FORMAL MODEL OF TRUST DYNAMICS FOR SHORT-TERM HUMAN-ROBOT INTERACTION

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Abstrak

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Perkembangan dalam bidang teknologi robotik pada tahun sebelum ini telah membuka pasaran serta cabaran yang luas dalam bidang tersebut. Interaksi dengan teknologi canggih telah membawa kepada perbincangan yang penting tentang bagaimana interaksi tersebut dimulakan itu mampu mewujudkan interaksi yang lancar antara manusia dengan robot (interaksi manusia-robot)dan mampu bertahan untuk masa yang lama. Salah satu faktor penting yang mempengaruhi tahap interaksi antara manusia dengan robot adalah tahap kepercayaan. Kepercayaan adalah keyakinan bahawa pergantungan kepada individu itu tidak akan membawa kesan negatif atau mendatangkan bahaya. Dari segi psikologi pengkomputan, model formal (model pengkomputan) telah digunakan untuk mendapat gambaran tentang fungsi kognitif serta corak tingkah laku manusia. Oleh itu, kajian mengenai pemodelan formal kepercayaan dalam interaksi manusia-robot dibina untuk menjawab persoalan bagaimana kepercayaan terbentuk semasa manusia berinterkasi dengan robot. Menerusi sorotan berkaitan, terdapat 18 faktor asas yang berkaitan dan ini meliputi; personaliti, penampilan fizikal, kepercayaan tingkah laku, isyarat tingkah laku, tahap automasi, pengalaman positif, ketelusan, persepsi risiko jangka pendek, persepsi risiko jangka panjang, kepercayaan kepada pergantungan jangka pendek, persepsi kecekapan, penyamaran positif, pengalaman positif jangka panjang, kepercayaan jangka pendek, kesangsian jangka pendek, kepercayaan jangka panjang dan ketidakpercayaan jangka panjang. Faktor ini telah digunakan sebagai pengetahuan asas untuk membangunkan kepercayaan manusia terhadap robot. Satu model formal

telah dibangunkan menggunakan set persamaan pembeza. Seterusnya, terdapat lima kes yang berbeza telah digunakan bagi membentuk simulasi untuk menerangkan proses kepercayaan dalam interaksi manusia dan robot; iaitu 1) tahap kepercayaan yang tinggi, 2) tahap kepercayaan sederhana tinggi, 3) tahap kepercayaan sederhana, 4) tahap kepercayaan sederhana rendah dan 5) tahap kepercayaan yang rendah. Model yang dibangunkan telah diuji dengan menggunakan analisis matematik (analisis kestabilan) dan pengesahan automatik (bahasa surih masa).

Abstract

Rapid advance of robotic technologies in the last years have opened numerous venues and great challenges in the field of robotics technology. Interacting with those advanced technologies has carried huge debates on how such interactions can be instigated to create fluent interaction between humans and robots that can last for long time (human-robot interaction). One of the crucial factors that majorly influence the level of interaction between human and robot is the level of trust. Trust is the feeling of confidence that the reliance on other partner will not yield negative or dangerous consequences. In computational psychology domains, formal models (computational models) were used to acquire deep insights of human cognitive functions and behavior patterns. Therefore, this study implements formal model of trust in human robot interaction to answer how trust can be a reason to initiate interaction between human and robot. From related literature, eighteen basic factors have been established that include; personality, physical appearances, believable behavior, behavior cues, level of automation, positive experiences, transparency, perception, long term perceive risk, short term perceive risk, reliable behavior, perceive competency, positive deception, long term positive experiences, short term trust, short term distrust, long term trust, long term distrust. Those factors provide the fundamental knowledge of developing trust in robot. A formal model was developed based on a set of differential equations. Next, Five different cases were implemented to simulate various scenarios that explain the development of trust in HRI; namely, 1) high level of trust, 2) moderate high level of trust, 3) moderate level of trust, 4) moderate low level of trust, and 5) low level of trust. The developed model was verified by using mathematical analysis (stability analysis) and automated verification (temporal trace language).

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Wadhah A. Abdulhussain

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Table of Contents

List of Tables

List of Figures

List of Appendices

CHAPTER ONE
INTRODUCTION

1.1 Background

In all facets of life, people normally communicate frequently and collaborate with each other in several ways and manners. A sample form of this communication and collaboration exists between human and artefacts such as robot, avatar, animation and software agent. The most essential key for interacting with other people or peers most times is based on their interpersonal trust.

In light of this, trust is a pivotal key for cooperative efforts in all aspects of our everyday life (Sanders, Wixon, Schafer, Chen, & Hancock, 2014). Human-interpersonal trust can be well-defined as the enthusiasm or willingness of a party to be exposed to the outcomes of another party. This is based on the expectation that the other party will execute a particular action significant to the trustor, without the capability to control or monitor that other party (Mayer, Davis, & Schoorman, 1995).

Based on previous clarification, specific expectation to the actions of parties, trustee and trustor have been addressed, where trust is typically the characteristic of the trustee (e.g., goodwill, honesty, morality, expertness and care). Trust is a much disputed and common topic in numerous research studies. Hence in addition, the term trust has been extensively examined in different fields such as economics, business, marketing, politics, e-commerce, psychology, sociology, medicine, nursing, and computing science (Masthoff, 2007).

A few numbers of researchers have mentioned in their studies that trust could be represented as different types such as trusting intention, trusting behavior, trusting

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