Unus Terra: Developing a Serious Game to Foster Social Distancing During the Pandemic

Sami Pohjolainen, Leena Arhippainen, Paula Alavesa
University of Oulu
Oulu, Finland
sami.pohjolainen, leena.arhippainen, paula.alavesa@oulu.fi

Juho Mattila, Jarkko Tuovinen
Ikune Labs
Finland
juho.mattila, jarkko.tuovinen@ikunelabs.com

Abstract—This paper introduces a serious mobile game to foster social distancing during the COVID-19 pandemic. The purpose of the game is to reach younger audiences and engage them in social distancing practices. Younger people often have a lower compliance towards these types of practices, so we see a casual game that also aims to be fun as a solution to improve their compliance over time. We report our findings from the study that was conducted to assess an early access version of the game, where the game was tested remotely by 15 players.

I. INTRODUCTION

The COVID-19 pandemic has caused major social disruption in society. The lockdowns have increased the consumption of gaming and other entertainment media significantly. [1][2][3][4] Organizations, such as WHO and industry leaders in interactive entertainment have actively promoted gaming as a positive thing to do during the pandemic with initiatives such as PlayApartTogether [5]. These initiatives promote the importance of social distancing. It has been shown that asymptomatic carriers play a critical role in the spread of the virus, which furthers the need to promote social distancing and other safety guidelines [6].

In the past, several games have been made that deal with pandemics. There is a boardgame from called Pandemic from 2008, a card game called Sauchenquartet from 2018, and the Plague Inc. video game from 2012 [7][8][9]. These games provide a mixture of entertainment and education, as each includes knowledge about pandemics and other similar disasters. During the COVID-19 pandemic, several news articles pointed out that young people are unknowingly spreading the virus. It has been shown that asymptomatic carriers pose a significant risk when it comes to spreading the virus, while the rules around social distancing are being neglected. [10][11] The pandemic has led governmental organizations and others to fund research and development of different tools to combat the outbreak. These include tools that help to increase compliance aspect of policies.

This paper introduces a casual 2D action arcade game, called Unus Terra (UT). It is developed for mobile platforms and includes more serious elements with a purpose that goes beyond mere entertainment [12][13]. The game aims to remind and foster social distancing among its players. After a brief background, we present the game development aspects of this study and our findings from remote user evaluation. The paper ends with discussion and our conclusions.

II. BACKGROUND

The original idea in our development process was to use a serious game approach [14][15]. The aim was to reach the younger audiences by reminding and engaging them in social distancing practices. This was done through specific gameplay elements that encourage players to play the game in a safe location to get most benefits out of it. Essentially, serious games can be defined in various ways but can be considered as a subgroup of games developed for more than just entertainment purpose [16].

UT has similarities to other location-based games. It uses a GPS location of the user to affect the gameplay. While most of the location-based games persuade players to go out from their homes, UT aims to achieve the opposite. During the current pandemic, many location-based games made changes to their game mechanics and advised people to stay home. [17] There are some COVID-19 related browser games like "Can You Save The World?" [18] but not that many COVID-19 related mobile games. One reason might be that it is difficult to publish COVID-19 related applications in major distributor platforms, such as Google Play or Apple Store.

One 2D survival-based game called SurviveCovid-19 was proposed by [19] to educate people about safety precautions to be taken for COVID-19 outside their homes. It has some similarities to UT in that it promotes social distancing and it is a 2D mobile game. The main difference between SurviveCovid-19 and UT is that UT has an augmented reality functionality that affects the game mechanics. These mechanics include GPS location of the player and the contagion data from real-life sources.

III. GAME DEVELOPMENT

This section presents the game design and implementation. An early version of the game and heuristic evaluation is introduced in [20].

A. Hackathon

The initial concept for the game won a hackathon competition that was held in Spring 2020. The theme of the hackathon was to develop data-driven solutions for epidemic and pandemic lifecycle management. The initial concept and an early prototype of UT were made during the event. The game was selected as the winner of 145 projects. After the win, the

game secured initial funding and the consortium continued the game development [13].

Agile method was used for the game development [21]. Further concepting of the game started in May 2020 and the first prototype shortly after that. The development of the MVP (Minimum Viable Product) version started in July 2020 and continued until the end of 2020. In the Spring of 2021, the game was evaluated and developed further to polish the design and gameplay aspects.

B. Design

The game takes the player into an engaging story where the role of the player is to help a group of undercover scientists to discover new pandemic threats impacting the world. The task is to try and prevent those threats from spreading. The main activity in the game (Fig. 1) involves moving around the world map and fighting against viruses and collecting genetic samples by defeating them. The idea is to collect enough genetic samples to advance research, find new virus strains, and make progress in the Research Tree that also works as the progression indicator for the player. Advancing in the Research Tree allows player to gain new playable avatars (Antigens) with unique features (Fig. 2), find new enemy virus strains, and unlock many different types of in-game items.

Fig. 1. The main gameplay activity in the early version of the game.

1) Safe Zone

The passive gameplay revolves around *social distancing*. The *Safe Zone Beacon* (SZB) can be set by the player in a place of their choice, usually at their home address. In essence, it acts as a geo-fenced area where the game is easier to play. The player can maximize their progression while playing the game in this location. The further away the player is from their SZB, the harder the game will get: Distance will also impact the passive fewer *Energy Points* regeneration rates. Selecting a battle from the world map requires *Energy Points*, accumulating points faster allows the player to complete more fights per day and thus advance faster. The player can also move their SZB or

even purchase a new location, but these options are intentionally costly, and the operation to perform these activities is limited by time as well.

2) Unsafe Zone

Social distancing has a huge effect on the gameplay whether the game is played from a safer location or not. The game has three levels of safety that the practice of social distancing affects (Fig. 3). The game accumulates a set amount of *Energy Points* passively. The rate of accumulation depends on the safety level of the zone where the player is physically located. As these points are important for continuous gameplay, it is in the best interest of the player to accumulate them faster. The action part of the game is relatively easy in the Safe Zone, but levels are also passable in Unsafe Zone, but harder. Harder fights can be challenging and the player might have to use many expensive powerups to successfully complete them.

3) Danger Zone

The third and the hardest level of safety is Danger Zone. It is an area that is in a heavily populated area in the real world. The game is very hard to play in these locations and the *Energy Point* accumulation is the slowest of all three levels. The player might still be able to complete a fight in Danger Zone, but can as easily fail to make enough progress due to extra challenge.

Fig. 2. The A) map and B) Antigen character view in the game version tested with users

B. Implementation

The architecture [20] behind the game is based on a client-server paradigm and consists of the business layer, data layer, and presentation layer. The business layer contains all the application logic and communicates with external APIs. The data layer comprises data utilities such as storing user data. The presentation layer contains user interface components.

Fig. 3. Player's location in the A) Safe Zone and B) Unsafe Zone is indicated for instance, via different background colors.

The social distancing part of the game is implemented by using the GPS location of a player to evaluate the level of safety. User data is stored in a database located in a cloud service. The communication between the server and the game is done via a Representational State Transfer (REST) API.

The game itself was made by using the Unity 3D cross-platform game engine. Manual functional tests were executed by developers for each sprint during the development phase. At the end of each sprint, integration, smoke, and system tests were performed. The Early Access version of the game is available [22] and a demonstration video can be found from [23].

IV. USER STUDY

This section presents the qualitative user study conducted remotely with 15 players.

A. Test setup and questionnaire

In the recruitment letter we informed remote users about the scenario and gameplay. We also informed them about the aspect of social distancing to be transparent: "*Your task in the game is to help an underground society of scientists by defeating and collecting virus samples in matches. These samples are used to research new virus strains for bonuses. While the game is intended as a fun arcade game, it also hopes to encourage people to think about and practice social distancing during the pandemic.*"

Participants were asked to play the game three to four times over a few days. Each gameplay session should last at least 10-15 minutes. It was important to inform players to play the game over a few days, as it allows them to progress a little in the game and notice things such as the passive *Energy Point* generation. After having enough experience with the game, participants were asked to report their findings and experiences via the Google Forms questionnaire. Filling the questionnaire was estimated to take approximately 8-15 minutes. The test and questionnaire were open for two weeks (11.1 - 25.1.2021).

In the questionnaire, we had questions relating to informed consent, background and demographics, technology use, gaming habits and previous knowledge. In addition, we had pandemic-related questions, but also general game and gameplay specific questions.

B. Recruitment and participants

Participants were recruited by advertising the possibility to partake using email lists and direct recruitment from a single course of Information Processing Science at the University of Oulu. We got 15 players in total who wanted to test the game and answer to the survey. The age of participants varied from 20 to 46 years: The average age was 28. (Fig. 4) From all test users 80 percentage were males and 20 percentage females. We had a total of 13 Finnish players, and one Pakistani and one Italian.

The whole test was introduced and carried out remotely. The language used was English. Notably, 80 % of the participants were students (Fig. 5) and 13,3 % had high school and undergraduate education background, 60% college or lower university degree (Fig. 6). In addition, 26,7% of the players had higher university degree (Fig. 6). 46,7 % of respondents did not have any prior user interface or game development experience.
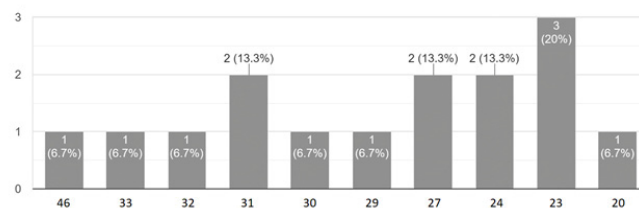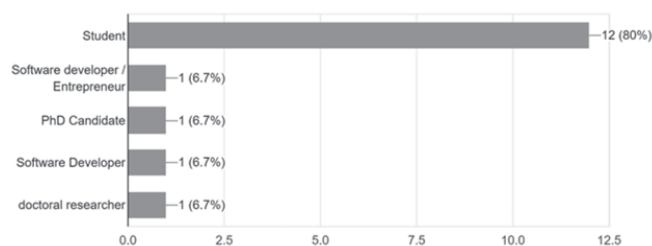

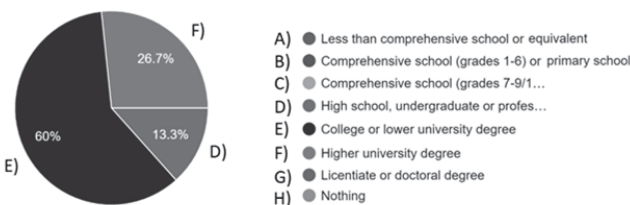Fig. 4. Players' age distribution (N=15)

Fig. 5. Players' profession

Fig. 6. Players' education

Because we were interested in possible influences of social distancing restrictions on players behavior, we also asked how many people were living in the same household with the respondent and found that majority lived alone or with one person (Fig. 7).
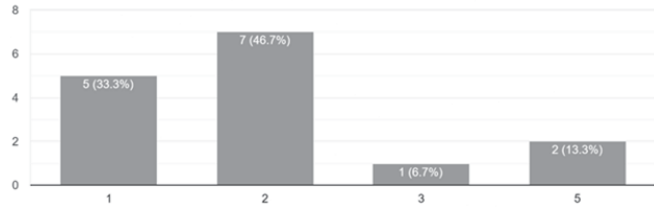

Fig. 7. Number of people living in player's household including respondent itself

C. Gameplay background

In the questionnaire, we asked several questions relating to gameplay background and habits. We asked questions like: Where do you best like to play mobile phone games? What type of mobile phone games do you like to play? How many hours do you play games on your mobile phone per week? Respondents best liked to play at home (60%), while traveling or transporting (26,7%) and at school (13,3%) (Fig. 8). The most liked genres of mobile phone games were arcade (60%), strategy (60%), adventure (53,3%), puzzle (53,3%), action (46,7%), casual (40%) games (Fig. 9).
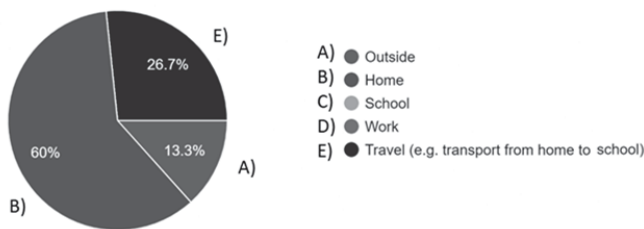

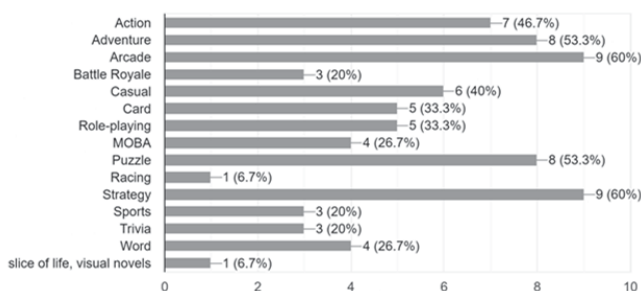Fig. 8. Location where respondent best like to play mobile phone games

Fig. 9. Type of mobile phone games respondents like to play

46,7% of the respondents estimated that they play mobile phone games under an hour per week. 40 % estimated playing mobile phone games one to five hours per week. The rest of the respondents estimated playing for five to 20 hours per week. In addition to mobile phone games, respondents played PD and console games.
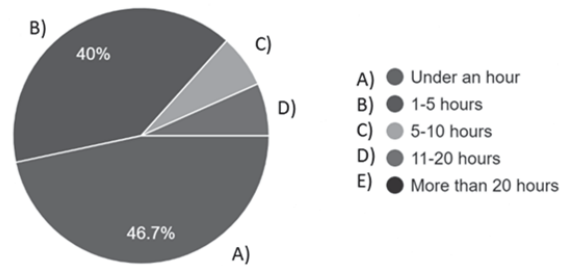

Fig. 10. Respondents' estimation of how many hours they play mobile phone games per week.

V. FINDINGS

This section presents findings based on the questionnaire responds.

A. Social distancing and behaviour change

In the questionnaire, we asked: "Have social distancing rules affected how you play games on your mobile phone?" If player answered 'yes', we asked to explain shortly how. Interestingly, 73,3% of the participants thought that social distancing rules have not affected their mobile phone playing habits, while 20% of respondents were not certain. Only 6,7% though that there has been change. When we asked to explain how social distancing rules have affected playing games on mobile phone, one participant commented: "*I'm focusing more on my surroundings and situational awareness, while trying to limit smart devices exposure to possible contaminants within environment*".

When asked "Have social distancing rules affected how you play games with your friends?" It was 60% of the participants that thought the rules have affected on how they play with friends, for instance, one participant commented that: "*We started playing online games with each other only after the social distancing*". Another participant commented: "*I happen to call them nowadays when playing. Before I almost never socialized when playing*".

In addition to mobile games, playing other types of games has decreased: "*Not sure if it's included but we play lots of board games. We've cut down gaming sessions a lot due to covid limitations, also we play with a small group of people that doesn't change. Before covid we played at the university board game club with lots of other people.*"

When asked a general question about consumption habits under the COVID-19 restrictions, 53,3% of the respondents thought that they now consume more entertainment (e.g. video games, social media, TV, movies, reading books) than before pandemic restrictions.

In addition to open questions, we had two statement questions: a) 'The game made me think about social distancing' and b) 'Playing this type of games makes me think more about my behavior during a pandemic'. Only 33,3% of the respondents agreed with the first statement and had started to think about social distancing. In contrast, 46,7% disagree

with the statement and 20% neither agree nor disagree. Relating to behavior statement, 33,4% agreed with it and 60% disagreed. These answers can indicate that the game did not fully achieve its goal of encouraging social distancing. However, our game was in early development phase and participants tested the game remotely by themselves during a relatively short period of time. Investigating behavior change would require longer term tests and follow up studies.

B. Player experiences

The issues respondents liked in the game were: real-life data and news, antigens and virus, the idea of the game, simple and quick to play, challenging enough, fun, background music, minimap's location and size, controls and visually aesthetic (Table I). One participant commented that it was nice how the music changes in the game, and the little characters were perceived as cute. Having a choice between two characters was liked. The aspects that respondents did not like related mainly to usability issues such as bugs, registration, long and un-interactive tutorial, a bit too simple gameplay and loading times. In this version of the game, the tutorial was added based on the earlier heuristic evaluation findings [20], but it was not implemented in an interactive manner or tested prior to these evaluations. Thus, it was perceived as difficult to use, as one player commented: "*Tutorial was way too long and not interactive, first time I played I was out of energy too soon*".

TABLE I. PLAYERS' EXPERIENCES OF THE UNUS TERRA GAME

Aspects players liked	Aspects players disliked
real-life data, real news	bugs
antigens and virus	registration
the idea of the game	long and un-interactive tutorial
simple and quick to play	The tutorial and the plasticity
challenging enough	a bit too simple
fun	loading time
background music	nothing
minimap's location and size	not enough depth/uninteresting
controls	UI responsiveness
visually aesthetic	graphics
readability	some designs,
topical theme	progression not meaningful

One participant compared test and real playing by commenting: "*Looong introduction - if not for game testing, would probably have quitted before even starting. There also was problem when giving location access to the game. I gave the access but had no location setting on from my phone, so the game just stopped working (would need a text explaining what to do if it doesn't load and gets stuck there before even starting). I happened to think of the way after a while, but all the users might not.*" This is an important comment and emphasize the nature of conducting remote gameplay testing. Players have to use their own phones and install the game by themselves following instructions. This often discount the fact that the players have different prior experiences, skills and phone models. Something typically goes wrong in the test situation, especially when testing early versions such as this. Even thought, a researcher is giving guidance and supporting the installation remotely, it may not be enough to ensure that the test goes smoothly and experience of playing the game is not affected.

This type of remote test setup can cause some bias and also influence player experiences negatively.

This type of feedback from players is valuable and would have been important to observe while the user was playing: "*Antigens sometimes get very close to the outside border of the gamescreen in gameplay. It makes dodging the viruses unnecessarily difficult. Also, when I was choosing the antigen that I wanted to play with, the "swipe-action" didn't work and I had to swipe multiple times to change the antigen to the next one.*"

The tutorial section at the start of the game was perceived too long and not meaningful, as one participant commented: "*the way how you are forced to wait, with no real reason*".

In this version, there were still some issues with visual and user interface design. Participants seemed to like the story of the game, even though it was perceived as too long in the tutorial. Thus, gameplay and how players are rewarded should be improved in the future version, so that the game would be more existing, engaging, and more meaningful. These are important things to achieve, as it is hard to achieve stickiness with mobile arcade games and not least because there is so much choice available. These are types of games were the first impression matters a lot.

In relation to open questions, we also used 5-point Likert scale type of questions. Fig. 11 shows that majority thought that the first-time experience was encouraging, and the game session can be started quickly. Still the game was perceived as too easy to play.

We also asked u opinions relating to feedback, terminology, player goals and rewards. In this, 60 % of the players though that the game gave feedback on the player's actions (Fig. 12). The terminology used in the game was not perceived as difficult to understand (80%), while 60% though that the game has clear goals that player can achieve. Rewards in the game we perceived as meaningful by 53,4% of the respondents and 66,7% of the participants disagree with the argument "It is difficult to follow the progress in the game".

In the end of the questionnaire, we asked: 'What would be your overall rating for the game?' From one to ten axel, participants average rate for the game was six.
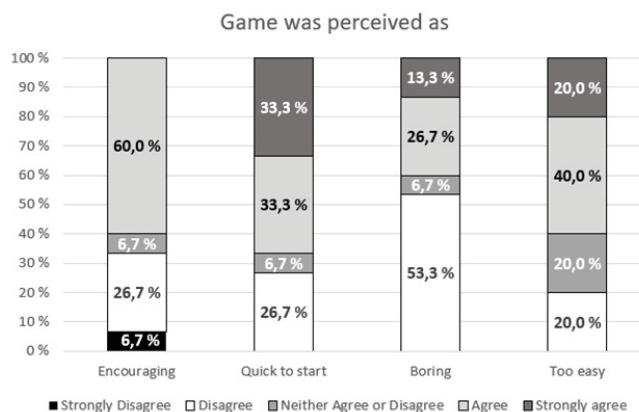

Fig. 11. Participants' experiences of the gameplay.
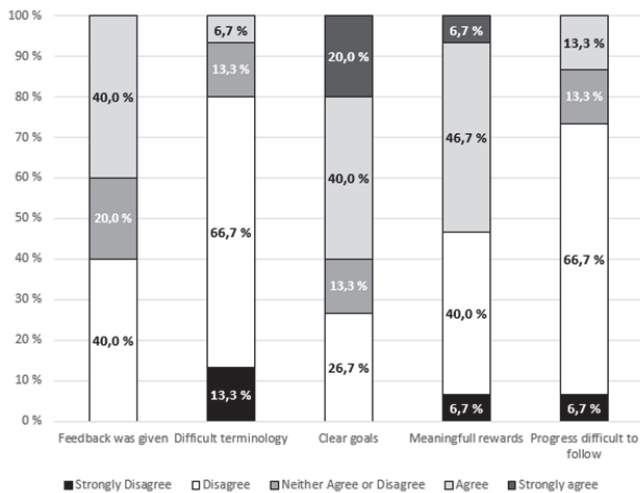
Fig. 12. How participants understood the purpose of the game

C. Zones and Matches

We were interested in how participants perceived different safety levels while playing. Over half, 53,3% of players, though that "It was easy to understand when in a Safe, Unsafe, or Danger Zone", but 20% disagreed with the statement, while26,7% neither agree nor disagree (Fig. 13). Majority of the respondents (86,7%%) liked the colors used for different danger zones. In addition, 46,7 % agreed that "It was not clear early on why being in a safer zone is important". This is very important element of the game and should be improved in the future. When encouraging social distancing, it should be clear and easily understandable why being in a safe zone is important. This is also something that we should investigate more for instance, by doing onsite tests with qualitative interviews.

Participants easily noticed and understood how to start the match (Fig. 14). Also, 86% though that the goal of a match was easy to understand.

When we provided a statement: 'It was noticeably more difficult to win a match in an "Unsafe Zone"' As a result, 33,4% agreed with it and 40% disagreed. Also, 46,7 % agreed that it was still fairly easy to win a match in a "Danger Zone" and 20% disagreed with the statement, while 33,3% neither agree or disagree. This can be caused by a gameplay situation in which a player may not have witnessed all zones and thus not able agree or disagree.

D. Player suggestions

Participants proposed several design improvements. Many of comments related to usability aspects and smooth gameplay, which is understandable since this game version was in an early stage.

Tutorial had been already added to the game based on the prior study [20]. However, it was not interactive and quick to use, which caused a lot of negative experiences. One respondent proposed: "*I would change the tutorial to be interactive. Game would start from the main menu with the assistant telling me what happens where, and I would navigate*

there myself." Also, other player commented: "*The introduction. It had fun story, but it shouldn't be too longsome. It should be either skippable or doable with just a few taps (now you have to tap quite many times)*". It is important to have a tutorial, but attention should be paid on what kind of tutorial supports the starting flow and overall gameplay.
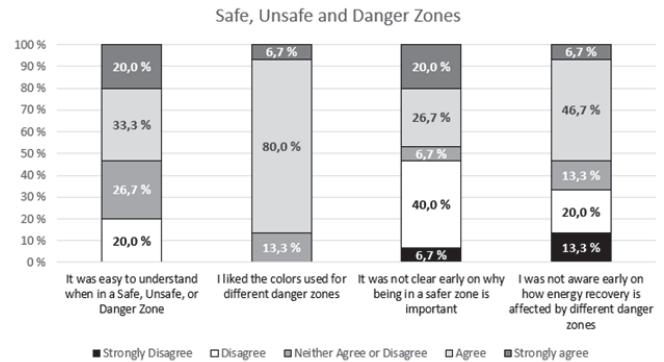

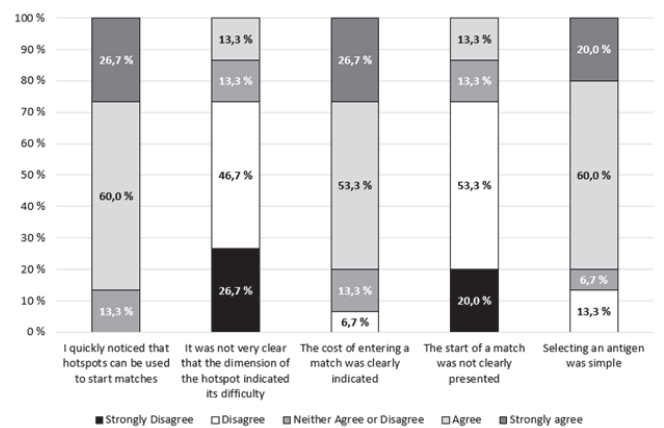Fig. 13. How Safe, Unsafe and Danger Zones were perceived

Fig. 14. How matches were perceived

The registration process and login were also a cause for irritation and were not seen as meaningful. Giving out their address was not clear for all players. Maybe it was not easy for a player to comprehend the importance of the safe location in relation to gameplay. Participants wished the gameplay to be more exciting, meaningful and rewarding.

Participants also wished improvements for the visual design: "*Change the color scheme of maps and add more clearly interactable buttons*". They also proposed to add more details and some tweak the sounds.

VI. DISCUSSION

This paper presents a mobile serious game to foster social distancing during the pandemic situation. We tested the game with 15 participants. We acknowledge that our sample is small and therefore we cannot generalize our findings. In the future, we should conduct more long-term tests with a bigger sample to investigate behavior change in terms of social distancing. In addition, we acknowledge that our study is lacking younger players, for instance, adolescents. Our purpose of the game was

to reach younger audiences and engage them in social distancing practices. Therefore, in the future we should recruit more young participants.

The game was still in its early development phase and thus included some lacks in usability and visual design, which may have influenced player experiences. The game needs to be developed further. Our evaluations have indicated that visual design and usability aspects require further improvements. Also, we have identified the need to consider conducting onsite player tests where a researcher can observe the gameplay and conduct interviews.

VII. CONCLUSION

In this paper, we present a serious mobile game against COVID-19. The purpose of the game is to reach younger audiences and engage them in social distancing practices. It is important to find solutions that would potentially save lives through innovative use of data and technology, and that is why this game was designed and developed. We present aspects of game development and our findings about how the game affected player experience and behaviour. As the theme of the game was related to the current COVID-19 pandemic, and developing the game was a very time-sensitive endevour, the project itself and the consortium participating in the process were formed in haste, this may have impacted the quality of the current stage of the game. The game MVP was to be developed in just six months, as EIT Digital Innovation Activity. This resulted in certain limitations on what the development team could achieve during the time.

Our study with 15 remote test players provided lots of player experiences and insights for the future game development. The user evaluations presented in this paper indicate that it is difficult to develop games in a short-time period that aim to change behavior and improve outcomes, such as is the case with social distancing. These types of games require long-term user studies to measure potential impact on behavior change. Arcade games are particularly challenging as stickiness is hard to achieve. However, it is also good to keep in mind that an appropriate measure should be used to assess the behavior change outcome. Raising the issue and making people think about their actions, might already be a good outcome.

Additionally, we found out that there are not still that many mobile games related to COVID-19, one reason for this being that the app stores restrict publishing COVID-19 themed games.

REFERENCES

[1] D.L. King, P.H. Delfabbro, J. Billieux, and M.N. Potenza. "Problematic online gaming and the COVID-19 pandemic". Journal of Behavioral Addictions J Behav Addict 9, 2 (June 2020), 184–186. DOI:https://doi.org/10.1556/2006.2020.00016

[2] Y.P.S. Balhara, D. Kattula, S.Singh, S.Chukkali, and R. Bhargava "Impact of lockdown following COVID-19 on the gaming behavior of college students". Indian J Public Health 64(Suplement), (June 2020), 172–176. DOI:https://doi.org/10.4103/ijph.IJPH_465_20

[3] T. Lemenager, M. Neissner, A. Koopmann, I. Reinhard, E. Georgiadou, A. Müller, F. Kiefer, & T. Hillemacher. "COVID-19 Lockdown Restrictions and Online Media Consumption in Germany". International journal of environmental research and public health 18, 1 (December 2020). DOI:https://doi.org/10.3390/ijerph18010014

[4] W.C. Kriz. "Gaming in the Time of COVID-19". Simulation & Gaming 51, 4 (July 2020), 403–410. DOI:https://doi.org/10.1177/1046878120931602

[5] Zynca. 2020. Games Industry Unites to Promote World Health Organization Messages Against COVID-19; Launch #PlayApartTogether Campaign. Retrieved February 1, 2021 from https://www.businesswire.com/news/home/20200328005018/en/Games-Industry-Unites-to-Promote-World-Health-Organization-Messages-Against-COVID-19-Launch-PlayApartTogether-Campaign

[6] G. Syangtan, S. Bista, P. Dawadi, B. Rayamajhee, L.B. Shrestha, R. Tuladhar, and D.R. Joshi. "Asymptomatic SARS-CoV-2 Carriers: A Systematic Review and Meta-Analysis". Frontiers in Public Health 8, (2021), 1066. DOI:https://doi.org/10.3389/fpubh.2020.587374

[7] Z-Man Games, Inc. Pandemic. BoardGameGeek. Retrieved February 1, 2021 from https://boardgamegeek.com/boardgame/30549/pandemic

[8] Weltquartett. WELTQUARTETT- Quartette: Öltanker, Atomkraftwerke, Tyrannen, Seuchen, Rauschgift und Ungeziefer auf 32 Spielkarten. Retrieved February 1, 2021 from https://www.weltquartett.de/

[9] Ndemic Creations. Homepage - Ndemic Creations. Retrieved February 1, 2021 from https://www.ndemiccreations.com/en/

[10] E., Farge. "Do you really need to party?' WHO asks world's youth," In World Economic Forum in collaboration with Reuters, 07 Aug 2020. https://www.weforum.org/agenda/2020/08/coronavirus-covid-19-who-youth-young-party-pandemic/

[11] P. Whiteside. "Coronavirus: Are young people to blame for a new rise in COVID-19 cases?" In SkyNews. 10 August 2020 https://news.sky.com/story/coronavirus-are-young-people-to-blame-for-a-new-rise-in-covid-19-cases-12039185

[12] EIT Digital: Unus Terra, a serious game from Finland, wins top prize at the EIT Digital DATA against COVID-19 DeepHack. 2020 Web: https://www.eitdigital.eu/newsroom/news/article/unus-terra-a-serious-game-from-finland-wins-top-prize-at-the-eit-digital-data-against-covid-19-deephack/

[13] EIT Digital: DATA Against COVID-19' EIT crisis support to digital European entrepreneurs and innovators. 13 August 2020. Web: https://www.eitdigital.eu/newsroom/news/article/data-against-covid-19-eit-crisis-support-to-digital-european-entrepreneurs-and-innovators/

[14] T. Marsh, Serious games continuum: Between games for purpose and experiential environments for purpose. Entertainment Computing. 2. 61-68. 10.1016/j.entcom.2010.12.004

[15] C. Girard, J. Ecalle & A. Magnan. "Serious games as new educational tools: how effective are they? A meta-analysis of recent studies," Journal of Computer Assisted Learning, 29, no. 3, 207–219.

[16] U. Ritterfeld, M. J. Cody, and P. Vorderer, Eds., Serious games: mechanisms and effects. New York: Routledge, 2009.

[17] S. Laato, T.H. Laine, A.K.M.N. Islam. "Location-Based Games and the COVID-19 Pandemic: An Analysis of Responses from Game Developers and Players," Multimodal Technol. Interact. 2020, 4, 29.

[18] BBC News: Coronavirus: Lockdown walk inspired social distancing game. 12 May 2020 https://www.bbc.com/news/uk-england-beds-bucks-herts-52616222.

[19] Venigalla, A.S.M., Vagavolu, D. & Chimalakonda, S. SurviveCovid-19 -- A Game for Improving Awareness of Social Distancing and Health Measures for Covid-19 Pandemic arXiv:2004.09759v1 [Submitted on 21 Apr 2020]

[20] S. Pohjolainen, J. Mattila, J. Tuovinen, M. Rajanen, L. Arhippainen, P. Alavesa, "Heuristic Evaluation of a Mobile Game Developed to Help Battle the Pandemic" IEEE CoG 2021

[21] L. Crispin & J. Gregory. Agile testing: A practical guide for testers and agile teams. Pearson Education. 2009

[22] The game in Google Play Store: https://play.google.com/apps/testing/com.i3lab.unusterragame

[23] Link to demonstration video: https://youtu.be/sjMFboo7WEI

[24] BBC News: Coronavirus: Lockdown walk inspired social distancing game. 12 May 2020 https://www.bbc.com/news/uk-england-beds-bucks-herts-52616222.

[25] A.S.M. Venigalla, D. Vagavolu & S. Chimalakonda. "SurviveCovid-19 -- A Game for Improving Awareness of Social Distancing and Health Measures for Covid-19 Pandemic" arXiv:2004.09759v1

[26] game. 12 May 2020 https://www.bbc.com/news/uk-england-beds-bucks-herts-52616222.

[27] A.S. Venigalla, D. Vagavolu, and S. Chimalakonda, SurviveCovid-19 - A Game for Improving Awareness of Social Distancing and Health Measures for Covid-19 Pandemic. ArXiv, abs/2004.09759. 2020

[28] Apple: Ensuring the Credibility of Health& Safety Information. March 14, 2020. Web: https://developer.apple.com/news/?id=03142020a