

# Research Design 2

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## I. INTRODUCTION, POSITIONING, RESEARCH UNION

User Experience design (UX), focuses mainly on the overall user perception during navigation. It strives to create positive user experiences through intuitive UI design which enhances readability and navigation. Yet, the quality of such UX/UI designs influences user engagement either in a positive or a negative manner. In this study, the main research topic is about UX/UI design, and analyzing the user's behaviour between a professional and unprofessional UX/UI design.

### A. Description of Theme and Topic Rationale

1) *Description of theme:* The theme of the study focuses on how the UX/UI design of digital interfaces affects how users feel and behave while interacting with such designs. By comparing professional and unprofessional design examples, the study aims to understand what makes interfaces engaging or frustrating for users. Using technologies like head tracking and computer vision, the research gathers data on user interactions to help designers create better experiences. Ultimately, the goal is to improve usability and satisfaction for people using digital interfaces.

2) *Topic Rationale:* Considering professional UX/UI design is crucial as it plays a vital role in delivering the optimal user experience. Differentiating between a professional and an unprofessional UX/UI design is acknowledged as a significant aspect. With the incorporation of the head tracking program using computer vision, examining user engagement with these designs becomes feasible. The rationale behind this study lies in the potential to utilize computer vision technologies for investigating and improving user experiences during navigation, regardless of whether the designs are professional or unprofessional. Due this type of utilization, valuable insights can be obtained as users interact with these designs through tracking their head movements and tilts. This study aims to close the gap between computer vision and UX/UI design user interaction, by investigating the viability of using the head tracker tool developed to assess and optimize user involvement in both the professional and unprofessional UX/UI designs. The aim of this study is to bridge the gap between computer vision and user interaction in UX/UI design. It seeks to explore the effectiveness of utilizing the developed head tracking tool to evaluate and improve user engagement in both professional and unprofessional UX/UI designs.

### B. Positioning

1) *Positioning:* The position of this research lies at the intersection of user experience (UX) design and computer vision technologies. This study addresses the increasing demand for seamless and intuitive digital experiences by investigating the role of computer vision, particularly head tracking, in evaluating user interactions across various design contexts. The aim of this research is to create a tool via computer vision which helps UX/UI designers in identifying flaws and frustration. A head tracker tool would be utilized during user interaction which this help in identifying that users are frustrated and UX designers have the chance to arrange and make the designs more professional. By examining both professional and unprofessional design interfaces, the study aims to uncover patterns in user behavior and preferences, providing knowledge on the effectiveness of various design approaches. Moreover, this study aims to help improve UX/UI design practices by offering practical insights that can guide the enhancement of interfaces to meet user needs and expectations more effectively. By exploring innovative technologies and their integration into user-centered design, this research positions itself as a valuable addition to the ongoing conversation about improving digital experiences for users.

### C. Research Union

1) *Research Philosophy:* The study adopts a positive philosophical stance, aiming to advance knowledge through empirical observation and quantitative analysis. Its objective is to explore the correlation between user interaction with professional and unprofessional UX/UI designs and head movements, by systematically collecting and assessing empirical data during navigation. Furthermore, the study employs an objective approach, recognizing the existence of observable realities linked to user behavior and head tracking data. It acknowledges that user navigation with both professional and unprofessional designs, along with the corresponding head movements, can be empirically observed and studied.

2) *Research Approach and Research Strategy:* The research approach and chosen strategy aim to employ an experimental design methodology. Through controlled experiments, the study seeks to systematically manipulate variables, such as the effects of professional versus unprofessional designs on user navigation and interaction. This approach facilitates thorough testing of hypotheses and the identification of causal

relationships between various types of UX designs and user navigation.

3) *Choice of Methodology*: The methodology chosen for this study integrates both quantitative and qualitative approaches, enabling a comprehensive investigation of both the research problem and questions. The quantitative approach is employed to analyze and collect data from the head tracking program tool, as its output is numerical. These numerical values represent the frequency of head tilts during navigation of both professional and unprofessional designs, along with the real-time duration of user navigation with each design separately. Conversely, the qualitative approach is utilized for the data gathered from interviews.

4) *Time Horizon*: Regarding time frames in this study, data collection occurs whenever the user tilts their head during navigation. As users interact with both professional and unprofessional designs, immediate user responses are recorded by the head tracking tool, with variations observed based on the design being navigated. The study explores the dynamics of interaction between professional and unprofessional designs and user behavior, examining how user actions vary during navigation with different designs.

5) *Techniques and Procedures*: In terms of techniques and procedures, a combination of hardware and software technologies was employed. For hardware, the laptop's webcam tracked user head movements during interactions with designs. On the software side, Python was utilized to develop the head tracking tool, with PyCharm serving as the programming software. To ensure the success of the head detection program, several libraries were integrated, including CSV, CV2, mediapipe, numpy, and datetime. The CSV library facilitated data display in an Excel file for clearer evaluation, while CV2 enabled head movement and face recognition tracking. Mediapipe implemented AI and machine learning techniques to optimize prototype performance, and datetime allowed the program to calculate user time spent on the UI. Additionally, numpy handled small mathematical calculations and functionalities. Adobe XD was utilized for creating UX/UI designs. Statistical procedures were then applied to analyze head tracking data, aiming to detect significant differences in head tilts during navigation of both designs. This comprehensive methodology framework guides the systematic exploration of the relationship between UX design and user behavior and navigation.

#### D. Background to this Research Theme

1) *Overview of UX and what makes UX Professional or Unprofessional*: User Experience (UX) design involves designing products that offer good experiences to users, especially concerning websites and web applications. It encompasses the entire user journey, aiming for a seamless and pleasant experience [1]. Key aspects include the look and feel, ease of use, accuracy, reliability of data, and interface responsiveness. UX designers strive for consistency throughout the project to maintain a positive user experience [2]. According to Nielsen's article [3], Professional and unprofessional UX designs are identified using heuristics such as system visibility, real-world

match, user control, consistency, error prevention, recognition over recall, flexibility, and efficiency, aesthetic design, error recovery, and help documentation. These heuristics acts as guidelines that helps UX/UI designers design professional design. Visibility of system status ensures users are always informed of their location within the system, preventing confusion and frustration. Designs should mirror real-world concepts and language to enhance user understanding and intuition, aligning with the match between system and real-world heuristic. User control and freedom empower users to navigate the system easily and recover from errors effortlessly. Consistency and standards maintain predictability and familiarity for users by ensuring uniformity in design elements and adherence to established norms. Error prevention involves proactively incorporating clear instructions and safeguards to mitigate user errors. Recognition over recall prioritizes presenting information and actions in a manner that reduces users' reliance on memory. Flexibility and efficiency of use cater to both novice and expert users by providing shortcuts and efficient interactions. Aesthetic and minimalist design principles prioritize simplicity and visual appeal, enhancing user comprehension and engagement. Lastly, helping users recognize, diagnose, and recover from errors, along with providing comprehensive help and documentation resources, further aids users in understanding and effectively utilizing the product [3]. These heuristics collectively contribute to crafting seamless, intuitive, and satisfying user experiences during navigation.

2) *Overview of computer vision and it's use in UX Design*: Computer vision is a component of artificial intelligence (AI), significantly influences user experiences (UX) by facilitating innovative and personalized interactions. It leverages advanced technology to understand how individuals engage with digital platforms such as websites and applications, enabling designers to tailor experiences to each user's preferences [4]. A key application of computer vision in UX design is through tracking techniques like head and eye tracking. Head tracking monitors users' head movements to gauge their understanding and engagement [5], while eye tracking observes where users look on the screen to identify points of interest and potential usability issues [6]. By analyzing this data, designers gain insights into user behavior and preferences, allowing them to refine interface designs for optimal usability and effectiveness [7]. For instance, in a study examining student interaction with an online learning system, eye tracking provided researchers with valuable information about students' visual focus and interaction patterns [8]. By combining this data with interviews and feedback, designers were able to make informed adjustments to enhance the system's usability and learning experience [8]. In summary, computer vision enhances UX design by providing designers with valuable insights into user behavior and preferences, enabling them to create more intuitive and engaging digital experiences.

### *E. Hypothesis*

The objective of this study is to explore how computer vision can assist in assessing user interaction with both professional and unprofessional UX/UI designs. The primary focus is on measuring the accuracy of user interaction with the provided User Interface, with the independent variable being the precision of head position tracking from the trained dataset. Hence the hypothesis of this study is that by using computer vision especially head tracking, it is possible to identify the user's head posture and head tracking while the user is navigating with a specific user interface.

### *F. Research Aim and Purpose Statement*

This study seeks to explore the application of computer vision, particularly head tracking, in evaluating user interactions with both professional and unprofessional design interfaces. The primary objective is to gain understanding of user behavior and interactions across various designs. The research aims to evaluate the feasibility of employing head tracking as a means to comprehend user navigation and improve overall user experience. Ultimately, the study aims to provide valuable insights that can guide the enhancement of UX/UI designs, thereby increasing user engagement and satisfaction.

## II. REVIEW OF RESEARCH METHODOLOGIES AND LITERATURE MAP

### *A. Literature review about the methodologies used in other studies*

Depending on the nature of the research, multiple research approaches could be used. The three most effective strategies are analytical, descriptive, and combined research approaches. As cited by Pedamkar [9], the analytical research methodology approach tries to employ proven facts as the foundation for the study. Researchers typically do research to gather supporting data that supports and validates their previous findings. It also contributes to the development of new concepts relating to the research topic. Thus, analytical research incorporates specific details to produce stronger hypotheses. The analytical research illustrates why a claim is valid. There are several approaches to conducting this research approach, including meta-analysis, literary or scientific trials, and learning about the opinions of others. Furthermore, the researcher using this approach, conducts a critical review of the material utilizing this method. As Pedamkar states [9], with regards to the descriptive research methodology approach, this approach aims to outline features of the population or issues found in a study. This approach mainly focuses more on the "what" of the research problem rather than the "why". The primary methods used in descriptive research include observations, surveys, and case studies. Finally, as Damyanov states [10], the mixed method approach is a mixture of both quantitative and qualitative data. Quantitative data includes numeric quantities such as ages, scores, and percentages. Qualitative data, on the other hand, consists of non-numerical variables such as beliefs, motivations, attitudes, and experiences that are frequently obtained through interviews and focus group research in order

to gain a better understanding of a study issue or phenomenon. This method provides a more meaningful conclusion to the study since both quantitative and qualitative data are analyzed in the same study.

### *B. Difference between academic and non-academic material*

It is of utmost importance for a professional research study to research sources to support and review the study's reliability, so the need for using sources is crucial. For research, the two categories of sources are Academic and Non-Academic. As cited by Mid-Michigan College [11], Academic articles or papers are written by professionals in a given field. They are edited by the author's colleagues and frequently take years to publish. Their language is formal, with field-specific terminology and principles. The author's name will be visible, as well as their credentials. A list of references is provided, showing where the author got the information utilized in the article or paper. Non-academic articles are written for the general public. They get published straight away and can be written by anyone. Their language is informal, and casual, and can contain slang. The author may not be identified and will have no credentials listed. There will be no references list. Some examples of non-academic sources are novels, blogs, book reviews, newspapers, and websites.

### *C. Recommendation of 5 peer-reviewed sources & Integrated Literature Research Material*

Since this is a professional study, the majority of the sources included were peer-reviewed. This study's peer-reviewed academic sources included papers and reliable articles from journals and websites. Given their credibility, these sources contributed to the dependability and validity of this research and its objectives. The purpose of this study was to research and write about UX design, what distinguishes professional and unprofessional UX design, and computer vision. [12] provided an outline of UX design. The next step in the study was to determine what distinguishes professional and unprofessional UX design. This was discovered thanks to Nielson [3] and [13], as their information was useful in this study. Since this study also included computer vision, IBM [14] provided a full understanding of what computer vision is. Finally, the study compared the effectiveness of head tracking with eye tracking. Ramakrisnan et al.'s study [8] helped in learning more about this.

### *D. Key Viewpoints And Discussions In Literature*

When writing and compiling this study's literature review, the sources mentioned above, as well as in other sections, were vital for producing a reliable and comprehensive literature review. The sources researched were also beneficial, as the literature review of this study mostly agrees with nearly all sources found to support it. A vital discussion in this study's literature review was when researching and analyzing the usage of computer vision in UX/UI design. Since the topic was broad, multiple studies discovered various sorts of computer vision techniques and aspects to incorporate into the field of

UX design. In addition, this study's literature review included a comparison and contrast of the use of head-tracking and eye-tracking methodologies to determine which is a better methodology to use as a metric. Due to comparisons, there was little difference, and it opted to utilize the head tracker as a statistic because both techniques produced roughly the same result. The sources found supported the study's literature review, which ultimately agreed with the sources discovered to strengthen knowledge in the utilization of head tracking (computer vision) to analyze different user behaviors and navigations between professional and unprofessional designs, intending to always assist UX/UI designers in improving designs and user experiences.

### E. Literature Map

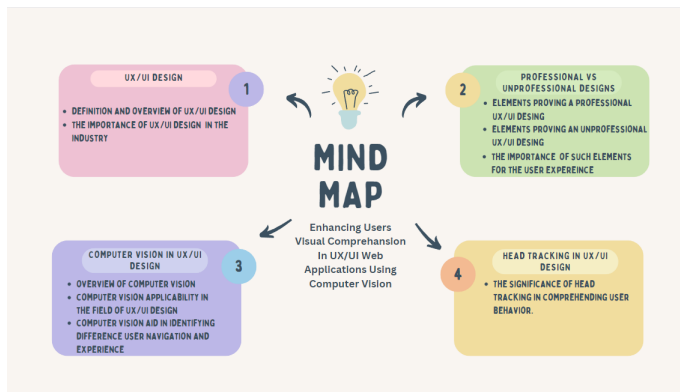


Fig. 1. Literature Mind Map

Figure 1 displays a clear overview of the literature relevant to this study, focusing mainly on UX/UI design, the distinction between professional and unprofessional UX/UI designs, the use of computer vision in general, and in the field, and finally, the application of head tracking technology within the context of UX/UI designs, which this technology helped in identifying a difference in user navigation and helps in enhancing such designs.

## III. REFLECTION OF THE CHOSEN METHODOLOGY

### A. Definition Of Research Questions

This study aims to comprehensively examine significant research issues concerning the utilization of a head tracker tool for analyzing user behavior across professional and unprofessional designs. The head is used as a metric simply because the user navigation is assessed depending on the number of head tilts the user makes while navigating. By addressing these identified research questions, the goal is to contribute valuable insights to the existing understanding of head tracking in UX design and user behavior.

- Was the head tracker able to distinguish differences in user behavior with both UX/UI designs?
- What were the differences between both UX/UI designs, if there were any?

- Was the intended result obtained from the head tracking prototype?

The first research question seeks to determine whether observable changes in user behavior can be detected following navigation with both the professional and unprofessional UX/UI designs, with head tilts and movements serving as metrics. The second research question investigates whether users perceived disparities between the two designs during navigation. Lastly, the third research question evaluates the suitability of the head tracking metric for analyzing differences in user behavior and experience.

### B. Definition Of Own Objectives

The primary goal of this study is to assess the effectiveness and precision of a head-tracking tool developed with Python utilizing computer vision techniques to evaluate user behavior and interactions with UX/UI designs. To reach this study's objective, the aim is to address the three main research questions stated. As a result, the main objective is to contribute to the development of head-tracking software in the field of UX design, assisting UX/UI designers enhance user experience in design and navigation.

### C. Understanding Of Research Philosophies, Approaches And Main Research Paradigms

According to Mgammal [15], research philosophy plays a crucial role in guiding researchers' approaches to a problem by encompassing their beliefs and assumptions. Mgammal [15] further emphasizes that a well-defined research philosophy promotes coherence in the research process and assists in justifying and defending research decisions. Hence, researchers need to identify and clarify their research philosophy to conduct meaningful research and ensure the credibility of their findings. Ultimately, every research project is underpinned by a research philosophy, dictating how research is conducted, decisions are made, and data analysis methods are employed. Acting as a framework, research philosophy aids researchers in comprehending and elucidating the nature of knowledge acquisition, comprising a set of principles and beliefs that steer them throughout the research journey.

According to Mgammal [15], various approaches exist, including ontology, axiology, epistemology, and paradigms. Ontology, for example, examines the underlying nature of existence and reality. It is essential in research topic selection and hypothesis development since it delves into what constitutes existence, what exists, how it appears, and the interactions between its components. In research, ontology greatly influences the researcher's perspective of reality, shaping their understanding of what is factual. Essentially, ontology is a foundation of research, defining the researcher's perspective on reality by thoroughly investigating the essence of existence and the relationships between entities. Its critical role guarantees that researchers approach their investigations holistically, resulting in realistic depictions of reality. Axiology, on the other hand, is concerned with the values and beliefs that underlie research and is critical in preventing bias or prejudice.

Furthermore, the role of researchers' morals in technical procedures is a major topic in axiology. It is critical to consider how a researcher's standards influence each stage of the study process in terms of approach and research philosophy. Philosophical axiology may incorporate ethics and aesthetics as values held by researchers. As a result, researchers must be aware of their values to deliver credible research results. By understanding their values, researchers can make their research more sustainable and strengthened.

As Mgammal states [15], the epistemology approach is essential in ensuring valid methods and tools to collect information. Mgammal also states [15] that epistemology explores the relationship between researchers and research participants. By following established protocols, researchers can conduct studies without bias and approach participants without preconceived ideas. This approach, known as objectivism, is crucial for ensuring fair and impartial research. Additionally, dualism suggests that researchers, participants, and topics are independent entities. To prevent bias, researchers must maintain objectivity and independence from participants throughout the research process. This adherence to objectivity serves as a significant guideline for conducting research. In summary, epistemology highlights the importance of objectivity and independence in research. By following established procedures and maintaining distance from participants, researchers can conduct thorough and unbiased research, leading to meaningful conclusions. Ultimately, as Mgammal also states [15] in his paper, A paradigm is the unique interpretation and explanation of social phenomena by researchers. This examination can provide useful insights and justifications. A research paradigm is a specific methodology that guides a researcher's selection of philosophical ideas, participants, tools, and techniques. When utilizing the scientific method, researchers adopt a positivist approach, highlighting impartiality, factual evidence, and autonomy. This methodology entails testing previously established hypotheses and addressing knowledge gaps. The selection of a research paradigm is crucial to the outcome of a study since it provides structure and guidance. It ensures a more organized approach, which simplifies the research process and increases the likelihood of discovering useful insights. Defining philosophical assumptions guides methodological decisions and data collecting, ensuring optimal organization and revealing gaps in current knowledge. Finally, Mgammal states [15] that integrating aspects of ontology, axiology, paradigms, and epistemology ensures the integrity of the research output, providing readers with reliable and valuable information.

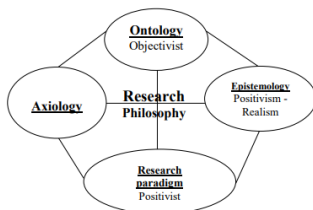


Fig. 2. Main Aspects of Research Philosophy

#### D. Chosen Methodology

After extensive research into suitable methodologies for this study, the mixed method approach emerged as the most fitting choice. This approach combines both qualitative and quantitative data analysis techniques. Qualitative research aims to collect and analyze data to comprehend individuals' attitudes and beliefs, often through interviews and surveys. Conversely, quantitative research deals with numerical values, typically employing metrics and statistics derived from software tools. By the integration of both qualitative and quantitative data, this study aims to enhance its validity and reliability.

#### E. Description Of Chosen Methodology, Experimental Design And Method Of Analysis, And How It Goes With The Research Objectives

1) *Description Of Chosen Methodology:* This study utilized a mixed method approach, incorporating both quantitative and qualitative approaches, to thoroughly investigate the use of a head tracking tool in analyzing different user navigations with different UX/UI designs. Regarding the quantitative data, this type of data is gathered from the head tracker tool, because its output is numerical. The numerical values presented by the head tracker present the number of changes in the head directions of the user during navigation with both designs. The head is used as a metric to identify the number of tilts made by the user during navigation, if there are a lot of head tilts, that means that the user is confused and frustrated, which contributes to having a bad user experience. In addition to this, the head tracker also outputs the time the user took navigating with each design. On the other hand, the qualitative data is gathered from the interviews. After the participants navigated with the professional and unprofessional designs, they were required to sit for a short interview. The aim of such interviews was to gather further insights from the participants about their navigation and behavior with such designs.

2) *Experimental Design:* The study's experimental setup features a tranquil and quiet environment in which the participants engaged with both the professional and unprofessional UX/UI designs with some tasks assigned for both designs to keep the navigation from one design to the other as similar as possible for accurate results. While the users were navigating with such designs, their head movements were tracked using the prior trained and developed head tracker software tool. Before the experiment, it was made sure that the participants are well positioned in front of the laptop's webcam to get and obtain accurate results from the head tracker tool. Throughout the experiment and navigation with both designs, the head tracker tool, which is built and developed with Python and computer vision training algorithms and libraries, accurately tracks and records the user's head's movements. After the participants finished with their navigation with both designs, the participants were required to sit for a one-on-one interview, which this interview aimed to gather more information on their navigation. The data gathered from the interview strengthened the data gathered from the head tracker tool. This is done because, if for example, participant A has more changes in

head directions after navigating with both designs, this shows that this was unprofessional design, and so when the participant is asked about his/her behavior during the interview, the participant should have an unpleasant user experience that corresponds to the data from the head tracker.

3) *Method Of Analysis:* The analysis approach in this study is to make sure that the head tracker program is trained and set up well for reliability to analyze the user's head movements well during navigation alongside the time taken for completion. As the head tracker starts to obtain data metrics, the users navigate through the tasks while navigating. After the participants navigated both designs with all the necessary data gained via the head tracker tool, one-on-one interviews were carried out with users to back up and support the data collected from the tracker, and also assess the data accuracy. This type of analysis approach makes sure that the data collected is validated and reliable as the qualitative data is used to support the quantitative data. Therefore, the data gathered from the head tracker tool and the interviews are strong feedback to UX/UI designers to help them enhance better user experiences in UX/UI.

4) *Research Objectives:* The mentioned analysis approach ensures that the data collected is validated and reliable, as qualitative data is used to support the quantitative data. As a result, the interviews and head tracker software tool provide valuable feedback to UX/UI designers, enabling them to further enhance user experiences.

#### *F. Reflections On Validity, Reliability And Generalizability/Transferability*

Reflections on the validity and reliability of the chosen research methodology include both the experimental design and the methods used for gathering data. The quantitative data analysis gathered through the head tracking program gives unbiased measurements that reflect the participants' head tilts and movements while navigating with both designs. This experimental design has a high level of reliability as it offers accurate measurement and analysis of vital variables such as the time it takes for participants to navigate both professional and unprofessional designs, as well as changes in the head direction across different design patterns, whether professional or unprofessional. Additionally, with regards to the qualitative aspect of this research, which includes a variety of interview questions, enhances the research by providing more insight into participants' experiences and perceptions of the head tracking program and navigation, hence validating the data extracted from the head tracking program. With regards to generalizability, the use of mixed methodology approach can be used in any other study that needs to use both quantitative and qualitative data additionally, this is also used in studies, where studies need to support qualitative data with quantitative data for more precise results. The mixed method approach can be used in the field of education when it comes to understanding the complexities of teaching and learning processes. A suitable example would be when assessing teaching methods and curriculum effectiveness. In

this, the mixed methodology approach can be used in such a way to evaluate the effectiveness of different teaching methods and curriculum designs. Quantitative data can be utilized by conducting surveys on a student's performance and test scores being numerical. On the other hand, the quantitative data method can be used for classroom observations, focus groups, or interviews which allow researchers to explore the contextual factors that influence learning outcomes. Finally, by integrating qualitative and quantitative methods, researchers can generate comprehensive insights, enhance the validity and reliability of their findings, and contribute to theoretical advancements and practical applications in the respective fields.

#### *G. Ethical Considerations Usage In Study*

Ethical considerations in this study are considered when conducting experiments with the head tracking software and in the interviews with the participants. Informed consent is of utmost importance, making sure that participants understand the study's objectives, the reason for participation, and any type of danger or risk of harm. Additionally, this research contains privacy and confidentiality throughout the interview process respects the participant's autonomy, and gives the participants the option, to stop their participation in the study at any time without any consequences if the participants don't feel comfortable. Implementing such considerations in data collection and participation is vital to ensure the reliability and integrity of such research. The participants were provided with an ethics form including all the necessary information that they needed to know, and whoever wanted to participate signed this ethics form.

## IV. RESULTS, ANALYSIS AND DISCUSSION

### V. CONCLUSION

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