Catalyzing Social Interactions in Mixed Reality using ML Recommendation Systems

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ABSTRACT: We create an innovative mixed reality-first social recommendation model, utilizing features uniquely collected through mixed reality (MR) systems to promote social interaction, such as gaze recognition, body language, noise level, congestion, and conversational intensity. We compare these results to the state-of-the-art recommendation methodologies which have not previously been applied to MR. We further extend these models to include right-time features to deliver timely notifications. By creating a new intersection of user features, MR features, and right-time features, we observe a significant boost in performance.

KEYWORDS
mixed reality, social networks, recommendation systems, collaborative filtering.

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1 INTRODUCTION

[TODO]

1.1 Value to user community

According to the U.S. Surgeon General's 2023 advisory, the most pressing, yet pre-existing, public health issue in 2023 was loneliness [1]. This work on social recommendations in mixed reality provides value to this user community, composed of lonely individuals located in the United States, ranging from 18 to 65 in age.

Contributions:

(1) Focus group analyzing user preferences and present-day perceptions around social interactions with co-located strangers.
(2) Novel dataset on social preference collected through an empirical study conducted using human participants.
(3) Four user-to-user recommendation models trained on combinations of MR features, user features, and right-time features for maximizing in-person interactions.

Since this research assumes certain technological advancements in MR technology, the contributions mentioned above may not provide immediate value to the target user group, specifically with regards to mixed reality. The non-MR models provided through this research would deliver immediate value by catalyzing novel social interactions through recommendations on the Hear application platform [2].

1.2 Research questions

We plan to address various research questions through the exploration of MR features, right-time features, and user features as inputs to the recommendation models introduced in this paper. The questions answered by this work are captured below:

RQ1. *What is the impact of mixed reality in catalyzing novel social interactions between people within close proximity?*

RQ2. *What environmental factors play the largest role in creating or preventing social interactions?*

RQ3. *What are the primary user features that make people want to interact with each other?*

2 BACKGROUND

[TODO]

3 METHODOLOGY

We wish to conduct a focus group and user study which collects data from real-life participants through two separate surveys.

3.1 Focus group

The focus group survey aims to understand how users socialize and their preferences for socialization in an MR context. In addition to collecting user information (e.g., age, hobbies, education), we will also ask questions along the lines of:

- How often do you want to interact with someone new in public?
- How difficult is it to meet new people in public?
- Do you prefer to meet new people in-person or via instant messaging?
- Do you feel comfortable sharing your imprecise location with strangers?
- Would you selectively share specific personal information with strangers?

The collected user information from the focus group survey will not only provide context for user socialization preferences, but will also serve as user data for the generated scenarios of the user study (described in section 3.2). In addition, the participants from the focus group will be the same individuals that participate in the user study.

3.2 User study

The data collected from this user study enables the prediction of three output classes – “Want to meet (in person)”, “Want to chat (via instant messaging)”, and “Reject”. These classes represent the different choices that users can make when they receive a recommendation. The output label has been simplified to these three categories, reflecting insights from our focus group discussions. Preliminary findings indicate significant differences in user preferences for in-person and online interactions, supporting the rationale to maintain these categories as distinct.

We assume that future technology will allow users to set their privacy preferences specifically on a MR device, such that their profiles are only publicly visible if they so choose. Consider the sample scenario below:

“You see user123 sitting at a bar and notice that they have glanced at you a couple of times. They go to the same university as you. Do you:”

A. Want to meet (in person)?
B. Want to chat (via instant messaging)?
C. Reject.

In the prior scenario, the study participant is asked to decide whether or not they want to interact with user123. The underlying assumption is that user123 has chosen to publicly share their profile, including which university they attend, with other users within some local proximity. Scenarios measuring social interactions in mixed reality assume the consent of both parties involved. These scenarios will be presented to users in our study to measure various data points about the underlying intricacies of the future of social interaction.

The collected data will include MR features (e.g., gaze, body language, fashion), user features (e.g., age, education, hobbies), and right-time features (e.g., location, time, weather), described through our scenarios. For instance, in the scenario described above, glances serve as a proxy for gaze, which would be recorded by an MR device via heatmaps.

4 EVALUATION

[TODO]

We will create four models, trained on four different subsets of the features:

- User features only.
- User features and MR features only.
- User features and right-time features only.
- User features, MR features, and right-time features.

Two of the four models we produce which are trained excluding MR features are similar to existing recommendation systems, whereas the other two models which include MR features are our novel recommendation models. Performance metrics of these four model types will be evaluated, comparing the models that include/exclude MR features and the models that include/exclude right-time features.

5 RESULTS

[TODO]

6 DISCUSSION

[TODO]

6.1 Demo expectations

The elevator pitch will describe the major impact of this research by incorporating elements from the abstract. In addition, the elevator pitch will describe mixed reality scenarios to demonstrate future changes in society driven by advancements in MR technology. We will showcase the contributions, research questions, and background sections of this paper to introduce the topic of social interactions in mixed reality. The focus group results will be used to motivate the necessity of this research and justify design decisions of the user study. We will discuss the performance of the provided recommendation models on data collected from the user study, and evaluate the impact of MR and right-time features in catalyzing novel social interactions.

RELATED WORK

[TODO]

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DELIVERY

Our GitHub repository contains the complete datasets from the user surveys, python scripts for data preparation, and the trained machine learning recommendation models used to trigger social interactions in mixed reality.
https://github.com/TODO

REFERENCES

[1] Harris E. Surgeon General Offers Strategy to Tackle Epidemic of Loneliness. JAMA. 2023; 329 (21):1818. doi:10.1001/jama.2023.8662
[2] Srivastava, Sparsh. "Quantifying Social Presence in Mixed Reality: A Contemporary Review of Techniques and Innovations." (2024).