

Lappeenranta University of Technology
School of Engineering Sciences
Master's Programme in Software Engineering and Digital Transformation

Md Johny Alam

Developing a toolkit for creating ethnographic personas in the form of interactive data videos

Master's Thesis

Date: 19.06.2023

Supervisor: Associate Professor Annika Wolff (LUT)
Junior Researcher Md Tanvir Hasan (LUT)

ABSTRSCT

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In today's world, data has emerged as a critical source of knowledge, necessitating its transformation into various formats and visual representations. The research aim of this study is to develop an interactive toolkit that effectively presents data, promoting user comprehension within a comprehensive framework, while also exploring the integration of data presentation and curation with video graphics to enhance the overall viewing experience for individuals. To achieve this, the concept of ethnographic personas is introduced to provide a broader sense of data visualization. The research follows a research-through-design methodology, meticulously analysing, implementing, and evaluating each requirement to drive continual improvement of the toolkit. Upon completion of the interactive data video toolkit, a qualitative evaluation is conducted, revealing commendable aspects that contribute to the success of the research in terms of design and development. Additionally, the evaluation identifies limitations and proposes areas for future enhancement, expanding the scope of the research topic. In this study, not only is the toolkit developed, but an extensive review of existing research and methodologies is also undertaken to enrich knowledge and its implementation. The research questions revolve around identifying appropriate design principles to embed data within a collaborative problem-solving process and exploring the existing principles utilized in toolkit development. The research process effectively integrates with the analysis of existing research, resulting in the realization of interactive persona-oriented video data presentation through toolkits. This form of interactive visualization and information sharing significantly influences user understanding, aligning with the principles of user-centered design.

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1. Introduction

In the ever-connected modern world, gaining a comprehensive understanding of diverse user perspectives and needs has become paramount in designing successful technological solutions. Ethnographic personas serve as a valuable user-centred design tool, providing insights into user characteristics, behaviours, and preferences.[21] However, traditional static personas may not capture the complexity and dynamic nature of user experiences.[21] To overcome this limitation, this thesis focuses on the development of a toolkit that enables the creation of ethnographic personas in the form of interactive data videos. This introduction presents an overview of the research topic, outlines the research questions, and emphasises the importance of incorporating data into the collaborative problem-solving process.

1.1. Background

This research prioritises the design of a toolkit that addresses the limitations of static personas by leveraging interactive data videos as a medium for creating ethnographic personas. Ethnographic personas serve as a human-centred lens for designers, providing a comprehensive understanding of user motivations, challenges, and aspirations by capturing the rich context of their lives. However, static personas fall short in conveying the multidimensional aspects of user experiences and engaging stakeholders effectively.[21] To overcome these limitations, the focus of this research is on developing a toolkit that integrates interactive data videos, enabling a more dynamic and engaging representation of ethnographic personas.

1.2. Motivation for the research

The motivation for this research stems from the recognition that incorporating data into the design process can enhance decision-making and problem-solving in various domains. By integrating data with ethnographic personas, designers can gain a more holistic view of user needs and behaviours, leading to more informed design decisions. Additionally, interactive data videos offer an engaging and immersive way to present complex information, fostering collaboration and understanding among the users.

1.3. Research questions

To steer the development of the toolkit and delve into the principles that underpin the integration of data into the process of collaborative problem-solving, this study will address the following research questions:

1. What design principles can be used to guide the design of technology for embedding data to a collaborative problem-solving process?
2. What existing principles have been used for this purpose?

1.4. Research Outcomes

The significance of this research extends to both academia and industry, as it contributes to a deeper understanding of user experiences and enables the translation of valuable insights into practical design decisions. The development of a toolkit for creating interactive data videos as ethnographic personas empowers designers and researchers to gain comprehensive insights into user experiences, facilitating the creation of actionable design solutions. Moreover, the exploration of design principles and existing practices related to embedding data in collaborative problem-solving processes contributes to the expanding knowledge base of user-

centred design. By enhancing decision-making and fostering innovation in diverse domains, this research broadens the potential for effective problem-solving and innovation. The research questions explore design principles for embedding data into the collaborative problem-solving process and examine existing practices in this domain. The outcomes of this study have the potential to enhance the design process, improve user understanding, and facilitate collaborative decision-making.

1.5. Argument

In the thesis, the argument develops by addressing the research question: "What design principles can be used to guide the design of technology for embedding data into a collaborative problem-solving process?" The aim of this thesis is to offer valuable insights into the design principles that can proficiently facilitate the incorporation of data within the context of collaborative problem-solving.

The argument in this thesis unfolds through a systematic analysis and evaluation of various design principles employed in successful implementations. Drawing upon real-world case studies, experimental designs, and existing frameworks, the thesis aims to propose specific principles that can guide the development of technology for embedding data into collaborative problem-solving. This analysis not only validates existing design principles but also presents an opportunity to refine and extend them based on the findings and insights derived from the literature review.

2. Literature Review

In today's world technology has become the key to social and economic development. Therefore, people are becoming familiar with several types of technological advancement and their uses. Everyday technology is surprising with new inventions and planning for a sustainable world environment development. In recent years, the use of data has become increasingly important in decision-making and policy development in various fields. However, many individuals may find it difficult to understand complex data sets or statistics, which can hinder their ability to engage in informed discussions and make informed decisions. To address this issue, interactive data visualization tools have been developed to present data in a more accessible and engaging manner. One such tool is the interactive data video, which combines data visualization with storytelling techniques to create a more compelling and understandable narrative. We examine the potential benefits of using interactive data videos as an educational tool, discuss the challenges associated with developing such a toolkit, and explore existing literature on interactive data visualization and its impact on audience engagement and understanding.

Now-a-days interactive data has a significant impact on the user behaviours and decision-making. Similarly, video data and ethnographic persona create a similar type of user attraction. In this literature review, we will understand the potential innovative approach for improving the communication of ethnographic research findings.

The objective of the literature review is exploring the existing toolkit which will help to generate knowledge on how toolkit enhances the user engagement with interactive data video. For evaluating the study, the existing literature review methods will be examined. This

literature review will find out the scope and limitations of the interactive data video with ethnographic persona.

2.1. How toolkit impact the user

Interactive data videos are an emerging data visualization tool that combines data analysis with storytelling techniques to present complex data sets in a more accessible and engaging way. These videos have the potential to enhance problem-solving skills by enabling individuals to explore data and draw insights in a user-friendly manner. Using interactive data videos, this literature review investigates the connection between data and problem-solving. We examine the potential benefits of using interactive data videos as a problem-solving tool, discuss the challenges associated with their implementation, and evaluate the existing literature on the impact of interactive data videos on problem-solving skills. We also examine the role of interactive data videos in decision-making processes, including their use in policy development and public engagement initiatives. Overall, this review aims to provide a comprehensive understanding of how interactive data videos can enhance problem-solving skills and support data-driven decision-making processes.

2.2. What problem it can solve

This section describes how data can be a resource to support solving complex and wicked problems. Interactive data has several features that make it a useful resource for solving complex and wicked problems. First, it allows users to explore and understand data in real time, enabling them to quickly identify patterns and relationships that might not be immediately apparent from traditional data analysis techniques. This real-time feedback can be especially useful when dealing with complex systems that are constantly changing. Second, interactive data allows users to manipulate data in ways that are tailored to their specific needs. For example, users can adjust the scale or filter data to focus on specific aspects of a problem or compare data across different time periods or geographic regions. This flexibility allows users to gain insights that might not be possible with static data analysis techniques. Third, interactive data can help users collaborate and share insights with others. Many interactive data tools allow users to annotate and share visualizations with others, enabling them to communicate complex ideas and insights in a more intuitive and accessible way. In conclusion, interactive data has the potential to assist users in making well-informed choices by equipping them with a more intricate comprehension of the issue they aim to resolve. By enabling users to explore and manipulate data in real-time, interactive data can help them identify potential trade-offs and unintended consequences of different solutions.

In this discusses the global trend of urbanization and the objective of digital transformations is to revolutionize local governments by leveraging information and communication technologies, aiming to make them "smart." Essential for engaging citizens in regional coordination processes, the availability of public information is vital. [1]

To enhance the effectiveness of local open data portals, RAND researchers utilized the open data portal of Los Angeles to obtain and analyse data. Their goal was to develop strategies that city leaders could implement on a broader scale. The study aimed to comprehend the influence of the virus situation of LA city services and residents, and it revealed significant challenges that could impede the open data portal's ability to increase transparency and empower local users. These obstacles were found to be common among open data portals governed throughout the USA. Consequently, the study underscores the necessity of enhancing the functionality of

open data portals and the importance of devising generalizable strategies to achieve this objective. [1]

2.3. Integration of Solutions strategies

In the article of Alexopoulos, two significant trends in government are examined, which have surfaced in recent years. These trends involve the utilization of Web 2.0 public platforms to facilitate collaboration and communication with citizens, as well as the disclosure of political data to the public via the web. The article emphasizes the limited integration of these two trends and highlights the necessity of developing a second generation of open political/government data (OGD) platforms. These platforms would combine traditional functionalities from the first generation with innovative Web 2.0 features, empowering users to actively engage as "prosumers" of data. [2]

In this article, a design science methodology is employed to create and assess the second generation of the iteration of open public data platforms, which facilitate the generation of value by users. The innovative Web 2.0 features incorporated into these platforms encompass functionalities for processing, exchanging information and knowledge, and promoting collaboration. The initial evaluation of the platform demonstrated that these features are both valuable and beneficial to users. [2]

By highlighting the possibilities of merging Web 2.0 social media and open government data, the research illustrates the capacity to amplify citizen engagement and collaboration. The advent of the iteration of open government data (OGD) platforms introduces an extensive array of features, empowering users to actively participate as data "prosumers" and effectively extract value from the available data. [2]

By adding to the sustained deliberation on the impact of public governance data and social media in bolstering citizen engagement and participation in governance, the article makes a significant contribution. The research underscores the significance of constructing user-centric open government data (OGD) platforms, equipping users with the necessary tools and functionalities to extract value from the data. Additionally, the article identifies prospects for future research that can delve deeper into the potential of integrating Web 2.0 social media and open government data within government contexts. [2]

2.4. Overview of creation

The paper by Fereshteh Amini addresses the existing gap in systematic understanding regarding the elements and processes employed in the creation of data videos, which have gained popularity as a storytelling medium for data. The authors present findings from two exploratory studies conducted with the aim of advancing this knowledge. The initial study encompasses a qualitative examination of 50 expertly produced data videos, where the authors extract and elucidate the most conspicuous constituents. The subsequent study comprises a sequence of training arranged with adept storytellers hailing from cinematography, graphic design. In these workshops, the authors observe the participants as they fashion storyboards for data videos utilizing a predetermined collection of data facts and visualizations. [6]

Drawing upon the knowledge gleaned from these preliminary investigations, the authors derive more extensive implications for developing an authoring tool that enables a varied spectrum of users to craft data visual. The observation underscores the priority of available versatile tool that supports a subsequential creative process, granting users the freedom to actively revisit distinct phases of the endeavours. Here we also found the literature on data-driven motion graphics by providing preliminary insights into the constituents and procedures involved in

crafting data videos, while also identifying essential design considerations for an authoring tool that can minimize barriers to developing captivating data videos. [6]

The authors' use of both qualitative analysis and workshops with experienced storytellers adds depth to their understanding of the creation process for data videos. Their findings are relevant not only to researchers interested in data-driven motion graphics but also to professionals who need to produce data videos as part of their work. The authors' insights into the constituents and procedures employed in the creation of data videos can serve as valuable guidance for designing authoring tools that simplify the process of generating captivating data-driven motion graphics for a broad range of users. [6]

2.5. Simplification of video data

The paper Amini discusses the challenges of creating data videos, which are becoming increasingly popular as a medium for storytelling. It notes that producing data videos requires a unique combination of skills, which can be a barrier for non-experts. In response to this challenge, the authors present Data Clips, an authoring tool designed to overcome obstacles associated with creating data videos. Data Clips empowers individuals without specialized knowledge to effortlessly merge data-driven "clips" into coherent sequences. [7]

The authors highlight the effectiveness of Data Clips in producing data videos, as evidenced by its ability to replicate a massive portion of their data video corpus, surpassing 90%. Furthermore, they present the results of an interpretive study that compares the allowing process and outcomes of non-experts using Data Clips with those of experts employing. The findings indicate that novice can swiftly grasp and utilize Data Clips, as they were able to generate a greater number of videos compared to the experts after just one hour of training. Moreover, the quality of the clips created by both non-experts and experts received similar ratings from an independent audience. [7]

2.6. User Engagement

The authors validate the effectiveness of Data Clips in reproducing a collection of data videos and demonstrate that non-experts can utilize the tool to generate videos that are on par with those produced by experts using professional editing tools. These findings hold practical implications for professionals who require data-driven motion graphics but lack the requisite technical expertise or resources. By offering a user-friendly authoring tool such as Data Clips, non-experts can craft engaging data videos with minimal training and investment.

The paper authored by Pourang Irani, and currently undergoing review explores the incorporation of pictorial representations and animation methods in narrative visualizations, specifically data videos. The authors note that these techniques are commonly employed to enhance the viewer's experience, yet there is a dearth of formal investigation into their effects on data insight communication and viewer engagement. To bridge this research gap, the authors propose a questionnaire based on a scale that encompasses five dimensions of viewer engagement, derived from diverse application domains. [8]

The paper illuminates the potential benefits linked to the use of pictorial depictions and animated methods in storytelling visualizations, like data videos. It acknowledges the prevailing notion that these approaches can enrich the observer feedback, cater to a varied user, and promote viewership of the complete video. However, the authors argue that there is a dearth of formal assessment regarding the influence of these techniques on the effective communication of data insights and viewer engagement. As a result, they put forth a scale-based questionnaire, drawing from various application domains, to gauge the influence of these

techniques on data videos. The questionnaire aims to assess the effect of pictographic representations and animation techniques on five key factors related to viewer engagement.

The authors report that both techniques influence viewer engagement, but impact varied factors. Pictographic representations increase viewer engagement with the video's content and enhance its aesthetic appeal, while animation techniques improve viewer immersion in the narrative and increase their emotional response. These insights are significant because they provide design considerations for creating engaging data videos.

The paper adds to the body of literature regarding the utilization of pictographic representations and animation techniques in narrative visualizations. It emphasizes the importance of assessing the advantage of the approach on data insight communication and user integration. Furthermore, the authors offer a validated scale-based questionnaire that serves as a tool to measure this impact. The study's findings also provide practical design considerations for creating engaging data videos, which have implications for fields like marketing, game design, and education.

2.7. Personalization

Jonathan Hook presents a research paper introducing a personalized film titled "Brooke Leave Home," which target to connect a novice participant with open data related to the help available to young adults transitioning out of the monitoring system in UK. The film employs a range of visual presentation data narrative techniques to provide every viewer with a different thinking on the topic, incorporating information specific to their local area. The authors outline the film's plan and elaborate on the development of its informing with story techniques, intended to facilitate viewers' idea and foster empathetic connections with the information of featured data and the effect the everyone leaving care. [5]

The paper further includes a study involving 47 viewers to investigate their experiences with these techniques and evaluate their effectiveness in facilitating engagement with the included data and its underlying significance. The findings suggest that the personalized approach was effective in engaging viewers with the data and that the storytelling techniques used in the film were successful in fostering empathy and understanding among the audience. The authors highlight the importance of using personalized approaches and storytelling techniques in data-driven media to make it more accessible and engaging to a wider audience. [5]

The paper contributes to the literature on data storytelling and the use of personalized approaches in data-driven media. The authors' focus on fostering empathy and understanding through storytelling techniques is particularly relevant to researchers and professionals working with open data and data-driven media. By demonstrating the effectiveness of personalized approaches and storytelling techniques in engaging non-expert audiences with complex data, the authors offer valuable insights on strategies to enhance the accessibility and engagement of data-driven media for a broader audience. [5]

2.8. Understandability

This section around the literature concerning the utilization of data videos as a tool to aid individuals in comprehending and interpreting data.

In their article of Yu Zhang and Mathias Funk, the authors delve into the issue of comprehending and interpreting data in everyday life, which frequently involves analytical interpretation that lacks intuitiveness and can lead to friction. To address this obstacle, the authors aim to create an innovative interactive video installation that converts real time data, duration, and external data into supplementary information dynamic and relatable video

snippets. The goal is to establish a link between the data and the underlying phenomenon, diminishing the emphasis on data itself and highlighting its importance in our everyday lives. [4]

The case study displays the process of designing and implementing the video installation, which underwent three iterations before being displayed as a part of a group exhibition. The authors provide insights into the significant design decisions and pivotal moments in the process, highlighting the interconnectedness of design and implementation throughout the preparation of the installation. [4]

The research underscores the significance of transforming data by projecting it into familiar contexts through concise and neutral video fragments. These fragments depict individuals in ordinary situations, either alone or engaging with various objects. By adopting this approach, the authors highlight how it can generate a distinct sense-making experience in daily life, promoting efficiency and functionality in the process. [4]

The article's contribution is in its demonstration of a novel approach to making sense of data in everyday life, which can have broader implications for the design and implementation of interactive installations and data representation. The study's findings suggest that a focus on creating a meaningful and engaging experience for users can improve their ability to understand and use data in their daily lives. The article concludes with an outlook on future work in this area. [4]

2.9. Complexity

In their paper, Zhang and Kim delve into the concept of "wicked problems" and its significance in digital public administration research. They highlight the Research, which centred around the theme of "Digital Government and Wicked Problems." The conference aimed to emphasize the growing complexity of the global challenges we encounter today. The paper provides insights into the relevance of addressing these wicked problems in the context of digital government. The term "wicked problems" characterizes societal and public planning issues that lack definitive solutions. The chosen conference theme reflects the determination and commitment of the digital government research community to tackle some of the most persistent problems by harnessing emerging technologies. [3]

Within the special issue, seven papers originating from the dg.o 2015 conference delve into the attributes of wicked problems and their significance in the context of digital government research. The editorial underscores the cruciality of understanding the inherent nature of wicked problems in digital government endeavours and offers suggestions for future research in this domain. [3]

The article emphasizes the imperative for digital government research to confront intricate societal and public planning problems that present challenges in definition and resolution. The collection of selected papers from the conference offers valuable insights into how emerging technologies can assist in tackling these complex and persistent issues known as wicked problems. [3]

2.10. Conclusion

In conclusion, the concept of developing a web toolkit for creating awareness among people with interactive data videos has gained significant attention in recent years. The use of interactive data videos in digital government research has been shown to effectively engage citizens and promote transparency, enabling them to participate in local planning processes. The literature examined in this study underscores the potential advantages of employing

interactive data videos to foster awareness and encourage citizen involvement in government decision-making processes. Nevertheless, it is crucial to acknowledge that the efficacy of these initiatives hinges upon the use of effective design, development, and implementation strategies.

3. Research methodology

3.1. Research through design

The focus of this thesis revolves around the development of an interactive data video toolkit for crafting ethnographic personas. The research aims to address the research question of which design principles can effectively guide the incorporation of data into a collaborative problem-solving process using technology. Furthermore, the study intends to explore how existing principles have been employed for this purpose. To evaluate the thesis question and problem-solving approach, our initial consideration is research through design.

3.1.1. Iterative approach

The rationale behind selecting research through design as the methodology for this thesis stems from its numerous advantages in developing a software system and defining a problem-solving approach. RTD (Research Through Design) offers an iterative approach that facilitates continuous refinement and improvement, which is particularly advantageous for software system development. This iterative process allows each phase to be developed and evaluated by the product owner or project owner, resulting in a more productive, refined, and goal-oriented development process. [16, 17]

3.1.2. Adaptive Behaviour

One key benefit of this method is it is an adaptive approach, which enhances the quality and performance of the product. By gathering feedback from users and stakeholders at various stages of the design process, it promotes design thinking and enables the creation of a more robust and user-centric product. This user-centric approach helps in understanding the needs, preferences, and challenges of end-users, providing insights into user requirements, behaviours, and demands. Consequently, it inspires a deeper understanding of the context and environment in which the developed toolkit will be utilized. [12, 13, 14, 15]

3.1.3. Advantage of research through design

In short, the advantages offered by this method, such as its iterative nature, adaptability, and user-centric focus, make it an ideal methodology for this thesis. It allows for continuous improvement, incorporates valuable feedback, and ensures a more comprehensive understanding of user needs and the intended deployment context for the toolkit.

By closely examining user behaviour and the challenges they encounter, I can enhance the toolkit to become an effective facilitator of collaborator for problem-solving and decision-making. Research through design offers the crucial advantages of flexibility and adaptability, which are essential for incorporating existing ideas and techniques into new developments and ways of thinking. Given that software development is a dynamic and ever-evolving process, the opportunity to learn from existing principles and implement them in our new development is invaluable. [9, 10, 11]

3.1.4. Method Utilization

This thesis delves into the utilization of the Research through design methodology for designing a web-based toolkit software. Through this approach, our aim was to harness the insights gained from understanding user behaviour and challenges, leveraging the flexibility

and adaptability to create an improved version of the toolkit. The goal is to develop a powerful tool that fosters collaboration and enables effective problem-solving. By applying these principles, I seek to incorporate existing knowledge while embracing the dynamic nature of software development.

To address the research questions and explore specific phenomena or concepts, Research through design employs design interventions or artifacts. This thesis incorporates the fundamental elements of research through design, namely reflection and analysis, user engagement, and knowledge generation. Throughout the design process, method emphasizes critical reflection and analysis, enabling researchers and designers to evaluate design artifacts, examine their implications, and derive insights from user interactions and evaluations.

User engagement holds significant importance in approach, actively involving users in providing feedback, testing artifacts, and sharing their experiences. This user involvement informs iterative iterations and refinements, ensuring the design process remains responsive to user needs. The primary objective of method is to generate novel knowledge, understanding, and insights that contribute to both design practice and research domains.

Through the iterative cycle of designing, testing, reflecting, and refining design interventions, RTD aims to generate advancements in theoretical frameworks and practical applications within the field of design. This knowledge emerges from the synthesis of insights gained during the iterative process, leading to contributions in both theoretical and practical aspects of design.

3.1.5. Summary of method

Overall, this thesis adopts the principles of research through design, leveraging its elements of reflection and analysis, user engagement, and knowledge generation to investigate research questions and contribute to the advancement of design practice and research domains.

3.2. Validation and reliability of the study

This research employs a qualitative approach to collect and analyses data, with the aim of developing concepts from the collected information. The process involves iteratively examining the qualitative data and constantly referencing the substantive area under investigation. By "comparing notes" with the existing knowledge in the field, the data is further refined and categorized, ensuring a thorough and rigorous analysis. The iterative nature of this process allows for continuous refinement and improvement, leading to a comprehensive understanding of the research topic. Through this qualitative research approach, the study aims to gain valuable insights and generate meaningful concepts from the collected data.

The thesis paper emphasizes the importance of validation and reliability in conducting a Research through design study for software toolkit design. It highlights several key considerations to ensure the trustworthiness and credibility of the study.

First, engaging experts in the field of software design or related domains is recommended. Their input and feedback can provide valuable insights, validate design decisions, and enhance the reliability of the study. Expert evaluations can be conducted through various means such as reviews, interviews, or feedback sessions.

User testing and feedback play a crucial role in validating the effectiveness and usability of the software toolkit design. Conducting usability testing sessions with representative users and gathering their feedback on their experience, challenges, and suggestions for improvement can enhance the reliability and validation of the design decisions.

The thesis emphasizes the significance of an iterative design process. By incorporating multiple design iterations based on user feedback and evaluation, the study ensures continuous refinement and improvement of the software toolkit design. This iterative approach helps validate design decisions and increases the reliability of the final design.

Thorough documentation of the design process, including decisions, iterations, and changes made during the development of the software toolkit, is essential. Detailed documentation promotes transparency and enables others to validate and replicate the design process, thereby enhancing the reliability of the study.

The method suggests submitting the study for peer review by experts in the field of software design or relevant disciplines. Peer reviewers can assess the methodology, design process, and findings, providing valuable feedback and suggestions to improve the validity and reliability of the research.

To ensure the reliability of the study, the use of multiple data sources and methods for triangulation is recommended. This involves combining qualitative and quantitative data, utilizing different data collection techniques, and analysing data from various sources. Triangulation strengthens the validity and reliability of the study's findings by corroborating results from different perspectives.

Lastly, the method highlights the importance of replicability and transparency. Clear documentation and description of research methods, design interventions, and data analysis techniques enable other researchers to replicate the study. This fosters transparency and enhances the reliability of the study.

By incorporating these validation and reliability considerations, the thesis concludes that a search through design study on software toolkit design can generate robust findings, increase the credibility of the research, and contribute to the advancement of the field.

4. Artefact Design and development

4.1. Requirements and planning

4.2. Entity Relationship Diagram (ERD Diagram)

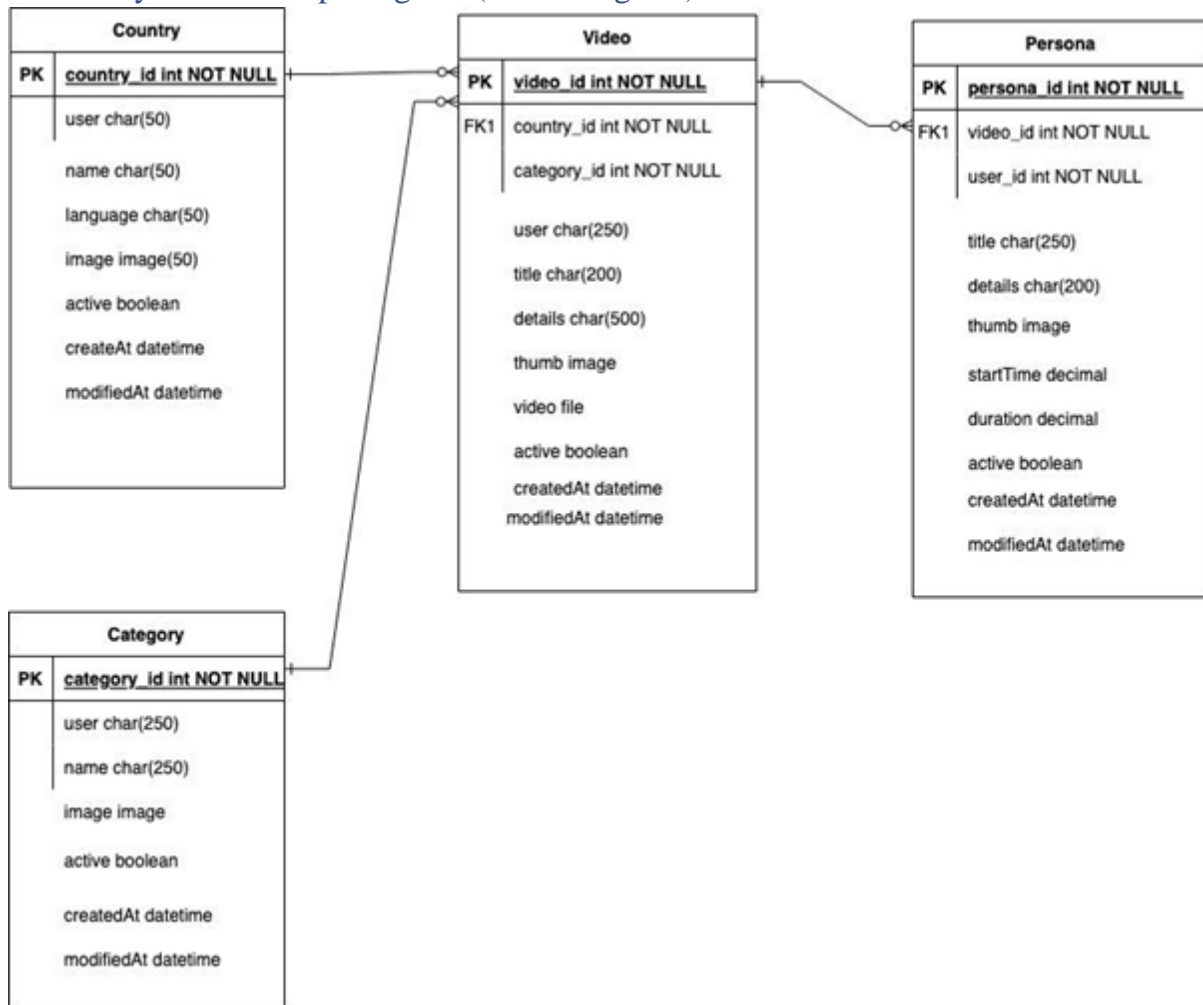


Figure 1. Tandem entity relationship diagram (ERD)

An Entity Relationship Diagram represents the relationships between entities within a database. It begins with entities, which are objects such as persons, places, or things that need to be tracked in the database. By examining our ERD diagram, we can observe that we have four entities (Country, Category, Video, and Persona) are interconnected. Each entity possesses its properties, known as attributes. For instance, the entity "Country" includes attributes such as country_id, user_id, name, language, image, active_status, created_date, and modified_date, which are represented as columns in the database. Similarly, the entity "Category" has attributes such as category_id, user_id, name, image, active_status, created_date, and modified_date, which are also depicted as columns in the database. Likewise, the "Video" and "Persona" entities have their respective attributes.

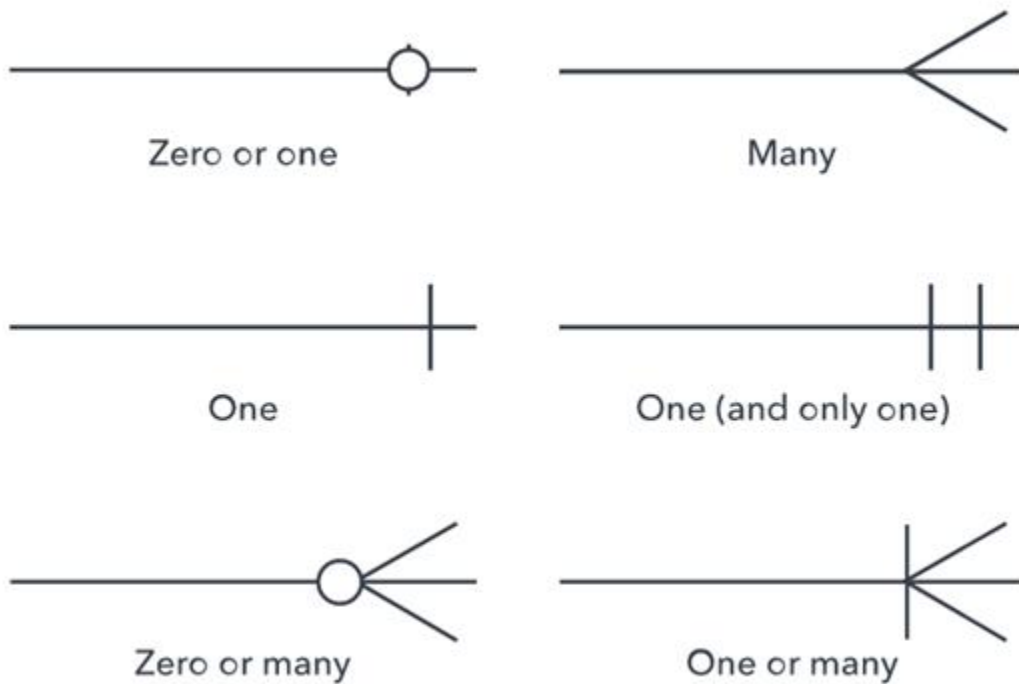


Figure 2. Single Entity Relationship diagram (ERD)

We have various entities and descriptive words represented on the diagram. To illustrate their interaction or connection, we draw lines between them. These lines are accompanied by notation known as cardinality, which adds numerical context to define the relationships. At the top of the diagram, we can observe diverse types of cardinalities, such as zero or one, many, one, only one, zero or many, and one or many. Now, let us delve into the relationships and cardinality that exist among the entities (Country, Category, Video, and Persona).

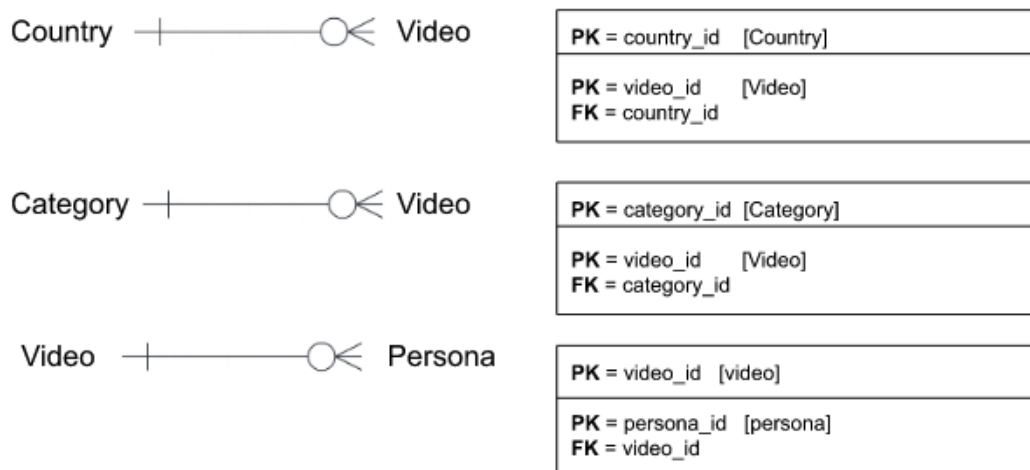


Figure 3. Toolkit entity relationship diagram

For a better overview of the entity relationship diagram, I have drawn a single entity relation with a different entity. Where we notice that the country entity has a one-to-many relationship with Video. On the right side of the diagram, we found that PK (Primary Key) (Primary Key =

country_id) becomes the FK (Foreign Key) for the Video entity. Similarly, the category has a one-to-many relationship with the video. One category can have many videos in the system where each video only can have one category. The video-to-persona has the same relationship as the country-to-video. Therefore, each of the videos can have multiple personas and each persona is only linked to one video. As a result, video PK (Primary key = video_id) becomes the FK (Foreign Key = video_id).

4.3. Use-case Diagram

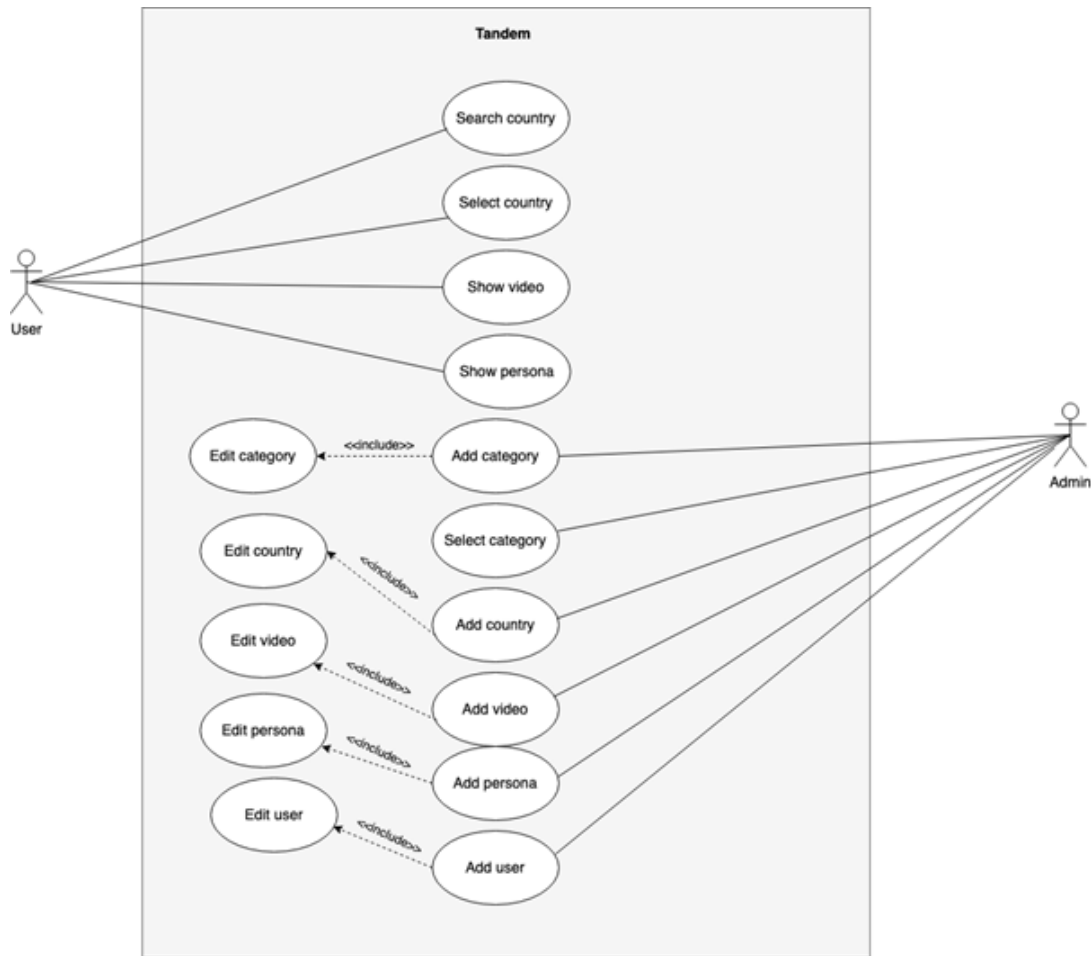


Figure 4. Tandem Use case diagram

Description of Use Cases:

Actor: User

Brief Description:

A user can search the country and select country-wise data video. The user can watch video data which includes different persona-wise information.

Use cases	Description
Search Country	The system is built to support multiple countries. Where a user can search his/her preferred country with the country name. Country name filters the country from the country list.
Select Country	Users can select the country when the country is found in the search result. The selected country is open a new page with the related video data of that country.
Show videos	Users are getting a list of topic videos and from there they can select and play the video to get topic details. Videos are combined with informative audio and visual content which is helping the user to understand the concept of visual

	presentation.
Show Persona	Persona is a characteristic of a user or user group. How a person or a user group thought about anything that is presented as a persona. In our video data, we give an opportunity to the user to show and hide the persona. As a result, users can get mode inside of any topic.

Actor: Admin

Brief Description:

The admin user is responsible for managing the backend panel in our system. Admin can perform insertion deletion and modification of Country, Category, Video, and Persona. Also, the admin can add different users with separate user roles.

Use Cases	Description
Add category	Admin user supports adding the category to the system. The category is needed to organize the video in the system.
Select category	Category selection is needed when a user is adding video data into the system in the time user needs to select a category to organize the topic or category-wise videos.
Add country	The country is added for this system to fasciitis different nationalities and territories to participate in the user data visualization and collaboration.
Add Video	Video data is the key concept of the system. Our system is dealing with the user with the visual content to create awareness among the end users.
Add persona	Persona is the most important and versatile thought inside video data. Users are often not convinced by whatever they watch or hear from the visual content, but an interactive persona can motivate the user to understand the actual idea of the topic. Which can help user to take decisions.
Add user	The system needs to maintain and operate from a distinct perspective. Therefore, need to create or add a different user group with assigned roles. Some users can only add the content in the system, but they do not have the permission for deletion. On the other hand, few users can have the super admin level of permission which can help to maintain the entire system.
Edit Category	The Eidt category has a particularly significant role in the system. Suppose you have entered the wrong name or properties in the system you need to edit the category. If you do not like keeping the category, then you can inactive the

	category which will be the dynamic solution for managing a category without deletion.
Edit country	Edit country facilities the user to control the country properties. Sometimes you need to modify some fields in the country database in that situation you can easily update the country.
Edit Video	Often the video data changes over time and situation, therefore you may need to update the data video. In that case, it will be an excellent feature to provide updated information to the end user.
Edit persona	Persona is another important part of the system. In our system, we are managing our persona with a dynamic time and duration. Your persona time duration is changed, or you need to add more text in the persona in that case it might be an interesting facility for the admin users to provide the updated information to the user.
Edit user	When a super admin creates an initial system used for one role. In some cases, the user got new responsibility or a new role for the system in that case may he/she need to add or remove the role in the system.

4.4. Software Development Methodology (Agile)

4.4.1. Why did we choose Agile?

4.4.2. Justification (With references)

4.4.3. Requirements are unclear

4.4.4. Changes adoption

4.4.5. Iterative approach

There are several software development methods present for developing a product. But the thing is that not all methodology is suitable for every project. When the user requirements are noticeably clear and precise with all kinds of documentation then the Waterfall model can be an ideal choice. In the waterfall model requirements cannot be changed during the development process. Therefore, it is not possible to adopt the changes in requirements during the development. When we think about our toolkit design and development requirements. We found that our requirements are not well defined and clear enough to decide what is the thing we are going to do. We have an initial idea of the project concept but there was nothing written in a developer documentation type of stuff. As a result, we had several requirement analysis meetings with the project owner and product owner. We notice that our investigation changes the project needs during every discussion session. Then we are trying to understand how we can adapt to requirements changes for creating a finished product. Selecting a suitable software development methodology, was quite an interesting investigation. We have created some parameters for our project which will help to select the right methodology. It was clear that our requirements can be changed at any time, or we need to add new features during the development. Therefore, our development team needs an iterative approach that will help to

adjust to the novel changes without major difficulties. We found that our project needs are completely alien to the agile methodology and therefore we have decided that our whole development process will follow the agile manifesto. When we fixed the agile methodology as our development method now, we need a supporting framework that can monitor the implementation the agile in the development process. Therefore, we decided that we will follow the scrum management framework to achieve the agile goal. If I recall the region, why we select agile because we have a limited time duration for our toolkit development therefore it will be exceedingly difficult to wait for the full documentation. Also, we are working with a small team which is why it is not possible to put a huge time into project requirements preparation. But in agile we can add modify or subtract new features which will facilitate a furnished product. Where our project goal will achieve with high success which will make happy project owner.

4.5. Project Initiation

4.5.1. Road Map

4.5.2. Initial Analysis

4.5.3. Time (Estimation time of development)

4.5.4. Requirements Breakdown

In agile-based software development, we need to track our development process therefore we need some management tools. That is why I have chosen a managing tool Jira which is a project management software. In Jira development requirements are split into small tasks or stories or epic or issues. Each story is a brief requirements instruction and elaboration of the task or epic. Similarly, in our development, we have divided our requirements into small tasks or epic. A similar group of ask and epic define a story. A story particularly represents a complete feature or task.

4.6. Backlog (Story)

4.6.1. I should be able to Select the Country (Story)

I should be able to select the country story will complete the user country selection features. Where a user can search country from the list of country and choose from the country.

4.6.1.1. Create country CRUD

Admin user can add edit and delete the country from the admin panel therefore database should support the data insertion and deletion. This task needs to do the country insertion UI interface is done and country data save successfully.

4.6.1.2. Create get country API

Create get country API (Application Programming Interface): Api is the communication interface for the frontend and backend. Therefore, toolkit is needing a country API for presenting the country information in the frontend. Country API need to support country search by keyword. Also, API response should be in Json format.

4.6.1.3. Design Home page

This task needs to be done the home page design. Frontend design should do with react and JavaScript. Also, the page needs to support multiple screen size (responsive design).

4.6.1.4. Country API (Application Programming Interface) integration

Country API needs to integrate with the frontend page where user can get the country response with the search keyword.

4.6.1.5. Country selection drop-down

For presenting the country drop-down selection interface need to add. User can select the country from the drop-down.

4.6.2. I should be able to watch Video data

I should be able to watch Video story will provide the opportunity to the user for selecting and playing video from the list. Video view will be a custom view where user can interact with button click or Slickbar.

4.6.1.1. Create category CRUD

Category is a feasible way to organize the same type of topic in the database. In this task we need to confirm that user can insert, edit, and delete the category from the database

4.6.1.1. Create video CRUD

Video is the main data source for our development tools. Our system should be able to insert, edit and delete video from the database. Also, Video data should be store in a folder in the backend storage.

4.6.1.1. Create get category API

When category data is present in our database now need to create a category API that we can use the category list for the order the video with category.

4.6.1.1. Create get video list API

Video list API will provide the all-video list from the database and those vide will return as a JSON format data

4.6.1.1. Design video grid view

This is the most important part of the toolkit where user can see the all video by the country. Those videos should present with a grid view that user can have multiple videos in a same raw.

4.6.1.1. Implement video list

In this task we will implement the video list API. Now, in the grid view we will present the real API response data.

4.6.1.1. Custom video player

This is the most advanced and interactive part of the toolkit. We need to develop a custom video player where we can modify and add things when necessary.

4.6.1.1. Video player integration

When player is ready now need to integrate the video player with the system. We need to track the video play time to trigger the different events.

4.6.3. I should be able to view the User persona while watching video data.

I should be able to view the User persona while watching video data story will provide the interactive persona where user can see the persona and get the opinion of each persona about any topic.

4.6.1.1. Create a persona for a video

Task will cover the persona insertion or creation in the backend and user can select video to include the persona where should be present.

4.6.1.1. Create persona API

Need to do one persona list API, which will filter the persona with the video id and provide a JSON response.

4.6.1.1. A persona details API integration

Persona API integration need to be done. While integrating the persona API remember to include the video wise persona filtering.

4.6.1.1. Add persona to video

This task needs to add persona in the video view and maintain the persona time duration and persona appears interval. Persona needs to be clickable that user can select persona and show the information.

4.7. Sprint

4.7.1. Sprint 1 (15 days): Setup

4.7.1.1. Environment setup

4.7.1.2. Database Design

4.7.1.3. Project breakdown

4.7.1.4. Use case scenario

Task Nuber	Task / Ticket Name	Progress
TANDEM-1001	Environment setup	Complete
TANDEM-1002	Project breakdown	Complete
TANDEM-1003	Database Design	Complete
TANDEM-1004	Use case scenario	Complete

Tech Stack:



Figure 5. Tech Stack

In a software development initial task to prepare the environment for the product development. Similarly, in first sprint was completely about software development environment setup and planning. In this sprint Python3 language and Django is install for the web application development. Also, an IDE (integrated development environment) visual editor is installed for the writing the program that one is Microsoft Visual Studio. For project breakdown a backlog is prepared with task defined. Before starting the toolkit development, a database prototype is

designed and discussed with the team. When the database part is done than we start scratching the use cases of the toolkit.

4.7.2. Sprint 2 (15 days): Development

4.7.2.1. I should be able to select country

4.7.2.2. Create country CRUD (CREATE, READ, UPDATE and DELETE)

4.7.2.3. Create country API

4.7.2.4. Home page design

4.7.2.5. Country API integration

4.7.2.6. Country selection drop-down

Task Nuber	Task / Ticket Name	Progress
TANDEM-2001	I should be able to select country	Complete
TANDEM-2002	Create country CRUD	Complete
TANDEM-2003	Create country API	Complete
TANDEM-2004	Home page design	Complete
TANDEM-2005	Country API integration	Complete
TANDEM-2006	Country selection drop-down	Complete

The screenshot shows the Django administration interface for adding a new country. The page title is 'Django administration' and the user is logged in as 'JOHNY'. The breadcrumb trail is 'Home > Base > Countrys > Add country'. The sidebar on the left shows a search bar and a list of models: AUTHENTICATION AND AUTHORIZATION (Groups, Users), BASE (Actions, Categorys, Countrys, Videos). The 'Add country' form contains the following fields:

- ModifiedAt:** Date and Time fields with 'Today' and 'Now' buttons. Note: You are 3 hours ahead of server time.
- CreatedAt:** Date and Time fields with 'Today' and 'Now' buttons. Note: You are 3 hours ahead of server time.
- User:** A dropdown menu with a search icon, a plus icon, a minus icon, and an eye icon.
- Name:** A text input field.
- Language:** A text input field.
- Image:** A 'Choose file' button and 'No file chosen' text.
- Active:** A checkbox.

At the bottom of the form, there are three buttons: 'Save and add another', 'Save and continue editing', and 'SAVE'.

Figure 6. Country adding form

In the second sprint I have started to develop the toolkit. Therefore, first I must complete the home page design. One thing I would like to mention that web pages are designed with react and backend is done with the python programming language. In our home page we have a country selection that is why I have implemented the CRUD (CREATE, READ, UPDATE and DELETE) operation in the backend part. As a result, later I can implement in frontend country selection functionality.

Data Communication

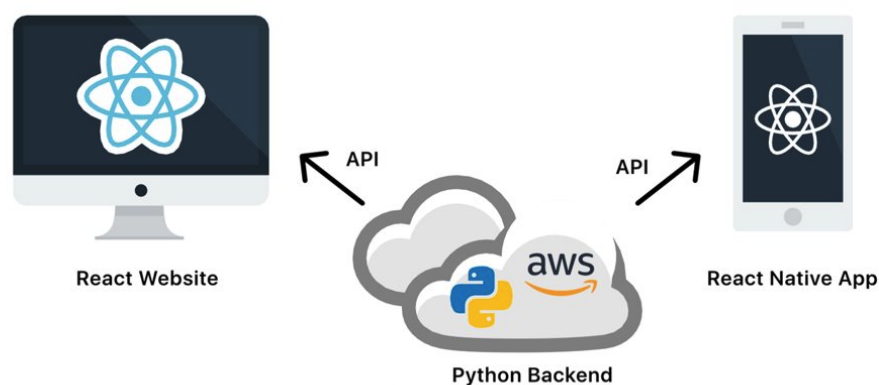


Figure 7. API Communication with server

For the data communication between frontend and backend I have designed the API (Application Programming Interface). An API can be considered as the service or functionality to talk frontend to backend server. When a user looking for the country list from the website than the web page calls the get country API for the country list and get country API fetch the data from the backend server through the local server or the AWS server and provide the actual data to the user. Later though data is presented in the drop-down in the selection.

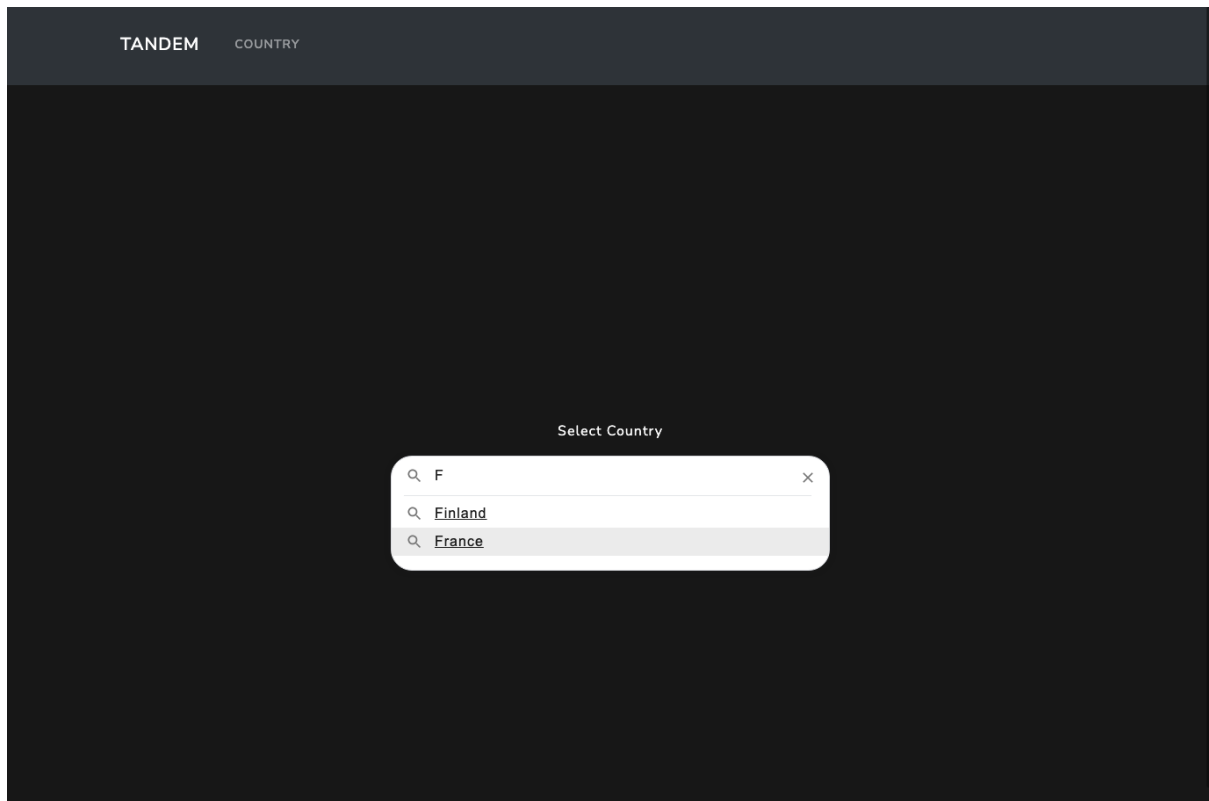


Figure 8. Country search view in home page

4.7.3. Sprint 3 (15 days): Development

4.7.3.1. I should be able to watch Video data

4.7.3.2. Create category CRUD

4.7.3.3. Create video CRUD

4.7.3.4. Create get category API

4.7.3.5. Create get video list API

Task Nuber	Task / Ticket Name	Progress
TANDEM-3001	I should be able to watch Video data	Complete
TANDEM-3002	Create category CRUD	Complete
TANDEM-3003	Create video CRUD	Complete
TANDEM-3004	Create get category API	Complete
TANDEM-3005	Create get video list API	Complete

Django administration WELCOME, **JOHNY** / VIEW SITE / CHANGE PASSWORD / LOG OUT

Home > Base > Categories > Add category

Start typing to filter...

AUTHENTICATION AND AUTHORIZATION

Groups + Add

Users + Add

BASE

Actions + Add

Categories + Add

Countrys + Add

Videos + Add

Add category

ModifiedAt: Date: Today | 📅
Time: Now | 🕒
Note: You are 3 hours ahead of server time.

CreatedAt: Date: Today | 📅
Time: Now | 🕒
Note: You are 3 hours ahead of server time.

User: + ✖ 🌐

Name:

Image: No file chosen

Active

Figure 9. Category adding form

In the sprint 3 I have done a major part of the toolkit development. I have completed the category **CRUD** operation and provide get category API for the toolkit to process the category for the video data. In this sprint also done the video data CRUD operation and linked the video data with the category. Because one category may have the multiple number of videos. When the video data is ready than I have created the video API for the web user to get the video information.

The screenshot shows the Django administration interface for adding a video. On the left is a sidebar with a search bar and a menu for 'BASE' containing 'Actions', 'Categorys', 'Country', and 'Videos'. The main content area is titled 'Add video' and contains the following fields:

- ModifiedAt:** Date and Time pickers with a note: 'Note: You are 3 hours ahead of server time.'
- CreatedAt:** Date and Time pickers with a note: 'Note: You are 3 hours ahead of server time.'
- Country:** A dropdown menu with edit, add, and delete icons.
- Category:** A dropdown menu with edit, add, and delete icons.
- User:** A dropdown menu with edit, add, and delete icons.
- Title:** A text input field.
- Details:** A text input field.
- Thumb:** A file upload field with a 'Choose file' button and 'No file chosen' text.
- Video:** A file upload field with a 'Choose file' button and 'No file chosen' text.
- Active:** A checkbox.

At the bottom right, there are three buttons: 'Save and add another', 'Save and continue editing', and 'SAVE'.

Figure 10. Video adding form

4.7.4. Sprint 4 (15 days): Development

4.7.4.1. Design video grid view

4.7.4.2. Implement video list

4.7.4.3. Custom video player

4.7.4.4. Video player integration

Task Nuber	Task / Ticket Name	Progress
TANDEM-4001	Design video grid view	Complete
TANDEM-4002	Implement video list	Complete
TANDEM-4003	Custom video player	Complete
TANDEM-4004	Video player integration	Complete

In this sprint I have done most of my integration works. I have designed a grid view to show the video list. When the grid view is ready, I have integrated the video list from the API information. Next challenging work was custom video player which provide a unique feature of showing persona middle of the video player. Now video player is ready so we can integrate the video with our toolkit.

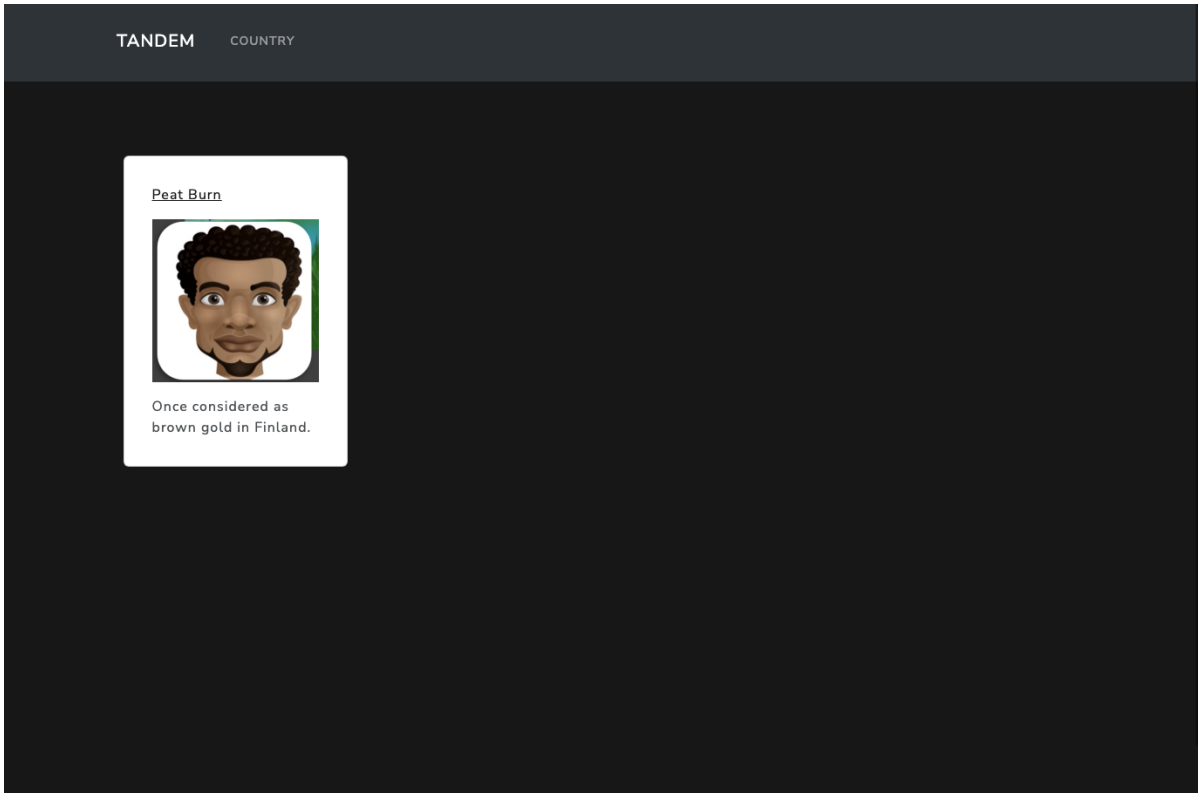


Figure 11. Video list view

4.7.5. Sprint 5 (15 days): Development

4.7.5.1. I should be able to view the User persona while watching video data.

4.7.5.2. Create a persona for a video

4.7.5.3. Create persona API

4.7.5.4. Persona view design

4.7.5.5. A persona details API integration

Task Nuber	Task / Ticket Name	Progress
TANDEM-5001	I should be able to view the User persona	Complete
TANDEM-5002	Create a persona for a video	Complete
TANDEM-5003	Create persona API	Complete
TANDEM-5004	Persona view design	Complete
TANDEM-5005	A persona details API integration	Complete

Persona is one of the advance features of our toolkit and I have completed most of my persona related work in Sprint 5. I have prepared my backend server for the persona certation, modification and deletion. I have made the persona API for the persona list for the individual video. In this sprint persona web view is designed and completed with persona API integration.

The screenshot shows the Django administration interface for adding a new action. The left sidebar contains a search bar and a menu with categories like 'AUTHENTICATION AND AUTHORIZATION' and 'BASE'. The 'Actions' item is selected. The main content area is titled 'Add action' and contains several form fields: 'ModifiedAt' and 'CreatedAt' (each with Date and Time pickers), 'User' and 'Video' (each with a dropdown menu and edit/delete icons), 'Title', 'Details', 'Thumb' (with a 'Choose file' button), 'StartTime', 'Duration', and an 'Active' checkbox. At the bottom right, there are three buttons: 'Save and add another', 'Save and continue editing', and 'SAVE'.

Figure 12. Adding persona form

4.7.6. Sprint 6 (15 days): Development

4.7.6.1. Add persona to video

4.7.6.2. Persona show & hide on interaction

4.7.6.3. Persona time duration modification

4.7.6.4. Video player overlay persona support

Task Nuber	Task / Ticket Name	Progress
TANDEM-6001	Add persona to video	Complete
TANDEM-6002	Persona show & hide on interaction	Complete
TANDEM-6003	Persona time duration modification	Complete
TANDEM-6004	Video player overlay persona support	Complete

Sprint 6 is the mostly last sprint of the development. Where I have added the persona with the video and enable the persona interaction with the user with click event. I have ensured that a user can click the persona and show the details of the persona also user can hide with the click of the persona. In this sprint I have completed persona dynamic time duration management.

Where each persona can show in a particular time with a particular time duration. Finally, I have integrated the overlay persona view with the video view.



Figure 13. Persona in video view

4.7.7. Sprint 7 (15 days): (Issue/Bug)

- 4.7.7.1. Home page design issue fixing
- 4.7.7.2. Search country suggestion fixing
- 4.7.7.3. Video list view design fixing
- 4.7.7.4. Video list API fixing
- 4.7.7.5. Database model fixing

Task Nuber	Task / Ticket Name	Progress
TANDEM-7001	Home page design issue fixing	Complete
TANDEM-7002	Search country suggestion fixing	Complete
TANDEM-7003	Video list view design fixing	Complete
TANDEM-7004	Video list API fixing	Complete
TANDEM-7005	Database model fixing	Complete

Sprint 7 is testing and bug fixing related task. In previous sprint review I got some feedback from the project owner and tester about different usability and functionality. I have gone through all issue one by one and solved those issues. Now after completing 7 sprints, we are ready to test and deploy.

4.8. Sprint Review

4.8.1. Change Requirements (CR)

4.8.2. Feedback (Product Owner)

4.8.3. Enhancements

Sprint review is one of the crucial events in the Scrum framework. In our toolkit development we have divided our task into different sprint. Our sprint duration was 15 days for one sprint and Sprint review was the last day of the sprint.[1] By the end of the Sprint review, we got a new product incremental evaluation which added new features or development things done. Also got the constructive feedback from product owner and project owner. Those feedback help me to shape the future enhancements and iterations that overall boost the product quality. Another important aspect of the sprint review is adaptation or adaptability which help me to understand the requirements changes and refine the backlog and reprioritized task list. Every sprint review provides me a new opportunity to improve the development quality and performance also make me able to identify the area of improvement and gave me upper hand to plan for the new sprint. [18, 19]

Some Example of what went well in the sprint review and what went bad or what the thing we learn from the sprint.

1. In sprint 4 we found that our video view is not compatible with our requirements therefore we made the decision to build a custom video player for achieving the goal.
2. In sprint 6 persona added a new requirement that persona should be dynamic time integration because of were design the persona implementation.
3. Something went very well from the beginning like UI/UX prototyping
4. Web toolkit design was excellent in the sprint 2.
5. In Sprint 3 API design went very well.
6. Sprint review added some additional feature like AWS and cloud services
7. Future scope of the project.
8. Project documentation like user manual
9. Project maintenance was another good suggestion during the sprint review.

5. Design

5.1. Wireframing

Wireframing is one of the challenging tasks before starting the development. In today's world, there is a wide variety of UI/UX tools at our disposal for creating wireframes, including popular options like AdobeXD, Figma, Sketch, InVision, Balsamiq, and Moqups. These tools are valuable for designers and developers as they facilitate the generation of mock-ups' for both interactive and non-interactive software prototypes, catering to distinct levels of fidelity.

5.1.1. Figma

We select the wireframing tools based on our toolkit need and visual framing interactions opportunities. We found that Figma is one of the suitable tools for our development prototyping. We also found Figma is a preferred choice among UI/UX designers and front-end developers for several reasons. Firstly, it offers an intuitive drag-and-drop editor that simplifies the process of creating wireframes and prototypes. This user-friendly interface allows for easy manipulation of elements, making it accessible to designers of varying skill levels.

5.2. UI-UX Prototyping

5.2.1. Focus on customer needs

We evaluated and got feedback from the product owner and refine the UI with the customer preference. In our UI/UX development we try to make our design simple modern and interactive that user could not get confused during the toolkit uses.

5.2.2. Visual framing

5.2.3. Interactive prototyping

Additionally, Figma provides a range of built-in features and plugins that enhance the prototyping experience. With plugins like Figma motion,[27] Autoflow, and the availability of tools like Arc Tool and Vector Networks, Figma offers extended functionality and flexibility in creating interactive prototypes. These additional features enable designers to bring their designs to life and highlight animations within their prototypes.

5.2.4. Design correction

Moreover, Figma's web-based nature makes it convenient for collaborative work. Designers can easily share and collaborate on projects in real-time, allowing for seamless teamwork and efficient communication.

However, despite their usefulness, these tools often lack explicit guidance on incorporating UI/UX design principles and staying up to date with the latest visual requirements. Consequently, finding a comprehensive and versatile tool that can guide users through this critical process can be quite challenging.[1][2]

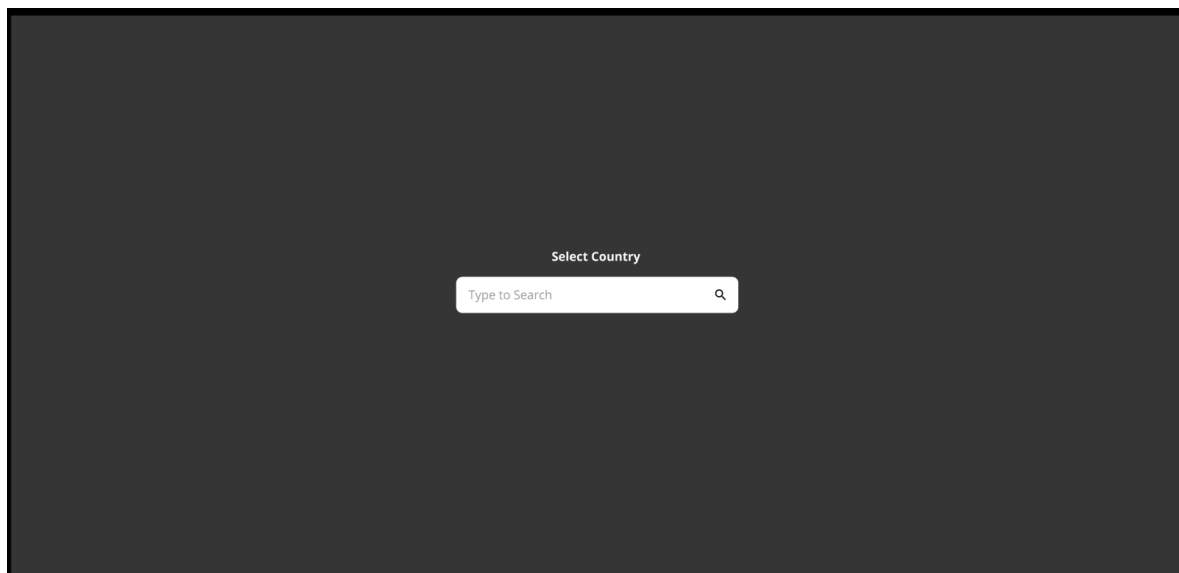


Figure 14. Home Screen in Figma design

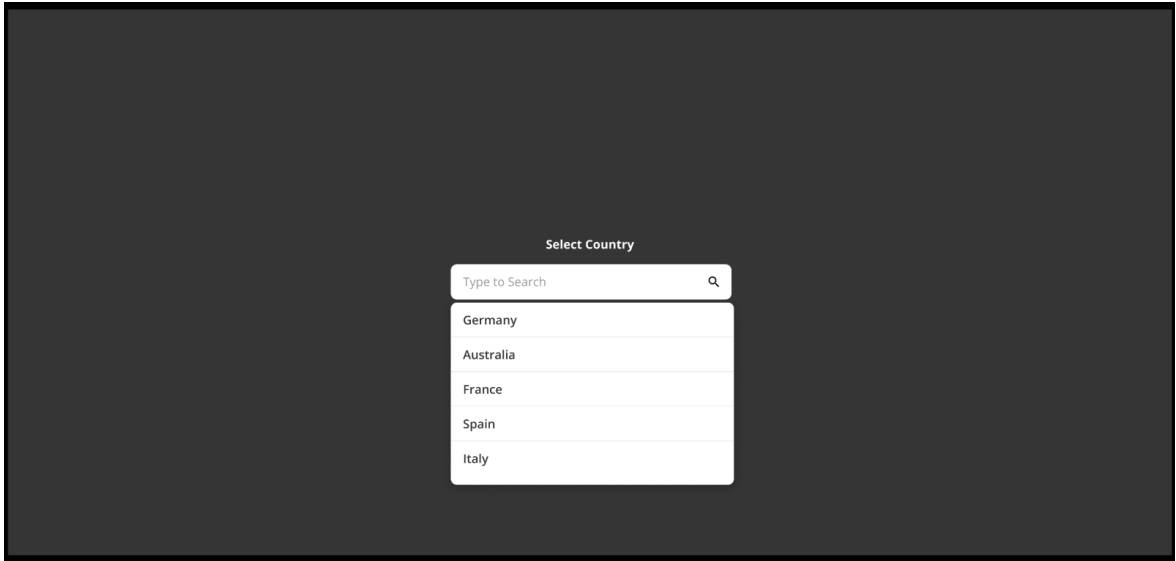


Figure 15. Country Search in Figma design

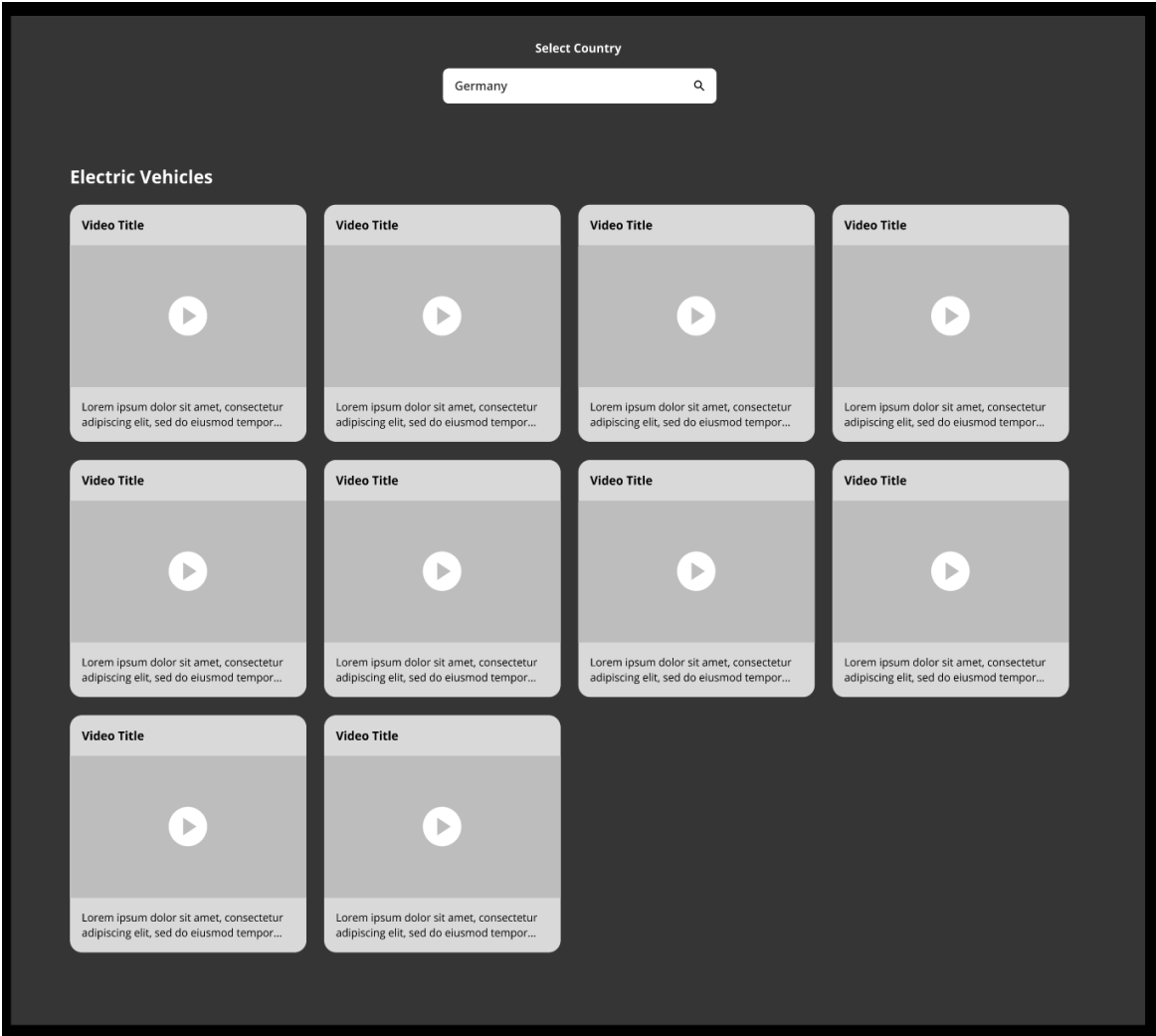


Figure 16. Video List in Figma design

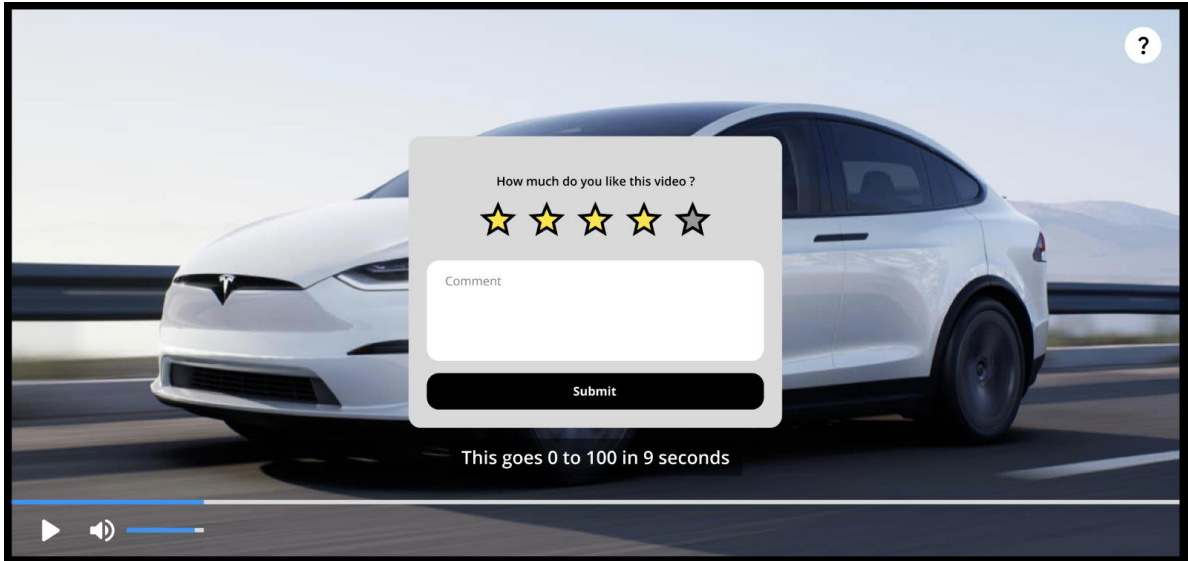


Figure 17. Video player and initial Integration design

6. Testing & Quality Assurance (QA)

6.1. Creating Test cases

No.	Test cases
1.	If a user can log in to the admin panel with a username and password, it passes; otherwise, it fails.
2.	If the user can add, edit, or delete a country in admin, it passes; otherwise, it fails.
3.	If the user can add, edit, or delete a category in admin, it passes; otherwise, it fails.
4.	If the user can add, edit, or delete a video in admin, it passes; otherwise, it fails.
5.	If the user can add, edit, or delete a persona in admin, it passes; otherwise, it fails.
6.	If the user can select a category while creating a video, it passes; otherwise, it fails.
7.	If the user can select the video when creating a persona, it passes; otherwise, it fails.
8.	If the country search filter with the input string, it passes; otherwise, it fails.
9.	If the user can select a country from the drop-down, it passes; otherwise, it fails.
10.	If the user can view a list of videos, it passes; otherwise, it fails.

11.	If the user can play a video on click, it passes; otherwise, it fails.
12.	If the video can play and pause, the test case passes; otherwise, it fails.
13.	If the persona is visible in an expected time interval, it passes; otherwise, it fails.
14.	If the persona shows the text on click and hides on another click, it passes; otherwise, it fails.

6.2. Testing

6.2.1. Functional

Software testing plays a crucial role in verifying the implementation of a software system, with functional testing garnering significant attention, particularly as a black box tester. Functional testing involves evaluating and testing each functional requirement against the software requirements. This process entails applying test cases to assess user input, capturing the output, and verifying that it aligns with the expected outcome. To ensure comprehensive functional testing, a list of use cases has been prepared, thoroughly testing each function with appropriate guidance. For instance, one use case involves testing the login functionality of the admin panel, passing if the user can successfully log in with a username and password, and failing otherwise. To complete the functional testing, a total of 14 use cases have been meticulously validated by myself and an expert reviewer. Additionally, a Google Form has been prepared to gather feedback from reviewers regarding the functional behaviour of the toolkit. Based on the feedback from the reviewers, it is evident that all the use cases successfully meet the functional requirements and achieve the desired objectives. The paper concludes with a comprehensive question and feedback list provided by the expert reviewer. It can be confidently stated that the toolkit effectively fulfils the software requirements and exhibits functional usability, thus demonstrating its successful completion of the functional testing process.

6.2.2. Usability

The main objective of our usability testing was to assess the user interface (UI) and user experience (UX) of the toolkit, with a particular emphasis on gauging the ease of user engagement and comprehension of the contextual data visualization. However, the lack of an actual real user interface presented challenges, resulting in significant difficulties when attempting to conduct thorough usability tests.[26]

6.2.3. Performance

The purpose of performance testing is to evaluate the system's ability to handle anticipated user engagement loads, which requires significant computing resources and time due to the generation of heavy loads.[25] Despite the lack of facilities for comprehensive performance testing, the Tandem toolkit conducted limited performance testing on a local server, demonstrating promising results in terms of API response and UI refreshment, while primarily focusing on the development of a problem-solving prototype.

6.2.4. Future Deployment plan

6.2.4.1. Improve Video Integration

The current toolkit offers support for video addition and persona integration; however, there are areas for improvement that need to be addressed. Specifically, the system should be capable of accommodating moderate-sized video uploads and could adjust the video resolution based on user input. This enhancement is crucial, as it not only addresses the issue of uploading large video data into the system but also aligns with a suggestion received during quality evaluation from an expert. The future development of the application should primarily focus on enhancing its accessibility and usability across diverse browsers and devices. Presently, the application faces limitations in terms of accessibility and usage on different platforms, necessitating a prioritized effort to overcome these constraints.

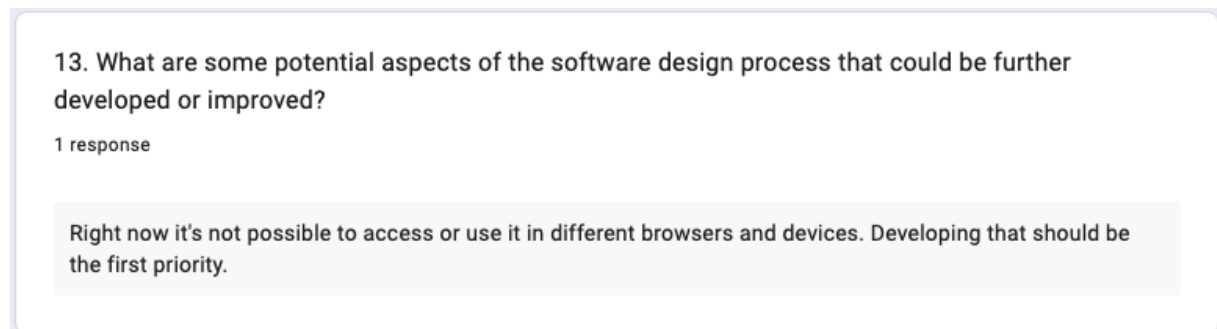


Figure 17. Improvement suggestion from the expert

6.2.4.2. API Integration Improvement

Now our toolkit API is designed with REST API which is a particularly good API design pattern for a small project. But when we have a complex project than we can think about GraphQL which is a query-based API design. The concept of GraphQL revolves around empowering the client to request and precisely receive the data it requires. Unlike traditional server responses that might deliver excess information, GraphQL ensures that only the specifically requested data is transmitted. If a project necessitates client control over data type and quantity, adopting GraphQL would be highly advantageous.

6.2.4.3. Machine Learning Integration

In our toolkit, the integration of data information with personas is a key feature; however, the current approach restricts users to default persona settings embedded within the video data. To enhance the persona suggestion process and improve the presentation of data in the toolkit, the integration of a machine learning model is proposed. By continuously adapting to new persona behaviours through user feedback, the machine learning model will provide relevant persona suggestions, enabling users to access subject or topic-specific information. This improvement aims to enhance data presentation in the toolkit and ensure user satisfaction.

6.2.4.4. Server Upgrade to AWS (Amazon Web Services)

The initial project requirements focused on prototype development, overlooking the hosting aspect by utilizing a local Python server. However, for the extended version of the project, migrating to AWS cloud hosting is proposed. This migration offers several benefits, including enhanced scalability through server load balancing,[22] improved security with built-in features like firewalls and encryption, and the ability to upgrade or downgrade resources as needed. Additionally, AWS provides cost-effective plans,[23] enabling efficient storage management based on service demands. Furthermore, AWS offers comprehensive monitoring services, allowing users to effectively track server traffic and resource utilization. By

embracing AWS cloud hosting, the project can achieve scalability, security, cost efficiency, and streamlined monitoring, thereby enhancing the overall performance and reliability of the application.[24]

7. Discussion

This thesis undertakes the development of a Toolkit to explore the concepts of creating ethnographic personas using data videos and problem solving. The objective is to obtain a deeper understanding of the dynamics between these elements. The research-through-design method is employed, which combines practical implementation with research inquiry, facilitating the examination of test results and feedback. This discussion reflects on the insights gained from the system development process and evaluates how this process has addressed the research questions.

7.1. Ethnographic Persona Creation and Problem Solving

The development process of the Toolkit has provided valuable insights into the creation of ethnographic personas using data videos and their connection to problem solving. By utilizing data videos within the Toolkit, it became evident that they offer a powerful means of presenting user characteristics, behaviours, and preferences. The use of data videos allows for a more immersive and engaging understanding of user experiences, enhancing the empathetic and human-centered aspects of persona creation. Additionally, the development process highlighted the iterative nature of problem solving, emphasizing the need for continuous analysis and refinement of solutions based on user feedback.

7.2. Test Results and Feedback

Through conducting tests and gathering feedback, the Toolkit development process yielded insightful results regarding its performance, usability, and user experience. The test results provided an understanding of the Toolkit's capabilities in effectively generating and presenting data videos as ethnographic personas. User feedback played a crucial role in identifying areas of strength as well as areas that required improvement. It was observed that the Toolkit's performance in data video creation and persona presentation was effective, although certain performance bottlenecks were identified that affected processing speed and video rendering.

User feedback also highlighted the importance of usability in the Toolkit. Users emphasized the need for intuitive interfaces, clear instructions, and smooth interaction patterns when working with data videos and creating ethnographic personas. Additionally, feedback emphasized the significance of customization options to cater to diverse problem-solving contexts and user preferences.

7.3. Addressing the Research Questions

The research aims to explore which design principles can be utilized to guide the development of a collaborative problem-solving toolkit for embedding data. To address this, our team has introduced an innovative design principle within our toolkit system.

Our toolkit incorporates the interactive design principle as a new addition alongside the existing principles. To achieve interactive data presentation, we have implemented ethnographic personas, which enable user interaction while viewing the data video.

For instance, we created a real data video on peat burn to test the integration of our toolkit for interactive data videos. The peat burn data is presented using our developed toolkit, allowing users not only to watch the video but also to interact with persona selection. This interaction with personas provides users with deeper insights into the topic information.

As a result, persona-based interaction facilitates the resolution of user problems, offering a more effective approach. The example demonstrates how our innovative design principles significantly influence user understanding and decision-making in problem-solving scenarios.

Considering the research question regarding the utilization of existing principles in our toolkit development, our approach involved conducting thorough research to identify the prevailing principles in the field of study. To accomplish this, we carried out a comprehensive literature review and discovered numerous principles that have already been implemented to enhance user engagement and bridge the existing gap in data visualization.

Through our literature review, we gained valuable insights into utilizing a storytelling approach for data presentation, which effectively captures users' attention and sustains their interest. These insights became the foundational objectives for our toolkit's development, with the goal of delivering a more engaging and captivating user experience.

Expanding upon these initial objectives, we introduced a novel design principle to augment the efficacy of the previous problem-solving approach. By incorporating this new principle, our intention was to refine existing methodologies and provide users with an enhanced toolkit that better addresses their challenges.

7.4. Conclusion

The development process of the Toolkit has yielded valuable insights into the dynamics of creating ethnographic personas using data videos and their role in problem solving. The findings from test results and user feedback have enhanced our understanding of the design and implementation principles involved in this process. By addressing the research questions and incorporating empirical evidence, this research contributes to a more comprehensive understanding of effective ethnographic persona creation and its connection to problem solving. This toolkit enhances the problem-solving approach addressing the existing research findings. The insights gained from this process will guide future developments in this field, leading to more effective and user-centric approaches in creating ethnographic personas using data videos for problem solving purposes.

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Appendix 1. Survey Question & Feedback

1. Does the website and admin panel perform as expected in terms of loading speed, response time, and uptime?

Answer: Yes

2. Are the features of the website and admin panel working as intended, without any bugs or errors?

Answer: Yes

3. Are the website and admin panel accessible and usable across different browsers and devices?

Answer: No

Comments: Answer given no this is because reviewer not able to test the toolkit in different web browser.

4. Does the website and admin panel comply with relevant industry standards?

Answer: Given rating 3 (1-5)

Comments: Reviewer suggested that website admin panel can be improve for achieving the industry standard

5. Is the website and admin panel layout and design user-friendly and easy to understand?

Answer: I would say okay but can be clearer OfCourse.

6. Are the navigation menus and buttons intuitive and easy to use?

Answer: Yes

7. Is the website and admin panel content presented in a clear and understandable manner?

Answer: Yes

Comments: It is okay.

8. Are the forms and input fields on the website and admin panel clear and easy to complete?

Answer: Given rating is 4 (1-5)

9. Are there any usability issues or struggling points that users may face while using the website and admin panel?

Answer: If someone is using the toolkit for the first time there are chances to get little bit confuse. Specially in "Action" feature.

10. How will you rate the tandem home page based on data presentation and graphical design?

Answer: Given rating is 4 (1-5)

11. Do you think that the country search option is presented in an interactive way?

Answer: Yes

12. What do you think persona is useful from the user's point of view?

Answer: Given rating is 4 (1-5)

13. What are some potential aspects of the software design process that could be further developed or improved?

Answer: Right now, it is not possible to access or use it in different browsers and devices. Developing that should be the priority.

Appendix 2. Feedback of survey Questions

Appendix 3. UI (User Interface) Design (Figma)

[https://www.figma.com/proto/YoRjvHDkDNNvPdxzorRT8l/ThesisWork\(TANDEM\)?node-id=8-2&starting-point-node-id=8%3A2&scaling=contain](https://www.figma.com/proto/YoRjvHDkDNNvPdxzorRT8l/ThesisWork(TANDEM)?node-id=8-2&starting-point-node-id=8%3A2&scaling=contain)

Appendix 4. Source code (GitHub)

<https://github.com/johnyalam/TANDEM-Python>

Appendix 5. Programming language (Python)

<https://www.python.org/>

Appendix 6. User Interface (React)

<https://react.dev/>

Appendix 7. Web Development Framework (Django)

<https://www.djangoproject.com/>

Appendix 8. Frontend design (React Bootstrap)

<https://react-bootstrap.netlify.app/>

Appendix 9. Database (PostgreSQL)

<https://www.postgresql.org/>