Correlation Management and Search for the Internet of Things

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To my mother and father,

my wife and my two little princes,

my brother and sister,

who made all of this possible,

for their endless encouragement and patience.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree. I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968. I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

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Abstract

The Internet of Things (IoT) is a compelling paradigm, which aims to enable everyday physical things embedded with electronics, software, sensors, and network connectivity to collect and exchange data on the Internet. It is anticipated that by 2020, billions of things get connected to the Internet. Creating future IoT search engines is a key step towards unlocking answering the above question. Future search engines can potentially in revolutionise various applications in different domains. Existing approaches for searching the IoT use simple techniques to obtain a list of things for a query. The state of the art needs to be improved in different aspects. For instance, it is often disregarded that in the context of IoT, we have two types of users including machines and human users. In addition, many have complained about the absence of the real-world IoT data. Unsurprisingly, a common question that arises regularly nowadays is "Does the IoT already exist?". So far, little has been known about the real-world situation on IoT, its attributes, the presentation of data and user interests. Moreover, existing approaches also disregard the attribute based correlations between things in the real-world. In this dissertation, we review the state of the art in IoT search domain and propose a novel framework to collect and analyse IoT data. Our system is also able to resolve IoT queries based on the knowledge that is acquired from the IoT data sources. Furthermore, we introduce a novel technique to extract the correlations between things. Our framework is capable of using the correlations to improve the quality of search results for both types of users. We investigate the scalability and the effectiveness of our approach using large scale and real-world datasets. Moreover, we investigate two case studies in transport systems in

our research. The first case study, challenges the complex problem of taxi ridesharing in the context of smart cities. The second case study, involves a real-time prediction method for flight delays based on the IoT sourced data.

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