University of Victoria

Human Research Ethics Board
Application for Research Ethics Approval for Human Participant Research

The following application form is an institutional protocol based on the
Tri-Council Policy Statement on the Ethical Conduct for Research Involving Humans

Instructions:

1. Download this application and complete it on your computer. Hand written applications will not be accepted. You will receive a response from the HREB within 4-6 weeks.
2. Use the *Human Research Ethics Board Annotated Guidelines* to complete this application: http://www.uvic.ca/research/conduct/home/regapproval/humanethics/index.php.
   Note: This form is linked to the guidelines. Access links in blue text by hitting CTRL and clicking on the blue text.
3. Submit one (1) original and two (2) copies of this completed, signed application with all attachments to: Human Research Ethics, Michael Williams Building (MWB), Room B202, University of Victoria, PO Box 1700 STN CSC, Victoria BC V8W 2Y2 Canada
4. Do not staple the original copy (clips O.K.).
5. If you need assistance, contact the Human Research Ethics Office at (250) 472-4545 or ethics@uvic.ca
6. Please note that applications are screened and will not be entered into the review system if incomplete (e.g., missing required attachments, signatures, documents). You will be notified in this case.
7. Once approved, a Request for Annual Renewal must be completed annually for on-going projects for continuing Research Ethics approval.

A. Principal Investigator

If there is more than one Principal Investigator, provide their name(s) and contact information below in Section B, Other Investigator(s) & Research Team.

Last Name: **Moshfegh Gohari**

First Name: **Marjan**

Department/Faculty: **Khoury college of Computer Science**

UVic Email: ycoady@uvic.ca

Phone: **604-779-3611**

Primary Email: moshfeghgohari.m@northeastern.edu

Mailing Address (*if different from Department/Faculty*) including postal code:

Title/Position: (Must have a UVic appointment or be a registered UVic student)

☐ Faculty ☐ Undergraduate ☐ Ph.D. Student

Staff ■ Master's Student ☐ Post-Doctoral

Adjunct or ☐ Sessional Faculty (Appointment start and end dates):_____

Students: Provide your Supervisor's information:

Name: Dr. Yvonne Coady Email: ycoady@uvic.ca
Department/Faculty: Faculty of Engineering, Department of Computer Science
Phone: 250-472-5715

Graduate Students: Provide your Graduate Secretary's email address:

All PIs: Provide any additional contacts for email correspondence:

Name: Email:

FOR HUMAN RESEARCH ETHICS' USE ONLY		Protocol No.
HREB Chair Approval Signature:		Date:
Start Date:	Annual Renewal Due:	Approval Expiry:

B. Project Information

Project Title: **User experience and Usability evaluation in Holographic Augmented Reality applications(**HoloX app**)**

Anticipated Start Date for Recruitment / Data Collection: **November 2021** Anticipated End Date: **Dec 2021**

Geographic location(s) of study: **BC / Vancouver**

Participant recruitment/data collection location(s)/site(s): Northeastern university Vancouver campus

Keywords: **Augmented reality, Hologram, usability, evaluation, user experience**

Is this application connected/associated/linked to one that has been recently submitted? ☐ Yes ☐ No If yes, provide further information:

All Current Investigator(s) and Research Team:
(*Include all current co-investigators, students, employees, volunteers, community organizations.)*

Contact Name	Role in Research Project	Institutional Affiliation	Email or Phone
Yvonne Coady	**Co-investigator**	**UVIC**	**ycoady@uvic.ca**
Derek Jacoby	**Co-investigator**	**UVIC**	**derekja@gmail.com**

For Faculty Only: Any Graduate Student Research Assistants who will use the data to fulfill UVic thesis/ dissertation/ academic requirements: Include all current Graduate Student Research Assistants

Student/Research Assistant	Email or Phone

C. Multi-Jurisdictional Research

Does the proposed project require Research Ethics Board (REB) approval from another research ethics board(s)? ☐ Yes ☑No

If yes, list the other research ethics board from which you or research team members have sought approval or will seek approval:

(Attach proof of having applied to other research ethics board(s). Please forward approvals upon receiving them. Be assured that UVic ethics approval may be granted prior to receipt of other research ethics board approvals.)

If you have answered "yes" above, please indicate your role in the multi-jurisdictional research project (Check all that apply):

☐ Recruiting participants

☐ Collecting data

☐ Analyzing data (with or without identifiers) collected by you and/or UVic research team members

☐ Analyzing data that *contains* identifiers: Data to be collected by non-UVic research team members as outlined in this application.

☐ Analyzing data that *does not* contain identifiers: Data to be collected by non-UVic research team members as outlined in this application.

☐ Dissemination of results via publications, reports, conferences, internet, etc.

☐ Other *(explain):*

D. Agreement and Signatures

For further information, on signature requirements, please see the Guidelines for Signatures.

Principal Investigator and Student Supervisor affirm that:

- *I have read this application and it is complete and accurate.*
- *The research will be conducted in accordance with the University of Victoria regulations, policies and procedures governing the ethical conduct of research involving human participants and all relevant sections of the TCPS 2.*
- *The conduct of the research will not commence until ethics approval has been granted.*
- *The researcher(s) will seek further HREB review if the research protocol is modified.*
- *Adequate supervision will be provided for students and/or staff.*

Principal Investigator	**Student's Supervisor or co-Supervisor (for student applicants only)**
Signature	*Signature*
Marian Moshfegh Gohari	Yvonne Coady
Print Name	**Print Name**
Dec 2021	Dec 2021
Date	**Date**

Chair, Director or Dean
(To be signed by the person to whom the PI, or student's supervisor reports, and must not be the same person as the PI or student's supervisor. The Research Ethics Office cannot accept applications with duplicate signatures)

I affirm that adequate research infrastructure is available for the conduct and completion of this research.

Signature

Print Name

Date

E. Project Funding

Have you applied for funding for this project? ☑Yes ☐ No If yes, please complete the following:

Source of Project Funding	Funding Applied	Funding Approved	Project Title Used in Funding Application (or additional information)
	☑ Yes ☐ No	☐ Yes ☐ No	

	☐ Yes ☐ No	☐ Yes ☐ No	
	☐ Yes ☐ No	☐ Yes ☐ No	
	☐ Yes ☐ No	☐ Yes ☐ No	

Will this project receive funding from the US *National Institutes of Health (NIH)*?

☐ Yes ☑ No

If yes, provide further information:

If you have applied for funding, have you submitted a funding application or contract notification to the UVic Office of Research Services?

☐ Yes ☑ No

F. Scholarly Review

What type of scholarly review has this research project undergone?

☐ External Peer Review (*e.g., granting agency*)

☐ Supervisory Committee or Supervisor—required for all student research projects

None

☐ Other, please explain:

G. Other Approvals and Consultations

Do you require additional approvals or consultations from other agencies, community groups, local governments, etc.?

☐ Yes, attached ☐ Yes, will forward as received ☑ No

(Attach proof of having made request(s) for permission, or attach approval letter(s). Please forward approvals upon receiving them. Be assured that ethics approval may be granted prior to receipt of external approvals.)

If **Yes**, please check all that apply:

☐ **School District, Superintendent, Principal, Teacher.** Please list the school districts or schools:

☐ **BC Health Authorities and/or BC Universities.** Check all that apply:

☐ Island Health (VIHA)

☐ Interior Health (IH)

☐ Vancouver Coastal Health (VCH)

☐ Northern Health (NH)

☐ Fraser Health (FH)

☐ Simon Fraser University

☐ University of BC

☐ BC Cancer Agency

☐ Children's &Women's Hospital

☐ Providence Health Care

☐ University of Norther BC

If you are UVic faculty, student or staff and will be conducting research under the auspices of any of the institutions listed above, (involving staff, patients, health records, sites and/or recruitment through their sites, including recruitment via poster placement), your application may be reviewed under the BC Ethics Harmonization Initiative. (a single coordinated review with the other institution(s) listed). Harmonization also applies when members of your research team consist of faculty, staff and students from the BC institution(s) listed above. Please contact ethics@uvic.ca, 250-472-4545 if you have questions about a harmonized review.

Please explain:

☐ **Other regional government authority**, please explain:

☐ **Community Group (e.g., formal organization, informal collective),** please explain:

☐ **Other Research Ethics Board (REB) Approval**, please explain:

☐ **UVic Biosafety Committee Approval.** *Attach your Biosafety Approval, or your correspondence with the Biosafety Committee, to this application. Note that Research Ethics Approval is contingent on Biosafety Approval.*

☐ **Other Approval**, please explain:

H. Researcher(s) Qualifications

In light of your research methods, the nature of the research, and the characteristics of the participants, what training, qualifications, or personal experiences do you and/or your research team have (*e.g., research methods course, language proficiency, committee expertise, training on the equipment to be used)*?

Human Computer Interaction course, Mixed Reality course, User Experience design certificate, design software (Augmented Reality, unity, etc.), computer science, Research Methodology

I. Research Involving Aboriginal Peoples of Canada (Including First Nations, Inuit and Métis)

The TCPS 2 (Chapter 9) highlights the importance of community engagement and respect for community customs, protocols, codes of research practice and knowledge when conducting research with Aboriginal peoples or communities. "Aboriginal peoples" includes First Nations, Inuit and Métis regardless of where they reside or whether or not their names appear on an official register. The nature and extent of community engagement should be determined jointly by the researcher and the relevant community or collective, taking into account the characteristics and protocols of the community and the nature of the research.

1. Conditions of the Research

1a. Will the research be conducted on (an) Aboriginal – First Nations, Inuit and Métis – lands, including reserves, Métis settlement, and lands governed under a self-government agreement or an Inuit or First Nations land claims agreement?

☑No

☐ Yes, provide details:

1b. Do any of the criteria for participation include membership in an Aboriginal community, group of communities, or organization, including urban Aboriginal populations?
☑No

☐ Yes, provide details:

1c. Does the research seek input from participants regarding a community's cultural heritage, artifacts, traditional knowledge or unique characteristics?

☐ Yes ☑ No

1d. Will Aboriginal identity or membership in an Aboriginal community be used as a variable for the purposes of analysis?

☐ Yes ☑ No

1e. Will the results of the research refer to Aboriginal communities, peoples, language, history or culture?

☐ Yes ☑ No

2. Community Engagement

2a. If you answered "yes" to questions a), b), c), d) or e), have you initiated or do you intend to initiate an engagement process with the Aboriginal collective, community or communities for this study?

☐ Yes ☑ No

2b. If you answered "yes" to question 2a, describe the process that you have followed or will follow with respect to community engagement. Include any documentation of consultations (*i.e. formal research agreement, letter of approval, email communications, etc.*) and the role or position of those consulted, including their names if appropriate:

3. No community consultation or engagement

If you answered "no" to question 2a, briefly describe why community engagement will not be sought and how you can conduct a study that respects Aboriginal communities and participants in the absence of community engagement.

J. International Research

4. Will this study be conducted in a country other than Canada?

☐ Yes ☑ No

If yes, describe how the laws, customs and regulations of the host country will be addressed (*consider research Visas, local Institutional Research Ethics Board requirements, etc.*):

K. Description of Research Project

5. Purpose and Rationale of Research

Briefly describe in non-technical language:
Please use 150 words or fewer.

5a. The research objective(s) and question(s)

The research question(s):

1- **What are the usability issues experienced by users while using holographic AR applications (HoloX)?**
2- **What are the design guidelines to improve the holographic AR applications(HoloX)?**
3- **To what extend the users of products are able to work effectively, efficiently and with satisfaction?**

The research objective(s):

1- **To explore the usability issues experienced by users while using holographic AR applications(HoloX).**
2- **To offer design guidelines to improve holographic AR applications(HoloX).**
3- **To measure the user experience and usability of the application based on effectively, efficiently and with satisfaction?**

Activity 1: Effectiveness: to measure the users' ability to complete the given tasks.
Activity 2: Efficiency: to measure the required user resources to complete the tasks.
Activity 3: User satisfaction: to discover the users' opinions and feedback.

5b. The importance and contributions of the research.

AR is one of the most promising technology that is growing rapidly in a variety of sectors. Hence , usability evaluation of AR apps is of prime concern. In the process of developing an application, usability evaluation plays an important role. Application developers are usually specialists in their fields, and the user interfaces they create may appear to be quite simple to use from their perspective. Unfortunately, the target users are often novice of the applications and find it difficult to use them. Therefor, usability evaluation plays a crucial role in any application having a user interface. This study identifies the problem of usability and proposes a series of design guidelines for Holographic AR applications.

c. If applicable, provide background information or details that will enable the HREB to understand the context of the study when reviewing the application.

This research is my project in the capstone course. In this research I will be working on usability evaluation of Holox application which has been made by a Nextech Company. HoloX is an application that lets you create, share and view human holograms on the smartphone devices. User see 2D Human hologram as 3D by using the Augmented Reality Technology.
The application can be used for Announcements, Delivering message, Virtual training, Product walk-through demos, In-store demonstration and so on. anyone for fun or for other ideas that users may come up with. users can pinch and zoom the hologram.

L. Recruitment

6. Recruitment and Selection of Participants

6a. Briefly describe the target population(s) for recruitment. Ensure that all participant groups are identified (*e.g., group 1 - teachers, group 2 - administrators, group 3 - parents*).

AR or User experience experts
Novice users above 12 years old

6b. Why is each population or group of interest?
Group 1: Experts : Usability inspection methods (Heuristic evaluation and cognitive walkthrough) is targeted to discover general usability problems by experts that might be ignored by real users but are important for their overall satisfaction.

Group 2: Questionnaire and observation will need any public users age over 12 who might use this application for create, view and sharing their hologram.

6c. What are the *salient* characteristics of the participants for your study? (*e.g., age, gender, race, ethnicity, class, position, etc.*)? List all inclusion and exclusion criteria you are using.

Group 1: Any person with the speciality in the area of augmented reality, or Human computer interaction and user experience design

Group 2: Over 12, female and male, various ethnicities and socio-economic status.

6d. What is the desired number of participants for each group?

Group 1: 4

Group 2: 10

6e. Provide a detailed description of your recruitment process. Explain:

i) List all source(s) for information used to contact potential participants (*e.g., personal contacts, listserves, publicly available contact information, etc.). Clarify which sources will be used for which participant groups:*

Group 1: Personal contacts and publicly available contact information

Group 2: publicly available contact information

ii) List all methods of recruitment (*e.g., in-person, by telephone, letter, snowball sampling, wordof-mouth, advertisement, etc.) If you will be using "snowball" sampling, clarify how this will proceed (i.e., will participants be asked to pass on your study information to other potential participants?). Clarify which methods will be used for which participant groups.*

Group 1: Word of mouth, in-person, email

Group 2: Word of mouth, in-person, email

iii) If you will be using personal and/or private contact information to contact potential participants (as stated above), have the potential participants given permission for this, or will you use a neutral third party to assist you with recruitment? *Note that this is not a concern when public and/or business contact information is used.*

A letter will go out to the potential participants describing that we are conducting a study and they are welcome to participate.

iv) Who will recruit/contact participants (*e.g., researcher, assistant, third party, etc.) Clarify this for each participant group.*

Group 1: Researcher and Supervisor

Group 2: Researcher

v) List and explain any relationship between the members of the research team (including third party recruiters or sponsors/clients of the research) and the participant(s) (*e.g., acquaintances, colleagues*). Complete item 7 if there is potential for a power relationship or a *perceived* power relationship (*e.g., instructor-student, manager-employee, etc.*). If you have a close relationship with potential participants (*e.g., family member, friend, close colleague, etc.)* clarify here the safeguards that you will put in place to mitigate any potential pressure to participate.

In order to mitigate any potential pressure to participate, participants will be provided with a cover letter describing the research and describe in detail that they have the option to not participate and be reminded that they can withdraw from the research at any time.

vi) In chronological order (if possible) describe the steps in the recruitment process. *(Include how you will screen potential participants where applicable).* Consider where in the process permission of other bodies may be required.

1) **Email potential participants**
2) **Provide an in-person information session**
3) **Give participants cover letter with detailed description of the study**

4) **Give participants consent forms, ask them to fill them out or take them home to complete in their own time (remind them that participation is optional)**
5) **5) Collect consent forms**

7. Power Relationships (Dual-Role and Power-Over)

If you are completing this section, please refer to the:
Guidelines For Ethics in Dual-Role Research for Teachers and Other Practitioners and the TCPS 2, Article 3.1 and Article 7.4.

Are you or any of your co-researchers in any way in a power relationship, including dual-roles, that could influence the voluntariness of a participant's consent? Could you or any of your coresearchers potentially be *perceived* to be in a power relationship by potential participants? *Examples of "power relationships" include teachers-students, therapists-clients, supervisors-employees and possibly researcher-relative or researcher-close friend where elements of trust or dependency could result in undue influence.*

☐ Yes ☑ No ☐ Varies

If *yes* or *varies*, describe below:

i) The nature of the relationship:

ii) Why it is necessary to conduct research with participants over whom you have a power relationship:

iii) What safeguards (steps) will be taken to ensure voluntariness and minimize undue influence, coercion or potential harm:

iv) How will the power or dual-role relationship and associated safeguards be explained to potential participants:

Recruitment Materials Checklist:

Attach all documents referenced in this section *(check those that are appended):*

☑ script(s) – in-person, telephone, 3rd party, e-mail, etc.

☑ Invitation to participate *(e.g., Psychology Research Participation System Posting)*

☐ Advertisement, poster, flyer

☐ None; please explain why *(e.g., consent form used as invitation/recruitment guide)*

M. Data Collection Methods

8. Data Collection

Use the following sections in ways best suited to explain your project. If you have more than one participant group, be sure to explain which participant group(s) will be involved in which activity/activities or method(s).

8a. Which of the following methods will be used to collect data? *Check all that apply.*

☐ **Interviewing participants:** ■ in-person ☐ by telephone ☐ using web-based technology (explain): survey monkey ☐ Conducting group interviews or discussions (including focus groups)	☐ **Attach draft interview questions**
☑**Administering a questionnaire or survey:** ☑In person ☐ by telephone ☐mail back ☑ email ☑ web-based* (see below) ☐ Other, describe: ***If using a web program with a server located in the United States (e.g., SurveyMonkey), or if there are other reasons that the data will be stored in the US (e.g., use of US-based cloud technology, sharing data with US colleagues, etc.), you must inform participants that their responses may be accessed via the U.S. Patriot Act. Please add the following to the consent form(s): *"Please be advised that this research study includes data storage in the U.S.A. As such, there is a possibility that information about you that is gathered for this research study may be accessed without your knowledge or consent by the U.S. government in compliance with the U.S. Patriot Act."*	☐**Attach questionnaire or survey:** ☐standardized (one with established reliability and validity) ☑non-standardized (one that is un-tested, adapted or openended)
☐ **Administering a computerized task** (*describe in 8b or attach details*)	
☑**Observing participants** *In 8b, describe who and what will be observed. Include where observations will take place. If applicable, forward an observational data collection sheet for review.*	
☐ **Recording of participants and data using**: ☐ audio ☑video ☑ photos or slides ☑ note taking ☐ flipcharts	☑ Images used for analysis ☑ Images used in disseminating results *(include release to use*
☐ data collection sheet *(attach)* ☐ other:	*participant images in consent materials)*
☐ **Using human samples** (*e.g., saliva, urine, blood, hair*) *Attach your Biosafety Approval, or your correspondence with the Biosafety Committee, to this application. Note that Research Ethics Approval is contingent on Biosafety Approval.*	
☐ **Using specialized equipment/machines** *(e.g., ultrasound, EEG, prototypes etc.)* or other. *(e.g., testing instruments that are not surveys or questionnaires).* Please specify:	
☐ **Using other testing equipment not captured under other categories.** Please specify:	
☐ **Collecting materials supplied by, or produced by, the participants** *(e.g., artifacts, paintings, drawings, photos, slides, art, journals, writings, etc.)* Please specify:	

☐ **Analyzing secondary data** or secondary use of data (Refers to information/data that was originally gathered for a purpose other than the proposed research and is now being considered for use in research (*e.g., patient or school records, personal writings, lesson plans, etc.).*

☐ Secondary data involving anonymized information (Information/data is stripped of identifiers by another researcher or institution **before** being shared with the applicant*).*

☐ Secondary data with identifying information (Data contains names and other information that can be linked to individuals,*(e.g., student report cards, employment records, meeting minutes, personal writings).*

In item 8b describe the source of the data, who the appropriate data steward is, and explain whether (and how) consent was or will be obtained from the individuals for use of their data.

☐ **Other:**

Please specify:

8b. Provide a sequential description of the procedures/methods to be used in your research study.

Be sure to provide details for all methods checked in section 8a. Clarify which procedures/methods will be used for each participant group. Indicate which methods, if any, will be conducted in a group setting. *List all of the research instruments and interview/focus group questions, and append copies (if possible) or detailed descriptions of all instruments. If not yet finalized, provide drafts or sample items/questions.*

Inspection method (Heuristic)

1- **A document with some questions about the 14 heuristic will be given to the Experts. The document contains the Heuristic evaluation definition. (appendix 4)**
2- **Each evaluator should test the application individually with the provided iOS devices(either mobile or tablet). Evaluators examine the interface and judge its compliance with 14 usability principles.**
3- **Evaluator will be asked to rate the ten heuristic principles in the interface and provide their feedback for each principle.**
4- **The Collected data will be analyzed by researcher.**

Inspection method (cognitive walkthrough)

1- **A document with some questions will be given to the evaluator. The document contains the cognitive walkthrough definition. (appendix 5)**
2- **Each evaluator should perform the pre-defined task individually with iOS devices(either mobile or tablet).**
3- **Evaluator will be asked to answer four questions for each task.**
4- **The Collected data will be analyzed by researcher.**

questionnaire:

1- **Users are first asked to use the application and perform pre-defined unstructured task.**
2- **Users rate 30 X pre-defined questions and provide their feedback. Also they will be asked to provide their demographic, experience and familiarity with the AR app(Appendix 6)**
3- **Researcher will collect the data and analyze them in some statistics format and some design guideline will be offered based on data analyze. The purpose if these questions is finding the design problem.**

laboratory test (It can be carried out with questionnaire) (appendix 7)

1- **users perform a set of unstructured pre-defined tasks in a controlled environment**
2- **video or at least audio recordings of user task and interaction with user interface will be done.**
3- **Users will be asked to rate the 10 questions from System Usability Scale (SUS) questionnaire for analyzing the satisfaction rate.**
4- **Researcher analyze the number of errors, the time spent on task, as well as user satisfaction.**

Commented [MP1]: It's a good practice to outline what kind of questions will be asked

I just noticed that you added all questions at the end of the document (which is great). Please insert here a reference to the questionnaire at the end of the doc so that it is clear what questions will be asked where.

Commented [MMG2R1]: solved

Commented [MP3]: Good!
FYI a good example of cog walkthrough https://www.youtube.com/watch?v=Edgjao4mmxM&ab_channel=ChrisKimmer

Commented [MMG4R3]: solved

Commented [MP5]: "allowed" or "asked"?

Commented [MMG6R5]: solved

Commented [MP7]: This should be more precise. What kind of questions are you planning to ask? What is the purpose of the questions (what are you hoping to understand?) here you are probably looking at the descriptive stats. You also want to understand the user preferences, demographics, previous experience with similar technology etc.

Commented [MMG8R7]: solved

The participants for laboratory test can be the same participants in the questionnaire.

8c. Where will participation take place for each data collection method/procedure? *Provide specific location, (e.g., UVic classroom, private residence, participant's workplace). Clarify the locations for each participant group and/or each data collection method.*

Group 1 - In the college

Group 2 – In the college

8d. For each method, and in total, how much time will be required of participants? *Clarify this for each participant group, each data collection method, and any other research related activities.*
30-45 minutes

8e. Will participation take place during participants' office/work hours or instructional time?

☐ No ☑ Yes. Indicate whether permission is required *(e.g., from workplace supervisor, school principal, etc.)* and how this will be obtained: Permission may be required from school principal, but may be conducted during a professional development day.

Data Collection Methods Checklist:

Attach all documents referenced in this section *(check those that are appended. Where draft versions are appended please ensure that final versions are submitted when available. If final versions differ significantly after you have obtained Research Ethics approval, you will need to submit a Request for Modification:*

☑ Standardized Instrument(s)

☑ Survey(s), Questionnaire(s)

☑ Interview and/or Focus Group Questions

☑ Observation

☐ Protocols

Other:

N. Possible Benefits, Inconveniences, and Risks of Harm to Participants

9. Benefits

Identify any potential or known benefits associated with participation and explain below.
Keep in mind that the anticipated benefits should outweigh any potential risks.

☑ To the participant ☑ To society ☑ To the state of knowledge

Holox application is already developed, but the target group should accept it to ensure product aims. This paper will present the usability test done to evolve the Platform.

The main purpose of this study is to explore the usability problems of an interactive 3D Holographic augmented reality applications in particular Holox.

10. Inconveniences

Identify and describe any known or potential inconveniences to participants:
Consider all potential inconveniences, including total time devoted to the research.

11. Level of Risk

The TCPS 2 definition of "minimal risk research" is as follows:

> *"Research in which the probability and magnitude of possible harms implied by participation in the research is no greater than those encountered by the participant in those aspects of their everyday life that relate to the research."*

Based on this definition, do you believe your research qualifies as "minimal risk research"?

☑ Yes it is minimal risk. ☐ No, it is not minimal risk.

Explain your answer with reference to the risks of the study and the vulnerability of the participants:

12. Estimate of Risks of Harm

Consider the inherent foreseeable risks associated with your research protocol and complete the table below by putting an X in the appropriate boxes. Be sure to take into account the vulnerability of your target population(s) if applicable:

Potential Risks of Harm	Very unlikely	Possibly	Likely
i) Emotional or psychological discomfort, such as feeling demeaned or embarrassed due to the research	☑	☐	☐
ii) Fatigue or stress	☐	☑	☐
iii) Social risks, such as stigmatization, loss of status, privacy and/or reputation	☑	☐	☐
iv) Physical risks such as falls	☑	☐	☐
v) Economic risk (e.g., job security, salary loss, etc.)	☑	☐	☐

vi) Risk of incidental findings (*See Article 3.4 of the TCPS 2 for more information*)	☑	☐	☐
vii) Other risks: motion sickness due to virtual reality experience	☑	☐	☐

13. Possible Risks of Harm

If you indicated in Item 12 (i) to (vii) that any risks of harm are *possible* or *likely*, please explain below:

13a. What are the risks? *(i.e., elaborate on risks you have identified above)*

Fatigue or stress

13b. What will you do to try to minimize, mitigate, or prevent the risks?

To mitigate risks we will minimize the time spent and the questions in the questionnaire.

13c. How will you respond if the harm occurs? *(i.e., what is your plan?)*

If a participant experiences fatigue we will stop the activity immediately and remove them from the study for their own wellness.

13d. If you have indicated that there is a risk of Incidental Findings (vi) please outline your proposed protocol for information and/or action.

13e. If one or more of your participant groups could be considered vulnerable please describe any specific considerations you have built into the protocol to address this.

14. Risk to Researcher(s)

14a. Does this research study pose any risks to the researchers, assistants and data collectors?

No.

14b. If there are any risks, explain the nature of the risks, how they will be minimized, and how you will respond if they occur.

15. Deception

Will participants be fully informed of everything that will be required of them prior to the start of the research session?

☑Yes ☐ No *(If no, complete the Request to Use Deception form on the ORS website)*

O. Incentives, Reimbursement and Compensation

16a. Is there any incentive, monetary or otherwise, being offered for participation in the research *(e.g., gifts, honorarium, course credits, etc.)*

☐ Yes ☑ No

If yes, explain the nature of the incentive(s) and why you consider it necessary. *Also consider whether the amount or nature of the incentive could be considered a form of undue inducement or affect the voluntariness of consent. Clarify which participant groups will be provided with which incentives.*

16b. Is there any reimbursement or compensation for participating in the research *(e.g., for transportation, parking, childcare, etc.)*

☐ Yes ☑ No

If yes, explain the nature of reimbursement or compensation and why you consider it necessary. *Also consider whether the amount of reimbursement or compensation could be considered a form of undue inducement or affect the voluntariness of consent. Clarify which participant groups will be provided with which kind of reimbursement or compensation.*

16c. Explain what will happen to the incentives, reimbursement or compensation if participants withdraw during data collection or any time thereafter *(e.g., compensation will be pro-rated, full compensation will be given, etc.)*

P. Free and Informed Consent

Consent encompasses a process that begins with initial contact and continues through to the end of the research process. Consult Article 3.2 of the TCPS 2 and Appendix V of the Guidelines for further information.

17. Participant's Capacity (Competence) to Provide Free and Informed Consent

Capacity refers to the ability of prospective or actual participants to understand relevant information presented about a research project, and to appreciate the potential consequences of their decision to participate or not participate. See the TCPS 2, Chapter 3, section C, for further information. Identify your potential participants: *(Check all that apply.)*

Competent	**Non-Competent**
☑ Competent adults ☐ A protected or vulnerable population (*e.g., inmates, patients*)	☐ Non-competent adults: ☐ Consent of family/authorized representative will be obtained ☐ Assent of the participant will be obtained (note that assent of the participant is always required)

☐ Competent youth aged 13 to 18: ☐ Consent of youth will be obtained and parental/guardian consent is required, *due to institutional requirements (such as school districts) or due to the nature of the research (e.g., risks, etc.)* Consent of youth will be obtained, parents/guardians will be informed ☐ Consent of youth will be obtained, parents/guardians will *NOT* be informed ☐ Other, explain:	☐ Non-competent youth: ☐ Consent of parent/guardian ☐ Assent of the youth will be obtained (note that assent of the participant is always required)
☐ Competent children under 13 (*who are able to provide fully informed consent)*: ☐ Consent of child will be obtained and consent of parent/guardian will be obtained ☐ Other, explain:	☐ Non-competent children *(young children and/or children with limited abilities to provide fully informed consent)*: ☐ Consent of parent/guardian ☐ Assent of the child will be obtained (note that assent of the participant is always required)

18. Means of Obtaining and Documenting Consent and/or Assent:

Check all that apply, consider all of your participant groups, attach copies of relevant materials, complete item 19:

☑ **Signed** consent (*Attach consent form(s) - see template available)*

☐ **Verbal** consent (*Attach verbal consent script(s) - see template available.*)

Explain in 19 why written consent is not appropriate and how verbal consent will be documented.

☐ Letter of Information for **Implied** consent (*e.g., anonymous, mail back or web-based survey. Attach information letter, see template)*

☐ **Signed** or **Verbal assent** for non-competent participants *(Attach assent form(s), or verbal assent script(s)).*

Explain how verbal assent will be documented in 19.

☐ **Other** means. **Explain** in 19 and provide justification.

☐ Consent **will not be obtained**. See TCPS 2 Articles 3.5 and 3.7. **Explain** in 19**.**

☑ **Signed** consent from the parents/guardians for youth/child participants *(Attach consent form(s)).*

Explain how parents/guardians will provide informed consent for child/youth participants in 19.

☐ **Information letters** for the parents/guardians of youth/child participants *(Attach information letter(s)). If consent will not be obtained from parents/guardians and the parents/guardians will not be informed, explain why not in 19.*

19. Informed Consent

Describe the exact steps (chronological order) that you will follow in the process of explaining, obtaining, and documenting informed consent. Ensure that consent procedures for all

participant groups are identified . Be sure to indicate when participants will first be provided with the consent materials *(e.g., prior to first meeting with the researcher?).* If consent will not be obtained, explain why not with reference to the TCPS 2 Articles 3.5 and 3.7.

Group 1-

1) Email to specialist explaining invitation with attached information letter, consent forms, and image/video release forms.
2) Information session describing research study and provide copies of: information letter, consent forms, and image/video release forms.
3) Collect forms at the end of information session or over email
1) Email to students explaining invitation with attached information letter, consent forms, and image/video release forms.
2) Information session for students describing research study and provide copies of information letter, consent forms, and image/video release forms.
3) Collect forms at the end of information session or over email

20. Ongoing Consent

Article 3.3 of the TCPS 2 states that consent shall be maintained throughout the research project. Complete this section if the research involves interacting with participants over multiple occasions (including review of transcripts, etc.), has multiple data collection activities, and/ or occurs over an extended period of time.

20a. Will your research occur over multiple occasions or an extended period of time *(including review of transcripts)*?

☐ Yes ☑No

20b. If yes, describe how you will obtain and document ongoing consent. If consent procedures differ for each group or activity, please clarify each group or activity that you are referring to.

21. Participant's Right to Withdraw

Article 3.1 of the TCPS2 states that participants have the right to withdraw at any time and can withdraw their data and human biological materials.

Describe what participants will be told about their right to withdraw from the research at any time
(*i.e., who to contact and how*). If compensation is involved, explain what participants will be told about compensation if they withdraw. *If you have different participant groups and/or different data collection methods, clarify the different procedures for withdrawing as necessary.*

If you do withdraw from the study your data will be used only if you give permission (see below).

22. What will happen to a person's data if s/he withdraws part way through the study or after the data have been collected/submitted? If applicable, include information about visual data such as photos or videos. *If you have different participant groups and/or different data collection methods, clarify the different procedures for withdrawing as necessary. Ensure this information is included in the consent documents.*

☑ Participant will be asked if he/she agrees to the use of his/her data. Describe how this agreement will be documented:

If you do withdraw from the study your data will be used only if you give permission (see below). Future Use of Data *PLEASE SELECT STATEMENT:* (Participant to provide initials)

I consentto the use of my data in future research: _____

I **do not** consentto the use of my data in future research: _____

I consentto be contacted in the event my data is requested for future research: _____

☐ It will not be used in the analysis and will be destroyed.

☐ It is logistically impossible to remove individual participant data (*e.g., anonymously submitted data*).

☐ When linked to group data (*e.g., focus group discussions*), it will be used in summarized form with no identifying information.

Free and Informed Consent Checklist:

Attach all documents referenced in this section *(check those that are appended):*

☐ Consent and Assent Form(s) – Include forms for all participant groups and data gathering methods

☐ Letter(s) of Information for Implied Consent

☐ Verbal Consent and Assent Scripts

Q. Anonymity and Confidentiality

23. Anonymity

Anonymity means that no one, including the principal investigator, is able to associate responses or other data with individual participants.

23a. Will the participants be anonymous in the data gathering phase of research?

☐ Yes ☑ No

23b. Will the participants be anonymous in the dissemination of results *(be sure to consider use of video, photos)*?

☑ Yes

☐ Maybe. Explain below.

☐ No. If anonymity will not be protected and you plan to identify all participants with their data, provide the rationale below.

24. Confidentiality

Confidentiality means the protection of the person's identity (anonymity) and the protection, access, control and security of his or her data and personal information during the recruitment, data collection, reporting of findings, dissemination of data (if relevant) and after the study is completed

(e.g., storage). The ethical duty of confidentiality refers to the obligation of an individual or organization to safeguard entrusted information. The ethical duty of confidentiality includes obligations to protect information from unauthorized access, use, disclosure, modification, loss or theft.

24a. Are there any limits to protecting the confidentiality of participants?

☑ No, confidentiality of participants and their data will be completely protected

☐ Yes, there are some limits to the researcher's ability to protect the confidentiality of participants (*Check relevant boxes below.)*

- ☐ Limits due to the nature of group activities *(e.g., focus groups):* The researcher cannot guarantee confidentiality
- ☐ Limits due to context: The nature or size of the sample from which participants are drawn makes it possible to identify individual participants *(e.g., school principals in a small town, position within an organization)*
- ☐ Limits due to selection: The procedures for recruiting or selecting participants may compromise the confidentiality of participants *(e.g., participants are identified or referred to the study by a person outside the research team)*
- ☐ Limits due to legal requirements for reporting *(e.g., legal or professional)*
- ☐ Limits due to local legislation such as the U.S.A. Patriot Act *(e.g., when there will be data storage in the United States).* When using USA based data instruments and data storage systems researchers are responsible for determining if this applies. Other:

24b. If confidentiality will be protected, describe the procedures to be used to ensure the anonymity of participants and for preserving the confidentiality of their data *(e.g., pseudonyms, changing identifying information and features, coding sheet, etc.) If you will use different procedures for different participant groups and/or different data methods be sure to clarify each procedure.*

Pseudonyms, changing identifying information

24c. If there are limits to confidentiality indicated in section 24a. above, explain what the limits are and how you will address them with the participants. *If there are different procedures for different participant groups and/or different data collection methods, be sure to clarify each procedure.*

R. Use and Disposal of Data

25. Use(s) of Data

25a. What use(s) will be made of all types of data collected *(field notes, photos, videos, audiotapes, transcripts, etc.)*?

Field notes, photos, videos, transcripts, digital artifacts

25b. Will your research data be analyzed, now or in future, by yourself for purposes other than this research project?

☐ Yes ☑ No ☐ Possibly

25c. If yes or possibly, indicate what purposes you plan for this data and how will you obtain consent for future data analysis from the participants *(e.g., request future use in current consent form)*?

25d. Will your research data be analyzed, now or in future, by other persons for purposes other than explained in this application?

☐ Yes ☑ No ☐ Possibly

25e. If yes or possibly:

i) Indicate whether the data will contain identifiers when it is provided to the other researchers or whether it will be fully anonymous *(note that "fully anonymous" means that there is no identifying information, links, keys, or codes that allow the data to be re-identified).*

ii) How will you obtain consent from the participants for future data analysis by other researchers? *(If the data will be transferred in fully anonymous form, this request for future use can be made in the current consent form. If the data will contain identifiers or links/keys/codes for re-identification, consider requesting permission to contact the participants in the future, to obtain consent for the use of the data at that time).*

26. Commercial Purposes

26a. Do you anticipate that this research will be used for a commercial purpose?

☐ Yes ☑ No

26b. If yes, explain how the data will be used for a commercial purpose:

26c. If yes, indicate if and how participants will benefit from commercialization.

27. Maintenance and Disposal of Data

Describe your plans for protecting data during the project, and for preserving, archiving, or destroying all the types of data associated with the research (*e.g., paper records, audio or visual recordings, electronic recordings, coded data*) after the research is completed:

27a. means of storing and securing data (*e.g., encryption, password protected computer files, locked cabinet, separation of key codes from raw data etc.*):

Encryption – password protected computer files, locked cabinet

27b. location of storing data *(include location of data-storage servers if using web-based technology)*:

Principal investigator computer and hard-drive

27c. duration of data storage *(if data will be kept indefinitely, explain why this is necessary and state whether the data will contain identifiers or links to identifiers)*:

Data will be stored up to 5 years as this is an iterative study and will require several phases over a number of years before the data will be written into publishable and presentable documents.

27d. methods of destroying or archiving data. If archiving data, please describe measures to secure or protect the data. If the archiving will involve a third party *(e.g., library, community agency, Aboriginal band, etc.)* please provide details:

Data will be deleted and removed from computers and shredded paper copies after 5 years

28. Dissemination

How do you anticipate disseminating the research results? (*Check all that apply)*

☑ Thesis/Dissertation/Class presentation

☑ Presentations at scholarly meetings ☑ Published article, chapter or book

☑ Internet (*Students: Most UVic Theses are posted on "UVicSpace" and can be accessed by the public)*

☐ Media (*e.g., newspaper, radio, TV*)

☐ Directly to participants and/or groups involved. Indicate how: *(e.g., report, executive summary, newsletter, information session):* ☑ Other, explain:

To share with the Royal BC museum through written work

S. Conflict of Interest

29a. Apart from a declared dual-role relationship (Section K, item 7), are you or any of the research team members in a perceived, actual or potential conflict of interest regarding this research project (*e.g., partners in research, private interests in companies or other entities*)?

☐ Yes ☑ No

29b. If yes, please provide details of the conflict and how you propose to manage it:

Attachments*

*Ensure that all applicable attachments are included with all copies of your application. Incomplete applications will not be entered into the review system. You will be notified in this case.

Information for Submission

- Applications may be printed and submitted double-sided
- Do **not** staple the original application with original signatures (clips O.K.)
- The two photocopies may be individually stapled or clipped

- Do **not** staple or clip the individual appendices

Title and label attachments as Appendix 1, 2, 3 etc. and attach the following documents (check those that are appended):

Section I - Recruitment Materials:

☐ Script(s) – in-person, telephone, 3rd party, e-mail, etc.

☑ Invitation to participate

☐ Advertisement, Poster, Flyer

Section J - Data Collection Methods:

☑ Standardized Instrument(s)

☑ Survey(s), Questionnaire(s)

☑ Interview and/or Focus Group

Questions ☑ Observation Protocols

Other:

Section M - Free and Informed Consent:

☑ Consent Form(s) – Include forms for all participant groups and data gathering methods

☐ Assent Form(s)

☐ Letter(s) of Information for Implied Consent

☐ Verbal Consent Script

☐ Approval from external organizations (or proof of having made a request for permission)

☐ Permission to gain access to confidential documents or materials

☐ Request to Use Deception form

☐ Biosafety Committee Approval

☐ Other, please describe:

Appendix 1 – Letter of Invitation

University of Victoria

Letter of Invitation - Information

Dec 2020

LETTER OF INVITATION AND INFORMATION

To Whom It May Concern:

You are invited to participate in a research study entitled User experience and Usability evaluation in Holographic Augmented Reality applications(HoloX app) that is being conducted by Marjan Moshfegh Gohari and Dr. Yvonne Coady from the Northeastern University Department of Computer Science in the Vancouver campus. We are interested in finding usability problem in the HoloX app . The total time necessary to participate in the study is approximately 30-45 minutes.

The aim of this letter is twofold. First, it describes the purpose and method of the research study. Second, it requests that you agree, in writing, that you will participate in the study. Please indicate your decision to participate in the study on the attached *Consent Form.*

This research will be used for Marjan Moshfegh Gohari's Capstone project . The purpose of this study is to analyze the usability factors of holographic augmented reality applications. In particular, we are addressing and analyzing the effectiveness, efficiency and satisfaction factor in the HoloX application.
.

Results of this research will be used to publish the findings of the study in professional journals and report/present them at conferences. At no time will the actual identity of the participants or their place of work

be disclosed. Participants will be assigned pseudonyms, and these only will be used in publications. We will maintain the strictest levels of protocols towards any and all information revealed in confidence. Agreement on your part in no way obligates you to remain a part of the study. Participation is voluntary, and you may choose to withdraw from the study at any time. If you do withdraw from the study your data will be used only if you give permission (see Consent form).

If you have any questions or desire further information with respect to this study, you may contact Marjan Moshfegh Gohari at Moshfeghgohari.m@northeastern.edu. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Thank you for your interest in this study.

Sincerely,

Marjan Moshfegh Gohari (Moshfeghgohari.m@northeastern.edu)

Appendix 2 – Consent Form for specialists

University of Victoria

Letter of Invitation - Information

Consent Form User experience and Usability evaluation in Holographic Augmented Reality applications (HoloX app)

Investigators
The principal investigator for this study is Marjan Moshfegh Gohari, a master's students in the department of Computer Science at the Northeastern University. Marjan is also working with Dr. Yvonne Coady, Professor in the department of Computer science. You may contact Marjan if you have any further questions at Moshfeghgohari.m@northeastern.edu

Study Purpose
The purpose of this study is to analyze the usability factors of holographic augmented reality applications. In particular, we are addressing and analyzing the effectiveness, efficiency and satisfaction factor in the HoloX application.

Participant Selection and Procedures
You are being asked to participate in this study because we would like to get valuable feedback from augmented reality and user experience specialist on the usability of this app. If you consent to voluntarily participate in this research, your participation will include questionnaires and video/written notes and observations will be taken with your permission (see permission below). The total time necessary to participate in the study is approximately 30-45 minutes.

Confidentiality & Anonymity
Your identity will be kept strictly confidential. Physical hard copies will be kept in a locked filing cabinet. Electronic copies will be encrypted and protected by password. Results of this

research will be used to publish the findings of the study in professional journals and report/present them at conferences. At no time will the actual identity of the participants or their place of work be disclosed. Participants will be assigned pseudonyms, and these only will be used in publications. We will maintain the strictest levels of protocols towards any and all information revealed in confidence.

Risks
There are one potential risks to you by participating in this research it is fatigue or stress when answering the questions. To prevent or deal with this risk we will reduce time and will discontinue use if you begin to feel symptoms.

Contact Information
If you have any questions or desire further information with respect to this study, you may contact Marjan Moshfegh Gohari at Moshfeghgohari.m@northeastern.edu. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Consent
Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. If you do withdraw from the study your data will be used only if you give permission (see below). Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Participant Signature	Date
Name of Participant	

Visually Recorded Images/Data Participant to provide initials, *only if you consent*:

- Photos may be taken of me for: Analysis _____ Dissemination* _____
- Videos may be taken of me for: Analysis _____ Dissemination* _____

*Even if no names are used, you may be recognizable if visual images are shown in the results.

Future Use of Data *PLEASE SELECT **ONE** STATEMENT:* (Participant to provide initials)

If I choose to withdraw from the study,

- I consent to the use of my data in future research: _____
- I **do not** consent to the use of my data in future research: _____
- I consent to be contacted in the event my data is requested for future research: _____

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix 3 – Consent form for the students

University of Victoria

Letter of Invitation Information

User experience and Usability evaluation in Holographic Augmented Reality applications(HoloX app)

Investigators
The principal investigator for this study is Marjan Moshfegh Gohari, a master's students in the department of Computer Science at the Northeastern University. Marjan is also working with Dr. Yvonne Coady, Professor in the department of Computer science. You may contact Marjan if you have any further questions at Moshfeghgohari.m@northeastern.edu

Study Purpose
The purpose of this study is to analyze the usability factors of holographic augmented reality applications. In particular, we are addressing and analyzing the effectiveness, efficiency and satisfaction factor in the HoloX application.

Participant Selection and Procedures
You are being asked to participate in this study because we would like to get valuable feedback from public users on the usability of this app. If you consent to voluntarily participate in this research, your participation will include questionnaires and video/written notes and observations will be taken with your permission (see permission below). The total time necessary to participate in the study is approximately 30-45 minutes.

Confidentiality & Anonymity
Your identity will be kept strictly confidential. Physical hard copies will be kept in a locked filing cabinet. Electronic copies will be encrypted and protected by password. Results of this research will be used to publish the findings of the study in professional journals and report/present them at conferences. At no time will the actual identity of the participants or

their place of work be disclosed. Participants will be assigned pseudonyms and these only will be used in publications. We will maintain the strictest levels of protocols towards any and all information revealed in confidence.

Risks
There are one potential risks to you by participating in this research it is fatigue or stress when answering the questions. To prevent or deal with this risks we will reduce time and will discontinue use if you begin to feel symptoms.

Contact Information
If you have any questions or desire further information with respect to this study, you may contact Marjan Moshfegh Gohari at Moshfeghgohari.m@northeastern.edu.. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Consent
Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. If you do withdraw from the study your data will be used only if you give permission (see below). Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Participant Signature _____ Date _____

Name of Participant _____

Visually Recorded Images/Data Participant to provide initials, *only if you consent*:

- Photos may be taken of me for: Analysis _____ Dissemination* _____
- Videos may be taken of me for: Analysis _____ Dissemination* _____

*Even if no names are used, you may be recognizable if visual images are shown in the results.

Future Use of Data *PLEASE SELECT **ONE** STATEMENT:* (Participant to provide initials)

If I choose to withdraw from the study,

- I consent to the use of my data in future research: _____
- I **do not** consent to the use of my data in future research: _____
- I consent to be contacted in the event my data is requested for future research: _____

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix 4 – Survey- Heuristic evaluation

HoloX: In this research we will be conducting usability evaluation for HoloX as one of the holographic AR applications which has been made by NexTech AR Solutions Company. HoloX is an application that lets you create, share and view human holograms on the smartphone Devices (currently available for iOS devices). Users see 2D Human hologram as 3D by using the Augmented Reality Technology.

Heuristic evaluation: In this method you should examine the user interface of a given application and try to find the most important usability issues in the interface's compliance according to ten standard usability principles. The purpose of heuristic evaluation is to improve the design effectively. We extended the 10 general principles of design methodology to the evaluation of AR application, including the effectiveness, efficiency, and satisfaction.

Please rate the fourteen heuristics we are evaluating below:

Commented [MP9]: This is good!

1- **Visibility of system status**
   Does the application keep the user informed during the interaction? (Information such as progress stages and system state should be provided continuously)

   For example, when creating Hologram the application should notify the user what the next step is. When scanning surfaces the user should be informed when the physical surfaces are difficult to detect or the object can be placed. If it takes time to load an object, the system should inform the user.
   Provide your feedback and possible solution:----------
2- **Match between system and the real world**
   Does the application design follow real-world conventions?

   For example, Hologram should appear as realistically as possible and must be coherent with the scene. They should be fixed to surfaces, as it is in the real world.

   Provide your feedback and possible solution:----------

3- User control and freedom

Does the application provide freedom for users to perform actions and undo incorrect actions?

For example, when creating Hologram, if user decide to retake or delete the hologram and when scanning surfaces, if user place Hologram in an unwanted location, or deletes the object by mistake, the system should support undo and redo and it should confirm with the user when deletion is selected.

Provide your feedback and possible solution:----------

4- Consistency and standards

Does the application have consistent interface layout and user interaction?

For example, Gestures used resize, move the hologram, capture or recording video should be consistent and similar to other application to avoid mistake. user-centered languages should be used.

Provide your feedback and possible solution:----------

5- Error prevention

Does the application avoid mistake and prevent undesired action?

For example, when user submit a video, system should present user with a confirmation option before they submit. If the user does not confirm, it would return the previous step.

Provide your feedback and possible solution:----------

6- Recognition rather than recall

Is it easy to memorize how to work with the application (e.g. create and edit hologram)

For example, useful gestures for resizing the Hologram, the marker functionalities and positioning, all possible actions should be easy to memorize (e.g. undo/redo, delete, change color);

Provide your feedback and possible solution:----------

7- Flexibility and efficiency of use

Is it easy to interact with the application for novice users?

For example, creating profile, recording, and viewing Hologram the minimum of action should be required. There should not be any inconvenience in the operation while the user is holding the device in one hand. system should allow the user to scan the surface, change the location or other properties of hologram easily without watching tutorial.

Provide your feedback and possible solution:----------

8- Aesthetic and minimalist design

Does the application show irrelevant or rarely used information to the user?

For example, process of create, edit, publish and viewing Hologram should be easy to understand for all users. The system should have easy-to-understand visual design for interactive AR environment.

Provide your feedback and possible solution:----------

9- Help users recognize

Does the application diagnose, and recover from errors?

For example, the moment the system has trouble detecting surfaces, the user should be informed of the reason and help the user correct the error.

Provide your feedback and possible solution:----------

10- Help and documentation

Does the application have a brief and easy to find tutorial for first time users?

Such a system usually should not have explicit documentation because it should be intuitive to use. However, the application should have a brief tutorial for first time users. Particularly, recording Hologram and surface detection is an action that most users are not familiar with. So there should be a brief tutorial and explicit indication telling the user how to create hologram and how to detect surfaces. The possibility of translating and rotating the objects should also be clearly communicated to the user.

Provide your feedback and possible solution:----------

11- Accessibility of off-screen objects.

Is it easy for novice users to find items when those items are outside the field of view?

In addition to visual elements, multimedia elements like audio should be provided.

Provide your feedback and possible solution:----------

12- Environment setup:

Does the application require the simple environment setup?

For example, recording video, setting up the environment and background, scanning the surface should be as simple as possible.

Provide your feedback and possible solution:----------

13- Accuracy:

Does the application achieve the accurate outcome?

For example, the created hologram or the detected surface should be right and accurate.

Provide your feedback and possible solution:----------

14- Satisfaction

Is the navigation, interaction and screen design enjoyable and pleasant?
Interaction is an important aspect of AR applications, and the user must have positive attitudes toward the system

Provide your feedback and possible solution:----------

Appendix 5 – Survey- Cognitive walkthrough evaluation

HoloX: In this research we will be conducting usability evaluation for HoloX as one of the holographic AR applications which has been made by NexTech AR Solutions Company. HoloX is an application that lets you create, share, and view human holograms on the smartphone Devices (currently available for iOS devices). Users see 2D Human hologram as 3D by using the Augmented Reality Technology. The application can be used for Announcements, Delivering message, Virtual training, Product walk-through demos, In-store demonstration and so on. Users can pinch and zoom the hologram.

Cognitive walkthrough evaluation: we are using this method as a structured approach to inspect the interaction between the user and the interface through some pre-defined tasks.

Please perform below tasks:

Task 1:

1- Open the application
2- Create account
3- Log out
4- Log in to your account
5- Edit your profile picture
6- Change password
7- Use forgot password option

Please answer the below questions:

1- Did you achieve the right outcome?
2- Did you notice that the correct action is available?
3- Did you associate the correct action with the outcome you expect to achieve?
4- If the correct action is performed; did you see that progress is being made towards your intended outcome?

Task 2:

(a) Open the application
(b) Scan the provided QR code

(c) Detect surface
(d) Place the model in your environment in a desired way
(e) Adjust the scale of the 3D model
(f) Try to move the 3D model
(g) Take a photo or record a video
(h) Read and close help window
(i) Try to download the hologram QR code
(j) Return to home page

Please answer the below questions:

5- Did you achieve the right outcome?
6- Did you notice that the correct action is available?
7- Did you associate the correct action with the outcome you expect to achieve?
8- If the correct action is performed; did you see that progress is being made towards your intended outcome?

Task 3:

(a) Open the application
(b) Try to make a hologram
(c) Take background picture
(d) Record your video
(e) Submit your video
(f) Publish your hologram
(g) Edit your hologram
(h) Play your hologram
(i) share your hologram

Please answer the below questions:

1- Will the user try and achieve the right outcome?
2- Will the user notice that the correct action is available to them?
3- Will the user associate the correct action with the outcome they expect to achieve?
4- If the correct action is performed; will the user see that progress is being made towards their intended outcome?

Please provide your overall feedback and suggestions for improvement:

Task 1:
Task 2:
Task 3:

Appendix 6 – Questionnaire

HoloX:In this research we will be conducting usability evaluation for HoloX as one of the holographic AR applications which has been made by NexTech AR Solutions Company. HoloX is an application that lets you create, share, and view human holograms on the smartphone Devices (currently available for iOS devices). Users see 2D Human hologram as 3D by using the Augmented Reality Technology. The application can be used for Announcements, Delivering message, Virtual training, Product walk-through demos, In-store demonstration and so on. Users can pinch and zoom the hologram.

Characterize your experience in the environment, by marking an "X" in the appropriate box of the 5-point scale. Do not skip questions or return to a previous question to change your answer.

Strongly Disagree 1	2	3	4	Strongly Agree 5
○	○	○	○	○

Please perform the following tasks:

Task 1: Create account
Task 2: Create Profile Photo
Task 3: Create Hologram
Task 4: View generated hologram
Task 5: Share generated hologram
Task 6: Scan the provided QR code
Task 7: Adjust the scale of hologram

Please rate the 30 questions below:

1- When beginning to use the device and application, it was straightforward. (e.g. create, view, and share the holograms and adjusting usage settings)
2- The system provided me with feedback on what I was working. I was not confused or lost while performing the task.
3- The messages that appeared in the application were self-explanatory and I understood what they were trying to explain.
4- I was in control of the application all the time.
5- I could easily undo/redo any action if I felt to do it.
6- If I mistakenly record video, I could easily stop uploading it.
7- The navigation through the application was easy.
8- The application had many errors and/or crashed.
9- The option to select the desired function was always clear and available all the time and the icon images helped me to know the appropriate functionality of the available options.
10- It was easy to find the desired options at any time.
11- The application was visually well-designed.
12- If error messages appeared, they were clear in their description and probable steps to recover from it were provided.

13- When I needed help, there was helping document to complete my task successfully.
14- The application provides hints throughout to guide with the next steps.
15- The system did not behave as I expected.
16- I could not always achieve what I wanted the system to do.
17- I kept making mistakes interacting with the system.
18- Accurate pointing to detect surface was easy to achieve.
19- Hand interactions were difficult to perform.
20- When creating hologram voice interactions were properly recognized by the system.
21- The audio instructions provided were easy to understand.
22- The quality of generated hologram was very realistic
23- Interaction with the system was fast enough.
24- If moving while using the application, the augmentations stay still regarding to the place they should appear in relation to my movement?
25- The hologram appears in appropriate size.
26- Generated Hologram and the background are easily differentiated from each other (i.e. is the brightness and contrasts appropriate)
27- The information offered by the application organised and grouped clearly?
28- The information which requires action is identified easily. (It is highlighted or differentiated in any other ways).
29- It is easy to create hologram.
30- The time of the usage of the application was appropriate.

Please provide your overall feedback and suggestions for improvement:

Appendix 7 – Laboratory evaluation

HoloX: In this research we will be conducting usability evaluation for HoloX as one of the holographic AR applications which has been made by NexTech AR Solutions Company. HoloX is an application that lets you create, share, and view human holograms on the smartphone Devices (currently available for iOS devices). Users see 2D Human hologram as 3D by using the Augmented Reality Technology. The application can be used for Announcements, Delivering message, Virtual training, Product walk-through demos, In-store demonstration and so on. Users can pinch and zoom the hologram.

Please perform the pre-defined tasks below and then characterize your experience in the environment, by marking an "X" in the appropriate box of the 5 point scale.

There is a possibility for the experimenter to do video/audio recordings of the user interface and user interactions. This helps the experimenter to analyze that given a user interface, how the users are going to use it.

Please perform the following tasks:

Task 1: Create account
Task 2: Create Profile Photo
Task 3: Create Hologram
Task 4: View generated hologram
Task 5: Share generated hologram
Task 6: Scan the provided QR code
Task 7: Adjust the scale of hologram

Strongly Disagree 1	2	3	4	Strongly Agree 5
○	○	○	○	○

Item No.	SUS Questionnaire
1	I think that that I would like to use this application frequently.
2	I found the application unnecessarily complex.
3	I think the application was easy to use.
4	I think the I would need the support of Assistant to be able to use this system.
5	I think that the various functions in this system were well integrated.
6	I think there was too much inconsistency in this application.
7	I think that most of the people would learn to use this system very quickly.
8	I found the application very cumbersome to use.
9	I felt very confident using the application.
10	I needed to learn a lot of things before they could get going with this application.