MixAR: An Immersive AR Game Designed to Aid Co-located Socialisation

Ambika Sharma
University College London
UCL Interaction Centre
WC1E 6BT, UK
ambika.sharma.21@ucl.ac.uk

Dhwani Khara
University College London
UCL Interaction Centre
WC1E 6BT, UK
dhwani.khara.21@ucl.ac.uk

Divya Dinesh Kavungal
University College London
UCL Interaction Centre
WC1E 6BT, UK
divya.kavungal.21@ucl.ac.uk

Oussama Nefzi
University College London
UCL Interaction Centre
WC1E 6BT, UK
oussama.nefzi.21@ucl.ac.uk

Vedant Gurav
University College London
UCL Interaction Centre
WC1E 6BT, UK
vedant.gurav.21@ucl.ac.uk

Theo Gittens
University College London
UCL Interaction Centre
WC1E 6BT, UK
theodore.gittens.21@ucl.ac.uk

Word Count: 4686

Abstract
With the increasing ubiquity of digital devices, there is growing concern that we retreat to our own 'digital bubbles' in co-located situations, rather than interacting with the people around us. We present MixAR: a customizable pre-mixer game that uses AR to enhance, rather than hinder co-located interaction. Using qualitative user research, we established two key themes: Firstly, that people find it difficult to approach new groups. Secondly, that common interests aid the development of initial conversations into meaningful interactions. MixAR applies AR visuals to link people together, encouraging the first step of physically approaching another person. It then employs gamification to foster interaction based on common interests. Presented in this study is an example of an iterative design process in which user testing and prototypes are used to offer a solution to how AR can be used to aid co-located socialisation.

Author Keywords
Augmented Reality; Co-located Socialisation; AR Games; Social AR.

Introduction

Growing concern for our ability to socialise appears to be inextricably linked to the rise of digital technology in society. The media provides daily updates on the state of our ability to have meaningful interactions with each other, and the message is overwhelmingly negative. Headlines such as "Shock! Horror! Do you know how much time you spend on your phone" (The Guardian, 2021) and "Have Smartphones Destroyed a Generation?" (The Atlantic, 2017) bolster the equally foreboding opinions of popular social scientists that technology actively dislocates us from one another (Turkle, 2011).

The impact of mobile phone usage on interaction in co-located environments has been examined extensively in human-computer interaction research. Here, empirical studies have shown that the presence of mobile phones results in the breakdown of social interaction cues such as smiling or offering help to proximate others (Banjo et al, 2008). Digital devices have been shown to fragment our attention (Oulasvirta, 2005), resulting in a reduction of the quality of face-to-face interaction when measured qualitatively in terms of satisfaction levels of time spent with friends (Rotondi et al, 2017).

Less attention is given to how technology might improve co-located interaction. Given that we frequently use our phones to avoid awkward situations it becomes useful to imagine technology as a tool to aid our social anxiety rather than an inhibitor. A study by Beasley et al (2016) showed that college students use smartphones to navigate their social lives by alleviating social discomfort. Most interviewed students said they used their phones to escape awkward social situations by communicating with people they feel more comfortable with. As digital devices are unlikely to disappear, it is necessary to explore ways in which the anxiety surrounding interaction with other people can be alleviated by technology.

This report follows the SNAP Creative Challenge: The Future of Co-located Social AR, an open challenge to design technology that promotes and enhances in-person interactions rather than inhibits them. Through a user-centered design process, we propose MixAR: an AR gaming experience designed to be played as a precursor to organized events with the aim of fostering interaction amongst co-located people.

AR and Socialization

While there is an abundance of research on the collaborative use of AR, the focus has been in specific settings such as in medical and technical training. There is relatively little research on the effects of AR on face-to face socialization (Hirskyj-Douglas et al, 2020; Alessandro Soro et al 2020). This is surprising given the possibilities made available by the technology.

An attractive aspect of using AR to aid interaction is that it can facilitate a shared experience. Research into the effects of Pokémon Go! has shown that the presence of AR objects has resulted in increased interaction amongst players (Paasovaara et al, 2017). Participants can see and interact with the same visuals much in the same way that sharing physical objects can improve storytelling. Inspired by the effectiveness of Pokémon Go! as an example of social AR, we decided to make use of visual objects in MixAR, which can be collaboratively manipulated by the users to create a shared experience.

In the research previously mentioned by Beasley et al, they found that their participants preferred face to face communication due to the ability to convey messages with greater accuracy. Furthermore, participants expressed annoyance when people frequently check

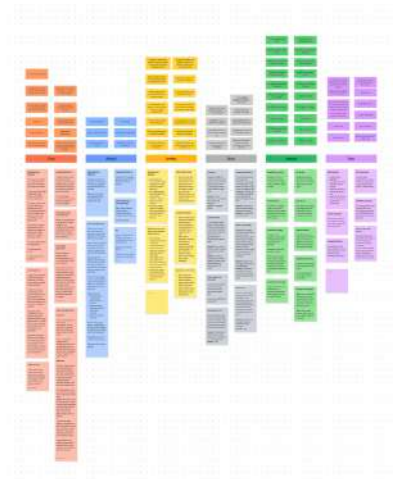

Figure 1: Affinity Map

Keywords:

1. Common Interests
2. Gamification
3. Making Friends
4. Augmented Reality
5. Meet new people

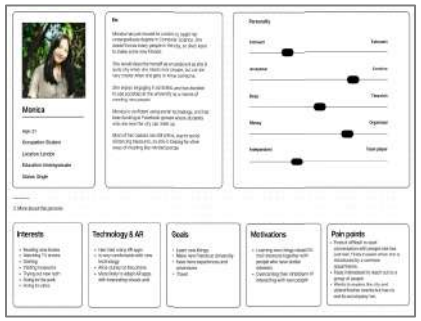

Figure 2: Persona

their phones during interpersonal interactions. This supports another fundamental advantage of using AR to aid socialization over other technologies, as AR glasses negate the need for the user to be switching their attention from a person's face to the screen of their device. For this reason, we decided to design MixAR with the Snap Spectacles. These specific glasses suited the socialization aspect of our design brief as their relatively small size in comparison to other headsets meant that facial expressions were clearly visible during interaction.

Research and Establishing Requirements

We began our research by discussing the difficulties we each encounter when socialising in person. We discovered a shared commonality in that we had all recently moved to London and had spent a significant amount of time meeting new people to establish new friendships. One team member produced an interesting anecdote, sharing that they had considered writing prompts on their hand to aid conversation with new classmates. Upon reviewing literature on the use of text prompts to foster social communication, we found that this approach was not uncommon and does, indeed, improve social engagement (Theimann and Goldstein, 2001). From these preliminary conversations, we decided that our research would be based on initial interactions and how these blossoms into meaningful relationships.

Interviews and Analysis

We conducted semi-structured interviews with ten participants who regularly met new people due of their lifestyles and occupation. These included eight students, a sales assistant, and a civil servant in the department for trade.

Our interview questions were grouped into three subcategories. The first set focused on initial interactions. Here we presented our participants with scenarios with the aim of finding out how people take the first step when meeting new people. For example:

"Imagine your friend has invited you to a party with people you have not met before. You arrive, but at the last minute, your friend is forced to cancel. You see a group of people who look friendly, how would you try to interact with them?"

The use of vignettes in qualitative research has been shown to provide rich detail more rapidly and effectively than with semi-structured interview questions alone (Sampson & Johannessen, 2020). Indeed, we found our participants engaged particularly well with our scenarios, possibly because of their immersive, playful nature. There was concern that these vignettes might be too prescriptive, prompting our participants to give pre-determined answers. However, we found that our participants enjoyed picking apart the scenarios, and in doing so, offered particularly rich data on initial interactions which went beyond the confines of the vignette.

For example, one participant gave this response to the party scenario above:

"If my friend cancels at the last minute, I'm getting out of there. I find it so difficult to start chatting to people I don't know. If I'm walking to the door and someone's t-shirt catches my eye, I *might* start talking to them…but otherwise no, I'm out of there."

Within this response we see the interviewee effectively shutting down the scenario. Their friend has not attended so they are leaving the party. However, what follows is a fascinating insight into their cognitive process. The interviewee imagines walking to the door to leave, and on the way, something catches their eye;

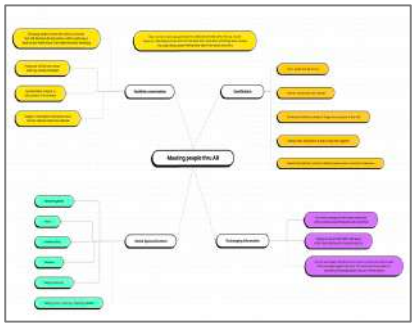

Figure 3: Idea Map

Figure 4: Mood Board

a familiar band t-shirt. From this response alone we have learnt that the interviewee is averse to social situations where they do not have a familiar friend alongside them. But secondly, the presence of a common interest prompt, i.e. the band t-shirt, has made them consider approaching an unfamiliar person.

The second set of questions were based around the nuances of conversation. Here we asked questions such as "what do you talk about when you first meet someone?" and "what do you think leads to awkward silences?"

One theme apparent here was that our interviewees would quickly try to discover common interest with a person they had just met, and if they were unable to the conversation became difficult. However, there also appeared to be a saturation point, where once a topic had been exhausted, the conversation failed. This is evident in the interviewee response below:

"Sometimes you can talk and talk about a subject then suddenly you've said everything about that and there's just silence."

This would go on to influence the inclusion of gamification in our idea, as it provides a means for guiding our users through an experience after the initial interaction, when conversation on a subject might have reached saturation point.

The final subset of questions focused on AR. Here we asked our interviewees about their previous experiences with AR so that when it came to designing MixAR, we could avoid the aspects of the technology which our users might find undesirable in a social context. Two interesting responses were:

"I have only used AR glasses once, and that was in a shop. It was just a simple game where you had to whack things which appeared in front of you. If it hadn't been on AR it would probably have been really boring, but it was fun to see the objects floating around the shop."

Within this response it is apparent that the augmentation of a user's environment can make a simple game more exciting. Research has shown that AR has the potential to introduce exciting concepts to unexciting situations thereby transforming real-world environments into 'playgrounds' (Laato et al, 2021). If we relate this back to the interviewee's response, we see how a mundane game has become more exciting after being physically transplanted into their environment.

However, another interviewee stated:

"When I first used AR glasses I found the visuals distracting, and I found it hard to concentrate on what was going on around me in the real world."

This presents an important issue for the design of an AR which aims to improve socialisation. It is crucial that the augmented aspect of our design does not distract the user from interacting with other people.

Thematic Analysis

The interviews were analysed inductively using a bottom-up qualitative methodology. Responses were codified and organised into an affinity map (**Figure 1**). From this analysis the following key themes emerged:

- Common interests help to break the ice in initial interactions.
- People find it easier to talk to new people if they are introduced by a shared acquaintance.

Figure 5: The Sims

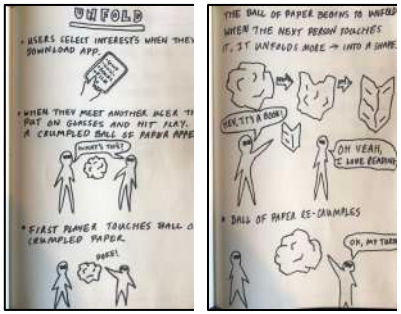

Figure 6: Idea 1

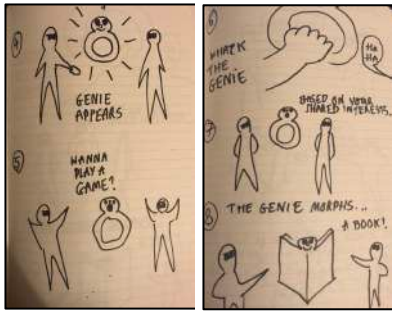

Figure 7: Idea 2

- Awkward conversation and small talk prevent interaction from evolving into a friendship.
- Augmenting environments can make them more engaging.
- AR should not distract from socialsation.

Creating a Persona

Using these themes, along with demographic information, we created a persona (**Figure 2**) to aid our design process. Monica is a 21-year-old student who has just moved to London. She is confident using technology and has used AR before, although she finds it awkward to use on a phone screen. She can be considered an ambivert, meaning that she has a mix of extroverted and introverted features to her personality. She is motivated to make new friends with common interests and overcome her inhibitions of meeting new people. She likes to explore the city and is interested in joining clubs and societies. Her pain points include difficulty in starting conversations with people she has just met and feeling intimidated by larger groups of people.

Defining a Context

In adherence to the SNAP Creative Challenge brief, our AR app should support engagement between co-located users. However, the specific context was influenced by our persona. We used idea mapping (**Figure 3**) to consider which environments our AR could aid Monica in. She enjoys exploring the city and joining groups of people with similar interests. We, therefore, decided that our app could be used in organised meetups with a predetermined theme (e.g., university society meetings, sports team socials and fan club meetups).

User Requirements

Based on our research, we decided that our product should:

- Facilitate initial interactions with people who have never met.
- Use prompts based on common interests.
- Use gamification to relieve awkwardness.
- Be customisable to fit different areas of interest.
- Make use of the creative possibilities of AR, but this should distract from the goal of aiding socialisation.

Pre-design Considerations

AR Glasses

One issue with using AR technology on a phone is that it creates a barrier between the two people interacting, as they have to switch their focus between their phone screen and the other person. The benefit of using AR glasses is that the users can see each other clearly, along with augmented visuals. Furthermore, the spectacles free up the user's hands, allowing for creative designs which utilise physical interaction with AR. We therefore decided that we would design our app for AR glasses. We were lucky to be provided with a pair of Spectacles by Snap. These suited the socialisation aspect of our design brief, as their relatively small size in comparison to other AR glasses meant that facial expressions were clearly visible.

Issues with Sharing Personal Information

Early on in our design discussions we considered using written prompts based on personal information to aid conversation. The concept was very much based around social media profiles, where written information could be shown in AR so that two people could see what they shared in common. However, this presented issues with data privacy. We held follow up interviews with two of our original participants which confirmed our concerns. Interestingly, the responses we received highlighted another issue within socialisation: that

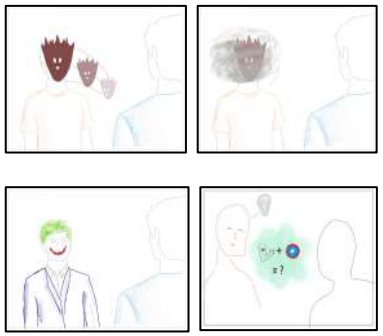

Figure 8: Idea 3

Figure 10: Modular Storyboard

sharing too much information too soon could prevent interaction. Two responses related to this were:

- "If I saw someone was interested in something I didn't like, like Rugby, I would probably avoid them, which could prevent a potential friendship."
- "I don't think I would like people to see that much information about me straight away. I enjoy the process of finding out about someone."

In light of this we decided to focus our designs around visual prompts rather than written information. Furthermore, we decided that our idea should facilitate the process of interaction, rather than providing personal information upfront.

Ideation Phase

We started our design process with a mood board (**Figure 4**) exercise to gather inspiration. We found stills from avatar-based games to be useful for imagining how the heads-up visuals might look. Screenshots from The Sims gave us inspiration for how visuals might appear around a person's body (**Figure 5**).

Sketching

A brainstorming and rapid sketching activity produced a number of ideas for how we might use AR to meet our user requirements. We narrowed these down to three concepts for which we produced lo-fi user flow sketches (**Figures 6,7,8**).

Idea 1

In our first idea, two co-located people play a guessing game in which a virtual ball of paper morphs into shapes based on the player's shared interests. The ball of paper unfolds in stages to reveal a series of clues, encouraging the players to work together.

Idea 2

The idea for our second sketch came from responses in our interviews stating that initial interactions are easier when a third person provides an introduction. We came up with a character which appears in AR and acts as a mediator between the participants, offering visual prompts to encourage conversation.

Idea 3

Our third idea was an adaptation of the well-known guessing game where the players are required to guess the fictional or famous character written on their foreheads. For this idea we used AR to alter the person's face to look like the character which had been chosen for them by the other player.

Design Analysis

A Harris Profile (**Figure 9**) was used to analyse these three ideas. The purpose of this analysis matrix was not to decide which idea was best overall but to better visualise which aspects of each idea had potential in light of our user requirements.

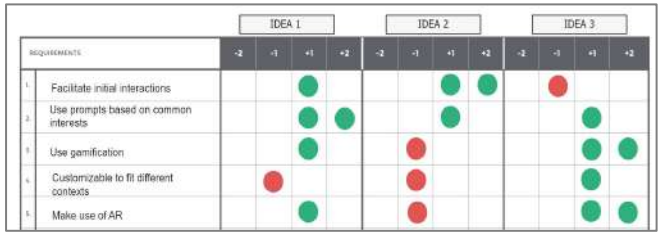

Figure 9: Harris Profile

Findings

Idea 1 made good use of prompts based on common interests and gamification. However, it was not easily customisable to fit different contexts. Idea 2 was effective for facilitating initial interactions, as the character provided an introduction- however, it lacked in gamification. Finally, Idea 3 made excellent use of

Figure 13: User's Wrist

gamification and the creative aspect of AR, but it did little to facilitate initial interactions.

Developing our designs

We had now identified which the aspects of our three initial designs fit our user requirements, and which didn't. The next task was to develop the positive elements of each design into a complete user experience. Here, we used a modular storyboard to finalise our design. The benefit of using a modular storyboard (**Figure 10**) is that it is a democratic process where all ideas are given space for consideration.

Two developments emerged from this exercise. We were attracted to the AR character in idea 2. If we imagined our persona Monica at a society meetup, we could see how this might help her socialise, given that she finds it easier to approach new people when she is introduced. However, the AR character presented two issues. Firstly, it might become a distraction when we are striving to promote interaction between the two users. Secondly, it would be difficult to customise the character for different meetups. Therefore, we came up with the concept of a 'beam of light' style link (**Figure 11**) which appears between two players, encouraging them to walk together and begin interacting.

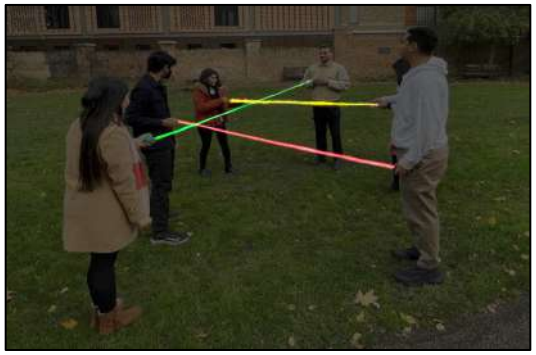

Figure 11: Beam of Light Link

The second development came with the gamification aspect of our app. Ideas one and three were both based around a guessing game related to the user's personal interests. This was developed into a game where the players had to guess a prompt from a set of emojis. These prompts are based on the theme of the meetup (**Figure 12**).

Figure 12: Emoji Prompts

Prototyping and Final Iteration

We gathered feedback on these two developments by creating prototypes which were used as artefacts in user interviews. To illustrate the 'beam of light' link we acted out a series of user flows using different coloured rope as physical prototypes. We took photos of these steps and added visual effects to communicate how the linking aspect progressed into the emoji guessing game (**Figures 11&12**). Our interview subjects gave positive feedback on these prototypes. Two pertinent responses are discussed below:

1. "I like how the link really encourages you to actually walk up to another person, I feel like I could do with that kind of decisive action!"

We related this response back to our persona. The visual link presents an effective solution to how we

Figure 14: Ball of Random Emojis

Figure 15: Emoji Guessing Game

Figure 16: One Pair v/s another

Figure 17: Avengers-themed items

could encourage two previously unacquainted people to approach each other and begin an interaction.

2. "I would like to be able to move objects in the guessing game."

We discussed ways of making better use of the AR technology through the physical manipulation of objects. One such iteration, came with attaching the answers to the guessing game on the user's wrist (**Figure 13**). They are then required to drag the correct answer onto another grid. We discussed how this aspect could be optimised to encourage collaboration between the players. A solution was to give each player one half of the answer in the selection on their wrists. The players must therefore work together if they are to make the correct selection.

Our Product- MixAR

MixAR is an app which uses AR technology to aid socialisation amongst groups of co-located people. The experience uses gamification to initiate first interactions amongst people who have not previously met and is customisable to fit multiple contexts. To illustrate our idea, we will use the example of an Avengers fan meetup.

- The user arrives at the meetup location and finds a group of people they have not previously met. The organiser of the event suggests that the group use MixAR to become acquainted.

- Each member of the group opens MixAR on their phones and either enters the game pin or scans a QR code provided by the organiser. At this stage they can enter their names. They then take out their AR glasses and select join game.

- A beam of light appears in AR, linking the user to another person in the group. Once they approach each other, the beam morphs into a ball of randomly shuffling emojis (**Figure 14**). A sequence of emojis appear from the ball and the players must interpret their meaning. They then have to match this to a grid of answers attached to their hands in AR. Each player has one half of the answer on their grid, which means that they must work together to complete the round.

- If the players select the correct answer they are teamed up, and they will be linked up to challenge other pairs in the same emoji guessing game (**Figure 15**). However, if they are unsuccessful, they will be split apart and linked with another single player to begin the process again.

- Each time a pair beats another pair (**Figure 16**), the losing team is split up. The first team to win three consecutive games is the overall winner. The result is that by the end of the tournament, the majority of players have been linked, split-up and re-matched with each person at the meeting.

Additional Features

Players are awarded matching items when they are successful in the emoji guessing game. These items are customisable to fit the context of the meeting. For example, in an Avengers-themed meetup two players win matching Captain America shields (**Figure 17**). Research on socialisation in Pokémon Go! Has found that the collection and sharing of AR items (in this case Pokémon) led to conversations amongst players who might not previously have interacted (Paasovaara et al, 2017). By awarding our players matching items we are

Figure 18: Wireframes

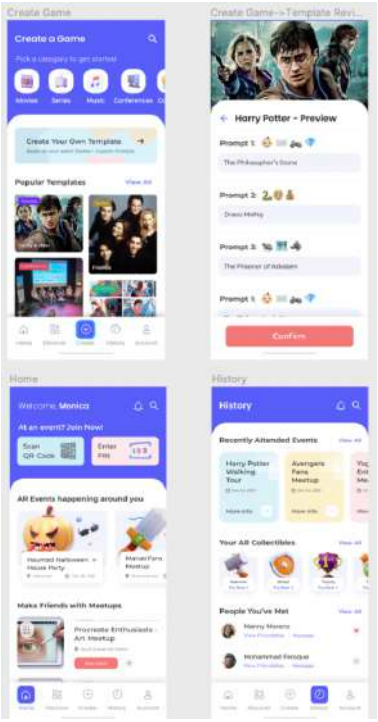

Figure 19: Visual Designs

fostering a sense of belonging to a team, as well as offering playful cues for conversation.

Wireframes and Visual Designs

With clear goals and user needs in mind, it was necessary to define an architecture of how the information will flow seamlessly from the app to the AR experience and back. Thus, we created a quick sketch of the information architecture of the app which helped us in identifying all the screens to be designed and the kind of information they will display.

To be able to lay out all that information into the interface of our product, it was necessary to create wireframes. We started with rough pen and paper sketches to quickly iterate on the structure of the screens. Next, we digitised them using Figma and sorted the visual hierarchies of various elements.

After consolidating the flows and wireframes (**Figure 18**) for our interface, we began thinking about the visual appearance of our app. Here, we decided the identity of the product in terms of colours, typography, grids, illustrations, images, etc. We chose bright visual designs to mimic the playful nature of the game and its focus on socialisation. We laid out the designs and styling of various components to define the experience as well as maintain consistency throughout the app. Once all the screens were designed, we created a high-fidelity clickable prototype of the app (**Figure 19**). The final prototype of the app can be viewed here: https://bit.ly/3GMx33t

Designing for Accessibility

Throughout our project we were mindful of design features which could potentially make our AR app inaccessible to users with disabilities. Augmented Reality is usually imagined as an experience which utilises sensory information on a visual, aural and physical level. However, for disabled users it is often used in an either/or format based on their type of disability (Richards-Hill, 2018). We were inspired by studies in AR exploring interfaces which facilitate the personalisation of software and hardware to improve accessibility for disabled users (Biswas et al, 2021).

In relation to our project, we acknowledged that the 'linking-up' aspect of our app required the users to walk towards each other, presenting issues for those with reduced mobility. We therefore created a feature where the interface could adapt to this situation. Within the wireframe we added the option of personalising mobility settings which can be seen in (**Figure 20**). The user selects mobility settings and is presented with the option of either playing with less walking, or with no walking at all. The interface then uses locational information to either link the user to nearest players so that they don't have to take too many steps, or it will factor in other players coming to them so that they are not required to walk.

Discussion

We believe that MixAR presents an effective solution to aiding socialisation amongst co-located people. Possibly the most successful aspect of our design is the ‘beam of light’ style link, as it provides an innovative solution to how users can be encouraged to approach each other. From our own experiences we have found it easier to interact with people when the initial step of approaching a person is curated by either another person or by technology. An example of this can be seen with the breakout room mechanics in Zoom, where the software randomly pairs members of a group and puts them together in their own private meetings. The linking system in MixAR uses similar mechanics whilst utilising the creative possibilities available in AR through engaging visuals and locational data.

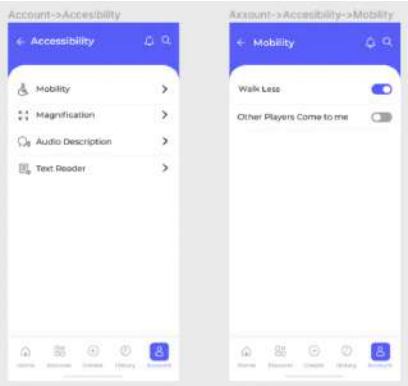

Figure 20: Accessibility Screens

The greatest challenges we faced came with designing a product for a technology which is still very much in its developmental stages. The first head-mounted display for viewing AR was developed by Ivan Sutherland in 1968 (Van Krevelen, 2007). Since then, efforts to place this technology in the mainstream have been largely unsuccessful, as can be seen with Google's now defunct Google Glass headsets. This presented two issues within our project. Firstly, it was difficult establish reliable user opinion of AR technology in our initial research, given that the vast majority of people do not own an AR headset. Secondly, our limited access to the technology, (partly due to their extreme cost) had implications for our design process as we were unfamiliar with the capabilities of the technology. We overcame the issue of being unable to conduct user testing with actual AR glasses by creating POV style photographs (**Figure 11**) which were used as artefacts in interviews. While this did allow for some useful feedback leading to design iterations, it would have been more effective had we been able to test early prototypes of MixAR on a headset.

The next step for MixAR would be to create a working prototype which could be tested on AR headsets. From here, it would be possible to conduct extensive user testing to explore whether the mechanics of the game work as intended. It would be particularly interesting to conduct qualitative research with users at a real event. The effectiveness of the app as a tool for aiding socialisation could be measured by interviewing users to determine whether MixAR had helped them interact with other players after the game had finished and the event was underway.

Conclusion

This paper has illustrated the research and design of MixAR: an AR game which aims to encourage socialisation amongst groups of co-located people. We followed an iterative design process, where user research and testing was used to shape our final product. MixAR employs three key elements: firstly, it links players together with visuals in AR, encouraging initial interaction. Secondly, it uses a guessing game where players are required to work together to solve puzzles. Finally, the 'splitting up' mechanics of the game are designed so that each player interacts with the majority of the other people at the event. The contribution of this paper is show that through a user-centred design process, AR can be utilised to help us burst free from our digital bubbles in co-located spaces.

Acknowledgements

We would like to thank our mentor Katherine Wang and Leon Reicherts for their advice and feedback. We would also like to thank Professors Nicolai Marquardt, Yvonne Rogers and Catherine Holloway for their inspiring lectures at UCL.

References

Banjo, O., Hu, Y., & Sundar, S. (2008). *Cell Phone Usage and Social Interaction with Proximate Others: Ringing in a Theoretical Model. The Open Communication Journal*, 2(1), 127-135. https://doi.org/10.2174/1874916x00802010127

Biswas, P., Orero, P., Swaminathan, M., Krishnaswamy, K., and Robinson, P. (2021). *Adaptive Accessible AR/VR Systems.* Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, Article 92, 1–7. DOI: https://doi.org/10.1145/3411763.3441324

Hirskyj-Douglas, I., Kantosalo, A., Monroy-Hernández, A., Zimmermann, J., Nebeling, M., and Gonzalez-Franco, M. (2020). *Social AR: Reimagining and Interrogating the Role of Augmented Reality in Face*

to Face Social Interactions. Conference Companion Publication of the 2020 on Computer Supported Cooperative Work and Social Computing. Association for Computing Machinery, New York, NY, USA, 457–465. DOI: https://doi.org/10.1145/3406865.3418585

Laato, S., Rauti, S., Islam, A., & Sutinen, E. (2021). *Why playing augmented reality games feels meaningful to players? The roles of imagination and social experience.* Computers In Human Behavior, 121, 106816.

Matei, A., (2021). *Shock! Horror! Do you know how much time you spend on your phone?* The Guardian,https://www.theguardian.com/lifeandstyle/2019/aug/21/cellphone-screen-time-average-habits

Oulasvirta, A. (2005). *The fragmentation of attention in mobile interaction, and what to do with it. Interactions,* 12(6), 16-18. https://doi.org/10.1145/1096554.1096555

Richards-Hill, R. (2018). *How Augmented Reality Has Changed Life For the Disabled*. ARPost.co. [https://arpost.co/2018/02/21/augmented-reality-changed-life-disabled/] https://arpost.co/2018/02/21/augmented-reality-changed-life-disabled/

Rotondi, V., Stanca, L., Tomasuolo, M., (2017).*Connecting alone: Smartphone use, quality of social interactions and well-being*, Journal of Economic Psychology, Volume 63

Sampson, H., & Johannessen, I. A. (2020). *Turning on the tap: the benefits of using 'real-life' vignettes in qualitative research interviews.* Qualitative Research, 20(1), 56–72. https://doi.org/10.1177/1468794118816618

Soro, A., Brown, R., Wyeth, P., & Turkay, S. (2020). *Towards a Smart and Socialised Augmented Reality. Extended Abstracts Of The 2020 CHI Conference On Human Factors In Computing Systems.*

SusIPaasovaara, I., Jarusriboonchai, P., and Olsson T. (2017). *Understanding collocated social interaction between Pokémon GO players.* In Proceedings of the 16th International Conference on Mobile and Ubiquitous Multimedia (MUM '17). Association for Computing Machinery, New York, NY, USA, 151–163. https://doi.org/10.1145/3152832.3152854

Thiemann, K. S., & Goldstein, H. (2001*). Social stories, written text cues, and video feedback: Effects on social communication of children with autism*. Journal of Applied Behavior Analysis, 34(4), 425-446.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. Basic Books.

Twenge, J. M. (2017). *Have Smartphones Destroyed a Generation?* The Atlantic, https://www.theatlantic.com/magazine/archive/2017/09/has-the-smartphone-destroyed-a-generation/534198/

Van Krevelen, R. (2007). *Augmented Reality:Technologies, Applications, and Limitations.* 10.13140/RG.2.1.1874.7929.

Appendix

Visual Designs