User Perceptions of GeoAI in a Comfort-based Route Planner: Preliminary Results and Design Considerations

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Abstract. In this work in progress, we apply a first step in a user-centered design framework to assess the user requirements surrounding the use of AI in a thermal comfort-based navigation application. Initial findings from a survey of 129 participants in Europe suggest that users would like general information about how a navigation application is using AI, with the option to access more detailed information, but care less about the details of the uncertainty of the prediction. Furthermore, designers should take care to clearly describe data security and use practices and explore ways to address doubts about reliability and accuracy. Additionally, our results encourage further development of routing services focused on diverse factors other than time and distance.

Keywords. user perception of GeoAI, user-centered design, GeoAI

1. Introduction

GeoAI is the integration of geospatial science and artificial intelligence (AI) (Gao, 2021). It is playing an increasing role in spatial data collection and processing, in information extraction and analysis, and in quality assessment of geodata (Richter & Scheider, 2023; Herfort et al., 2023). As a technical solution, GeoAI has been used for human-centered smart city planning to improve the efficiency of urban services (Mortaheb & Jankowski, 2023). In environmental health, GeoAI has been applied to model and capture the built environment to address various factors that affect health (Kamel Boulos et al., 2019). Meanwhile, recent projects in LBS are incorporating variables like pollution, noise, safety, and greenness into route calculation (e.g. Hecht

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et al. 2021; Heidelberg University, 2023; Helle et al., 2021), and applying GeoAI methods could be useful for these dynamic variables.

Several guidelines exist for designing human-AI system interfaces (e.g. Amershi et al., 2019; Cheng et al., 2019). However, to our knowledge, human-AI design considerations have not yet been explored in the LBS community. On the one hand, usability engineering offers guidelines that are relevant to mobile applications with AI, such as Nielsen's (1992) usability heuristics for UI (e.g. "visibility of system status"). On the other hand, human-AI design recommendations may not be deemed as pertinent given the often efficiency-prioritized use case of navigation applications.

Our project *CoolStreet* is a proof-of-concept route planner for pedestrians and cyclists which is being developed collaboratively with Climateflux GmbH, following a streamlined user-centered design (UCD) process, as outlined in Roth et al., 2017. The project aims to predict the outdoor thermal comfort of different routes based on deep learning models using a variety of urban and climatic data sources.

This work in progress focuses on a subsection of a user requirements survey developed in the realm of the CoolStreet project, specifically related to two research questions: Do users want to be informed when a navigation application is using AI? What concerns or suggestions do they have? The feedback from our initial survey provides potentially transferable insights into how users would like to be informed of the use of AI in a comfort-oriented navigation application design.

2. Method

As a first step in assessing user needs and preferences for our use-case, an online self-reported user requirements survey was deployed. The broad survey aimed to evaluate current patterns of mobility relating to thermal comfort, the use-contexts of users' current navigation tool, user preferences about the use of AI, and to gather feedback and ideas about the initial proposal. This paper focuses on the subsection of the survey related to user perception of AI.

First, users were given a detailed description of the use-case and shown a prototype of the application. It was clarified that AI was used for efficient prediction of the thermal comfort of each route and that no personal data was used for the calculation. Then users were asked a series of open- and close-ended questions relating to whether they would like to be informed about the use of AI in the application, and at what level of detail. They were also asked if they would like to be informed about the uncertainty of the AI

prediction of shade along the route, as well as the desired level of detail. Participants could also indicate additional features or capabilities they would like to see from a navigation application using AI, as well as any concerns they might have. These text answers were analyzed using thematic content analysis and sub-themes were identified (Braun & Clarke, 2006).

While the initial proof-of-concept will focus on the city of Munich, it is planned to develop the API into a city-independent solution. Therefore, the survey was distributed publicly via posted flyers, snowballing, social media, and email invitation. Over 90% of respondents were based in Europe, with the majority from Germany, Switzerland, and Austria and will be the focus of the preliminary results presented in this paper.

3. Preliminary results

129 (female = 59) inhabitants of Europe with ages ranging from 18-74 answered, though half (52%) of the respondents were 25 to 34 years old. 64% reported that they "have a basic understanding of AI," while 27% "have advanced understanding of AI and related concepts."

Participants most frequently use public transport in urban areas (100 responses). Walking and cycling were the second and third most frequently used modes of transport, with 64 and 57 responses respectively. Most users selected two or more answers for this multiple-choice question. 37% of participants walk between 30 minutes to an hour on average per day in a typical week. The rest of the answers were evenly balanced from under 30 minutes to over two hours per day. Participants spend less time per day cycling, with 46% spending less than 30 minutes and 24% between 30 minutes and an hour. Six participants skipped the question. Interestingly, 85% of participants indicated Google Maps as their most frequently used navigation tool.

3.1. Keep the user informed

After receiving a detailed description about how AI is used in the application and a prototype, users were asked "While using the application, how much information would you like to have about its use of AI?" (*Figure 1a*). The vast majority would like to be informed, indicating either that "just a basic explanation of the use of AI" is okay, or that they preferred "detailed information on why and how AI is being used." *Figure 1b* shows responses to the question "Would you want to see the uncertainty of the prediction?" Here, a general explanation is relevant to most.

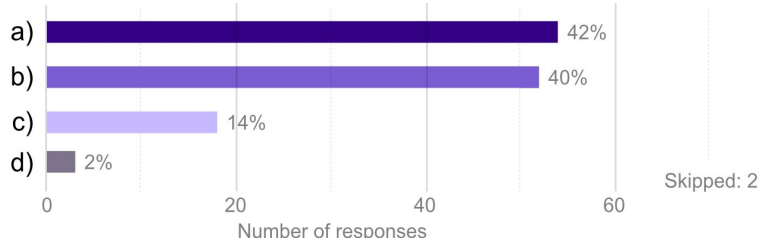

Figure 1a. How users want to be informed about the use of AI in the application. Answer choices in the survey were: a) "I want detailed information on why and how AI is being used in the application," b) "just a basic explanation of the use of AI is okay," c) "I don't care to know about the use of AI in the application," and d) "other."

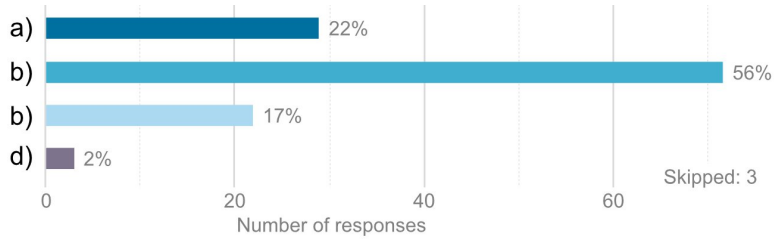

Figure 1b. How users want to be informed about the uncertainty of the AI prediction in the application. Answer choices in the survey were: a) "I want detailed numbers and visualizations on the prediction of the AI," b) "just a general explanation of the uncertainty is okay," c) "as long as it's reliable, I don't care about the details," and d) "other."

3.2. Concerns and doubts about AI

Results from the thematic analysis are summarized in *Figure 2*. Main concerns consisted of data security *("How do I know that no data is really being collected from me?"),* lack of control *("I want to decide myself")* and that context matters for how users feel about the use of AI *("not in this case").* Primary expressions of doubt related to reliability *("I would just always questioning if the suggested AI route is the best" [sic])* and accuracy *("can it derive more or less accurate results?").*

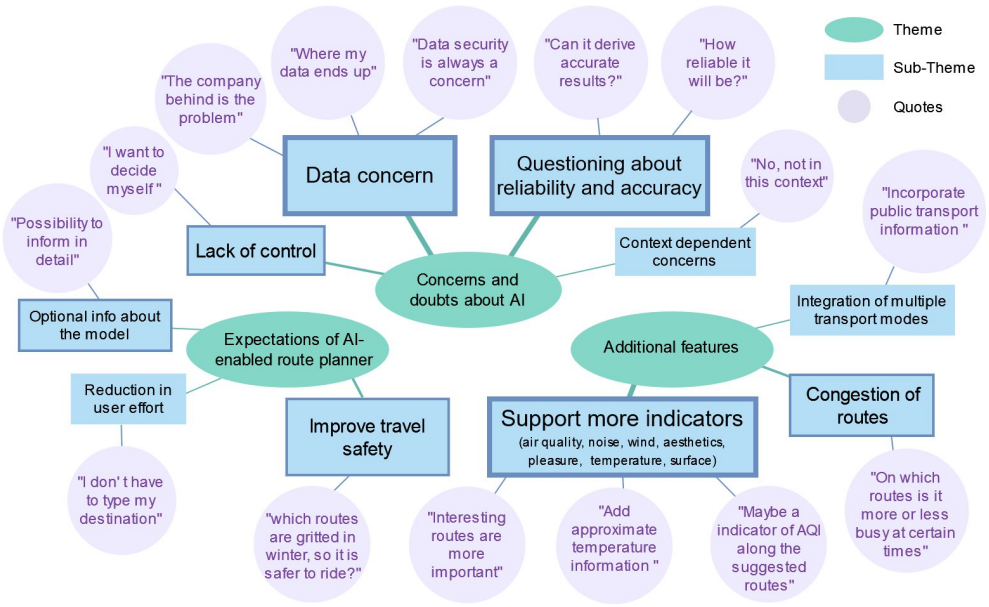

Figure 2. The result of theme analysis. The thicker the border of the polygon, the more users discussed that theme. No borders indicate fewer than four mentions, thin borders between five and eight, and thick borders more than nine mentions.

4. Discussion

Our preliminary findings related to user perceptions of AI in a navigation application for thermal comfort-based travel in the city indicate several design considerations. While narrow in use-context, we argue that these considerations may be transferable to other use-cases in the field, potentially "stimulat[ing] new considerations for future projects" (Roth, 2019).

Users want to be informed about the use of AI, even if it is only involved in real-time calculation of urban shading and is unrelated to personal data. Some want a detailed explanation about why and how it is used, while others accept a general explanation. Designers should consider including both, allowing a drill-down approach for those who want to learn more. Providing an appropriate level of detail may also assuage doubts or concerns among users, given that some indicated their lack of concern as contextual. Interestingly, the participants were less concerned about being informed in detail about the uncertainty of the prediction, with the majority preferring a general explanation. In our survey, "uncertainty" was referred to only in the context of "uncertainty of the prediction," without a detailed explanation of the AI concept. Given the range of experience with the topic of AI amongst the participants, this should be clarified in the future.

Attention should be given to explaining data security practices clearly and transparently. More than a third of participants indicated data concerns such as third-party access, how their data is used, or company intentions as concerns, despite receiving explanation that the use of AI was unrelated to their personal data. Details on data security should be sufficiently detailed and very easily accessible for the users that would like to learn more.

Users are interested in multiple route criteria beyond the shortest or fastest. This has been explored in the LBS research community (e.g. Hecht et al., 2021; Helle et al., 2021; Novack et al., 2018; Quercia et al., 2014), but there is a need for sustainable solutions such as APIs (done only to our knowledge by Helle et al., 2021), given that some in our study mentioned not wanting to download another application. It also speaks to the individuality of user preferences, maybe indicating a need for multiple additional route qualities, presented simultaneously, allowing users to opt-in to those they are most interested in.

Finally, many users expressed desire for a comprehensive multimodal transport network that incorporates live updates from local transport associations, as well as visualization of congestion along street, cycle, and pedestrian ways.

5. Conclusion

We conducted a broad user requirements survey for the development of a comfort-based navigation application. In this work in progress paper, we present the preliminary results of a subset of the survey focusing on user perception of the use of AI in the application. We discuss our results and offer design considerations for further research. Development continues with analysis of the complete user requirements survey, derivation of user personas, and initial prototyping.

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