. The Postgres query language structured has several attributes that users might identify in other databases. This database is old. So, with this database, users can find problem-solving is simple. The PostgreSQL user base is broad. it works is versatility. With primitive it endorses user-defined data types once. Primitive denotes one that came with the language itself. One framework that introduced MVCC (Multi-Version Concurrency Control) is the Postgres standardized query language. PostgreSQL like any other language has its instructions. A single database server typically gets for various projects [25].

Table 13. *Pros and Cons of Postgres Search*

Advantages	Disadvantages
It is user friendly.	If compared PostgreSQL is not excellent on efficiency.
It works on every operating system.	It is not very popular compared with other database systems.
Open-source and Using Stored Protocols.	Lack of qualified practitioners.
A lot of support from the community.	It is more difficult to do the replication.
It is ACID (Atomicity, Consistency, Isolation, Durability) support.	For the beginner, installing isn't convenient.

Algolia Search

Algolia is composed primarily of two sections, search implementation and search analysis. It offers tools that enable designing and sustaining great search interactions for your users and convenient for your developers; and resources for your business users to evaluate and optimize the effect of those insights so that they can better tackle your fast-changing business goals. Imagine finding a way to ask every single person who came into a physical store with all of the items, "What do user wants? "And document their reactions. Quickly, that will give a sense of what they're searching for, what they're not, or how these two interact with what you're currently delivering. Algolia lets users start gathering this information on your users effectively. Your search interface Algolia that include a search bar, tabs, infinite floating, recommendations for queries, filtering, modifications, etc. These help what customers are searching for and explore new features [26].

Table 14. *Pros and Cons of Algolia Search*

Advantages	Disadvantages
It's a super-fast search tool, so the user can customize it to check for interpretation and still it works well.	Specific variables can be very challenging for optimizing the search results.
It can be a reasonable way to prevent configuring an Elasticsearch server to yourself. The free group plans to support projects open source.	User can't drag and drop its toolbar to modify search terms.
It is highly user friendly and easy to implement in your application. Also, the UI (User Interface)/UX (User Experience) is fantastic.	The problem integrating with WordPress. The costs are too high.
The versatility it allows consumers to control the types of outcomes that they get with various product types.	The lack of versatility when interacting with other systems for which Algolia isn't coming out of the box.
It helps users to monitor several different attributes which will show the different items on your website.	If the user is a non-technical person then it would be hard to grasp the SW.

Elasticsearch

Elasticsearch is an open-source search and insights engine which is easily customizable. It enables users to easily and in close real-time store, scan, and analyse massive quantities of data. It is commonly used as the underlying engine/platform that enables power to applications with complex search functionality and needs. Documents are the basic understanding unit that can be indexed in JSON's (JavaScript Object Notation) Elasticsearch, which is the popular data sharing format on the web. In a database system, a developer can conceive of a record as a row, describing a given entity the item

users are looking for. Elasticsearch enables enterprise-wide searching that involves document searching, e-commerce item search, blog check, people searching, and any type of search that user may think about. It has constantly invaded and substituted the search strategies of most of the major sites that customer uses every day [27].

Table 15. *Pros and Cons of Elasticsearch*

Advantages	Disadvantages
Elasticsearch is comfortable with running on any platform, as it is written in Java.	In Elasticsearch the issue of split-brain circumstances often arises.
It is a real-time search tool, which ensures that searchable in this engine is just one second before the added text.	Unlike Apache Solr search, Elasticsearch has no support for managing query and acknowledgement data in multi-language.
Elasticsearch provides the gateway framework which makes complete backups easy to build.	Elasticsearch isn't a good store of data
In Elasticsearch multi-tenancy can be easily accomplished.	It works well for limited use cases, but it either pulls or loses the data in case of streaming of TB's (Terabyte (1,024 Gigabytes)) data every day.
Its documentation is in various languages. Hence it can be used in their languages by people from various areas.	It is a versatile and efficient search engine for data storage, but learning is a bit difficult.

Apache Solr Search

Solr provides a diverse, versatile collection of search features. To grasp the scope of that versatility, beginning with a summary of the steps and components involved in a Solr quest is beneficial. When a user performs a search in Solr, a request handler handles the search query. A request handler is a Solr plug-in which specifies the reasoning to use when Solr evaluates a query. Solr provides several petitions handlers. Solr has multi-tenant infrastructure support which helps users to scale, distribute, and maintain indexes

for large-scale applications. In Solr, a document is a simple unit of information that can be stored and indexed. Documents are held in groups. Solr operates by collecting, processing and indexing information from various sources and making them near-real-time searchable. It requires a 3-step process involving indexing, querying, and finally ranking out the results all in near-real-time, but it can function with huge amounts of data [28].

Table 16. *Pros and Cons of Apache Solr Search*

Advantages	Disadvantages
Flexible and efficient query language helps users to create a diverse and complex query to extract information.	It does not help user authorization so users must have to put it within a secure network.
Query on high-speed answer.	Working in the cloud with Solr requires extra Zookeeper.
Strong documentation, and great support from the community.	If the Master Node is down, reconfiguration is necessary.
User can scale each form base to increase data input or speed of response.	In some situations, CPU usage can be heavy.
Offers various methods of indexing and filtering the search results.	Simple to use this is not necessarily the easier to manage tool.

2.2.4 Database

To make it readily available, accessible and modified, the database is an organized set of complex information. You may say in simple terms, a database at a location where the data is processed. The library is the greatest comparison. The library includes a large selection of books of various genres, here the database is server, and the details are books. A dynamic website shows modified web page details when the host updates the database, or even when users upload details using web forms. The server updates web

pages dynamically, removing the need to explicitly modify the Web address on various articles [29].

A website database is an application that is designed to be controlled and accessed over the Internet. This data collection and analysis results can be handled by website operators based on the information in the single web framework [29]. Within hundreds of criteria, web databases allow data gathered to be organized and catalogued thoroughly. The web server does not require advanced programming skills, and with no complex coding, most databases provide an easy click-and-create style. Fill in the fields so each record is saved. Although the lead to potentially to organize the data, for example sequentially, alphabetical order or by a range of constraints.

PostgreSQL

For its proven architecture, durability, data security, versatile feature, configurability, and the commitment of the development community behind SW to continually produce effective and innovative solutions, PostgreSQL has received a strong credibility. PostgreSQL operates on all operating systems, so it's no wonder that for many people and organisations PostgreSQL is becoming the free SW relational database of choice. Starting in using PostgreSQL was never easier-pick a project you would like to create and let PostgreSQL storage user information securely and expeditiously [30].

Table 17. *Pros and Cons of PostgreSQL*

Advantages	Disadvantages
Only PostgreSQL offers enterprise-class output and functions without any end of future opportunities between existing Open Source DBMS.	Postgres is not owned by one organization. So, it has trouble.
One of PostgreSQL's features would be that a wide range of communities exist. As for PostgreSQL as free SW DBMS, users can create plugins themselves and introduce the application to the group.	Changes made to increase speed require more research than MySQL, so consistency is the goal of PostgreSQL.
For server setting, SQL functions named 'Store Procedure' can be used.	Many open source apps support MySQL but may not support PostgreSQL.

Not only does PostgreSQL have B+ tree index methods, but also various kinds of strategies, such as GIN (Generalized Inverted Index) and GiST (Generalized Search Tree), respectively.	Most open source applications help MySQL, but PostgreSQL may not be supported.
When looking for sequences with function operation execution and vector search, full-text search is accessible.	It's slower on efficiency metrics than in MySQL.

Oracle NoSQL

SQL is the collection of expressions used to access in-formation in an Oracle database for all programmes and users. Application programmes and Oracle tools also enable customers to access the database through the use of SQL, but in effect, these programs must use SQL when performing the user's query. Currently the default RDBMS (Relational DBMS) language is recognised as SQL. Requesting data, adding, updating and removing columns in a table, developing, replacing, changing and dropping objects, managing access to the database and its item, maintaining accuracy and integrity of the database. In one clear language, SQL combines all of the previous tasks [31].

Table 18. *Pros and Cons of Oracle NoSQL*

Advantages	Disadvantages
Although the past of Oracle helping its users may at best be sketchy, the nature of MySQL, which started as an open-source platform, implies that there is a wide and prosperous group of developers and experts to whom one may switch for aid.	Since Oracle took advantage of the growth of MySQL, progress seems to have come to a halt, only with one big release in the past few years.
Oracle's acquisition of Sun Microsystems had been met with certain developer community disagreement.	Oracle database is costly.
Creating a decent database of oracles gives a reasonably good pace and large databases as well.	Even Oracle SQL is tougher than its rivals to recognize and function.

The oracle database increases the efficiency and speed of transfer checking and locking	Oracle also appears to be complicated or difficult to handle for certain operations.
Using a restoration to take a complete backup of entire data backup in the Oracle is helpful.	If a user use index, Oracle database would have an extra charge because of the maintenance.

MySQL

A database is just a standardized data set designed to be easy to access and to retrieve. Within the current big data world, MySQL is one of the most recognized technology. Often referred to as the most common database and finally experiencing widespread, efficient usage regardless of industry, it is obvious that everyone interested in business data or general IT should at least strive for a simple MySQL familiarity. MySQL is a SQL open-source RDBMS platform that is supported by Oracle. MySQL functions on approximately all platforms, including Linux, UNIX and Windows. MySQL is greatest and popular with web and online crowdfunding tools, although it can be used in a broad array of applications [32].

Table 19. *Pros and Cons of MySQL*

Advantages	Disadvantages
MySQL is quite simple to install, and establishing an application is a reasonably small process thanks to a bevy of third-party resources which can be applied to the database.	MySQL appears to be far less accurate than its rivals, as per cloud hosting.
MySQL is recognized globally for becoming the safest and perhaps most reliable database which is being used in famous web applications.	While MySQL is designed to handle a nearly unlimited amount of data, if it is expected to comply with far too many activities at a time, it has a disturbing propensity to ground to a standstill.
MySQL features a distinct database engine architecture to support server administrators.	Stored procedures are hard to modify. Only few more data base management

	programs allow the stored procedures to be debugged.
MySQL tops the list of accessible publicly usable transaction-based database engines.	Although it is simple to set up MySQL, it appears to get less out-of-the-box features on the marketplace than most other relational databases.
MySQL is a convenient system with auto-gestion functions.	MySQL does not accept restrictions on SQL reviews.

mongoDB

MongoDB is a database that is data focused. This implies that this does not using tables & rows to hold its data, but rather JSON-like entry requirements. These reports have integrated domains, so you can store related data inside them. MongoDB is indeed a template-less database, so prior to adding our data, developers do not need to determine the amount or type of columns. MongoDB is a NoSQL document-oriented repository used for data storage of high volumes. Development teams will also say their groups are not columns and rows but with key-value pairs get a clear system. The MongoDB database schema helps you to much more conveniently reflect hierarchy, to store ranges and other complicated systems [33].

Table 20. *Pros and Cons of mongoDB*

Advantages	Disadvantages
MongoDB is a database that is schema-less. In a single column, that means that users could have any type of information.	Like such a relational database, MongoDB does not allow joins. You can also use links features by applying it automatically by programming it.
By transmitting it to multiple servers linked to the app, users can store enormous amount of data. If a server is unable to manage such data analytics, then there would be no reason for failing.	For each value pair, MongoDB saves key names. There's also unstructured data due because of no joins feature.
MongoDB is a database that is document focused. Scanning provides quick access	User could not do report nesting for more than 100 grades.

to records. It therefore provides fast answers to queries. MongoDB has a speed that is four times larger than a database system.	
MongoDB has replication capabilities. In MongoDB, these functionalities help to boost the volume of information. The output is therefore very high.	The first one is the lack of specifically specified, verified and implemented RI (Referential Integrity), relationships between different chunks of information in user repositories.
A major advantage of MongoDB is that this is a database that is platform independent. Users can distribute it to many devices when they need to handle big information.	Whenever the data set is broad and diverse, RI could tend to have in-flexible and space wasteful. Relational assistance is next considered.

OrientDB

The first NoSQL multi-model free SW DBMS that incorporates the power of charts and report versatility into one high-performance, flexible operational database. Both text and graph DBMSs have OrientDB functionality. Crafted to be incredibly fast and writing in Java: it can hold up to 150,000 documents per second on popular HW. Not only does it incorporate documents like every other database text, but it handles relationships with close ties between records like graph databases. Within a few milliseconds you can traverse sections of or whole forests and record graphs. OrientDB supports template-less, schema-full and template-mixed modes and has a robust user and role-based security profile framework [34].

Table 21. *Pros and Cons of OrientDB*

Advantages	Disadvantages
Many database modules integrated into one DB (Database).	GitHub projects have a bug label that has a bright red background and most project owners don't change this or use another bright/contrast colour, so they stand out among other issues.
Good user profit-based security system.	In the google group post-stable version of OrientDB for distributed environment? a couple of users claim OrientDB v2 has instability issues in distributed setup.
SQL engine developed from scratch to improve performance.	Transactions are a feature that not everyone uses but for those who do use it's usually a mission critical feature that must be reliable.
Without even using database join, OrientDB handles relationships but rather simple pointers.	A bug was identified in OrientDB v2.0.6 in which transactions crashed over binary transportation.
OrientDB is a distributed database of graphs which gives versatility to a database of documents.	One needs to be careful about making entries in OrientDB to do these one at a moment.

2.3 Tool Evaluation and Selection

Application development tools help developers use a few technologies. There are various templates to choose for web development online which saves developer's time to write extensive HTML code. These templates include power customization tools and are ready for SEO. These templates give optimized CSS and JS which boost the scores for loading time. HTML is an essential part of front end programming language without HTML a developer cannot create a website. CSS is used to make a website stylish. If a user does not choose CSS support, then website will not look as a stylish website. Python is used for latest website development. Python supports machine learning techniques as well. Django is the framework of Python and it is a strongest framework with a

lot of features explained earlier as well. For our Access Portal, search functionality is mandatory, so query-based search is quite basic search for beginner's. Database helps store all the documents in one place, so we choose PostgreSQL which is a cloud-based database using pgAdmin database management tool.

Reason for development of our own DMS is that as a company-wide solution, we use SharePoint and it is still in the background, but it is one of several storage / documentation tools. We decided to have a simple and effective first test in order to put all sources together under one umbrella if this could be a way forward. Due to format and access problems, one storage solution is most likely not feasible, so the solution for now is to prototype one document access location. According to the analysis conducted in this thesis, established market solutions were not feasible for our requirements. Thus, we do not necessarily want to invest money in another commercial tool, which could be a partial match to our requirements.

2.3.1 Front End

Front end frameworks are SW packages designed to format and set out the websites. Frameworks consist of ready-made control menus, keys, shapes, typeface, and other materials so developers don't need to write any of the code anyway. Bootstrap is great for beginners since a developer can install and include files in the code, developers who can customize the files to exactly match their needs. Other things involve Semantic UI, which features a wide selection of themes from which to choose [35].

Table 22. *Selected Front end Languages, Definition, and Usage*

Language	Definition	Usage
HTML	HTML is a standardized system for labelling text files on World Wide Web sections to obtain font, colour, graphics, and hyperlink effects.	HTML ensures that all the elements will be correctly configured so that the Internet browser can show them as they perceive fit.
CSS	CSS adjusts the presentation of web pages to various devices, like large screens and small screens. It also helps to create pages that are printer friendly.	CSS is used for formatting web page layouts. This involves verifying for text styles, table sizes, and colours.

Bootstrap	Bootstrap is a free. Modern websites and mobile apps are developed using Bootstrap. It contains graphic design, forms, buttons, set of menus, and other essential elements.	Starting with Bootstrap is incredibly a simple and fast process. Bootstrap is likewise quite flexible. Bootstrap can also be used with CSS.

HTML is a SW development language used to describe the system architecture on a website page. HTML, CSS, and JS combined form the basic building blocks of website, including CSS managing the design of a page, and JS programming its features.

Bootstrap is a free. Modern websites and mobile apps are developed using Bootstrap. It contains graphic design, forms, buttons, set of menus, and other essential elements.

CSS is a style sheet language used to describe a text written in Markup language for display. CSS is a leading technique many websites are using to build visually appealing web pages, web app interface and interfaces for several mobile apps.

HTML

The presence of HTML dominates the web and that it is the language most accepted for web design. Common web browsers easily recognize and interpret this. HTML is the friendliest to search engine. Creating websites which comply with SEO using HTML is considerably easier than any other programming language. HTML5 provides a lot of new features that are easy to use for developers. HTML5 has many new updates, the latest tags which makes a web page more attractive. HTML is a very simple, descriptive language. The results are very great and faster loading times and reliable viewing performance [12].

CSS

CSS helps create webpages much simpler. CSS helps developers to conveniently connect to many other website documents. With the support of CSS developer, you will have control over various elements in your site's different web pages. CSS specifies only the structure and content of a website. Improved loading of websites is an undervalued but important advantage of the CSS. Browsers download the CSS rules once, and cache them to load all website pages. It allows smoother web browsing and improves the overall customer experience. This function is useful in making websites run smoothly at lower Internet speeds. Low-end system availability also improves charging speeds well [13].

Bootstrap

Bootstrap help to make a page responsive when page render on different devices like mobile, tablet, desktop. So that user can easily interact with web page. Bootstrap allows back end developers the ability to pseudo-implement layouts without the need for a front end developer. It gives people who don't know much about how CSS works an easy way to implement basic grid structures for modules and full-page layouts. It is a great tool for rapid prototype development. As we all know, bootstrap is a framework for front end web design using HTML, CSS and JS etc. It's a free SW platform that supports and allows websites and apps to be sensitive across different platforms [16].

2.3.2 Back End

Modern web creation is difficult because the techniques and technology are constantly evolving. What's in vogue today could become outdated in less than a year. What's more, the web applications have become much more nuanced and richer. The designer of the web will continue to identify new applications of film, virtual reality and quantum computing on websites. And, of course, the savvy web developer of today needs to continue learning and developing, which is equally difficult since the systems are rapidly evolving. Back end devices use different methods to build or add clean, portable, excellently documented code to web applications [36].

Table 23. *Selected Back end Languages/Frameworks, Definition, and Usage*

Languages/ Frameworks	Definition	Usage
Django	Django is indeed an open source platform for Python-based Back end web applications.	Django is an open-source framework which is used for fast, practical, manageable, simple look and safe websites. A web app framework is a set of tools containing all the elements required to build applications.
Python	Python is a strong, object-oriented programming language with flexible semantic, simple to	Python is used to develop GUI (Graphical User Interface) desktop SW, websites, and mobile ap-

	learn syntax of Python emphasizes usability and thus reduces SW maintenance costs.	plications. As a high-level programming language, Python also helps a developer to concentrate on the application's core functionalities.

Today the culture of Django unites more than 11,000 programmers across 166 countries. Django follows the idea of DRY (Don't Repeat Yourself), making the system time efficient. In other terms, no need to rewrite existing code, as Django enables developers to build websites as just a Lego set. It's no secret that Python is among the programming languages that are used frequently. Python has retained the number one spot as "a most common coding language" for both the past five years. For its heavy focus on usability and performance it is the preference among several developers [36].

Django Framework

For rapid development of web applications Django framework is available which is a python based open-source platform used to website security, maintain, clean the design. The main feature of the Django framework is to allow developers to focus on application mechanisms which are new, slightly than spending time on components that have already been formed. It's completely featured on the market as are several other frameworks. It's looking for a lot of trouble. Involved in web development; helps users to concentrate on designing components required for their application [17].

Python

Python is a versatile programming language of high level that enables developers to create a wide array of uses. With a minimal of developers, Python helps us to create manageable functionality in track-time. Python has a clean and organized code base which makes it easier for developers to update and manage the SW tasks. Python is a dynamic programming language of high level, comprehension and specific intent that focuses on the readability of code. The Python syntax lets programmers do programming in lesser time than in Java or C++. The Python is widely used in larger organizations because of its complex programming paradigms. Usually they include directive and object-oriented functional programming. It has a large and vast standard library with automated memory management and dynamic functions. Python offers a broad library covering such topics as web services, string operations, web server resources, and operating system frameworks [37].

2.3.3 Search Functionality

Internet users obtain search engines for the various search categories. A searcher will build his search terms differ based on what he wants to do and will also expect a different result maybe posts, videos or even a whole site. Google and others need to consider the purposes of the user in order to produce the correct content. Individual and organizations keywords and keyword configurations inside the terms of the search input is not enough and comparing them with websites that contain the same sentences. It is also necessary to correctly decide and react to the true intent of the invitation in directive to identify the consumers search correctly [38].

Query Based Search

Once a developer develops the data replicas or model, Django provides automatically an API of database abstraction that agreements objects be developed, retrieved, modified, and deleted. Explain how to use API in this text. For complete details of all the different lookup options, see the data model reference. Query terminologies describe a cost or a calculation that can be utilized as part of an update, development, description or aggregate. When an expression generates a Boolean value then a user can use this directly in the filters. There is diversity of built-in terminologies that can be used to support a developer write interrogations and quires. Expressions may be joined to make more complex computations, or in some cases nested [39].

2.3.4 Database

Text-oriented databases are used to handle semi-structured data often known as record stores. These data do not conform to a set structure but instead form their own structure. Document-oriented systems are much more adaptable, they are not strict in structuring individual records.

PostgreSQL is an object-relational database system, it is strong and open-source, that combines the SQL with several other functionality to use expand. PostgreSQL has gained a strong credibility because of its confirmed architecture, durability, data security, versatile feature set, configurability, and it has a community which is open-source behind SW’s commitment to continually produce creative and effective approaches [40].

PostgreSQL

PostgreSQL offers two distinct types of binary data storage. Binary records can be processed in a table using the data type or using Large Object function which stores the binary information in a specific section in a separate table and references to that table

by saving a type identifier reference in your table. PostgreSQL is an open-source database, and it's a database system that is far more obsessed with compliance with international standards and configurability than with freeing up on how developer’s aspect of the business. It utilizes either dynamic and static schemes and given jurisdiction to use it to store relational data and standardize type. PostgreSQL will do the job if a user needs a relational database that can run SQL Queries and function with loads of existing applications built on a tabular, relational data model [41].

3 IMPLEMENTATION

The Chapter gives an overview of the implementation phase of the thesis work which includes explanation of back end, front end, search functionality, database, cloud integration, and challenges faced in the thesis work. In back end, we will discuss Django framework, admin panel, MVT (Model, View, Template) pattern, and back end sequence and flow. In front end, we will discuss HTML, CSS, Bootstrap and front end sequence and flow. In search functionality, we will tell about query-based search functionality, and Django forms.

3.1 Back end Description

Application back end architecture refers to server-side activities. The back end developers work hand in hand with front end developers and supply server-side argumentation for the outward-facing web application components. In other words, back end developers use different programming language for example, Java or PHP to construct the logic to make the web application run efficiently. Back end developers are also accountable for optimizing the implementation for performance and power, in addition to making web applications usable. Moreover, back end developers also build a database storage solution, which would be a critical element for all web applications as its data stores (such as users, documents, messages, etc.). The compiled code from a back end developer helps transfer information from central database to an application. Back end production aims to function parallel to front end in order to give the end-user the final product. Back end developers primarily focus on how a website operates. Developers run scripts that concentrate on the features and logic that control the SW. The end users will never see the technology which they’re actually using. Back end technology is a mix of servers, databases, and applications [17].

Django is not a language but a complete framework. For the back end, Django arrives with an ORM layer that allows the developers to modify the source of data with ease, forms (an individual Markup implementation) to process user feedback and verify data and signals, and the observer pattern to be implemented [39].

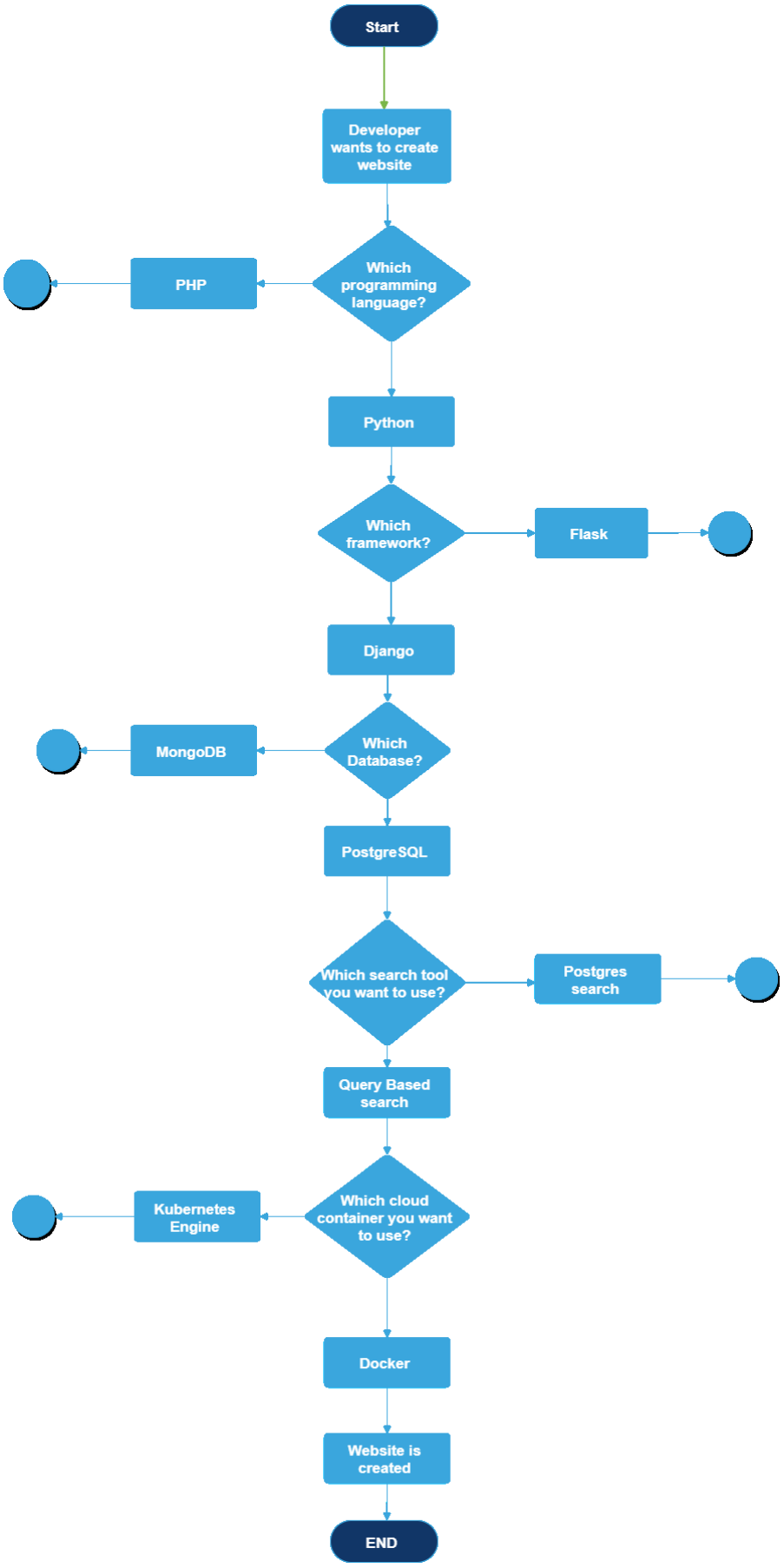

Figure 6. *Back end Flow Diagram*

A complete description of how developers can develop DMS with Django is shown in the above diagram. Python is used as a programming language as it is a general-purpose language. In Python, there are two major web development frameworks Django and Flask. Django framework is used to develop this DMS. Django can work with a variety of Database management systems. PostgreSQL is used as a Database. For search functionality, the Query-based search is used to search the files faster. For deployment, Docker is used as a cloud container.

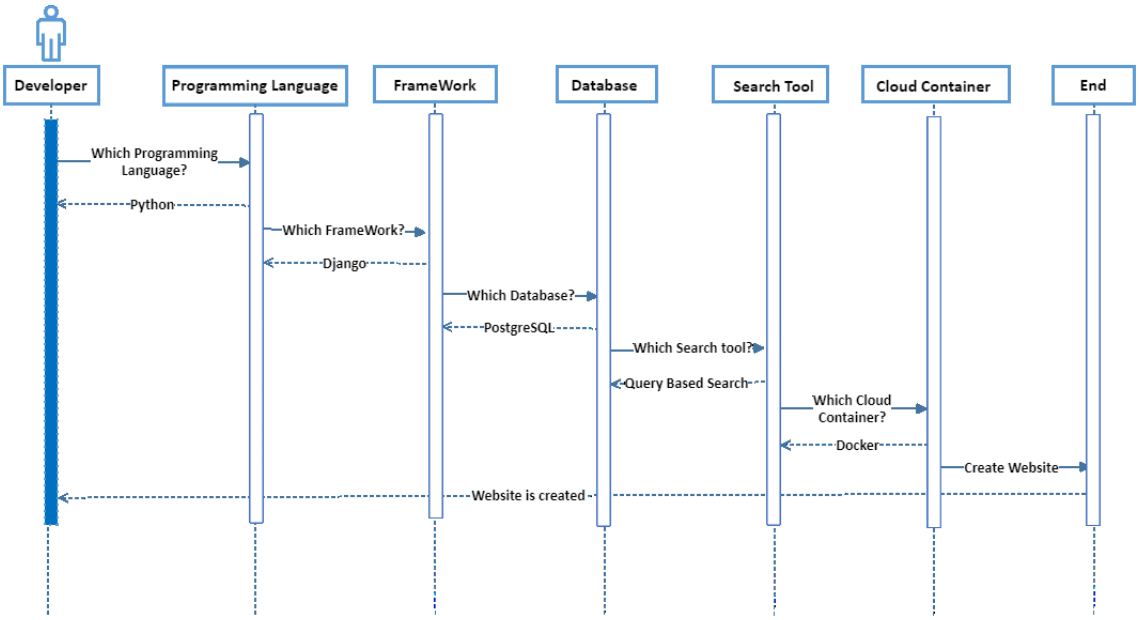

Figure 7. *Back end Sequence Diagram*

For developing a website, a developer first needs to select the programming language then comes the web development framework. After choosing the framework, database is selected then a search tool for searching purposes. At the end, cloud container is used like Docker for Deployment.

3.1.1 Overview of Django

Choosing a platform for web creation is a massive issue. There are many other frameworks on the marketplace, each built to answer various project requirements. The Django platform is a simple choice for many businesses and individual projects. It is one of the most common web development tools. Platforms allow developers to build apps or websites from an authoritative source [39]. Django platform provide advanced functionalities such as the authentication support, admin panels and techniques of management, different contact forms, support for the file uploading and more. In other words, if a developer wants to develop a website from scratch. These modules are already built using a framework alone, so developer only need to customize them to suit for site properly.

Django offers a wide variety of modules so programmers can easily build projects. There are many frameworks to save the time and trouble of programmers, and Django takes a lot of care of the web creation issues, thus developers can concentrate on creating different projects. For instance, Django delivers a safe technique to handle username and password, attempting to avoid common mistakes such as putting session information in vulnerable cookies or immediately storing passwords rather than a default password [17].

The responsibility for designing cloud-based applications rests with Django programmers. Developers would need to collaborate with front end Developers on UX. Django's most important thing and benefit is that it is used to create and design the RESTful APIs which are used for internal consumption. Developers have to work in an agile environment [39].

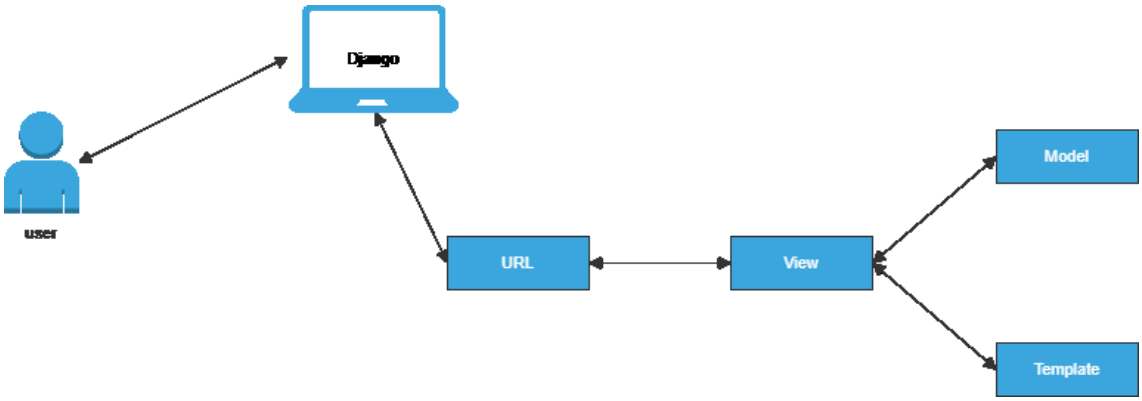

Figure 8. *MVT Django Architecture*

Django is entirely built on MVT architecture. The user interacts with the system and requests a specific URL. There is a file in Django with the name urls.py, which handles all the URL requests and asks views about the request. The URL redirects to the user to the respective template. When the user on a specific page requests some information from the database, the request goes back to the view and views, gets the detailed information from the database, and returns it to the template.

```
124  # Static files (CSS, JavaScript, Images)
125  # https://docs.djangoproject.com/en/3.0/howto/static-files/
126
127  STATIC_URL = '/static/'
128
129
130  # To add static files:
131
132  STATICFILES_DIRS = [
133      os.path.join(BASE_DIR, 'static')
134  ]
135
136  STATIC_ROOT = os.path.join(BASE_DIR, 'assets')
137
138  MEDIA_URL = '/media/'
139  MEDIA_ROOT = os.path.join(BASE_DIR, 'media')
140
```

Figure 9. *Declaring Static URL, Directory, Root, Media URL and Root*

Django recommends keeping all the static files like CSS, JS, and images in one folder. In the above code, first, we defined “STATIC_URL” to tell Django about our static files. Then we connected the path of the static with “BASE_DIR” (Base path). Django copies all the files to its own project folder just to improve the process. For that, we need to define the “STATIC_ROOT”. Developer can set any name for the new folder as in our case the name of the folder is “assets” where we keep all the static files. Same process for the media files. First, we defined “MEDIA_URL” telling Django where our media files are and then connecting it with the base path.

```
31  # Application definition
32
33  INSTALLED_APPS = [
34      'thesisApp.apps.ThesisappConfig',
35      'django.contrib.admin',
36      'django.contrib.auth',
37      'django.contrib.contenttypes',
38      'django.contrib.sessions',
39      'django.contrib.messages',
40      'django.contrib.staticfiles',
41      'crispy_forms',
42  ]
```

Figure 10. *Defining Installed Applications in settings.py*

Developer needs to define the Django app in Installed_Apps section in settings.py of Django project. In our case, name of our Django project is thesisProject and name of our Django app is thesisApp. So, we need to define this in settings.py file that our Django app is thesisApp as shown above in the code.

```
17  from django.urls import path, include
18  from django.conf import settings
19  from django.conf.urls.static import static
20
21
22  urlpatterns = [
23      path('admin/', admin.site.urls),
24      path('', include('thesisApp.urls'))
25  ]
26
27
28  #urlpatterns += static(settings.STATIC_URL, document_root=settings.STATIC_ROOT)
29  urlpatterns += static(settings.MEDIA_URL, document_root=settings.MEDIA_ROOT)
30
```

Figure 11. *Defining URL Patterns in urls.py in Django Project folder*

In code above, developer needs to define the URL patterns in the Django project folder (thesisProject) urls.py file so our Django project urls.py is connected to Django app (thesisApp) urls.py file. First import requires libraries, after that define URL paths like admin webpage, then all the other webpages are defined as URL paths in the thesisApp urls.py file, which is defined in the code above.

```
1   from django.urls import path
2   from . import views
3
4
5   urlpatterns = [
6       path('', views.index, name='index'),
7       path('about/', views.about, name='about'),
8       path('contact/', views.contact, name='contact'),
9       path('categories/', views.categories, name='categories'),
10      path('docList/docAdd/', views.docAdd, name='docAdd'),
11      path('docList/', views.docList, name='docList')
12  ]
13
```

Figure 12. *Defining URL Patterns in urls.py in Django App folder*

Django manages all the URLs in a file named urls.py. First, create urls.py in the Django app folder then define the URLs pattern. We have multiple URLs that map to different functions defined in the views.py file. Let's take an example:

```
path('about/', views.about, name='about')
```

Whenever the user tries to visit the “about” page, the “about” function defined in the views.py will be called. We also name our path as “about” to use in HTML code. Same goes for all the URL paths defined above in the code.

3.1.2 Django Admin Panel

One of Django's best aspects is the automated admin interface. Django creates admin UI automatically based on the project templates for developers. It reads user model metadata to provide a simple, model-centred interface whereby trusted consumers can control the content on the web site. Django offers a default admin interface which is used explicitly on the model to build, read, update, and uninstall operations. It reads a data set that describes and offers information about the model's data to provide an immediate interface for users to change the application's material. This is an in-built module and design for the user to perform admin work related to it [39].

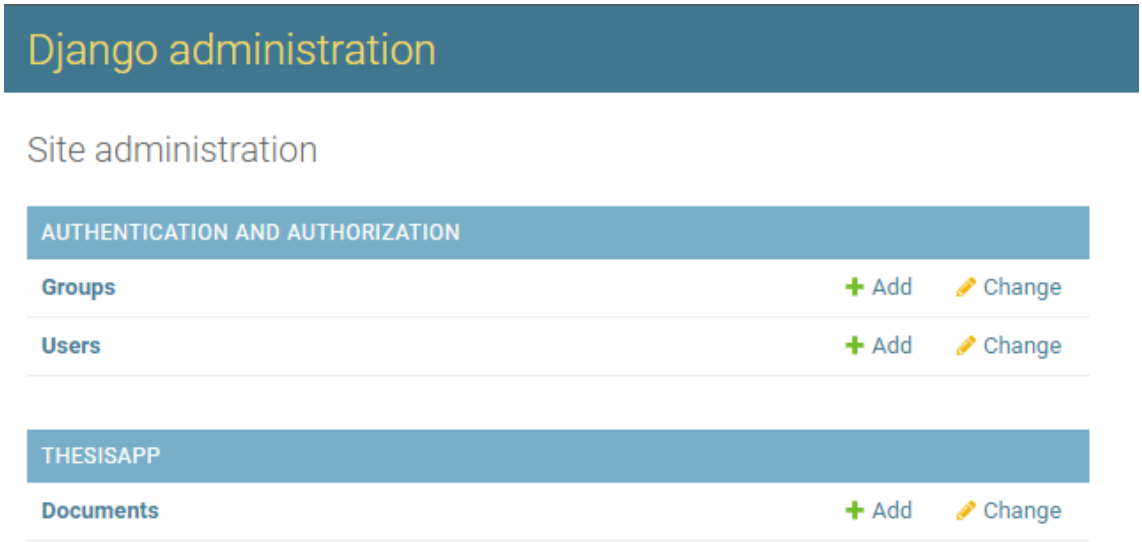

Figure 13. *Django admin panel*

```
1   from django.contrib import admin
2   from .models import Document
3
4   # Register your models here.
5
6   admin.site.register(Document)
7
```

Figure 14. *Document Model registration in admin.py file*

First, we register our model in the admin panel so that the admin can add and remove data using the admin panel. For registering models, we need to import admin as the “register” function resides inside “admin.site”. We also need to import our model from

models.py that we want to register. Then we will register the “Document” model using the register function.

3.1.3 Model

A web Platform is a SW tool for developing and running web applications. As a result, a developer doesn’t have to write code alone and waste time searching for potential bugs and miscalculations. A web-framework has a simple model view SW design pattern for controller architecture to build web applications and Django is a little different in a great way. MVT diverges significantly from MVC. The main difference between the two patterns is that Django himself wants to take care of a Controller component (SW Code which controls the Model and View interactions), left us to the example. Mixed with DTL (Django Template Language), the template is an HTML file [17].

The Model serves as your data interface. It's responsible for the data protection. It is behind the entire application's logical data structure and it defines databases (usually relational databases like MySQL, Postgres). A Django model is the built-in function to build tables, their fields and different constraints. In short, Django Models is the Database SQL someone is using for Django. SQL is complex and involves several different queries to build, delete, update or any other data base-related material. Models Django simplifies the activities and organizes tables into templates. Each model maps to a specific table in the database [42].

```
1   from django.db import models
2
3   # Create your models here.
4
5   CATEGORY_CHOICES = (
6       ('Hardware','Hardware'),
7       ('Software','Software'),
8       ('Bugs','Bugs'),
9       ('External IPs','External IPs'),
10      ('Git & SVN','Git & SVN'),
11  )
12
13
14  class Document(models.Model):
15      name = models.CharField(max_length=200)
16      storage = models.CharField(max_length=200, blank=True)
17      product = models.CharField(max_length=200, blank=True)
18      product_Release = models.CharField(max_length=200, blank=True)
19      types = models.CharField(max_length=200, blank=True)
20      topic = models.CharField(max_length=200, blank=True)
21      category = models.CharField(choices=CATEGORY_CHOICES , max_length=100)
22      url = models.URLField(max_length=250, blank=True)
23      upload = models.FileField(upload_to='documents', null=True, blank=True)
24      objects = models.Manager()
25
26      class Meta:
27          verbose_name_plural = "documents"
28
29      def __str__(self):
30          return self.name
31
```

Figure 15. *Defining Document class in models.py*

In Django, the models.py file is used to create, delete, update, and remove the database. The developer only needs to define a class that is converted into database automatically by the Django. The models class lives inside the “django.db” module that is imported for working with models. In the above screenshot of models.py, a variable CATEGORY_CHOICES contain all the categories in the form of a Python tuple. The “Document” class inherits the basic structure of the model. For creating a column in the database Let’s look at the example below:

```
name = models.CharField(max_length=200)
```

The above line of code creates a column with heading as “name”. The “models.CharField” represents that the data stored in the column will be of type “CHAR” and one field can have a maximum of 200 characters.

Meta Class

The Meta class defines how the class behaves. In the above screenshot, the plural name of the database is explicitly defined in the Meta class. If the developer does not define it explicitly then the Django automatically adds “s” that can be wrong in some cases.

__str__ function

The __str__ function is used to get any object in the form of string. Here this function returns the name of the Document when called.

3.1.4 View

The View is the user interface that a user sees in the browser when a website launches display. What a user sees when render a website in browser is called view.HTML/CSS/JS and Jinja represent the View. Django Views is a vital participant in Django's MVT System. A view function, as per Django Documentation, is a function that takes up the requests of web and provides response from the web [39].

```python
from django.shortcuts import render, redirect
from django.http import HttpResponse
from django.core.paginator import Paginator
from django.core.files.storage import FileSystemStorage

from .forms import DocumentForm
from .models import Document
from django.db.models import Q

# Create your views here.


def index(request):

  #  docs = Document.objects.all() add this with index.html, , {'docs': docs}

    return render(request, 'index.html')


def about(request):

    return render(request, 'about.html')


def contact(request):

    return render(request, 'contact.html')

```

Figure 16. *Defining Template pages in views.py*

In Django, the views.py file contains the functions that take web request as input and returns a web response. The developer needs to import some essential functions that are listed below:

Render

The render function is imported from the shortcut's library. It is used to combine the request and the template.

Redirect

The redirect function is also from the shortcut's library of Django. It is used to call some other function or URL as a return.

HTTP response

HTTP response class resides in the HTTP module of Django. It is typically used for passing the data of the page as a string or in other formats.

Forms

For interacting with forms, the developer needs to import the Django forms in the view.py file.

Models

For interacting with forms, the developer needs to import the Django forms in the view.py file

Paginator

The paginator is used to split the data. In Django, this function resides in the core module.

Q Object

The Q object handles the input given by the user for search functionality. The Q object resides inside the model's module. After imports, the developer needs to define the functions that take web request and returns web response.

Index function

The index function takes the request and returns the index.html page using the render function.

About function

The about function takes the request and returns the about.html page using the render function.

Contact function

The contact function takes the request and returns the contact.html page using the render function.

```
29
30  def categories(request):
31
32      return render(request, 'categories.html')
33
34
35  def docAdd(request):
36      if request.method == 'POST':
37          form = DocumentForm(request.POST, request.FILES)
38          if form.is_valid():
39              form.save()
40              return redirect('docList')
41      else:
42          form = DocumentForm()
43      return render(request, 'docAdd.html', {
44          'form': form
45      })
46
47
48  def docList(request):
49      documents = Document.objects.filter()
50      search_query = request.GET.get('q')
51      if search_query:
52          documents = documents.filter(
53              Q(name__icontains=search_query) |
54              Q(category__icontains = search_query)
55          )
56          print(search_query)
57
58      return render(request, 'docList.html', {
59          'documents': documents
60      })
61
```

Figure 17. *Defining Template pages and Query Based Search in views.py*

Categories Function

The categories function takes the request and returns the categories.html page using the render function.

DocAdd Function

The docAdd function is used to add the document to the database. The developer first needs to check the type of request method whether it POST or GET. If the method of the request is POST, that implies that the user wants to add a document. The document resides inside the form that the user submits. “Is_valid” functions are used to check whether the form is valid or not.

The last step for uploading the document and user information that comes inside the form is to call “form.save” function. Then the user is redirected to the “docList” function that displays the documents. If the method of the request is GET, that implies that the user wants to see the same page again. By using the render function, a new form is returned to the user.

DocList Function

The “docList” function displays the list of documents to the user. The documents are searched using the Q object. First, the developer needs to create an object that can access all the documents. The search_query variable captures the input given by the user. In the searching process, the input by the user is compared against the name and the categories of the document. All the documents that match the search query are displayed to the user by redirecting “docList.html”.

3.1.5 Template

Templates are the third and most significant component of MVT Structure in Django. A template in Django is composed in a HTML format, essentially in HTML, CSS, and JS. Django Platform manages and creates dynamically accessible end-user HTML webpages. Django primarily deals with a back end, so we use templates to provide the Front end and a theme for our website. Depending on needs there are many two ways to connect the prototype to the website. Developers may use a single template directory that will spread across the whole project. A developer can make a unique template directory with each app in a project [39].

```
56  TEMPLATES = [
57      {
58          'BACKEND': 'django.template.backends.django.DjangoTemplates',
59          'DIRS': [
60              os.path.join(BASE_DIR, 'templates')
61          ],
62          'APP_DIRS': True,
63          'OPTIONS': {
64              'context_processors': [
65                  'django.template.context_processors.debug',
66                  'django.template.context_processors.request',
67                  'django.contrib.auth.context_processors.auth',
68                  'django.contrib.messages.context_processors.messages',
69              ],
70          },
71      },
72  ]
```

Figure 18. *Defining Template folder as Base Directory in settings.py*

For HTML files we need to create a folder with the name “templates”. The above code shows the setting related to the template folder. First, the path of the template folder is defined then some context processors are defined.

```
{% load static %}
{% static "images" as baseUrl %}


<!DOCTYPE html>
<html lang="en">

<head>
  <title>Ugalizer - Unifying What's Scattered!</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">
  <script src="https://kit.fontawesome.com/0eafd60c5f.js" crossorigin="anonymous"></script>

  <link href="https://fonts.googleapis.com/css?family=Work+Sans:100,200,300,400,700,800" rel="stylesheet">

  <link rel="stylesheet" href="{% static 'css/open-iconic-bootstrap.min.css' %}">
  <link rel="stylesheet" href="{% static 'css/animate.css' %}">
```

Figure 19. *Load Static, Image as Base URL, Jinja template for APIs*

Django recommends keeping all the static files like CSS, JS, and images in one folder, in our case *static* folder. In the above code, first we loaded the static files whose path is defined in the settings.py file. The base template of the website is created in which all the static files are loaded and linked. All the API's are linked using Jinja template.

```
<div id="hardware" class="row">
  <div class="block-3 d-md-flex ftco-animate" data-scrollax-parent="true">
    <a href="/categories/" class="image" style="background-image:url({% static 'Images-2/hardware-1.png' %}) "
      data-scrollax=" properties: { translateY: '-20%'}">
    </a>
```

Figure 20. *Inserting images as static URL in Jinja Template*

In the above code, categories of the document are linked in a tag in the above *div* container. We are using Jinja for using Python in the HTML code. Jinja is the web template engine of the Python programming language. Using Jinja we are loading background images. "Static" template tag is there to build the URL for the given relative path.

```
<div class="col-md-8 text-center heading-section ftco-animate">
    <h2 class="h1"><strong class="px-3">Upload a File OR a URL</strong></h2>
    <form class="" method="post" enctype="multipart/form-data">
        {% csrf_token %}
        <div style="text-align: left;" class="btn btn-primary mt-3 py-3 px-5"> {{ form|crispy }}
        </div>
        <center> <button type="submit" class="btn btn-primary mt-3 py-3 px-5">Upload Here</button>
        </center>

    </form>
</div>
```

Figure 21. *Using form in HTML, CSRF Token, Crispy Forms*

In the above code, first create the form to take a file as input from the user. The file is then sent to views.py using the POST method. The CSRF (Cross-site Request Forgery) token guarantees that only forms from entrusted domains can be used to POST data back. We are using Crispy Forms that help in managing data. It permits modifying forms' properties (like method, CSS classes, or send button) on the back end without re-writing them in the template.

```
{% for document in documents %}
<tr>
    <td>{{ document.name }}</td>
    <td style="text-align: center;"> {{ document.category }}</td>
    <td style="text-align: center;">
        {% if document.url %}
        <a href="{{ document.url }}" class="btn btn-primary"
            target="_blank">Click Here</a>
        {% else %}
        <span class="text-muted">No Link</span>
        {% endif %}
    </td>
    <td style="text-align: right;">
        {% if document.upload %}
        <a href="{{ document.upload.url }}" class="btn btn-primary"
            target="_blank">Download File</a>
        {% else %}
        <span class="text-muted">No File</span>
        {% endif %}
```

Figure 22. *Using Document Model to Add a new Document*

In the above code, we are using Jinja format for looping through all the documents in the database. In each iteration, developer picks a document and displays its name and category. Developer needs to write an if-else statement in Jinja format that ensures that if he/she provides the URL of the document then the user can click on the link otherwise Django displays “No Link”. Another if-else statement that ensures that if the document is available in the database then the user can download the document else “No File” is displayed.

```
{% block content %}
<form method="GET" action="/docList/">
    {% csrf_token %}
    <div class="search-box">
        <input type="text" class="search-txt" placeholder="Search Here" name="q"
            value="{{request.GET.q}}">
        <button class="search-btn" type="submit" name="action"><i
                class="fas fa-search"></i></button>
    </form>
</div>
{% endblock %}
```

Figure 23. *Using Form in HTML, CSRF Token, Search Functionality*

In the above code, first we create a form that takes input from the user to search for a document. The “block content” overrides the base template. Then a form is created that uses the GET method to transfer data from client machine to server. The CSRF token guarantees that only forms that have arisen from entrusted domains can be used to GET data back. We are using a query-based search that’s why “request.GET.q” is used in Jinja format which we defined in views.py file.

3.2 Front end Description

A front end developer is basically a creator of SW who write the code of a front end website. The design of the web describes that how a website appear, web designing is completely implemented on front end. A front end developer ties the engineering and

manufacturing environment together, presenting back end functionality in an engaging way for users to connect. This involves layout, design, text, buttons, photos, menu and inbound links [35].

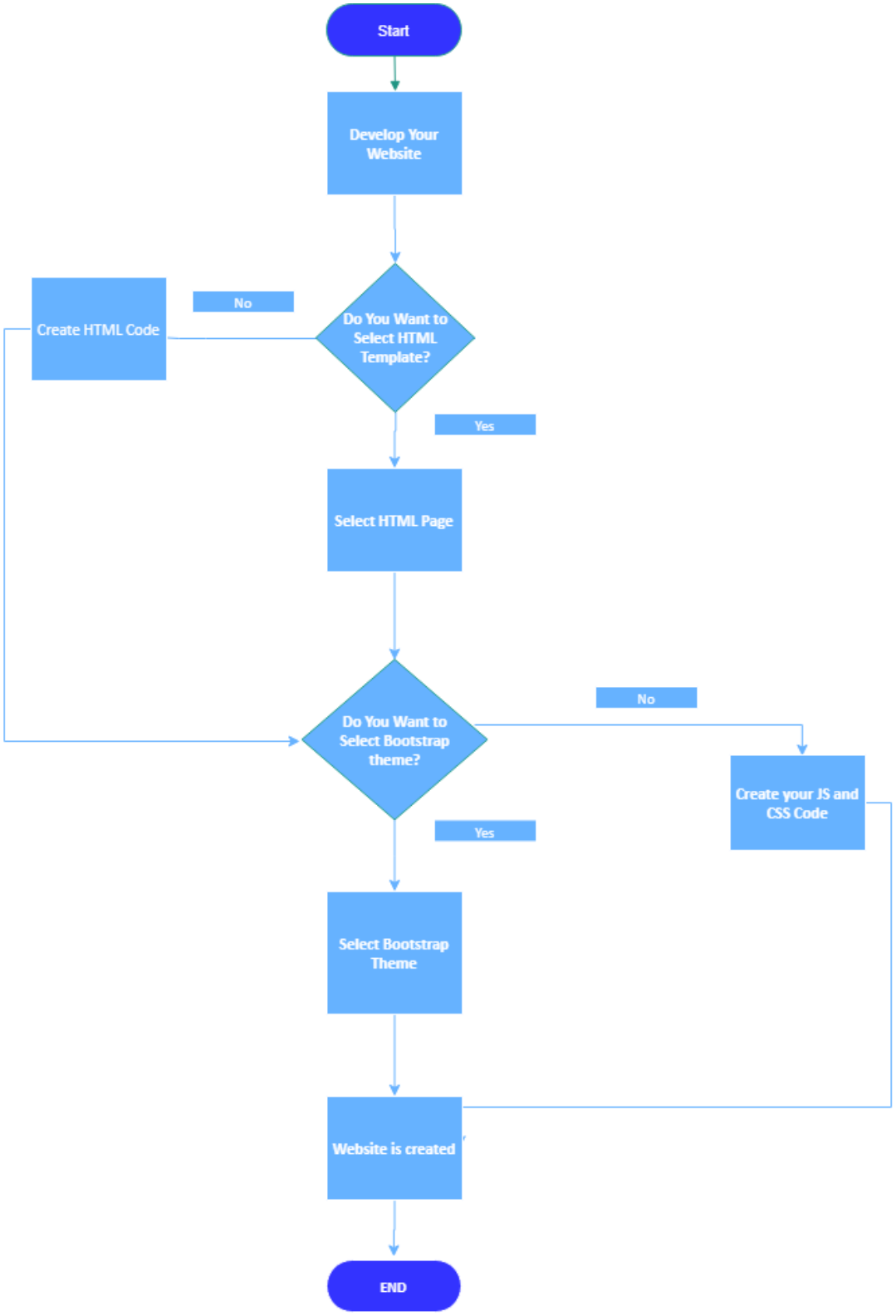

Figure 24. *Front end Flow Diagram*

When developer wants to develop a website there are two options either to select an HTML template or create your own HTML code which is time consuming, in our case an HTML template is selected. After the first step, then there are two more options, either to choose a Bootstrap theme or create your own CSS and JS code which is time consuming and complex as well (not so beginner-friendly), in our case a Bootstrap theme is selected. Now website front end it complete, there will be still some changes needed when you want to integrate your front end code with your back end code but that's another story.

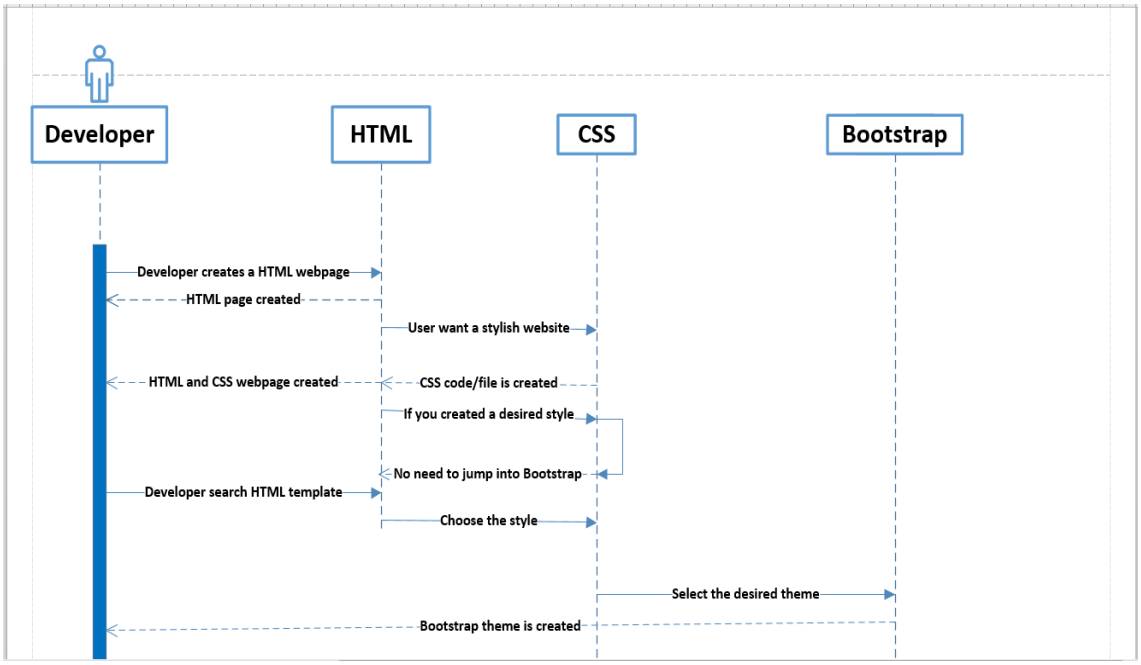

Figure 25. *Front end Sequence Diagram*

In this sequence diagram a developer wants to create a webpage in HTML. There are two ways the developer must choose one way to develop website. If developers want to create a website according to specific requirements, then they will develop a custom HTML page after this the developer will generate the CSS code according to HTML setting. The second way is to choose a designed Bootstrap theme. The Bootstrap theme include HTML and CSS pages. The developer will choose the desired page and the website is ready.

3.2.1 HTML

HTML used in construction of webpages. Hypertext establishes the relation between web pages. The HTML document consists of two main sections, HEAD with BODY. Each one has its own items and specifications which are authorized, the elements itself may have specifications on where they can exist, and what elements can occur within them [12].

```
<!DOCTYPE html>
<html>
<body>

<h1>My First Heading</h1>

<p>My first paragraph.</p>

</body>
</html>
```

Figure 26. *Basic example of HTML Code*

The coding of HTML starts as <HTML> and ends as </HTML>. The < body > tag specifies the body of a text. The component < body > includes all the contents of an HTML document, including headings, sections, photos, web links, columns, tables, etc. Note: The HTML document can contain only one < body > item. Typically, the header attribute, or the < h1 > tag in HTML, is the title of an article, or some other highlighted text on the document. Typically, it would be the widest text that sticks out. There are also other headers labels in HTML, such as a h2, h3, h4.

3.2.2 CSS

CSS is a basic method to apply style to web documents like fonts, colours, and spacing. It is a set of styling guidelines used by developers to manage content layout and display on a web page. One very cool feature of CSS is that developers can store all the CSS rules in one document, keeping that document distinct from the Html page and linking the two. So, when the developer updates the CSS, the required changing is updated immediately and automatically on all HTML files [13].

```
<!DOCTYPE html>
<html>
<head>
<style>
body {background-color: powderblue;}
h1   {color: blue;}
p    {color: red;}
</style>
</head>
<body>

<h1>This is a heading</h1>
<p>This is a paragraph.</p>

</body>
</html>
```

Figure 27. *Basic example of HTML CSS Code*

In above code, CSS code allows HTML code to be stylish and coloured. The <style> tag defines the CSS code styling inside HTML code. Body colour is defined as ‘powderblue’ colour, heading1 colour is defined as blue colour, and paragraph colour is red.

3.2.3 Bootstrap

Bootstrap is a stylish, elegant, and powerful first front end mobile platform for quicker, easier web creation. It uses JS, HTML, CSS. Bootstrap 3, system consists of first Application styles in the extensive catalogue instead of them in different directories. Every common browser supports this. Only the knowledge of HTML and CSS helps everyone to start with Bootstrap. Even the official website of Bootstrap has clear documentation. The Bootstrap adapts to desktops, laptops, and mobile phones. Bootstrap includes over a dozen interchangeable components which are designed to include iconography, drop-down menus, navigation, warnings, popovers, and more [16].

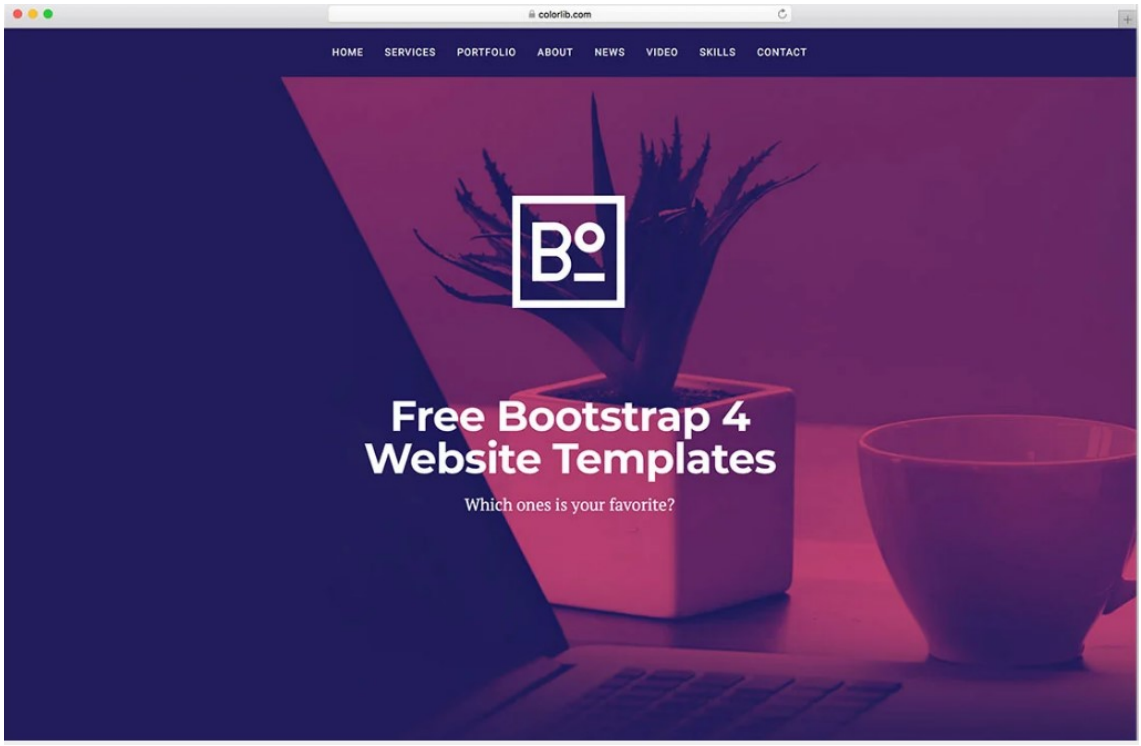

Figure 28. *Ready-made HTML, CSS, JS template from Bootstrap*

Bootstrap allows the developer to use ready-made templates which reduces a lot of effort in designing the web interface. Indeed, there are still many modifications needed to integrate with back end part and change the front end part according to application.

3.3 Search Functionality

Search functionality includes two main areas which are Django Forms and Query Based Search Functionality. Development of Django Forms and Query Based Search Functionality doesn't take much time but it's not that easy to learn for beginners. Search functionality always helps the user to find the document easily. Query-based search functionality searches the document faster. Users can implement this functionality on the Django website or can make a website entirely for this purpose. If user have a large database that contains millions of documents, then the website should be made entirely for the searching functionality. Query-based searching helps in finding the document faster than matching the names of the documents [39].

3.3.1 Django Forms

Django includes a type of Form that is used to construct HTML templates. It describes a shape, and how it appears and functions. It's like the Model Form class that uses the Model to construct a form, but it doesn't need the Model. GET and POST have been the only HTTP methods which can be used when managing files.

GET and POST are usually used in various applications. Any application that may be used to change device status-such as a query that updates the database and use POST. A web application practices GET requirements for administrator forms is a potential threat: it would be relaxed for an assailant to imitate the request of a form to gain access to vulnerable system pieces. POST, combined with other protections such as Django's CSRF security, provides more access control. On the other side, GET is perfect for items like a web search type, so you can quickly bookmark, distribute, or re - submit the URLs that reflect a GET request [39].

Forms help in implementing search functionality in Django forms. Just like other forms, the views.py receives the input. There are two methods POST and GET to send and receive the data from the client machine to the server and vice versa. The GET method is used for sending search functionality requests. Using Q objects a developer can easily manage to filter the search request in Django forms.

```
1  from django import forms
2  from . models import Document
3
4
5  class DocumentForm(forms.ModelForm):
6      class Meta:
7          model = Document
8          fields = ('name', 'storage', 'product', 'product_Release', 'types', 'topic', 'category', 'url', 'upload')
9
```

Figure 29. *Defining DocumentForm class in Django Forms*

In the above code, we are creating forms from the models. Forms are imported from Django and Document is imported from models.py file. For creating a form from models, we need to define a class with the name “DocumentForm” that inherits “ModelForm”. Then Meta class is defined to state the metadata of the form and “Document” is used as a model.

3.3.2 Query Based Search

Search functionality always helps the user to find the document easily. Query-based search functionality searches the document faster. Users can implement this functionality on the Django website or can make a website entirely for this purpose. If user have a large database that contains millions of documents, then the website should be made entirely for the searching functionality. Query-based searching helps in finding the document faster than matching the names of the documents.

Query structures are useful for complex queries, since logical operators may combine them. The search functionality is also not advantageous for the traffic but can also help developers. By incorporating it into Google Analytics, a developer can monitor how often users search for a specific term. User can use this data effectively to alter the layout of the website and the design hierarchy [42].

3.4 Database

Django provides a simple way to interact with the database. Django provides a file name models.py in which users can define classes. These classes act as tables in the database. Django provides an easy way to convert these classes into tables. Django models clarify tasks like creating, deleting, updating, and design tables. Usually, every model outline to a separate database table.

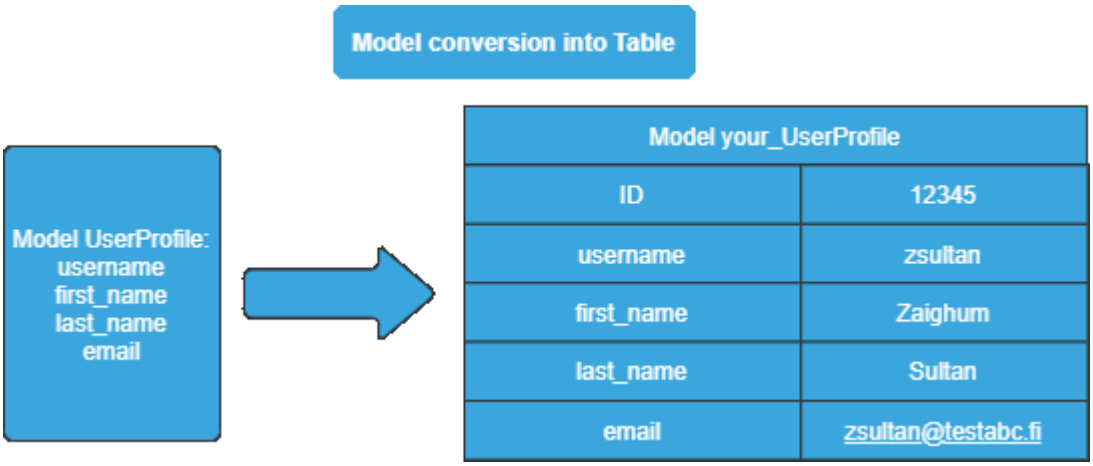

Figure 30. *Model Creation in Database through Django Example*

As shown in the above example the “UserProfile” model is converted into the “your_UserProfile” table with all the details which user enters in the front end part.

By default, Django will automatically build your project's SQLite database. A database setup on its own will take time. If developers really want the quickest setup to promote Django with a database, the preceding setup would end up leaving as it is [43].

3.4.1 PostgreSQL

PostgreSQL, like so many other RDBMSs, utilizes the SQL to handle and analyses data. The SQLite, MySQL and PostgreSQL are three of the most deployed open source RDBMSs. When a website is set up using Django, it will automatically set up a SQLite database for the application's repository, same goes for PostgreSQL if developer wants to use PostgreSQL [30].

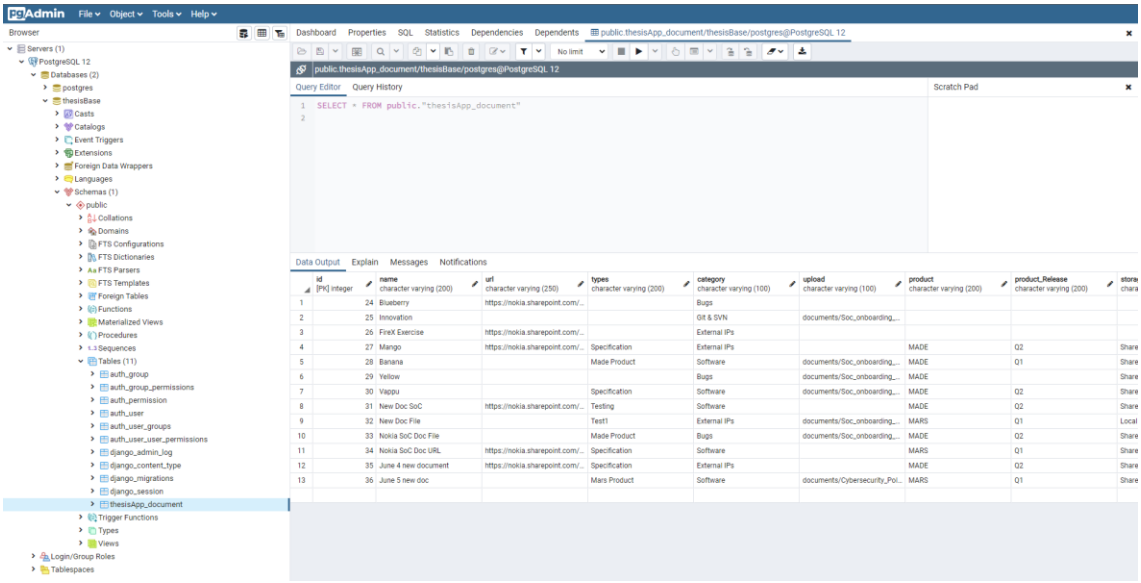

Figure 31. *PostgreSQL Interface using pgAdmin Management Tool*

3.4.2 pgAdmin

PgAdmin is the most common and feature-rich PostgreSQL Open Source Administration and Creation Framework, the world's most advanced Open Source database. PgAdmin may be used for the management of PostgreSQL and EDB Advanced Server 9.5 and above on Linux, Unix, macOS and Windows. PostgreSQL reflects the functions of the accounts. Positions that could be logged into so-called login positions or users. Roles involving other roles are called community roles. In this segment you'll learn how to effectively handle roles and classes [40].

3.5 Cloud Integration

Our company has already cloud running, so we will just install a cloud container and deploy our Access Portal Ugalizer to the cloud. For this purpose, Docker is perfect to deploy Ugalizer on our company's cloud. The Ugalizer will be used by internal employees and customers only.

3.5.1 Docker Cloud Container

Docker is a platform intended to make applications easier to build, deploy, and run utilizing containers. Containers allow the programmer to assemble and distribute an application as one assembles, with all the components it needs, like libraries as well as other components. Through doing so, the developer can be sure, thanks to the server, that the program can run on any Linux machine irrespective of any specific settings the machine may have that may vary from the computer used to write and check the code [44].

Today, Docker and his open-source father now called Moby is bigger than ever. More than 3.5 million applications were put in container using Docker technology, and over 37 billion intermodal applications were downloaded, as per Docker. Docker is sort of like a virtual machine, in a way. But unlike a virtual machine, instead of building a full virtual operating system, Docker allowed developers to use the Linux kernel as the scheme they are running on and needs only apps to be shipped with items that are not actually operating on the host. This provides a substantial boost in efficiency and decreases application size [44].

3.5.2 Docker Integration with Django and PostgreSQL

Define the project components

For this thesis, you need to create a Dockerfile, a Python dependencies file, and a docker-compose.yml file. Create a new file named as Dockerfile in your main project directory. The Dockerfile specifies the image content of an application through one or more construct commands configuring that image. Once created, you can run the image in a container.

```
Dockerfile > ...
1   FROM python:3
2   ENV PYTHONUNBUFFERED 1
3   RUN mkdir /thesisProject
4   WORKDIR /thesisProject
5   COPY requirements.txt /thesisProject/
6   RUN pip install -r requirements.txt
7   COPY . /thesisProject/
8
```

Figure 32. *The Dockerfile content.*

A Python 3 parent image begins with this Dockerfile. By inserting a new code directory, the parent image is updated. By installing the Python specifications described in the requirements.txt file, the parent image is further updated. Now, save and close the Dockerfile. Create a requirements.txt in your main project directory, this file is used by the *RUN pip install -r requirements.txt* command in your Dockerfile.

```
requirements.txt
1   asgiref==3.2.7
2   Django==3.0.5
3   django-crispy-forms==1.9.0
4   Pillow==7.1.1
5   psycopg2==2.8.5
6   pytz==2019.3
7   sqlparse==0.3.1
8
```

Figure 33. *Content for the requirements.txt file.*

The requirements.txt file contains all the libraries that you need to install for your project. After listing all the required libraries, save and close the requirements.txt file. Create a file called docker-compose.yml in your project directory.

docker-compose.yml

```yaml
version: "3.8"

services:
  db:
    image: postgres
    environment:
      - POSTGRES_DB=postgres
      - POSTGRES_USER=postgres
      - POSTGRES_PASSWORD=postgres
  web:
    build: .
    command: python manage.py runserver 0.0.0.0:8000
    volumes:
      - .:/code
    ports:
      - "8000:8000"
    depends_on:
      - db

```

Figure 34. *The configuration for the docker-compose.yml*

Two services are specified by this file, the db service and the web service. A file named docker-compose.yml defines the resources that make up the software. These servers are a web server and a database in this instance. The compose file also describes the Docker images used by these services, how they connect together, any volumes within the containers that they may need to be assembled. Finally, the file docker-compose.yml defines which ports are exposed by these services. For more detail about how this file operates, see the docker-compose.yml reference. Now, save the docker-compose.yml file and close it.

Create a Django project

Usually user needs to create a new Django project but, in our case, we already have a Django project named as thesisProject and Django app as thesisApp. Change to the root of your project directory. To create the Django project, run the docker-compose command as follows:

$ sudo docker-compose run web django-admin startproject composeexample .

This instructs Compose to run *django-admin startproject composeexample*, using the image and configuration of the web service in a container. Since the web image does not yet exist, Compose creates it from the current directory, as defined by the compiler. Once the image of the web service is created, Compose runs it and executes in the

container the *django-admin startproject* command. This command instructs Django to create a collection of directories and files that describe a project in Django. List the contents of your project after the docker-compose command finishes. If you run Docker on Linux, the generated django-admin files are owned by the root. This happens because the root user is running the container. Change the ownership of the new files using command: *$ sudo chown -R $USER:$USER .*

You should already have ownership of all files, including those created by django-admin, if you are running Docker on Mac or Windows. To check this, just list the files.

Connect the database

Now, for Django, you need to setup a database connection. Edit the composeexample / settings.py file in your project directory. Substitute DATABASES = ... with the following:

```
92  DATABASES = {
93      'default': {
94          'ENGINE': 'django.db.backends.postgresql',
95          'NAME': 'postgres',
96          'USER': 'postgres',
97          'PASSWORD': 'postgres',
98          'HOST': 'db',
99          'PORT': 5432,
100     }
101 }
102
103
```

Figure 35. *Database configuration in settings.py file for Docker.*

The postgres Docker image defined in docker-compose.yml describes these settings. Now, save the file and close it. Run the *docker-compose up* command for your project from the top level directory. At this stage, Ugalizer runs successfully using Docker on your localhost.

3.5.3 Docker Integration with Company's UNIX Server

In this thesis, we are using our company's own cloud platform for the Access Portal deployment. So, here are few steps in order to setup the cloud integration with company's UNIX server. First, we will install PuTTy. After that, generate public key using PuTTygen, save both private and public key. Put public key in server. Then open PuTTy and go to SSH, then Auth, and give path to private key in the bottom section. Write the host address: root@xx.000.xxx.00 and press open, now you should be connected.

After following above steps, clone the git repository: *git clone repo name*. List all folders using command: *ls -al*. Move to your folder which is zaighum-thesis in our case, using command: *cd zaighum-thesis.* Install all the required libraries including Django latest version or whichever version you are using. Now update settings.py HOST from HOST: "localhost" to HOST: "xx.000.xxx.00" and push it to the git repo. Open Port 5432 (check your database port number) for your project from admin portal of company's cloud. At last, pull the repo using command: *git pull repo name.* Now migrate all files using command: *python manage.py migrate.* Now run the server using command: *python manage.py runserver.* Now the Access Portal is running on company's cloud internally.

4 SYSTEM END RESULT

The Chapter gives an overview of system end results. The diagrams below states user interaction with the website.

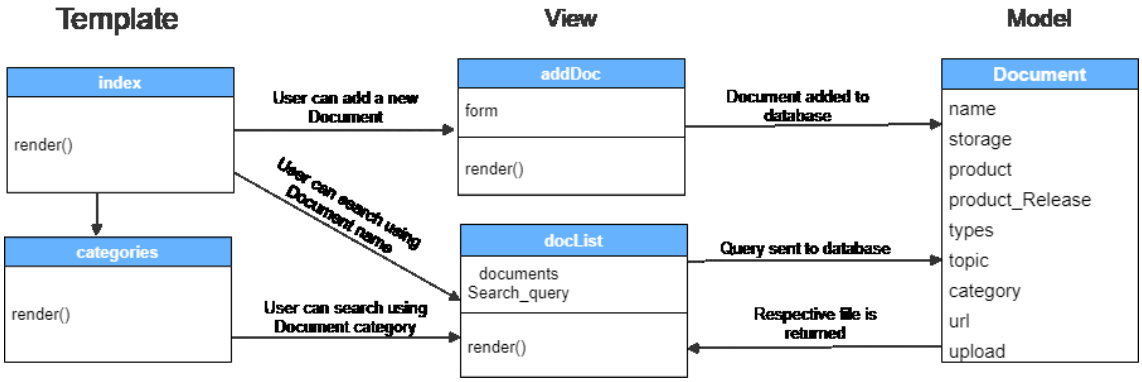

Figure 36. *Class Diagram of User interaction on Ugalizer and MVT process*

The index file shows the user mainly two options, one is to add a new document to the database and the other is to search the respective document. If the user chooses to search the doc then the DocList class listens to the query and gets the document from the database. If the user chooses AddDoc then the AddDoc class takes the respective document and information and stores it in the Database.

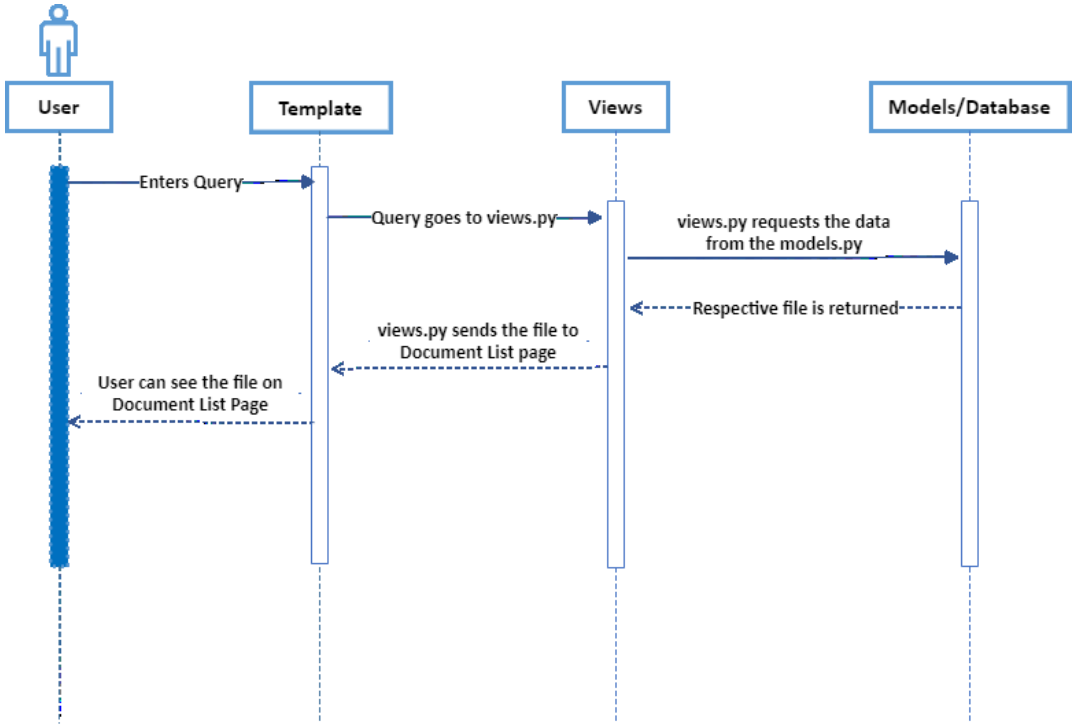

Figure 37. *Sequence Diagram of User Search interaction on Ugalizer*

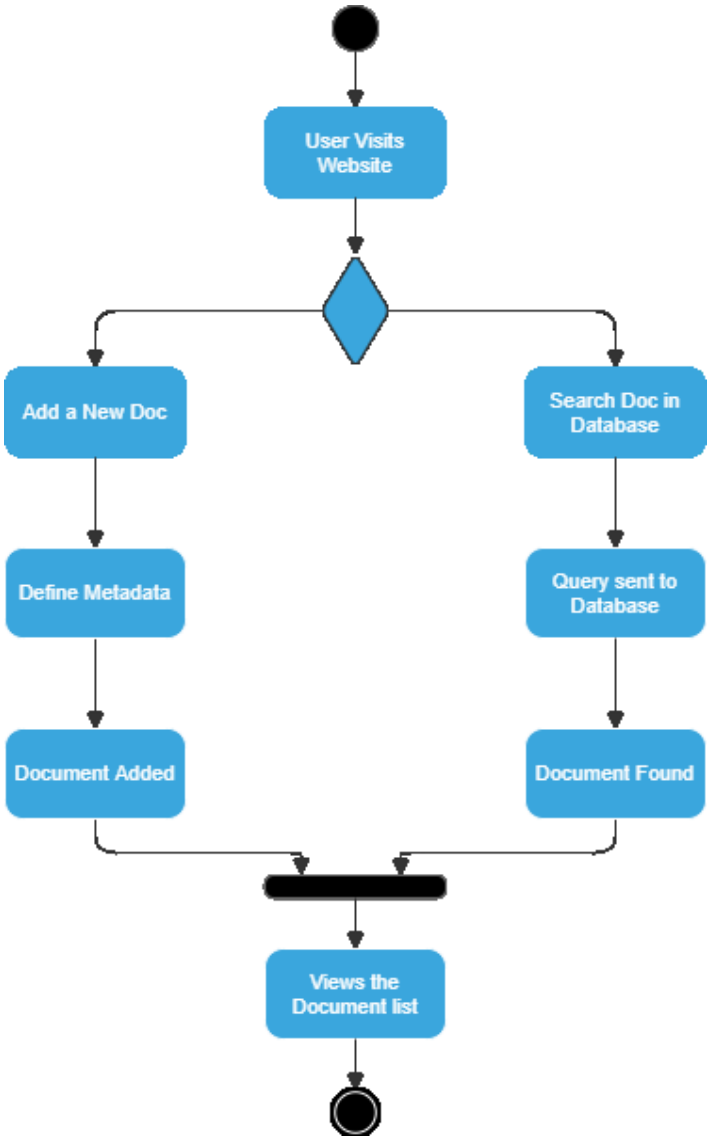

Figure 38. *Activity Diagram of Search/Add Documents on Ugalizer*

When the user visits the website, he/she can perform two functions:

User can add a new document

If the user wants to add a new document to the database, user should define the metadata for the document. There is an option while adding a new document either to “upload a file” or “add a link”, once document is uploaded successfully then user can see the list of documents.

User can search for existing documents

The user enters a query in the search bar. If the document is available in the database, then it will be listed in the document list. There are two ways to search for a document, either via entering the “document name” or by entering the “document category”.

4.1 Ugalizer – Documentation Access Portal

Here we will show end result of our Access Portal Ugalizer, show how the pages are structured and how the portal is used.

4.1.1 The Home page

The Home page includes a search bar where user can enter the name, or the category of the document and start searching by pressing enter or clicking the search icon. After this, user is redirected to the Document List page where related documents will be listed as per the query. On the top of the webpage, the navigation bar shows the sub-pages like About, Categories, Add Documents, Document List, and Get in Touch page etc.

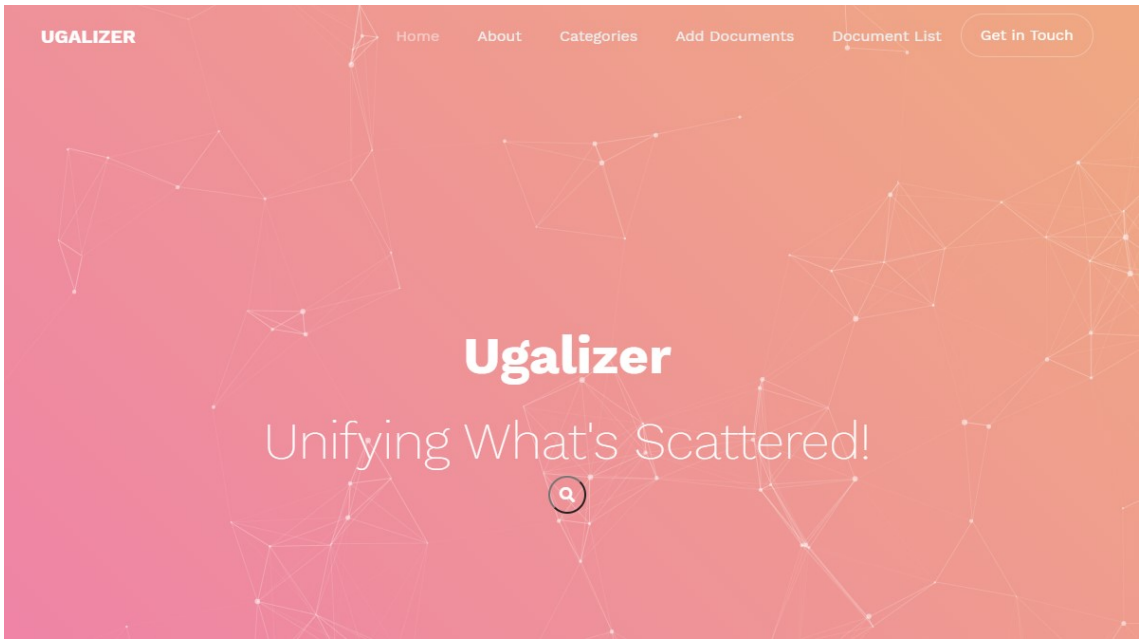

Figure 39. *The Home page of Ugalizer*

4.1.2 The About page

The About page tells about our designer documentation team.

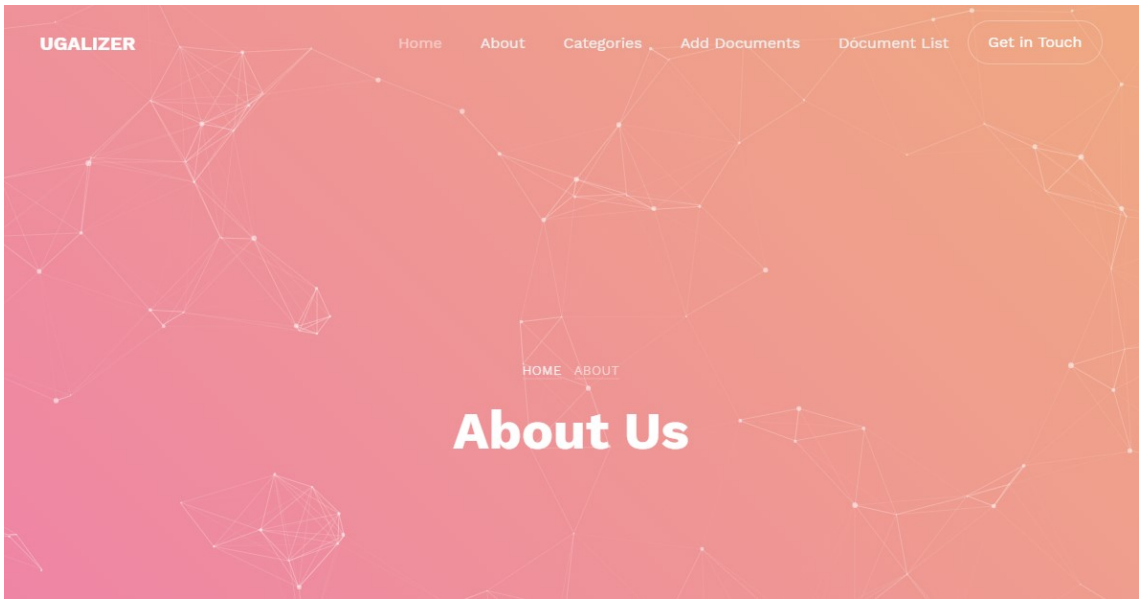

Figure 40. *The About page of Ugalizer*

The About page also contains links to the contact page “Get in Touch” so user can contact our team directly, footer of Ugalizer is also visible.

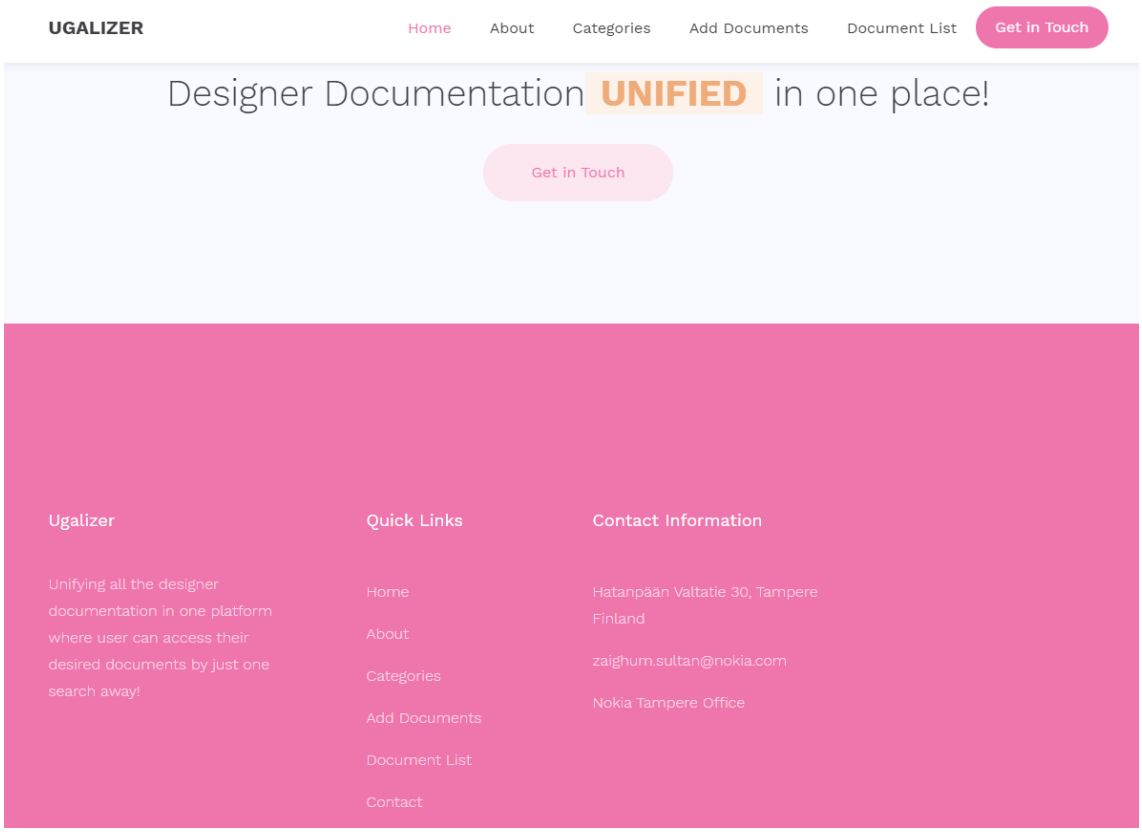

Figure 41. *The About page of Ugalizer in detail*

4.1.3 The Categories page

The Categories page lists all the document categories.

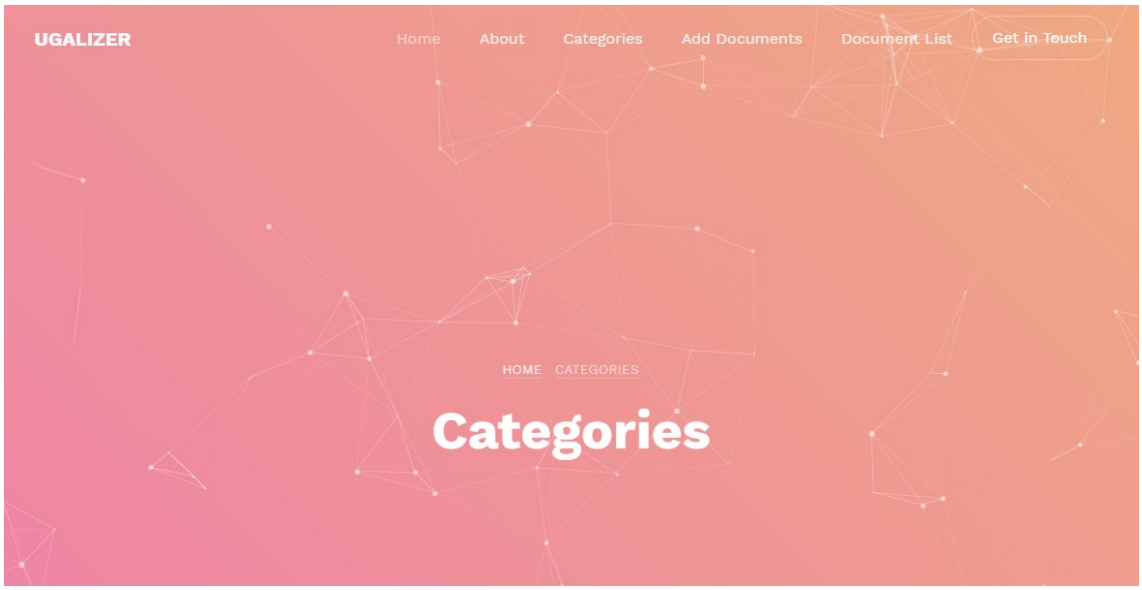

Figure 42. *The Categories page of Ugalizer*

Categories are Hardware, Software, Bugs, External IPs, and Git & SVN. Each category has a short description in the bottom section of the Categories page as well.

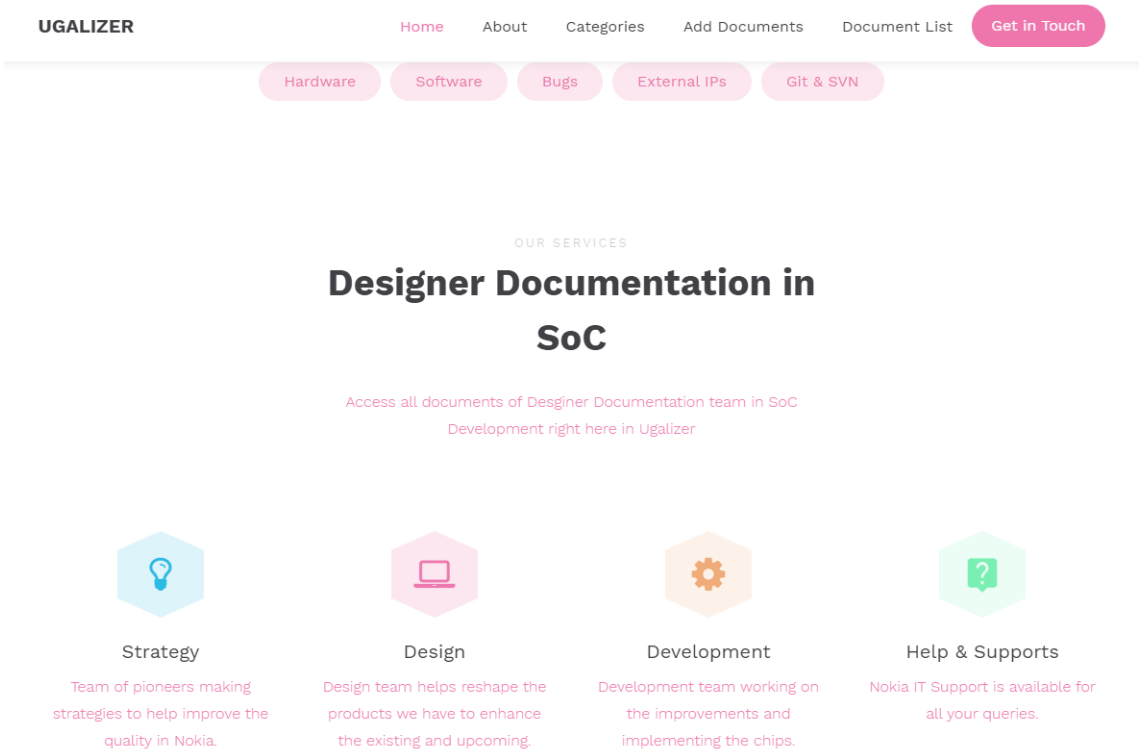

Figure 43. *The Categories page of Ugalizer in detail*

4.1.4 The Add Documents page

In the Add Documents page, a user can add a new document. Below is the landing page in the Figure 44.

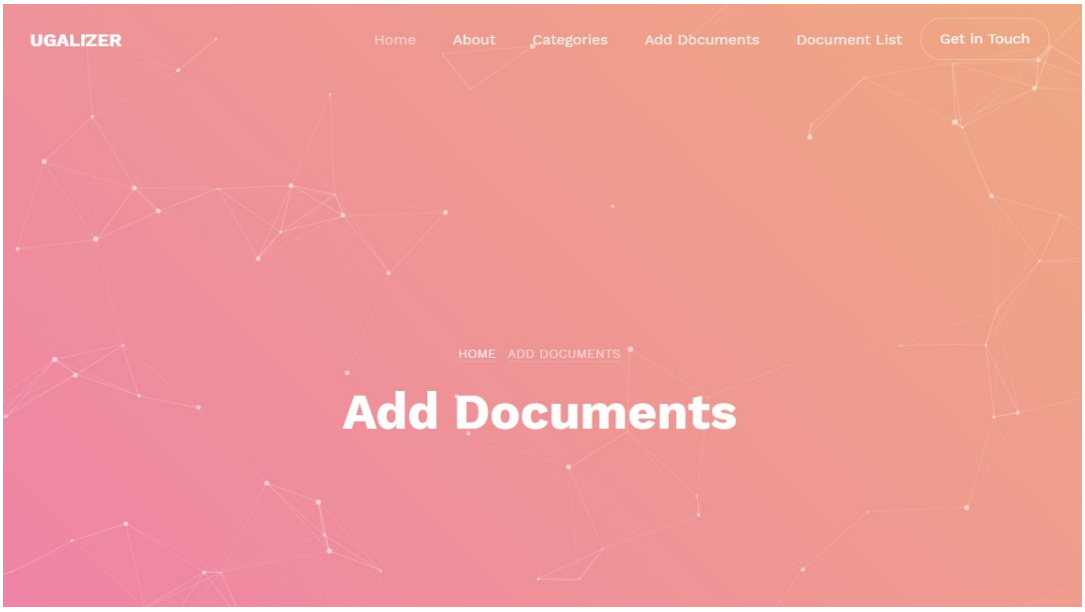

Figure 44. *The Add Documents page of Ugalizer*

Whenever a user adds a new document, he/she needs to define the metadata for the document. In our case, metadata is shown below in the Figure 45.

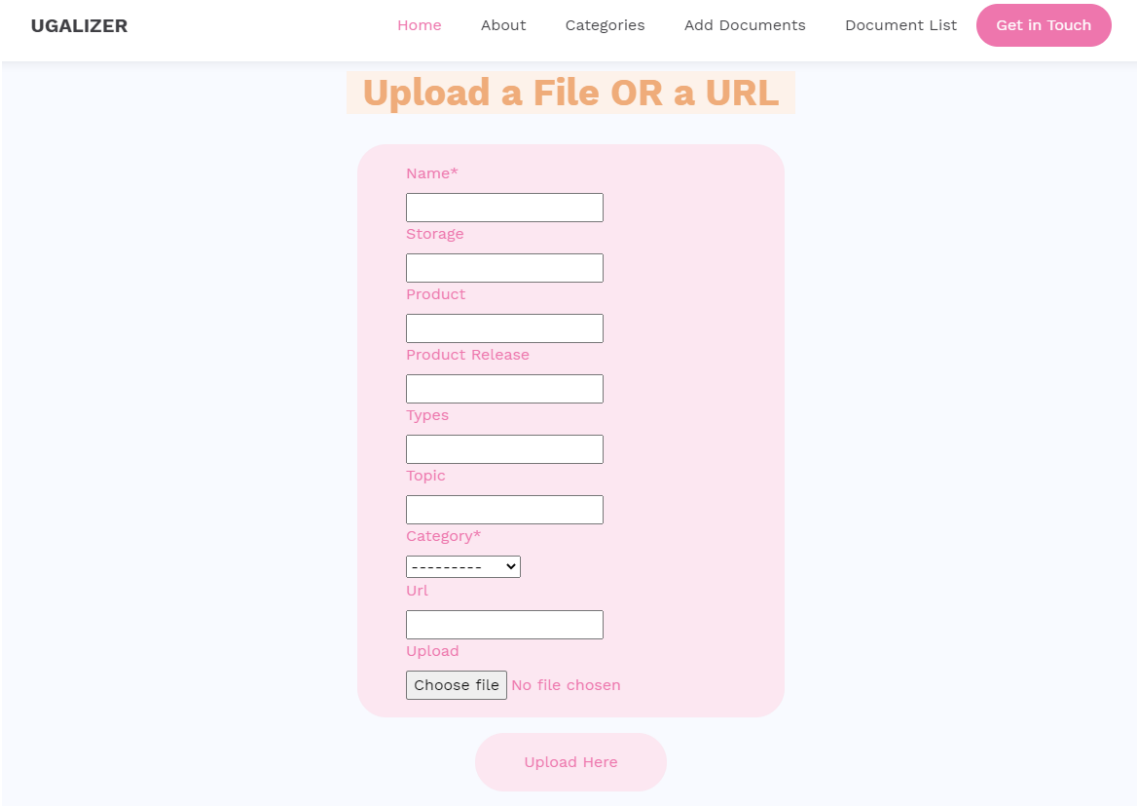

Figure 45. *Metadata for adding a new document*

4.1.5 The Document List page

In the Document List page, all the documents are displayed here as a list with title, category, URL, File headings. User can search directly from document list as well instead of going to homepage. There is an option to add a new document directly from document list.

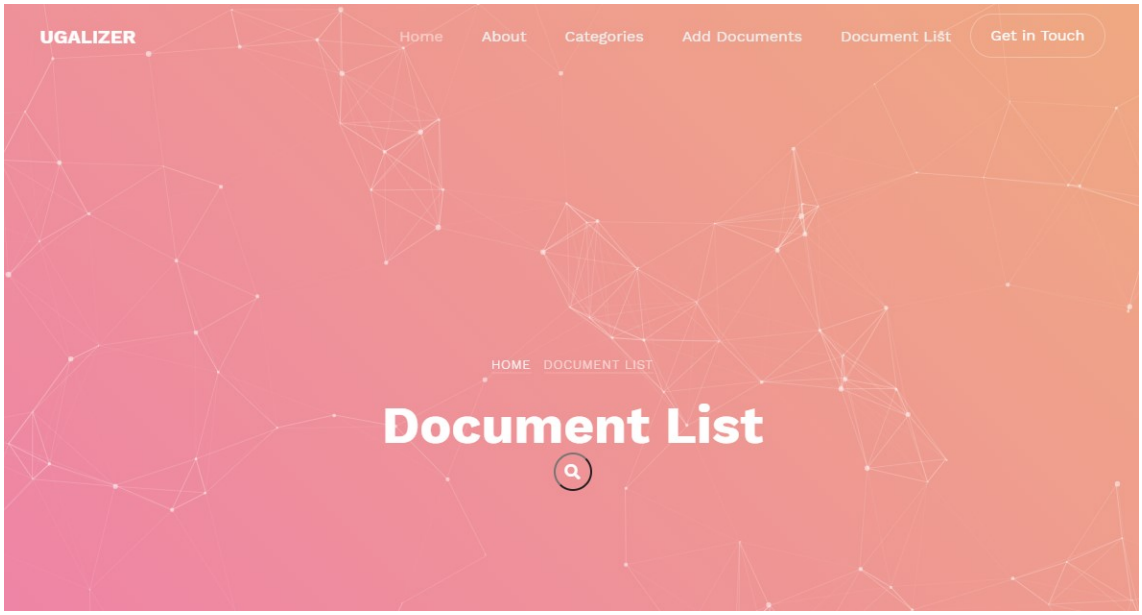

Figure 46. *The Document List page of Ugalizer*

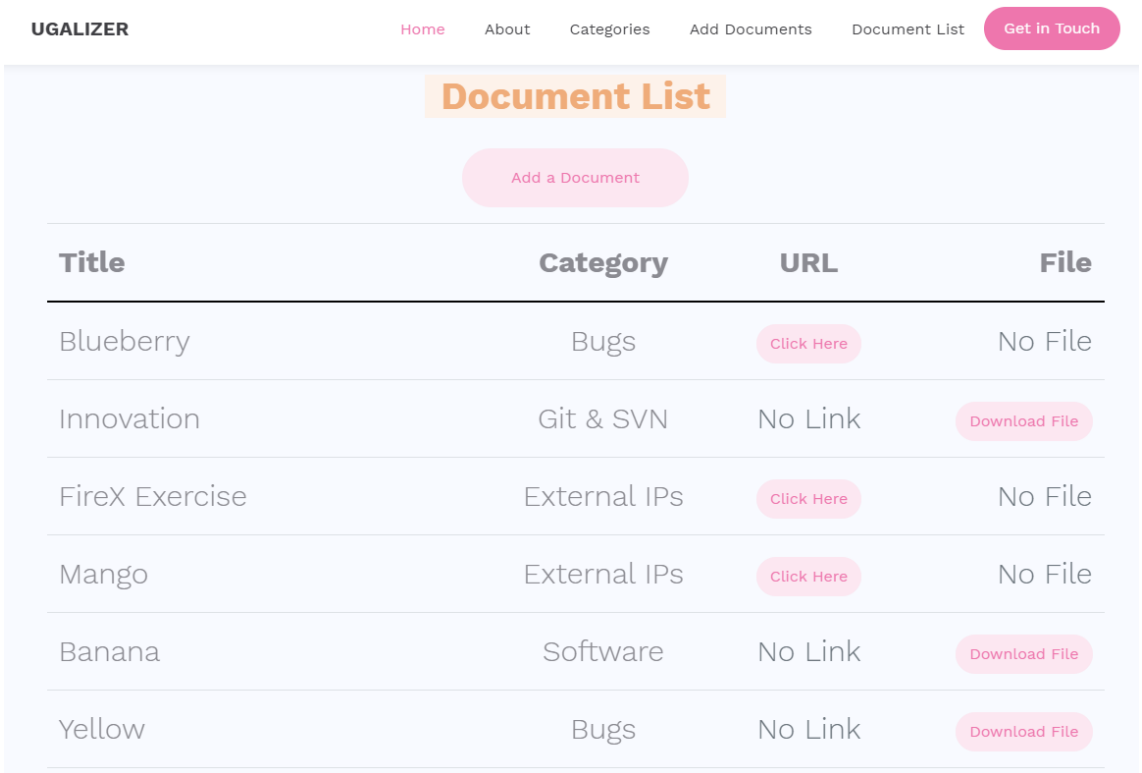

Figure 47. *The Document List page in detail*

4.1.6 The Get in Touch page

The Get in Touch page displays the contact information for our designer team representatives so user can directly contact them in need of any issue or query. Necessary fields to fill in the contact form are name of the user, email address, subject of query, and message body then user sends the message.

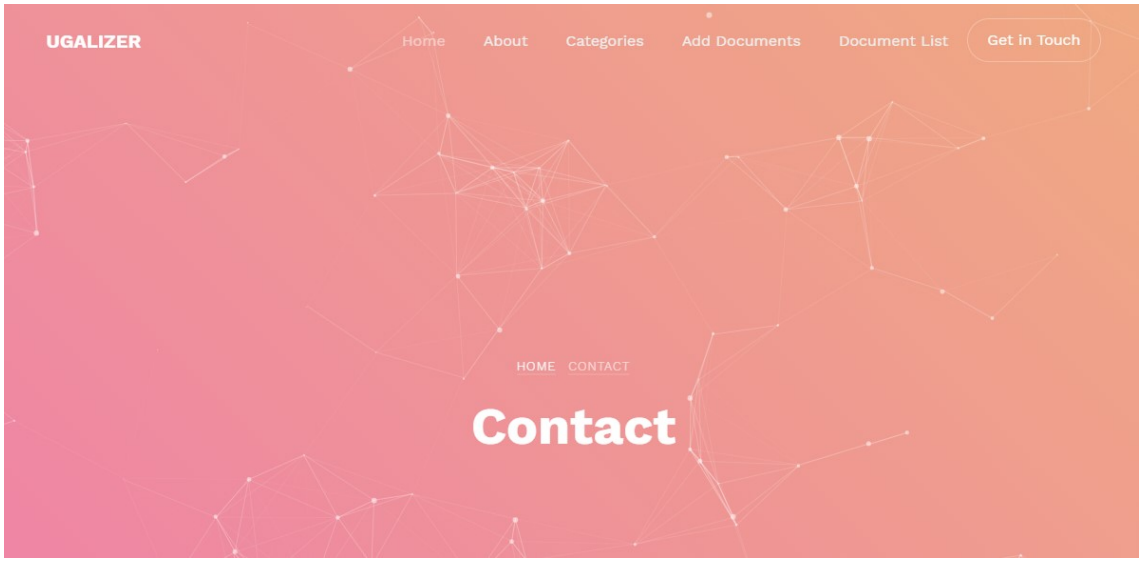

Figure 48. *The Get in Touch page of Ugalizer*

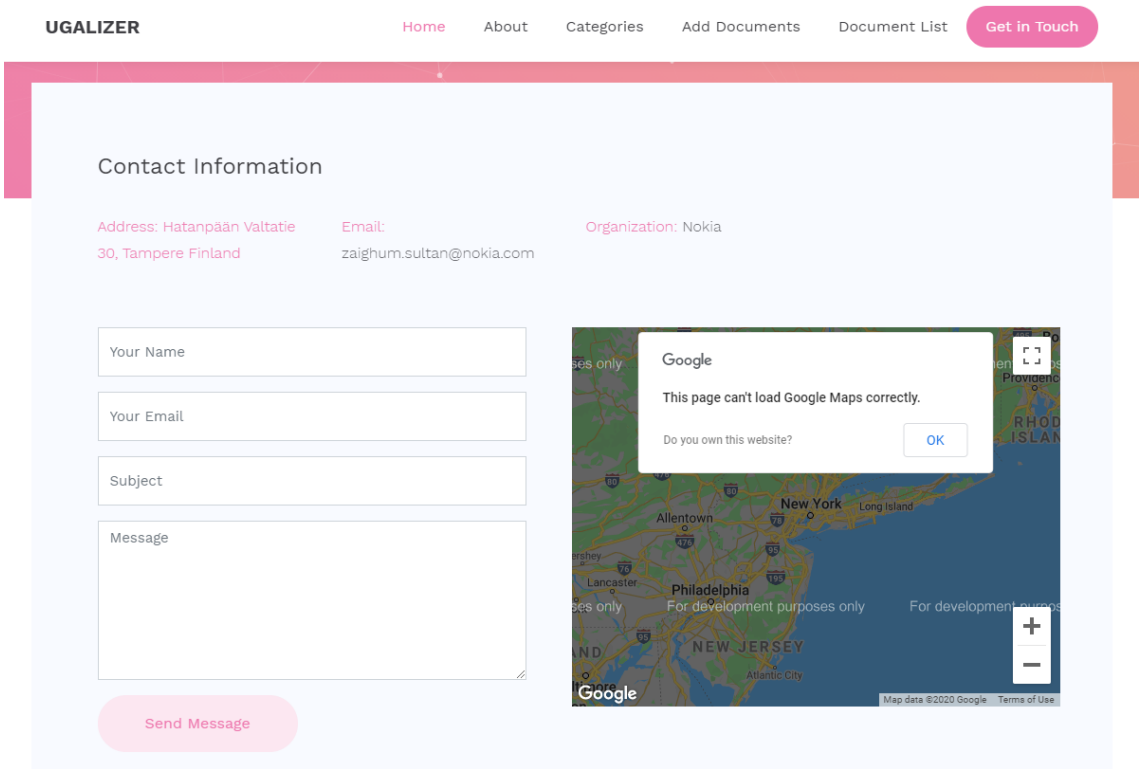

Figure 49. *Contact form on The Get in Touch page*

5 CONCLUSION

DMS is the use of a SW computer to coordinate, execute, manage, and preserve electronic records and items based on paper data. A platform for the electronic implementation of conventional physical paper filing activities is provided by several other record management systems. In this thesis, a detailed description of various DMS is provided. There were different choices to choose from the front end, back end, database, search feature, cloud container etc. to build Ugalizer.

Front end web creation is the procedure of converting data using HTML, CSS, and JS into a graphical interface, to permit users to display and interrelate with the information. Bootstrap is the largest common CSS framework for flexible and mobile-first website creation. HTML is one and only language which is used in front end development of different websites. HTML is indeed a standard and unique Markup language which is commonly used to build front layer web pages and websites. HTML is supported with the CSS and JS programming languages to view the documents on an internet browser. CSS and JS are used with HTML to make a website more stylish, attractive and powerful to fulfill the requirements and functionality of end user.

Each programming language has its own unique framework. There are many framework and tools for back end development of a website. In this thesis, different frameworks are described with full detail for example Laravel framework, Node.JS framework, Flask framework and Django framework. By comparing these frameworks according to robustness, functionality, latest features, it is concluded that Django is more powerful tool for modern development. Search functionality plays an important role in searching different unique contents from the internet. End users use search functionalities on daily basis. Different kind of search functionalities are discussed with detail in this thesis. In our case we are using Query based search for Ugalizer.

A database is an essential part of website development. A database keeps the record and retrieves the result of queries. All the important databases including OrientDB, MongoDB, MySQL, PostgreSQL, Oracle DB are mentioned in this thesis. PostgreSQL is the database which we are using for Ugalizer. It has unique features, security protection of data, and speed to respond any query.

To deploy any website to users, a cloud platform is required. In our case, we are using our own company’s cloud server. So, we only need a cloud container to deploy the Ugalizer. Docker is a development framework allowing developers to rapidly develop,

deploy, and test different applications. Docker integrates applications into regular units' containers which include all resources, device services, code and runtime necessary to run the application. In the end, I would like to say that thesis is a great source of self-learning and self-improvement technical and personal wise.

5.1 Challenges Faced

Due to no prior knowledge of web development and basic knowledge of Python, I had to spend too much time on trainings for back end and front end part. The main challenge faced during overall process of the thesis was time management, as I had also other tasks along my thesis writing so I had to manage time efficiently. I must say that prioritize your thesis on everything else (goes same for your important task in daily life).

Sometimes in this corona-virus situation I was not much focused on my thesis writing part while I was working from in start of epidemic so I would say that stay focused, steady and never lose hope. Keep yourself self-disciplined as it helps improve your personality as well. Be in contact with your supervisor for guidance and support, this is very important factor because if you are not in contact with the supervisor than there will be issues in future, as I had this issue in the start of thesis writing and due to this lack of contact I had to work hard more on writing part due to quite a lot of changes. Finding related sources and research articles was a big issue for me during thesis writing.

5.2 Future Considerations

There are quite a lot of improvements required in Ugalizer like limited no. of administrators who can add/remove the documents (our Documentation team can login and add/remove documents). Main categories and subcategories, one document can belong to more than one category, mutually excluding. Remove the animation and colour theme to Blue theme. Change the metadata “storage” to “source storage”. Hide the Title/Name column in the Document List page and add original title of the URL or File here.

In the Document List page, change the order like upload URL and upload file below title and other things go down. Narrowing the search when user is typing in the search bar, not clicked the search button yet. Tick box filtering for the category with the search bar. In the Document List page, display the versions of the file/URL. Replacing the existing file/URL based on version number of the file/URL. In the Document List page, replace “--“ with “No Link” or “No File”. The document access should be limited to specified users.

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