

UNIVERSITY OF TECHNOLOGY SYDNEY

DOCTORAL THESIS

---

# Managing Privacy in Photos and Videos in Social Media Applications

---

*Author:*

Srinivas R Madhisetty

*Joint Supervisors:*

Distinguished Professor Mary-Anne Williams

and

Doctor Benjamin Johnston

*A document submitted in fulfilment of the requirements  
for the degree of Doctor of Philosophy*

*in the*

Innovation and Enterprise Research Laboratory (The Magic Lab)

Faculty of Engineering and Information Technology

May 2019

# Declaration of Authorship

I, Srinivas R Madhisetty, declare that this thesis is submitted to fulfill the requirements for the award of Doctor of Philosophy, in the Faculty of Engineering and Information Technology at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

Signed:      Production Note:  
Signature removed prior to publication.

---

Date:      21 - May -2019

---

# *Abstract*

Privacy protection can be attributed primarily to a change in the nature and size of threats to privacy partly attributed to the rapid technological change. Unprecedented use of technology such as surveillance, social media recording, storage, and retrieval of information have made it difficult for individuals to retain and maintain levels of privacy that was once enjoyed before extensive use of such technologies. ” *Traditional expectations of privacy with regards to the gathering and processing of personal data are increasingly difficult to*” maintain in the new environment[1].

This research developed a conceptual model for managing privacy when photos and videos are exchanged via social media. What is considered as sensitive for privacy reasons varies from individual to individual. For example, when a document is shared the exchange of information is grounded to a specific context. Such contextual grounding may not be explicitly present when a photo or a video is shared because a photo or a video may have tacit information embedded in it. Information which is not explicit but is stored in a photo or a video that disclose unintended information is called tacit information in this thesis.

It is difficult to gauge the loss of privacy if a photo or a video contains sensitive information which is tacit in nature and if such information is shared.

By sharing such a photo or a video, it may result in harm to the individual’s privacy. Harm, could be understood as a loss of reputation in this thesis. As social media transmits such photos and videos to others, this makes the management of the published content’s privacy difficult.

Social media applications like Facebook, Twitter, WhatsApp and many more applications are becoming popular. The instant sharing of information via photos and videos is making the management of privacy more difficult. There is a lack of awareness amongst users of social media that the content they published could be used against them or in ways which they did not intend when they first published the content.

A state of reasonable privacy is achieved through trust and negotiation with other parties, often with the implicit expectation that the information shared will not be used or shared without the content owner's consent. However, when users upload content, they may lose the control of the content they provided.

The objective of this research is to determine how photos and videos can be securely stored and retrieved by identifying how to manage key sensitive information? In photos and videos.

Identifying sensitive information in a photo or a video is a major problem for people who use social media, therefore rather than making assumptions about what is sensitive in a photo or a video, this research asked a group of study participants why they share content and what concerns they have. This enabled inferences to be made about categories of sensitivity in accordance with the participants' responses.

This research uses particular words such as 'sensitive', 'managed', 'privacy'. Defining these terms is difficult because what is considered as sensitive or managed or privacy to one person may be different from another. This research rather than defining or scoping these terms in a particular context, it asked participants what 'sensitive', 'management' and 'privacy' mean to them.

The latter part of this thesis develops a new conceptual framework based on how participants believe privacy could be managed. Interviews were conducted, the interview responses were collated and analyzed using Grounded Theory. A major theme and three sub-themes in which varying levels of privacy concerns were developed, and nine sub-categories that can be applied to the main theme and sub-themes. Key Performance Indicators (KPI's) were developed for each theme. KPI's are measures, for effective management of privacy for each theme. One of the contributions in this dissertation is a description of how the identified KPI's are interrelated.

The conceptual framework produced can be used as an evaluation tool or an assessment tool for existing users of social media to ensure privacy to individuals who like to share photos and videos via social media.

# *Acknowledgements*

I would like to thank my joint supervisors, Distinguished Professor Mary-Anne Williams and Dr Benjamin Johnston for their patient guidance, advice and encouragement.

I would like to thank all my colleagues for their support and guidance they have given. I want to specially thank Dr Richard Billingsley and Dr George Feuerlicht for their help and guidance they provided. I will always be grateful to Dr. Richard Raban for providing useful advice many times during my career.

I would like to thank my wife Aparna and my daughter Gowri who supported me in this journey. I dedicate this thesis to my late mother, Smt. Radha, who supported and encouraged me while I was undertaking this study.

# Contents

Declaration of Authorship	i
Acknowledgements	iv
Contents	v
List of Figures	xi
List of Tables	xii
Abbreviations	xiii

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	The Problem: How to Manage Privacy . . . . .	1
1.1.1	Why privacy management is important . . . . .	4
1.1.2	Evidence that privacy management is an unsolved problem . . . . .	5
1.1.3	Research question . . . . .	9
1.1.4	Testing the research question . . . . .	9
1.2	Research . . . . .	11
1.2.1	Research objectives . . . . .	11
1.2.2	Research methodology . . . . .	11
1.2.3	The research domain . . . . .	13
1.2.4	Understanding the current situation . . . . .	13
1.3	Significance of Research . . . . .	16
1.3.1	Solving problems in relation to privacy issues . . . . .	16
1.3.2	Revealing new concepts and opportunities . . . . .	17
1.3.3	Stakeholders . . . . .	18
1.4	Summary . . . . .	19
<b>2</b>	<b>Literature Review</b>	<b>21</b>
2.1	Chapter Overview . . . . .	21
2.2	Privacy Problem . . . . .	28
2.3	Trust and Control Used to Manage Privacy . . . . .	28

2.4	Confidence vs Confidence Like Behavior . . . . .	31
2.5	Measuring Confidence . . . . .	31
2.5.1	How to measure confidence about what is shared in photos and videos . . . . .	33
2.5.2	Interpolation and application of confidence from one cate- gory to another . . . . .	33
2.5.3	Overview of current camera technology . . . . .	36
2.6	Conclusion . . . . .	38
<b>3</b>	<b>Research Design and Methodology</b>	<b>39</b>
3.1	Introduction . . . . .	39
3.2	Overview . . . . .	39
3.3	Grounded Theory Methodology (GTM) . . . . .	40
3.4	Coding Interviews . . . . .	43
3.5	Approach . . . . .	43
3.5.1	Finding determinants or key performance indicators of pri- vacy management in a photo or a video . . . . .	44
3.5.2	Analysis of data using grounded theory . . . . .	45
3.5.3	Assumptions . . . . .	46
3.6	Research Method . . . . .	46
3.6.1	Data collection . . . . .	47
3.6.2	Research procedures . . . . .	48
3.6.2.1	Sample saturation . . . . .	48
3.7	Recruitment Process . . . . .	49
3.7.1	Selection of participants . . . . .	50
3.8	Profile of the Participants . . . . .	51
3.9	Interview Style . . . . .	53
3.10	Approach . . . . .	54
3.10.1	Motivation for approach . . . . .	55
3.10.2	Interview integrity . . . . .	56
3.10.3	Grounded theory data analysis . . . . .	57
3.10.4	Interview coding . . . . .	59
3.10.5	Coding refinement to generate themes . . . . .	59
3.11	Theoretical Sensitivity . . . . .	60
3.12	Summary . . . . .	61
<b>4</b>	<b>Research Findings</b>	<b>62</b>
4.1	Overview . . . . .	62
4.2	Themes . . . . .	63
4.3	Core Categories . . . . .	66
4.4	Main-Theme (no concern) . . . . .	67
4.4.1	Main C.1 Trust vs control of information . . . . .	67
4.4.2	Main C.2 The kind of photo shared and its appropriateness . . . . .	68
4.4.3	Main C.3 Unintended consequences . . . . .	69

4.4.4	Main C.4 Perceptions of others and how they engage with their belief systems . . . . .	70
4.4.5	Main C.5 Effective ways to communicate . . . . .	71
4.4.6	Main C.6 Being able to relate to a larger audience . . . . .	72
4.4.7	Main C.7 Information overload . . . . .	72
4.4.8	Main C.9 Targeting by third parties to use information in ways that are unintended . . . . .	73
4.4.9	The three sub-themes under the main-theme . . . . .	74
4.4.10	Low concern sub-theme 1 . . . . .	74
4.4.11	Sub-themes categories . . . . .	75
4.4.11.1	Low C1.1 Trust vs control . . . . .	75
4.4.11.2	Low C1.2 What kind of photos are appropriate for uploading to social media . . . . .	76
4.4.11.3	Low C1.3 Unintended consequences . . . . .	76
4.4.11.4	Low C1.4 Perceptions of others and how they engage with their belief system . . . . .	77
4.4.11.5	Low C1.5 Effective ways to communicate . . . . .	78
4.4.11.6	Low C1.6 Being able to relate to a larger audience . . . . .	78
4.4.11.7	Low C1.7 Information overload . . . . .	79
4.4.11.8	Low C1.8 Effective ways to filter information . . . . .	80
4.4.11.9	Low C1.9 Targeting by third parties to use information in ways that are unintended . . . . .	80
4.4.12	Medium concern sub-theme 1.2: . . . . .	81
4.4.12.1	Med C2.1 Trust vs control . . . . .	81
4.4.12.2	Med C2.2 What kind of photo is suitable? . . . . .	82
4.4.12.3	Med C2.3 Unintended consequences . . . . .	82
4.4.12.4	Med C2.4 Perceptions of others and how they engage with their belief systems . . . . .	83
4.4.12.5	Med C2.5 Effective ways to communicate . . . . .	83
4.4.12.6	Med C2.6 To be able to relate to a larger audience . . . . .	84
4.4.12.7	Med C2.7 Information overload . . . . .	85
4.4.12.8	Med C2.8 Effective ways to filter information . . . . .	85
4.4.12.9	Med C2.9 Targeting by third parties to use information in ways that are not intended . . . . .	86
4.4.13	High concern about privacy sub-theme 1.3: . . . . .	86
4.4.13.1	High C3.1 Trust and control of information . . . . .	86
4.4.13.2	High C3.2 The kind of photo shared and its appropriateness . . . . .	87
4.4.13.3	High C3.3 Unintended consequences . . . . .	87
4.4.13.4	High C3.4 Perceptions of others and how they engage with their belief systems . . . . .	88
4.4.13.5	High C3.5 Effective means of communication . . . . .	88
4.4.13.6	High C3.6 To be able to relate to a larger audience . . . . .	89
4.4.13.7	High C3.7 Information overload . . . . .	89



4.4.13.8	High C3.8 Effective ways to filter information . . .	89
4.5	Summary . . . . .	90
<b>5</b>	<b>Data Analysis</b>	<b>91</b>
5.1	Introduction . . . . .	91
5.2	Questions Used for the Theme . . . . .	93
5.2.1	No concern main-theme 1, sub-themes (low concern, medium concern, high concern) . . . . .	93
5.2.1.1	No concern main-theme 1 . . . . .	93
5.2.1.2	Low concern sub-theme 1.1 . . . . .	94
5.2.1.3	Medium concern sub-theme 1.2 . . . . .	95
5.2.1.4	High concern sub-theme 1.3 . . . . .	95
5.3	Key Performance Indicators . . . . .	96
5.3.1	Main-theme kpi no concern. . . . .	96
5.3.1.1	Forced trust vs control . . . . .	96
5.3.1.2	Content viewed and by whom . . . . .	97
5.3.1.3	Contextual representation . . . . .	97
5.3.1.4	High aperture lenses . . . . .	98
5.3.1.5	Tacit knowledge . . . . .	98
5.3.1.6	Perception . . . . .	98
5.3.1.7	Information overload . . . . .	99
5.3.1.8	Filter information . . . . .	99
5.3.1.9	Downloaded information . . . . .	99
5.3.2	Sub-theme low concern 1.1 key performance indicators for managing privacy. . . . .	100
5.3.2.1	Inhibitions link to forced trust . . . . .	100
5.3.2.2	Diversity in the nature of photos . . . . .	100
5.3.2.3	Awareness ratio to its consequences . . . . .	101
5.3.2.4	Inference of positive privacy . . . . .	101
5.3.2.5	Sharing vs perception . . . . .	102
5.3.2.6	Discretion . . . . .	102
5.3.2.7	Customized photos . . . . .	103
5.3.2.8	Permission to view and download . . . . .	103
5.3.3	Sub-theme medium Concern 1.2 key performance indicators for managing privacy . . . . .	103
5.3.3.1	Trust vs control ratio . . . . .	104
5.3.3.2	Instant availability of information . . . . .	105
5.3.3.3	Profile pictures . . . . .	105
5.3.3.4	Timeframe . . . . .	105
5.3.3.5	Intended reason ratio to perceived reason ratio . . . . .	106
5.3.3.6	Published photos and copyright . . . . .	106
5.3.3.7	Limit the number of photos which the user can see during a day . . . . .	106
5.3.3.8	Learn user behaviour to customise content . . . . .	107

5.3.3.9	Digital identifier . . . . .	107
5.3.3.10	Misuse of a photo or video . . . . .	107
5.3.4	Sub-theme high concern 1.3 key performance indicators for managing privacy . . . . .	107
5.3.4.1	Relevance vs harm . . . . .	107
5.3.4.2	Number of times a photo or a video is renewed . . . . .	108
5.3.4.3	Ability to generate a profile . . . . .	108
5.3.4.4	Trustworthiness . . . . .	109
5.3.4.5	Situation-present or past . . . . .	109
5.3.4.6	Managing the content or ignoring the content . . . . .	109
5.3.4.7	What kind of photo is shared and its appropriateness . . . . .	110
5.3.4.8	Perception of others and how this perception changes the beliefs of others . . . . .	110
5.3.4.9	Effective ways to communicate . . . . .	111
5.3.4.10	To be able to relate to a large audience . . . . .	111
5.3.4.11	Information overload . . . . .	112
5.3.4.12	Effective ways to filter information . . . . .	112
5.3.5	Relationship between key performance indicators in different themes . . . . .	113
5.3.6	Representation of grounded theory data analysis after axial coding. . . . .	115
5.3.7	No concern main-theme 1 . . . . .	116
5.3.8	Low concern sub-theme 1.1 . . . . .	126
5.3.9	Medium concern sub-theme 1.2 . . . . .	134
5.3.10	High concern sub-theme 1.3 . . . . .	141
5.4	Summary . . . . .	145
<b>6</b>	<b>Conclusion</b> . . . . .	<b>146</b>
6.1	Introduction . . . . .	146
6.1.1	How can sensitive information in a photo or a video be man- aged to ensure privacy? . . . . .	147
6.1.2	The objectives of the research and how they were addressed. . . . .	148
6.1.3	Outcomes and how this framework solves specific problems: . . . . .	153
6.1.4	Reasons for choosing grounded theory . . . . .	155
6.1.5	Assumptions in this research . . . . .	156
6.2	One Main Theme and Three Sub-themes . . . . .	156
6.2.1	No concerns main-theme . . . . .	156
6.2.2	Low concern sub-theme 1.1 . . . . .	157
6.2.3	Medium concern sub-theme 1.2 . . . . .	157
6.2.4	High concern sub-theme 1.3 . . . . .	158
6.3	Impact of this Research . . . . .	158
6.3.1	Contributions to the body of knowledge . . . . .	159
6.3.2	Camera technology . . . . .	159
6.3.3	Everyday users . . . . .	160

---

6.3.4	Limitations . . . . .	160
6.4	Future research . . . . .	161
6.5	Conclusion of this Dissertation . . . . .	161
6.5.1	Overarching view about privacy in photos and videos . . . . .	161
6.5.2	Privacy management helps users control their perceived role	162
6.5.3	Privacy management should be taught in schools . . . . .	162
6.5.4	Information should be used only for intended purposes . . . . .	162
6.5.5	Consumers need more control . . . . .	163
6.5.6	Need for accountability . . . . .	163

**Bibliography****164**

# List of Figures

3.1	The Grounded Theory Process . . . . .	41
3.2	Criteria to establish trustworthiness of research Lincon and Guba (1985) [2] . . . . .	58
5.1	Illustration of all privacy concerns from all themes presented in a tabular form. . . . .	115

# List of Tables

3.1	Profile of the participants. . . . .	52
4.1	Related research questions which allowed for the development of the four themes. . . . .	65
5.1	Main-theme 1 Illustration of privacy concern. . . . .	113
5.2	Sub-theme 1.1 Illustration of privacy concerns . . . . .	113
5.3	Sub-theme 1.2 Illustration of privacy concerns in an abbreviated form in the first column, the second column is its description and the third how it has been coded. . . . .	114
5.4	Sub-theme 1.3 Illustration of privacy concerns . . . . .	114

# Abbreviations

<b>CCTV</b>	<b>C</b> losed <b>C</b> ircuit <b>T</b> elevision
<b>DOF</b>	<b>D</b> epth <b>O</b> f <b>F</b> ield
<b>PET</b>	<b>P</b> rivacy <b>E</b> nhancing <b>T</b> echnologies
<b>GTM</b>	<b>G</b> rounded <b>T</b> heory <b>M</b> ethod
<b>ISO</b>	<b>I</b> nternational <b>O</b> rganization for <b>S</b> tandardization
<b>KPI</b>	<b>K</b> ey <b>P</b> erformance <b>I</b> ndicators