Instituto Superior de Engenharia do Porto

Smart IoT Service Builder Platform

Filipe Cruz

A dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science, Specialisation Area of Software Engineering

Supervisor: Dr. Nuno Silva

Evaluation Committee:
President:
TODO, Professor, DEI/ISEP

Members:
TODO, Professor, DEI/ISEP
TODO, Professor, DEI/ISEP
TODO, Professor, DEI/ISEP

Porto, June 30, 2022

Dedicatory

TODO

Abstract

Today there are more smart devices than people. According to Statista 2021 the number of devices worldwide is forecast to almost triple from 8.74 billion in 2020 to more than 25.4 billion devices in 2030.

The Internet of Things (IoT) is the connection of millions of smart devices and sensors connected to the Internet. These connected devices and sensors collect and share data for use and evaluation by many organisations. Some examples of intelligent connected sensors are: GPS asset tracking, parking spots, refrigerator thermostats, soil condition and many others. The limit of different objects that could become intelligent sensors is limited only by our imagination. But this devices are mostly useless without a platform to analyse, store and present the aggregated data.

Recently, several platforms have emerged to address this need and help companies/governments to increase efficiency, cut on operational costs and improve safety. Sadly, most of this platforms are tailor made for the devices that the company offers. This dissertation presents a platform and its development that assembles multiple services related to IoT into a single application. All the services provided by this platform attempt to be sensor-neutral and are to be exhibited under the same unified application.

Keywords: Internet of Things, Stream Processing, Big Data, Configurability, Real Time Systems

Resumo

Atualmente, existem mais sensores inteligentes do que pessoas. De acordo com Statista 2021, o número de sensores em todo o mundo deve quase triplicar de 8,74 bilhões em 2020 para mais de 25,4 bilhões em 2030.

O conceito de IoT está relacionado com a interacção entre milhões de dispositivos inteligentes através da Internet. Estes dispositivos e sensores conectados recolhem e disponibilizam dados para uso e avaliação por parte de muitas organizações. Alguns exemplos de sensores inteligentes e seus usos são: dispositivos GPS para rastreamento de activos, monitorização de vagas de estacionamento, termostatos em arcas frigoríficas, condição do solo e muitos outros. O número de diferentes objectos que podem vir-se a tornar sensores inteligentes é limitado apenas pela nossa imaginação. Mas estes dispositivos são praticamente inúteis sem uma plataforma para analisar, armazenar e apresentar os dados por eles agregados.

Recentemente, várias plataformas surgiram para responder a essa necessidade e ajudar empresas/governos a aumentar a sua eficiência, reduzir custos operacionais e melhorar a segurança dos espaços e negócios. Infelizmente, a maioria dessas plataformas é feita à medida para os dispositivos que a empresa em questão oferece. Esta tese apresenta uma plataforma que permite a criação e agregação de vários serviços relacionados com IoT num ambiente único. Todos os serviços fornecidos por esta plataforma procuram ser agnósticos em relação aos dispositivos inteligentes suportados.

Acknowledgement

TODO

Contents

List of Figures

List of Tables

List of Algorithms

List of Source Code

List of Symbols

a	distance	m
P	power	W ($\mathrm{J\,s^{-1}}$)
ω	angular frequency	rad

Chapter 1

Introduction

Chapter 2

State of the Art

2.1 Internet of Things

2.1.1 Brief Description

2.1.2 Practical Applications

2.1.3 Enterprise Challenges

2.1.4 Renowned Solutions

2.2 Big Data

2.2.1 Brief Description

2.2.2 Challenges

2.3 Synopsis

Chapter 3

Analysis

3.1 Business Analysis

3.1.1 Fleet Management

3.1.2 Smart Irrigation

3.1.3 Asset Tracking

3.1.4 Smart Parking

3.1.5 Public Health and Indoor Fire Outbreak Surveillance

3.2 Technical Analysis

3.2.1 Data Aggregation

3.2.2 Data Filtering

3.2.3 Data Storage

3.2.4 Data Transformation

3.2.5 Data Analysis

3.2.6 Data Presentation

3.2.7 Trigger Warning System

3.2.8 User Authentication/Authorisation

3.3 Synopsis

Chapter 4

Requirements Elicitation

4.1 Functional Requirements

4.2 Non Functional Requirements

4.3 Synopsis

Chapter 5

Design - Platform

5.1 C4 Level 1 - Context

5.2 C4 Level 2 - Containers

5.3 C4 Level 3 - Components

5.4 Synopsis

Chapter 6

Design - Environment

6.1 Reference architecture

6.2 Shared Domain

6.3 Configuration View

6.4 Operation View

6.5 C4 Level 1 - Context

6.6 C4 Level 2 - Containers

6.7 C4 Level 3 - Components

6.8 Synopsis

Chapter 7

Implementation

7.1 Technical Environment Decisions

7.2 Technical Environment Description

7.3 Environment Testing

7.4 Synopsis

Chapter 8

Evaluation of the Solution

8.1 Approach

8.2 Subjective Critique Evaluation - Configuration View

8.3 Subjective Critique Evaluation - Operation View

8.4 Synopsis

Chapter 9

Conclusion

9.1 Achievements

9.2 Unachieved Results

9.3 Future Work

9.4 Synopsis

Bibliography

Statista, Arne von See (2021). *Number of Internet of Things (IoT) connected devices worldwide from 2019 to 2030*. Accessed: February 6, 2022.

Appendix A

Appendix Title Here

Write your Appendix content here.