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Cyber security risks in telepresence robotics and their mitigation

Master's Thesis (21 ECTS)

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Cyber security risks in telepresence robotics and their mitigation

Abstract:
Telepresence robotics (TRPs) have become increasingly popular, particularly in higher education systems, as they enable users to remotely partake in events. However, this increased usage also presents potential security risks specific to TRPs, such as remote connections, cyber-physical presence, and live video and audio feeds. Current risk assessment models do not adequately address these unique concerns, leading to a gap in understanding and mitigating TRPs related risks. This thesis aims to map potential security issues, offer mitigation strategies for found weaknesses, and bridges the gap by conducting case studies and expert interviews. This research will provide organizations utilizing TRPs with a better understanding of security risks and effective solutions to protect their systems and users.

Keywords: Cyber security, risk assessment, telepresence robotics

CERCS: T120 System technology, computer technology

Küberturvalisuse riskid kaugkohalolu robootikas ja nende vähendamine

Lühikokkuvõte:
Kaugkohalolu robotid on muutunud üha populaarsemaks, eriti kõrgemas haridussüsteemis, kuna need võimaldavad kasutajatel osaleda üritustel kaugjuhtimise teel. Siiski kaasnevad selle suurenenud kasutamisega ka kaugkohalolu robotitele omased potentsiaalsed turvariskid, nagu kaugühendus, küber-füüsiline kohalolek ning reaalajas video- ja heliside. Praegused riskihindamise mudelid ei käsitle piisavalt neid ainulaadseid probleeme, ning on olemas lünk seotud riskide mõistmisel ja nende leevendamisel. Käesoleva magistritöö eesmärk on kaardistada potentsiaalsed turvaprobleemid ja pakkuda leitud nõrkuste leevendamiseks strateegiaid ning ületada lünk, viies läbi juhtumiuuringuid ja ekspert intervjuusid. See uurimus annab kaugkohalolu roboteid kasutavatele organisatsioonidele parema arusaama turvariskidest ja tõhusatest lahendustest nende süsteemide ja kasutajate kaitsmiseks.

Keywords: Küberturvalisus, riskianalüüs, kaugkohalolu robootika

CERCS: T120 Süsteemitehnoloogia, arvutitehnoloogia

List of Abbreviations and Terms

TRPs Telepresence robotics

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1 Introduction

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1.1 Problem Statement

With the increasing popularity of TRPs in higher education systems, enabling users to remotely partake in events, new security risks specific to TRPs have emerged. These risks include remote connection, cyber-physical presence, and live video and audio feed vulnerabilities. However, current risk assessment models do not adequately address these unique concerns, resulting in a knowledge gap in understanding and mitigating TPR-related risks. This master's thesis aims to explore potential security issues associated with TRPs and propose methods to mitigate them by incorporating existing frameworks, such as RSF, CIA, OCTAVE A, ISO27005, and NSMROS.

The research will involve identifying and validating potential risks through case studies and expert interviews, with a focus on user data security. By proposing mitigation strategies and emphasizing user data security, this study seeks to provide organizations utilizing TRPs with a better understanding of security risks and effective solutions to protect their systems and users. Ultimately, this research will contribute to bridging the gap between existing risk assessment models and the unique security concerns presented by the growing use of TRPs in higher education systems.

1.2 Objectives and Roadmap

1.2.1 Research Objective

The primary objective of this thesis is to identify cybersecurity risks related to organizations using TRPs and propose mitigation strategies to reduce the identified risks, focusing on user data security.

1.2.2 Research Questions

RQ: To what kind of security risks are organisations using TRPs exposed to, and how to mitigate the risks?

The main research question is divided into three different how questions, the potential security risks posed by TRPs, how organisations have assessed the potential risks and the solutions that can be provided to reduce the identified risks. The following sub-research questions are formulated in sequential order according to their importance:

1. **RQ1**: What are the potential security risks posed by TRPs, and how do these risks uniquely impact organizations utilizing these systems?

2. **RQ2**: How have organizations implemented assessment and management strategies to address cybersecurity risks associated with telepresence robotics?
3. **RQ3**: What potential solutions can be provided to reduce identified security risks?

RQ1: Identification of potential security risks posed by TRPs is the first step. In this step the possible security risks will be identitified by analyzing existing frameworks, migigation strategies and examining the case study. This sub-research question focuses on uncovering the distinct security risks associated with telepresence robotics and examines their implications for organizations that deploy TRPs. By identifying these risks, the research will contribute to a comprehensive understanding of the challenges and vulnerabilities that need to be addressed in order to protect user data and ensure secure operation of TRPs systems. This exploration will consider various aspects of TRPs, such as remote connectivity, cyber-physical presence, and live video and audio feeds, to highlight the unique security concerns that arise from their use. Additionally, the research will investigate how these risks may differ from those faced by organizations using other types of robotics and what factors contribute to the increased vulnerability of TRPs systems.

RQ2: Once we have identified possible security risks the next step is to examine how have organizations implemented assessment and management strategies to address cybersecurity risks associated with TRPs? This sub-research question focuses on understanding the mechanisms and processes involved in managing TRPs systems . Finding the issues and gaps in current implementation is important to validate found security risks from teoretical material, but is also important before appropriate mitigation strategies can be considered. Addressing this question is essential for identifying potential vulnerabilities and areas where security improvements can be made.

RQ3: What potential solutions can be provided to reduce identified security risks? Following the identification of security risks associated with TRPs, this sub-research question concentrates on investigating and proposing potential mitigation strategies that effectively address the recognized risks. The study will explore a range of solutions, including technological advancements, policy implementation, and organizational practices, to provide a comprehensive understanding of how organizations can secure their TRPs systems.

The proposed solutions should be practical, effective to the needs of organizations using TRPs. This will involve considering the unique security risks posed by TRPs and the distinct contexts in which they are deployed. The focus will be on user data security and the interaction between external users and TRPs, ensuring that the proposed mitigation strategies safeguard sensitive information and maintain the privacy and security of all parties involved.

By addressing these three sub-research questions, the thesis aims to provide a comprehensive understanding of the security risks faced by organizations using TRPs and offer practical solutions for mitigating these risks, ultimately contributing to a more secure and reliable TPR environment.

1.2.3 Roadmap and Structure

To achieve the research objective, the following roadmap and structure will be followed:

1. Literature Review and analysis: A comprehensive review of existing research on TRPs, risk assessment models, and related frameworks will be conducted to identify potential issues within TRPs systems.
2. Case Studies: Case studies will be conducted to validate the newly developed risk assessment model by analyzing real-life scenarios involving TRPs usage in organizations.
3. Expert Interviews: Interviews with technical staff who have experience in integrating TRPs into organizations will be conducted to confirm the identified risks and explore possible mitigation strategies proposed by the experts.
4. Data Analysis and Proposed Mitigation Strategies: The findings from case studies and expert interviews will be analyzed to identify potential security concerns and risks posed by TRPs, as well as potential solutions to these risks.
5. Conclusion: The thesis will conclude by summarizing the key findings, discussing the limitations of the research, and suggesting avenues for future research.

Following this roadmap, the thesis will contribute to bridging the gap between existing risk assessment models and the unique security concerns presented by the growing use of TRPs in higher education systems.

1.3 Limitations

Time, resources, nr of case studies and access to experts are the main limitations of this research.

1.4 State of the Art

1.5 Preliminaries

None?

2 Related Work

3 Background

3.1 Telepresence Robotics

3.2 Cyber Security Risks in Robotics

3.3 Existing Risk Assessment Models

4 Data Analysis

4.1 Identified Security Risks in TPRs

4.2 Existing risk assessment and management strategies

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9.3 Limitations and Future Research

Appendix

I. TPR-specific Risk Assessment Model

II. Interview Guide and Consent Form

III. Licence

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