DALHOUSIE UNIVERSITY

RESEARCH ETHICS BOARDS APPLICATION FORM

Prospective Research

This form should only be used if new data will be collected. For research involving only secondary use of existing information (such as health records, student records, survey data or biological materials), use the *REB Application Form – Secondary Use of Information for Research.*

This form should be completed using the *Guidance for Submitting an Application for Research Ethics Review*.

SECTION 1. ADMINISTRATIVE INFORMATION [File No: office only]

Indicate the preferred Research Ethics Board to review this research:

[ ] Health Sciences OR [x] Social Sciences and Humanities

Project Title: Use of Augmented Reality for Coastal Water Navigation

1.1 Research team information				
Lead researcher (at Dalhousie)	Name	**Randy Herritt**		
	Email (@dal)	**rn851080@dal.ca**	Phone	**(**902) 817-2048
	Banner #	**B00423833**	Academic Unit	**C**omp Sci
Co-investigator names, affiliations, and email addresses	Dr. Stephen Brooks, sbrooks@cs.dal.ca			
Contact person for this submission (if not lead researcher)	Name			
	Email		Phone	
Study start date	May 3, 2021	Study end date	May 7, 2021	

1.2 For student submissions (including medical residents and postdoctoral fellows)			
Degree program	Masters of Computer Science		
Supervisor name and department	Dr. Stephen Brooks		
Supervisor Email (@dal)	sbrooks@cs.dal.ca	Phone	
Department/unit ethics review (if applicable). **Undergraduate minimal risk research only**.			
Attestation: [ ] I am responsible for the unit-level research ethics review of this project and it has been approved. Authorizing name: Date:			

1.3 Other reviews		
Other ethics review (if any) for this research	Where?	
	Status?	
Scholarly/scientific peer review (if any)		
Is this a variation on, or extension of, a previously approved Dal REB submission?	[ ] No [ ] Yes Dal REB file #_____	
If yes, describe which components of the current submission are the same as the previously approved submission (list section numbers), and which components are different from the previously approved submission (list section numbers). You may also use highlighting to clearly indicate revised text.		

1.4 Funding [X] Not Applicable		
Funding (list on consent form)	Agency	
	Award Number	
	Institution where funds are/will be held	[ ] Dalhousie University [ ] Other: _____

1.5 Attestation(s). The appropriate boxes *must* be checked for the submission to be accepted by the REB

[X] I am the **lead researcher** (at Dalhousie) named in section 1.1. I agree to conduct this research following the principles of the Tri-Council Policy Statement *Ethical Conduct for Research Involving Humans* (TCPS) and consistent with the University *Policy on the Ethical Conduct of Research Involving Humans*.

I have completed the TCPS Course on Research Ethics (CORE) online tutorial.

[X] Yes [ ] No

For Supervisors (of student / learner research projects):

[X] I am the **supervisor** named in section 1.2. I have reviewed this submission, including the scholarly merit of the research, and believe it is sound and appropriate. I take responsibility for ensuring this research is conducted following the principles of the TCPS and University Policy.

I have completed the TCPS Course on Research Ethics (CORE) online tutorial.

[X] Yes [ ] No

SECTION 2. PROJECT DESCRIPTION

2.1 Lay summary

2.1.1 In **plain language**, describe the rationale, purpose, study population and methods to be used. Include a summary of background information or literature to contextualize the study. What new knowledge, or public or scientific benefit is anticipated? [maximum 500 words]

Coastal water navigation is the process of directing a ship's movements when in close proximity to land and other shipping. It is a very complex tasks that requires a Navigator to combine and process information from multiple sources. While interacting with these information systems, the Navigator is unable to look out the ship's windows. Any time spent not looking out the windows increases the risk of a maritime incident (running aground or colliding with other shipping). Additionally, the large amount of information can cause delays in making assessments that also increases risk.

Augmented Reality (AR) provides a way for computers to process multiple sources of data and then visualize the information obtained. This presents an opportunity to visualize navigation information in ways that may assist a Navigator in the conduct of coastal water navigation. The information can be presented via optical see through devices which would allow the

Navigator to remain looking out the ship's windows. This has the potential to improve maritime safety and decrease risk of groundings and collisions.

The purpose of this study is to simulate the presentation of navigation information visualizations to ship's navigators for appraisal to gain insight into how AR can be used to used as a tool for coastal water navigation.

This user study will be conducted remotely to respect COVID-19 social distancing requirements. The participants and the researchers will not be collocated. Instead, distributed desktop applications, screen share and voice communication software (Microsoft Teams) will be used. A desktop application will be provided that presents a virtualized maritime environment. A set of proposed AR visualizations will be presented to the Navigator. After a tutorial session for each visualization, the Navigator will attempt to safely navigate the virtual ship using mouse and keyboard controls. The participants will be provided a questionnaire asking for feedback on the visualizations.

[ ] This is a pilot study.

[x] This is a fully developed study.

2.1.2 Phased review. If a phased review is being requested, describe why this is appropriate for this study, and which phase(s) are included for approval in this application. Refer to the guidance document before requesting a phased review.

[x] Not applicable

2.2 Research question

State the research question(s) or research objective(s).

The research objective will be to gain feedback from subject matter experts on the feasibility of using AR for the conduct of coastal water navigation and to identify how the proposed visualizations could be improved to best suit user need.

2.3 Recruitment

2.3.1 Identify the study population. Describe and justify any inclusion / exclusion criteria. Also describe how many participants are needed and how this was determined.

The study population will be professional navigators with at least 1 year of navigation experience. The preference will be given to those navigators familiar with the navigation principles outlined in Bowditch's American Practical Navigator (Bowditch) because the visualizations were developed with consideration for these navigation practices. We want navigators who have at least 1 year experience to ensure they the appropriate amount of expertise to adequately judge the visualizations being presented.

As the principles outlined in Bowditch are in use by professional Navies of the world, naval officers from the Royal Canadian Navy (RCN) and Royal Australian Navy (RAN) Officers will be recruited. A secondary population of consideration is commercial mariners. As such, recruits may include coast guard navigators or professional mariners operating for private companies.

2.3.2 Describe recruitment plans and append recruitment instruments. Describe who will be doing the recruitment and what actions they will take, including any screening procedures.

Recruitment will be done by the primary researcher. The primary method for recruitment will be to contact professional mariners directly via email or phone call and to follow up on any referrals. LinkedIn and referrals will be used to identify professional mariners.

2.3.3 If you require permission, cooperation, or participation from a community, organization or company to recruit your participants, describe the agreement obtained from the relevant group(s). Attach correspondence indicating their cooperation and/or support (required). Describe any other community consent or support needed to conduct this research. (If the research involves Indigenous communities complete section 2.11).

[x] Not applicable

2.4 Informed consent process

2.4.1 Describe the informed consent process:

A) How, when and by whom will the study information be conveyed to prospective participants? How will the researcher ensure prospective participants are fully informed?

Prospective participants will receive a copy of the consent form (Appendix A) via email (Appendix B) after they indicated an interest in participating in the study. They will be instructed to read the consent form before giving consent. The email will also indicate to prospective participants that they can ask clarifying questions regarding the study or the form itself.

B) Describe how consent will be documented (e.g. written signature, audio-recorded, etc).

Consent will be recorded via a web survey (hosted at surveys.dal.ca).

Participants who opt not to provide consent and not to participant will receive a “Thank you” message and will not be able to proceed.

[X] Append copies of all consent information that will be used (e.g. written consent document, oral consent script, assent document/script, etc).

Note: If the research will involve third party consent (with or without participant assent), and/or ongoing consent, ensure these are described above.

2.4.2 Discuss how participants will be given the opportunity to withdraw their participation (and/or their data) and any time (or content) limitations on this. If participants will not have opportunity to withdraw their participation and/or their data explain why.

Participants are informed in the consent form and that they can withdraw from the study at any time.

Participants can opt to withdraw their data from the study up to 2 weeks after the interview. If a participant opts to withdraw from the study, their questionnaire will be securely erased.

2.4.3 If an alteration/exception to the requirement to seek prior informed consent is sought, address the criteria in TCPS article 3.7A. If the alteration involves deception or nondisclosure, also complete section 2.4.4.

[X] Not applicable

2.4.4 Describe and justify any use of deception or nondisclosure and explain how participants will be debriefed.

[X] Not applicable

2.5 Methods, data collection and analysis

2.5.1

A) Where will the research be conducted?

Research will be conducted remotely using Microsoft Teams. Participants will be able to participate in the study at their homes.

B) What will participants be asked to do?

The Participant will be asked download and install an application onto their computer. Images of the software in use is included in Appendix C. The software application will be pre-scanned with anti-virus software. They will be asked to share their screen using Microsoft Teams while running the application. As illustrated in Appendix C, the participant will use the desktop application to learn more about each ARNA. The application will provide a description of each ARNA followed by a guided tour with prompts to direct the user to view different aspects of the visualization. They will then answer questions to rate the visualizations (Appendix D). They will be given a task to control the virtual ship to avoid collision with other ships, avoid running aground, and to arrive at a destination within 30 seconds of a estimated time of arrival. They will then be asked follow on questions on how they used the visualizations through the task (Appendix D).

C) What data will be collected using what research instruments? *(Note that privacy and confidentiality of data will be covered in section 2.6)*

The following data will be collected:

- answers to the questionnaire questions (Appendix D) will be collected using Opinio at https://surveys.dal.ca/opinio/admin/folder.do
- video and audio recording of screenshare session will be collected using Microsoft Teams and Open Broadcaster Software (OBS).

D) How much of the participant's time will participation in the study require?

Approximately 2 hour will be required. The guided ARNA presentations and user driven portion of the application have programed duration of approximately 1 hour. Another hour is anticipated for completion of questionnaire questions.

[ ] Append copies of all research instruments (questionnaires, focus group questions, standardized measures, etc)

[ ] This is a clinical trial (physical or mental health intervention) – ensure section 2.12 is completed

2.5.2 Briefly describe the data analysis plan. Indicate how the proposed data analyses address the study's primary objectives or research questions.

After using the desktop application, the participant will be asked to complete the questionnaire (Appendix D). The questionnaire will ask how much they agree with the statements about each ARNA (Strongly Disagree/Somewhat Agree/Neither Agree nor disagree/Somewhat agree/Strongly agree). The interview results will be tabulated to provide a scoring for each question. Scoring will be conducted by assigning the following numbers to each checkbox:

- Strongly Disagree = -2
- Somewhat Disagree = -1
- Neither agree nor disagree = 0
- Somewhat agree = +1
- Strongly Agree = +2

In some cases, where the statement is negative towards the ARNA, then the scoring will be reversed. For example, "The Track ARNA is confusing" would consider "Strongly Disagree" as +2 instead of -2.

Participant responses will be compared and aggregated. Positive averaged scores for each ARNA will support the hypothesis that augmented reality can be used to assist in coastal water navigation. Positive average responses for each question related to improving safety will support the assertion that AR can be used to improve maritime safety.

Participants feedback is also requested in written form. This feedback, in addition to comments made by the user during the screenshare, will be used as suggestions for future work.

2.5.3 Describe any compensation that will be given to participants and how this will be handled for participants who do not complete the study. Discuss any expenses participants are likely to incur and whether/how these will be reimbursed.

The participants will not be compensated.

2.6 Privacy and confidentiality

2.6.1

A) Describe who will have knowledge of participants' identities.

Only the PI will know the relationship between participant's name and unique participant IDs.

B) Describe the level of identifiability of the study data (anonymous, anonymized, de-identified/coded, identifying) (see TCPS Chapter 5A – types of information for definitions).

Data from this study will be associated to participants IDs (Coded Information).

C) Specify which members of the research team (or others) will have access to participants' data and for what purpose.

The results from the interview questions might be used in presentations, publication and defenses.

D) Describe measures to ensure privacy and confidentiality of study documents and participant data during the data collection and analysis phase. *[Note that plans for long term storage will be covered in 2.6.2*]

- Address: handling of documents/data during data collection; transportation or transfer of documents/data; storage of documents/data (during the study).
- If a key-code will be maintained, describe how it will be kept secure.
- For electronic data, describe electronic data security measures, including file encryption and/or password protection as applicable.
- For hard copy documents, describe physical security measures (specify location).

We will use Opinio (Dal Surveys) for the questionnaire. The questionnaire will include multiple choice answers and written responses to questions. Personal information from the questionnaire will be stripped to a separate file. Data will always refer to Participant ID.

[ ] This research involves personal health records (ensure section 2.13 is completed)

2.6.2 Describe plans for data retention and long-term storage (i.e. how long data will be retained, in what form and where). Will the data eventually be destroyed or irreversibly anonymized? If so, what procedures will be used for this? Discuss any plans for future use of the data or materials beyond the study currently being reviewed.

Survey responses will be stored on Opinio on the Dalhousie Servers. Recorded audio and video from the screenshare will be stored on a secure encrypted server at the Faculty of Computer Science, Dalhousie University. The data will be retained for three years and after this span of time all of the electronic data will be deleted permanently from the system. Only the researchers listed in the consent form will have access to the data collected in this study.

[ ] This research will be deposited in a data repository (ensure section 2.14 is completed)

2.6.3

Describe if/how participant confidentiality will be protected when research results are reported:

A) For quantitative results - In what form will study data be disseminated?

[ ] Only aggregate data will be presented

[X] Individual de-identified, anonymized or anonymous data will be presented

[ ] Other. If "other", briefly describe dissemination plans with regard to identifiability of data.

[ ] Not applicable, only qualitative data will be presented

B) For qualitative results - Will identifiable data be used in research presentations/publications? If participants will be quoted, address consent for this and indicate whether quotes will be identifiable or attributed.

[ ] Not applicable, only quantitative data will be presented

Participants are given the option to allow or not researchers to use quotes when disseminating results in the consent form. These quotes would be collected from the written questions in the questionnaire (Appendix D) and from the recorded audio capture during the user study. We will use participant IDs for quotes.

2.6.4 Address any limits on confidentiality, such as a legal duty to report abuse or neglect of a child or adult in need of protection, and how these will be handled. Ensure these are clear in the consent documents. (See the guidance document for more information on legal duties and professional codes of ethics).

[X] Not applicable

2.6.5 Will any information that may reasonably be expected to identify an individual (alone or in combination with other available information) be accessible outside Canada? And/or, will you be using any electronic tool (e.g. survey company, software, data repository) to help you collect, manage, store, share, or analyze personally identifiable data that makes the data accessible from outside Canada?

[X] No

[ ] Yes. If yes, refer to the University *Policy for the Protection of Personal Information from Access Outside Canada*, and describe how you comply with the policy (such as securing participant consent and/or securing approval from the Vice President Research and Innovation).

2.7 Risk and benefit analysis

2.7.1 Discuss what risks or discomforts are anticipated for participants, how likely risks are and how risks will be mitigated. Address any particular ethical vulnerability of your study population. Risks to privacy from use of identifying information should be addressed. If applicable, address third party or community risk. (If the research involves Indigenous communities also complete section 2.11)

There are no anticipated physical risks associated with participation beyond those associated with everyday computer use. There may be some mild confusion for participants in that they will be using a new software application for the first time. We do not anticipate that this will exceed the usual levels of concentration or confusion commonly experienced when someone uses new software for the first time.

2.7.2 Identify any direct benefits of participation to participants (other than compensation), and any indirect benefits of the study (e.g. contribution to new knowledge).

Participating in the study might benefit participants in the long term. Results from the study might be used to create new navigation tools which could be used by the participants.

2.8 Provision of results to participants and dissemination plans.

2.8.1 The TCPS encourages researchers to share study results with participants in appropriate formats. Describe your plans to share study results with participants and discuss the process and format.

Participants are given the chance, when completing the consent part of the questionnaire, to add their e-mail address to receive the results of this researcher when after it has been accepted for publication.

Those participants that provided their email addresses for this purpose will receive a summary of the findings after the results are published.

2.8.2 If applicable, describe how participants will be informed of any material incidental findings – a discovery about a participant made in the course of research (screening or data collection) that is outside the objectives of the study, that has implications for participant welfare (health, psychological or social). See TCPS Article 3.4 for more information.

[X] Not applicable

2.8.3 Describe plans for dissemination of the research findings (e.g. conference presentations, journal articles, public lectures etc.).

Results from this study will be used for the lead researcher's MCS thesis and possibly for publication in Computer Science journals or conferences.

2.9 Research Team

2.9.1 Describe the role and duties of all research team members (including students, RA's and supervisors) in relation to the overall study.

Dr. Brooks is a faculty member in Computer Science. He will provide oversight during the study trials and will take part in analysis after the event. Investigator Randy Herritt has developed the study design under the direction of Dr. Brooks. This study is an integral part of his MCS Thesis.

2.9.2 Briefly identify any previous experience or special qualifications represented on the team relevant to the proposed study (e.g. professional or clinical expertise, research methods, experience with the study population, statistics expertise, etc.).

Dr. Brooks has previous experience designing and executing user studies in the data visualization field. Investigator Randy Herritt does not have experience in conducting user studies.

2.10 Conflict of interest

Describe whether any dual role or conflict of interest exists for any member of the research team in relation to potential study participants (e.g. TA, fellow student, teaching or clinical relationship), and/or study sponsors, and how this will be handled.

[X] Not applicable

2.11 Research involving Indigenous peoples

Consult TCPS Articles 9.1 and 9.2 in determining whether this section is applicable to your research.

[X] Not applicable – go to 2.12

2.11.1 If the proposed research is expected to involve people who are Indigenous, describe the plan for community engagement (per TCPS Articles 9.1 and 9.2). If community engagement is not sought, explain why the research does not require it, referencing TCPS article 9.2.
2.11.2 State whether ethical approval has been or will be sought from Mi'kmaw Ethics Watch and if not, why the research does not fall under their purview. If the research falls under the purview of other Indigenous ethics groups, state whether ethical approval has been or will be sought.
2.11.3 Describe plans for returning results to the community and any intellectual property rights agreements negotiated with the community with regard to data ownership (see also 2.11.4 if applicable). Append applicable research agreements.
2.11.4 Does this research incorporate OCAP (Ownership, Control, Access, and Possession) principles as described in TCPS Article 9.8? [ ] Yes. Explain how. [ ] No. Explain why not.

2.12 Clinical trials
[X] Not applicable – go to 2.13
2.12.1 Will the proposed clinical trial be registered? [ ] No. Explain why not. [ ] Yes. Indicate where it was/will be registered and provide the registration number.
2.12.2 If a novel intervention or treatment is being examined, describe standard treatment or intervention, to indicate a situation of clinical equipoise exists (TCPS Chapter 11). If placebo is used with a control group rather than standard treatment, please justify.

2.12.3 Clearly identify the known effects of any product or device under investigation, approved uses, safety information and possible contraindications. Indicate how the proposed study use differs from approved uses.

[ ] Not applicable

2.12.4 Discuss any plans for blinding/randomization.

2.12.5 What plans are in place for safety monitoring and reporting of new information to participants, the REB, other team members, sponsors, and the clinical trial registry (refer to TCPS Articles 11.6, 11.7, 11.8)? These should address plans for removing participants for safety reasons, and early stopping/unblinding/amendment of the trial. What risks may arise for participants through early trial closure, and how will these be addressed? Are there any options for continued access to interventions shown to be beneficial?

2.13 Use of personal health information

[X] Not applicable

2.13.1 Research using health information may be subject to Nova Scotia's *Personal Health Information Act*. Describe the personal health information (definition explained in the guidance document) required and the information sources, and explain why the research cannot reasonably be accomplished without the use of that information. Describe how the personal health information will be used, and in the most de-identified form possible.

2.13.2 Will there be any linking of separate health data sets as part of this research?

[ ] No

[ ] Yes

If yes:

A) Why is the linkage necessary?

B) Describe how the linkage will be conducted (it is helpful to append a flow diagram)

C) Does that linkage increase the identifiability of the participants?

2.13.3 Describe reasonably foreseeable risks to privacy due to the use of personal health information and how these will be mitigated.

2.14 Data Repositories [X] Not applicable
2.14.1 Identify and describe the data repository in which the research data will be deposited. What is its focus, who are its target users, who can access deposited data and under what circumstances? For how long will the data be kept in the repository?
2.14.2 Describe the data set to be released to the repository. If there is personal and/or sensitive information in the data, describe how you will prepare the data for submission to the repository and mitigate risks to privacy. Identify all fields that will be included in the final data set (include as an appendix).
2.14.3 Is agreeing to have one's data deposited a requirement for participation in the study? If yes, provide a justification. If no, indicate how participants can opt in or out.

SECTION 3. APPENDICES

Appendices Checklist. Append all relevant material to this application in the order they will be used. This may include:

[ ] List of References

[ ] Permission letters (e.g. Indigenous Band Council, School Board, Director of a long-term care facility)

[ ] Research agreements (required for research involving Indigenous communities)

[ ] Support/cooperation correspondence

[X] Recruitment documents (posters, oral scripts, online postings, invitations to participate, etc.)

[ ] Screening documents

[X] Consent/assent documents or scripts

[X] Research instruments (questionnaires, interview or focus group questions, etc.)

[ ] Debriefing forms

[ ] List of data fields included in data repository

Consent Form Templates

Sample consent forms are provided on the Research Ethics website and may be used in conjunction with the information in the *Guidance* document to help you develop your consent form.

DALHOUSIE UNIVERSITY

CONSENT FORM

Project title: Use of Augmented Reality for Coastal Water Navigation

Lead researcher: Randy Herritt, Dalhousie University, rn851080@dal.ca, (902) 817-2048

Other researchers
Dr. Stephen Brooks, sbrooks@cs.dal.ca

Funding provided by: NIL

Introduction
We invite you to take part in a research study being conducted by Randy Herritt, who is a student at Dalhousie University. Choosing whether or not to take part in this research is entirely your choice. There will be no impact to you if you decide not to participate in the research. The information below tells you about what is involved in the research, what you will be asked to do and about any benefit, risk, inconvenience or discomfort that you might experience.
You should discuss any questions you have about this study with Randy Herritt or Dr. Stephen Brooks. Please ask as many questions as you like. If you have questions later, please contact Randy Herritt.

Purpose and Outline of the Research Study
The aim of this study is to get feedback on the use of augmented reality visualizations for assistance to coastal water navigation. The application simulates the user being on the bridge of a ship while displaying simulated AR visualizations within a desktop application.

The application has sections for each visualization. Each section of the application has an associated description section that explains the visualization's purpose followed by a tutorial. The user can look around the scene by using the computer mouse similar to being in a first-person video game. In these sections, control of the ship is automated.

The final section combines the visualizations together in a simulated navigation passage. The user has control of the ship using the keyboard arrow keys. The user is asked to use the visualizations to maintain track and avoid collision with other ships.

The user is provided with a questionnaire to evaluate each visualization and to provide general feedback.

Who Can Take Part in the Research Study
You may participate in this study if you are a professional mariner with at least 1 year of navigation experience, have access to a Window's computer running Windows 10, have an internet connection, and have a microphone connected to the computer.

Mariners familiar with the navigation principles outlined in Bowditch's American Practical Navigator (Bowditch) are preferred.

What You Will Be Asked to Do
If you decide to participate in this research, you will be asked to download and run a desktop application to a window's computer. You will be asked to connect to a meeting with an audio connection. You will be asked to close all other applications besides the downloaded software and the communication software itself. You will be requested to share your desktop screen with the researcher.

You will be asked to select and view each sections description and carry out the tutorial. Upon completion of the tutorial, you will be asked to control the simulated ship using the mouse and keyboard arrow keys to carry out a simulated navigation passage using the AR visualizations.

Possible Benefits, Risks and Discomforts
Benefits: Participating in the study might not benefit you directly, but we might learn things that will benefit others.

Risks: The risks associated with this study are minimal; there are no known risks for participating in this research beyond being bored or fatigued, or confused by using a new piece of software. You will be offered breaks between activities to reduce these risks.

During the user study, you will be asked to share your screen and audio with the researchers. Your screen and audio will be recorded.

Compensation / Reimbursement
Participants are not being compensated for their participation in this study.

How your information will be protected:
Your participation in this research will be known only to members of the research team. At the beginning of the user study, you will be reminded that your screenshare and audio will be recorded.

The information that you provide to us, your audio, and your screenshare will be kept confidential. Only the research team at Dalhousie University will have access to this information. The people who work with us have an obligation to keep all research information confidential. All your identifying information (such as your name and contact information) will be securely stored separately from your research information. We will use a participant number (not your name) in our written and computer records so that the research information we have

about you contains no names. During the study, all electronic records will be kept secure in an encrypted file on the researcher's password-protected computer. No paper records will be kept.

We will describe and share our findings in the researcher's thesis and thesis's defense. We will only report group results and not individual results. This means that you will not be identified in any way in our reports.

We will not disclose any information about your participation except as required by law or our professional obligations. If you inform us about abuse or neglect of a child or an adult in need of protection, we are required by law to contact authorities. If we notice that you are at an immediate risk of harming yourself or other people, we are required by our professional code of ethics as social workers to seek assistance.

You can opt out in and out of having your quotes used as part of the disseminating results of this study. Quotes are collected from the questionnaire form in use. On the questionnaire form, you will be given an option to either allow or not allow excerpts from your written feedback to be quoted.

Once the study is over your personal information will be deleted from our data repositories. Stored information will contain the questionnaire responses and feedback but will be void of any personal identifying information. Despite these measures, I cannot guarantee your anonymity or predict how those who access the data will use them.

If You Decide to Stop Participating

You are free to leave the study at any time. If you decide to stop participating during the study, you can decide whether you want any of the information that you have provided up to that point to be removed or if you will allow us to use that information. After participating in the study, you can decide for up to 1 week if you want us to remove your data. After that time, it will become impossible for us to remove it because it will already be anonymized.

How to Obtain Results

We will provide you with a short description of group results when the study is finished. No individual results will be provided. You can obtain these results by providing your contact information at the time of participation.

Questions

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact Randy Herritt at 902-817-2048, rn851080@dal.ca or Dr. Stephen Brooks at sbrooks@dal.ca at any time with questions, comments, or concerns about the research study (if you are calling long distance, please call collect).

If you have any ethical concerns about your participation in this research, you may also contact Research Ethics, Dalhousie University at (902) 494-3423, or email: ethics@dal.ca (and reference REB file # 20XX-XXXX).

Signature
Signatures will not be required as part of this informed consent process. Downloading and running the application is taken as implied consent.

Appendix B – Sample Email

Good day Sir/Ma'am,

We are recruiting professional navigators for a Dalhousie University Master of Computer Science User Study. The User Study aims to get subject matter expert feedback on the feasibility of the use of Augmented Reality Navigation Aids (ARNAs) for coastal water navigation.

Currently, in order to obtain the navigation information required, Navigating Officers (NavOs) make use of bridge equipment. The time spent interacting with this equipment introduces risk, as it pulls their focus away the bridge windows and the quickly changing marine environment. We suggest that Augmented Reality (AR) will offer a way to provide the information required while still allowing the navigator to maintain a proper and effective lookout. Additionally, we suggest that some of this information could be visualized in new ways that could improve maritime safety.

This user study will be done completely remotely to ensure participant safety during the COVID-19 pandemic. We created a Desktop Application that allows testing and evaluating these ARNAs. After an initial privacy check, the participant would be requested to download the application to their computer and share their screen with the researcher while using it.

The application displays each visualization in series to the user. The participant is provided with a description of how the ARNA is used. Then, the use of the ARNA is demonstrated using a ship simulation. During the ship simulation, the participant can move the mouse around to view in first person the marine environment and ARNAs being demonstrated. Finally, the desktop application gives control to the user to allow them to control the ship's movements using keyboard arrow keys. They are provided with directions to avoid collisions with other shipping and to arrive at the destination on time. It is expected to take less than 1 hour to complete the desktop application portion of the user study.

After the desktop application portion, the participant is provided with a questionnaire which asks for feedback on each proposed ARNA. A series of statements are provided about each visualization. The participant indicates how much or how little they agree with the statement. For each visualization, the participant is provided an opportunity to provide written feedback to the researchers. After completing these sections, the participant is provided an opportunity to provide written feedback on the use of ARNAs as whole.

Participation in the study is completely voluntary and is not compensated. Meeting the following requirements are necessary for participation:

- You must be a current or former professional navigator with at least one year of experience in navigating ships at sea.
- You must have access to a Windows 10 Desktop Computer.
- You must have an internet connection
- You must be willing to share audio using either a computer microphone, such as a headset used for Skype communication, or a phone dialed into the meeting invite.
- You must be willing to download the application.
- You must be willing to share your screen with the researcher, including downloading any additional software required to do so (such as Skype).

Thank you for your consideration. If you are interested in participating, please contact the lead researcher at randy.herritt@dal.ca.

Appendix B – Sample Email

Thank you,

Randy Herritt

(902) 817-2048
Master of Computer Science Graduate Student
Dalhousie University
6299 South St, Halifax, NS B3H 4R2

Appendix C – Application Screenshots

This document provides screenshots of the application for the Augmented Reality in Costal Water Navigation User Study.

The application begins with a title screen, figure 1.

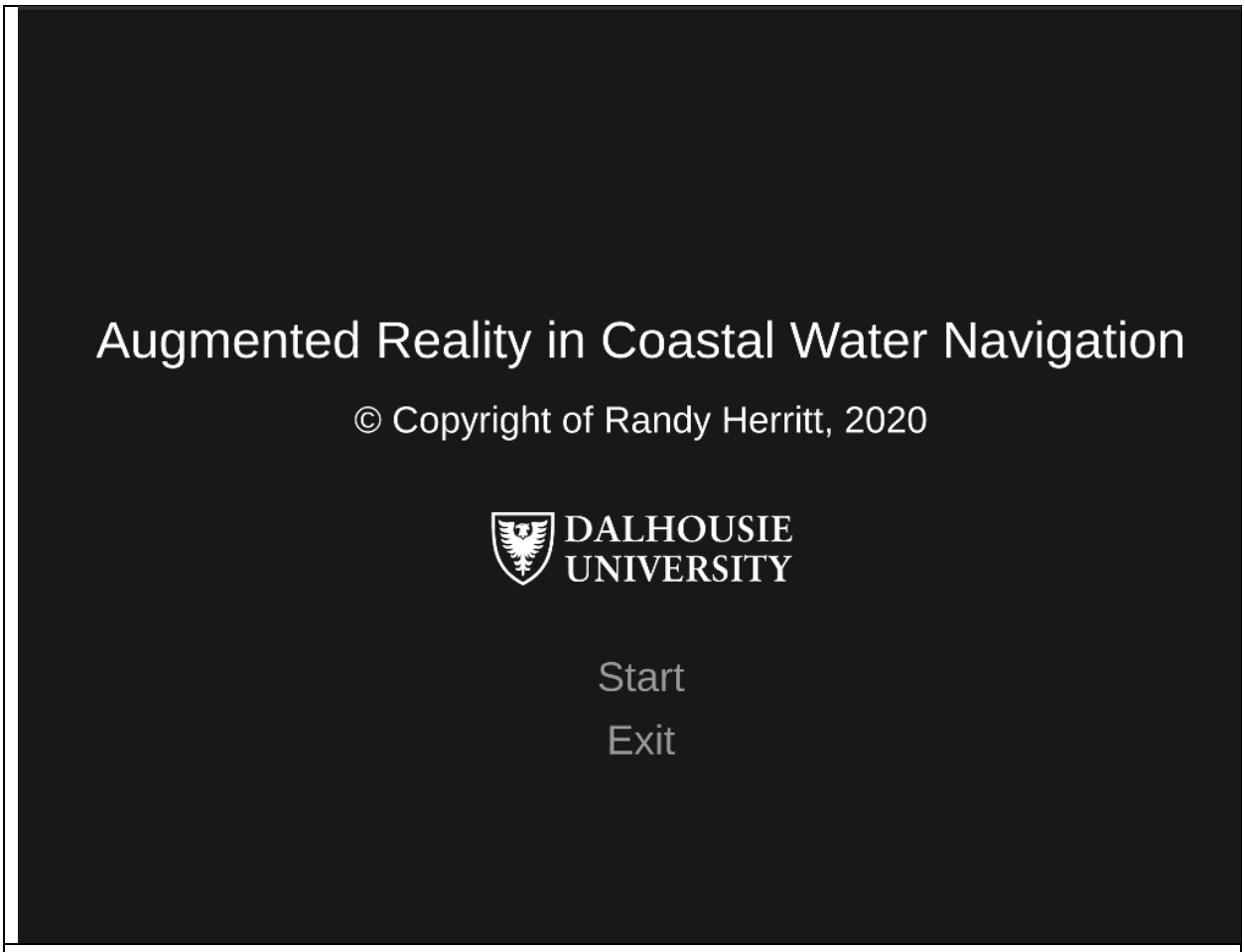

Figure 1: Title Screen

After clicking Start, the user is presented with an overview of the risks (figure 2).

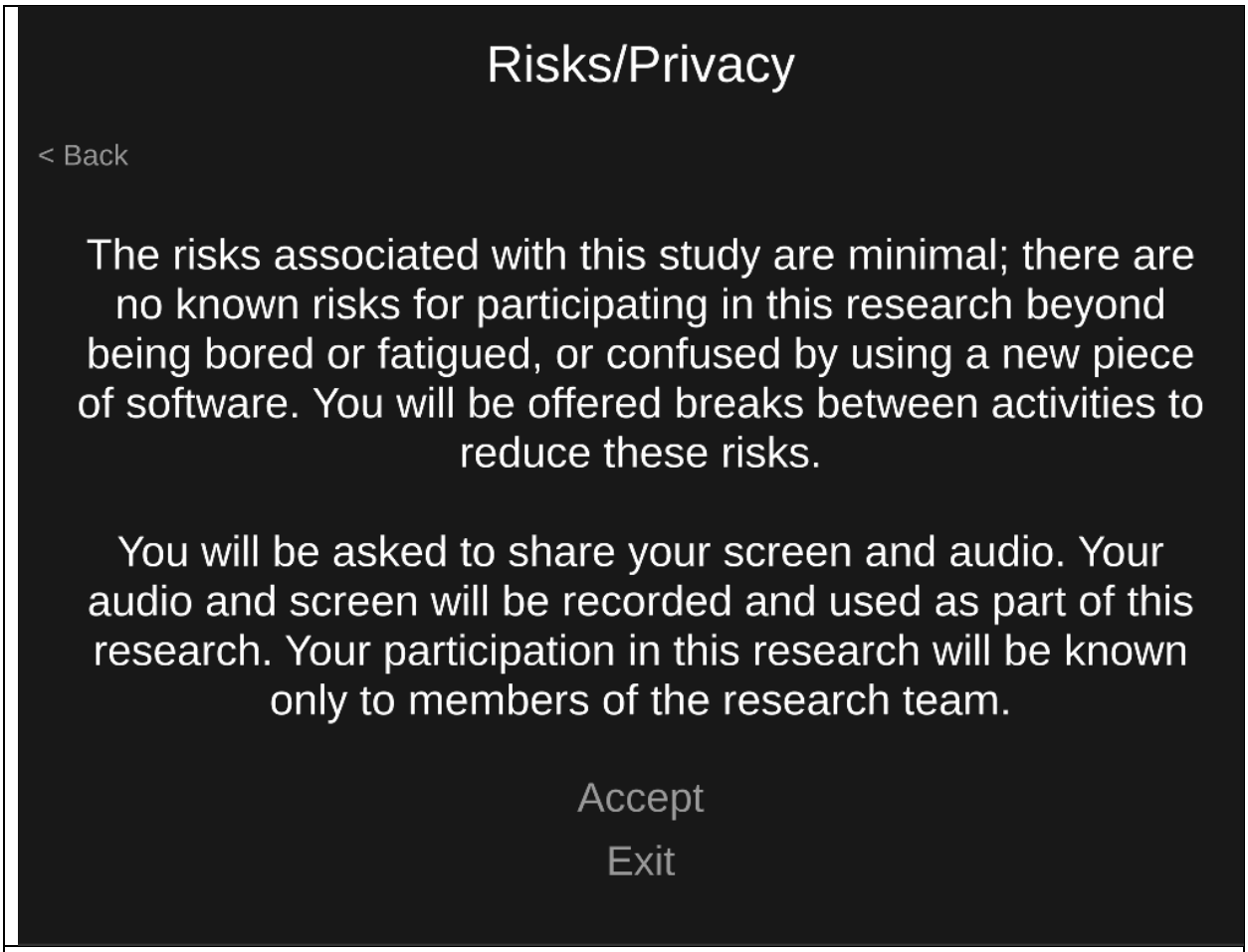

Figure 2: Risks

After accepting the risks, the application transitions to the main menu (figure 3).

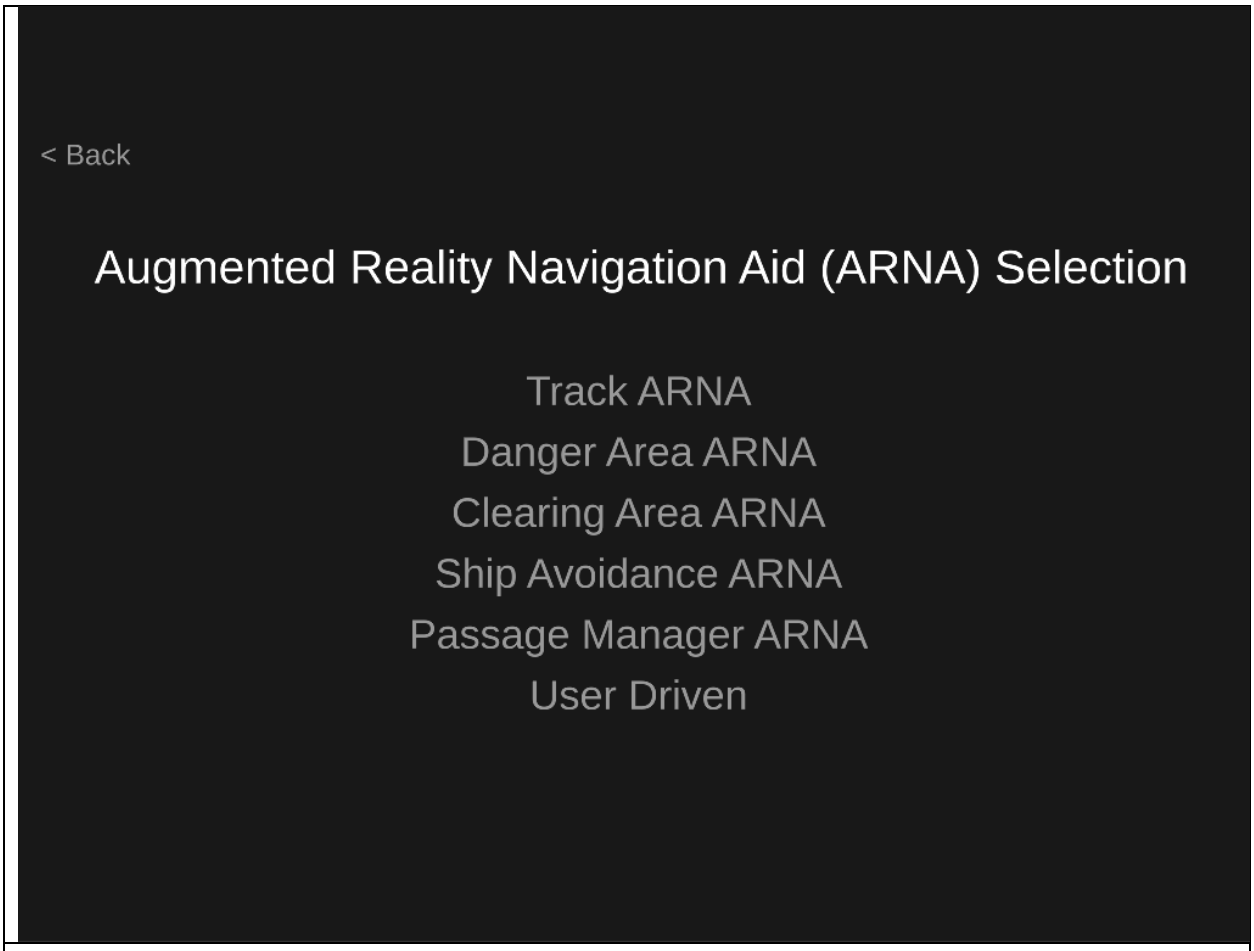

Figure 3: Main Menu

After selecting one of the options, the user is presented slides that show how the Augmented Reality Navigation Air (ARNA) works (figure 4).

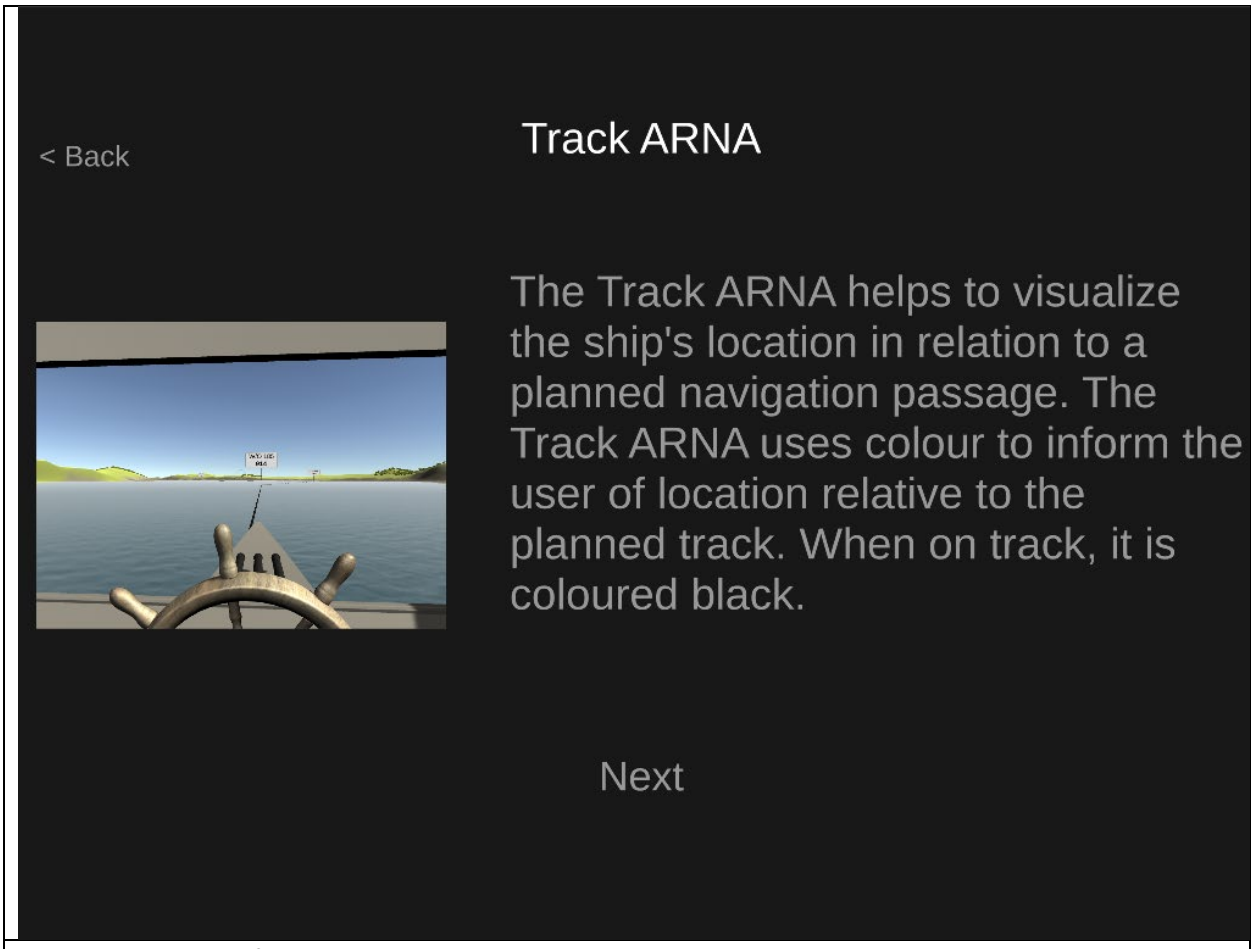

Figure 4: First Slide for Track ARNA instructions

After clicking next through multiple slides, the last slide gives the option to start that portion of the user study (figure 5).

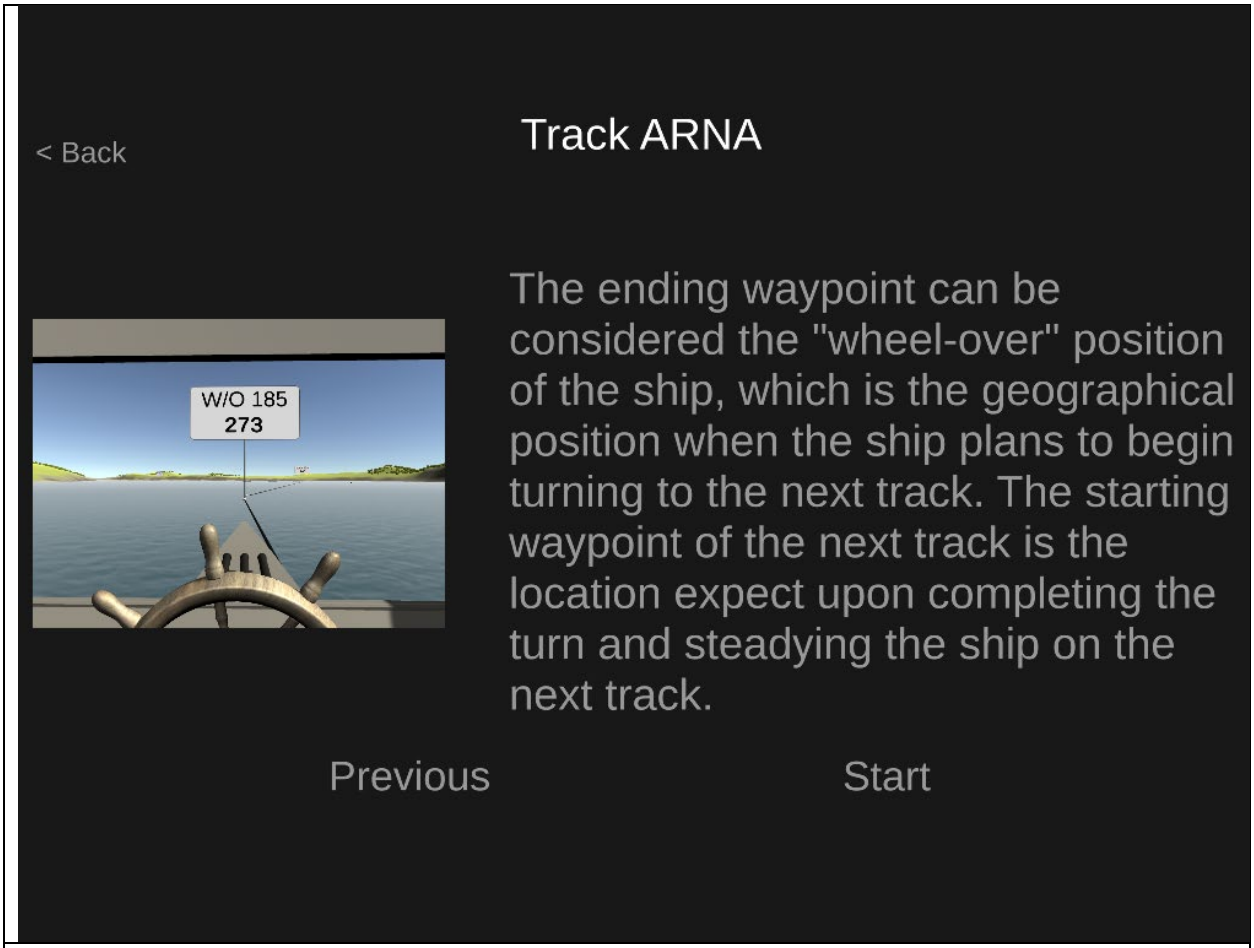

Figure 5: Final slide of instructions for Track ARNA

Upon clicking start, the scene transitions to a 3D visualization of being on the bridge of the ship (figure 6). The user is guided with prompts about the visualization in text form at the top of the screen to help them learn to use the visualization in situ.

Figure 6: Track ARNA visualization

As the user progresses through each visualization, more visualizations are added until the entire set being evaluated is presented. The user is then given controls to drive the ship to arrive at their destination and avoid other shipping (figure 7).

Figure 7: User controlled

DALHOUSIE UNIVERSITY

QUESTIONNAIRE FORM

Project title: Use of Augmented Reality for Coastal Water Navigation

Lead researcher: Randy Herritt, Dalhousie University, rn851080@dal.ca, (902) 817-2048

Other researchers
Dr. Stephen Brooks, sbrooks@cs.dal.ca

Funding provided by: NIL

Questions

1. Do you consent to the researchers quoting text you write in feedback sections below?

☐ **Yes, I consent to my written feedback in this questionnaire being quoted anonymously.**

☐ **No, I do not consent to my written feedback in this questionnaire being quoted.**

Track ARNA

2. Select the degree to which you agree or disagree with each of the following statements:

   a. **The Track ARNA helps to determine if the ship is port or starboard of track.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   b. **The Track ARNA helps to determine how far the ship is from track.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   c. **The Track ARNA helps to determine if the ship is on track.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

d. The Track ARNA helps to determine the distance to wheel over.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

e. **The Track ARNA is confusing.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

f. The Track ARNA would improve safety.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

g. **The Track ARNA would distract the navigator in the conduct of the passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

h. **The colour choices used for the Track ARNA visualization help to determine if you are port or starboard of track.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

3. Please provide any additional comments/feedback you wish the researchers to know about the Track ARNA.

Passage ARNA

4. Select the degree to which you agree or disagree with each of the following statements:

a. **The Passage ARNA is effective in providing the speed required.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

b. **The Passage ARNA is effective in providing the distance to go.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

c. **The Passage ARNA is effective in providing the speed made good.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

d. **The Passage ARNA is effective in providing the estimate time of arrival.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

e. **The information provided in the Passage ARNA is useful in the conduct of a navigation passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

f. The Passage ARNA is confusing.

Strongly disagree	**Somewhat disagree**	**Neither agree nor disagree**	**Somewhat agree**	**Strongly agree**
☐	☐	☐	☐	☐

g. The Passage ARNA would improve safety.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

h. **The Passage ARNA would distract the navigator in the conduct of the passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

i. **The Passage ARNA is confusing.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

5. Please provide any additional comments/feedback you wish the researchers to know about the Passage ARNA.

Collision Avoidance ARNA

6. Select the degree to which you agree or disagree with each of the following statements:

   a. **The Collision Avoidance ARNA is effective in providing the closest point of approach of other ships.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   b. **Being able to toggle the visibility of the Collision Avoidance ARNA is useful.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   c. **The Collision Avoidance ARNA provides information that is useful in determining if a risk of collision exists with other ships.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   d. **The Collision Avoidance ARNA's use of colours (white, yellow, and red) helps prioritize which ships require additional monitoring.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

   e. The Collision Avoidance ARNA is confusing.

Strongly disagree	**Somewhat disagree**	**Neither agree nor disagree**	**Somewhat agree**	**Strongly agree**
☐	☐	☐	☐	☐

f. The Collision Avoidance ARNA would improve safety.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

g. **The Collision Avoidance ARNA would distract the navigator in the conduct of the passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

7. Please provide any additional comments/feedback you wish the researchers to know about the Collision Avoidance ARNA.

Danger ARNA

8. Select the degree to which you agree or disagree with each of the following statements:

a. **Red is an appropriate colour for the Danger ARNA.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

b. **The Danger ARNA would improve safety.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

c. **The Danger ARNA would distract the navigator in the conduct of the passage**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

d. **The Danger ARNA is effective in showing the area marked by the limiting danger line.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

e. **The information gained by the Danger ARNA is useful in the conduct of a navigation passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

f. **The Danger ARNA is confusing.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

g. **The range to the Danger ARNA ahead is useful to the navigator.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

h. **The range to the Danger ARNA astern is useful to the navigator.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

i. **The range to the Danger ARNA abeam is useful to the navigator.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

9. Please provide any additional comments/feedback you wish the researchers to know about the Danger ARNA.

Clearing Area ARNA

10. Select the degree to which you agree or disagree with each of the following statements:

a. **Yellow is an appropriate colour for the Clearing Area ARNA.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

b. **The Clearing Area ARNA would improve safety.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

c. **The Clearing Area ARNA effectively visualizes clearing bearings and/or clearing depths.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

d. **The Clearing Area ARNA is effective in alerting the navigator to monitor the proximity of the ship's stern to dangers when altering course.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

e. **The Clearing Area ARNA is confusing.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

f. **The Clearing ARNA would distract the navigator in the conduct of the passage.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
☐	☐	☐	☐	☐

11. Please provide any additional comments/feedback you wish the researchers to know about the Clearing Area ARNA.

General Feedback

12. Please provide any additional comments/feedback you wish the researchers to know about the use of ARNAs for coastal water navigation.