A Context-Aware Internet of Things Framework for Remote Monitoring Services

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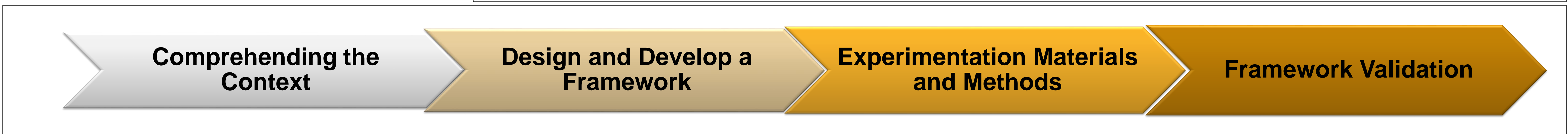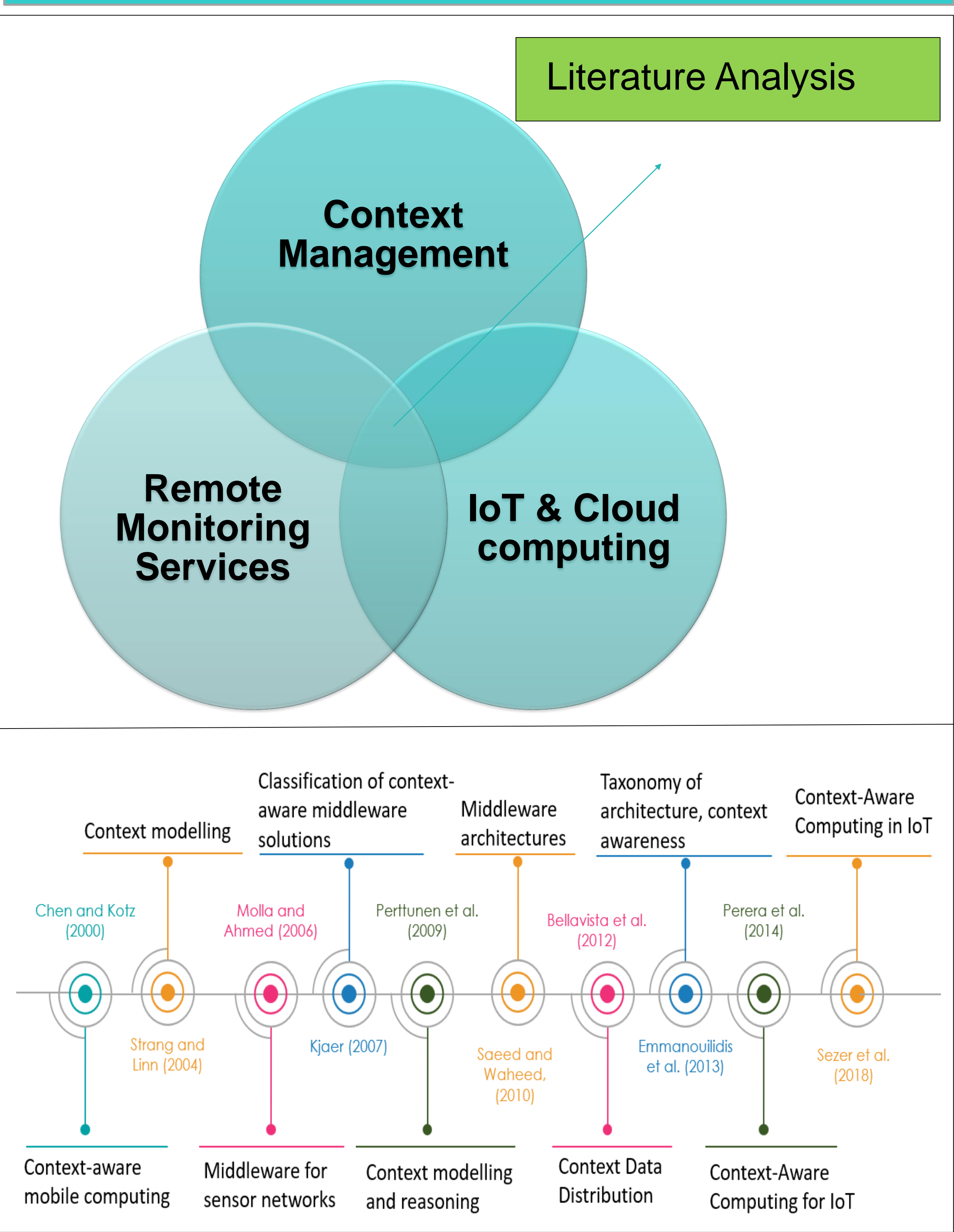## Cranfield University

1- Introduction

The fast evolution of technologies associated with the deeper penetration of IoT in industry creates significant opportunities but also introduces challenges for monitoring service. However, although it offers many benefits and holds many promises, substantial effort is required to manage and exploit the data generated by things. Among the key instruments to tackle such complexity is the concept of context information management.

2- Project Aim

The aim of this research is to design and develop a context-aware framework for the integration of IoT and Cloud computing for remote monitoring services.

3- Project Objectives

1- To define the factors contributing to context acquisition, modelling, reasoning and dissemination for IoT-enabled remote monitoring services.

2- To develop a framework and a context-aware monitoring architecture for employing IoT and cloud computing to address monitoring service challenges.

3- To validate the proposed framework through experiments, case study, and expert judgment.

4- Research Methodology

Comprehending the Context → Design and Develop a Framework → Experimentation Materials and Methods → Framework Validation

5- Literature Review

Literature Analysis

- Context Management
- Remote Monitoring Services
- IoT & Cloud computing

Context modelling — Chen and Kotz (2000), Strang and Linn (2004) — Context-aware mobile computing

Classification of context-aware middleware solutions — Molla and Ahmed (2006), Kjaer (2007) — Middleware for sensor networks

Middleware architectures — Perttunen et al. (2009), Saeed and Waheed (2010) — Context modelling and reasoning

Taxonomy of architecture, context awareness — Bellavista et al. (2012), Emmanouilidis et al. (2013) — Context Data Distribution

Context-Aware Computing in IoT — Perera et al. (2014), Sezer et al. (2018) — Context-Aware Computing for IoT

6- Initial Framework

Monitoring Services

Context Dissemination

Distribution Techniques
- Query Based
- Publish and Subscribe
- Event-Driven
- Micro-services

System Monitoring — Device Monitoring, Automatic Alerts, Dashboard Builder

Business Layer

Result Visualization
- Real-Time Monitoring
- Resource Monitoring
- Visualization

User Front End
- Dashboard Views
- Advanced Analytics
- Alarms
- Data Sharing

Context Reasoning

Reasoning Techniques
- Supervised Learning
- Unsupervised Learning
- Rules
- Fuzzy Logic
- Ontological Reasoning

Service Composition

Software as a service (SaaS)
- Hosted Applications
- Web Service
- Access app data from anywhere

Decision-Making
- Fault Diagnosis
- Maintenance Actions
- Detection and Identification of machine fault

Context Modelling

Modelling Techniques
- Key-Value
- Mark-up Scheme
- Graphical
- Logic-Based
- Ontology Based Modelling

Service Management

Platform as a service (PaaS)
- Middleware
- Analytics Tools
- Database Management Systems
- Operating System

Information Handling
- Outliers Detection
- Pre-Processing
- Conversion from digital signal (data) to real quantities

Context Acquisition

Acquisition Techniques -Based on-
- Responsibility
- Frequency
- Source
- Sensor types
- Acquisition Process

Objects Abstractions

Infrastructure as a service (IaaS)
- Data Transfer
- Data centre physical facility
- Networking and Security
- Servers and Storage

Information Collecting
- Filtering
- Aggregation
- Acquiring useful data by using IoT devices and sensors

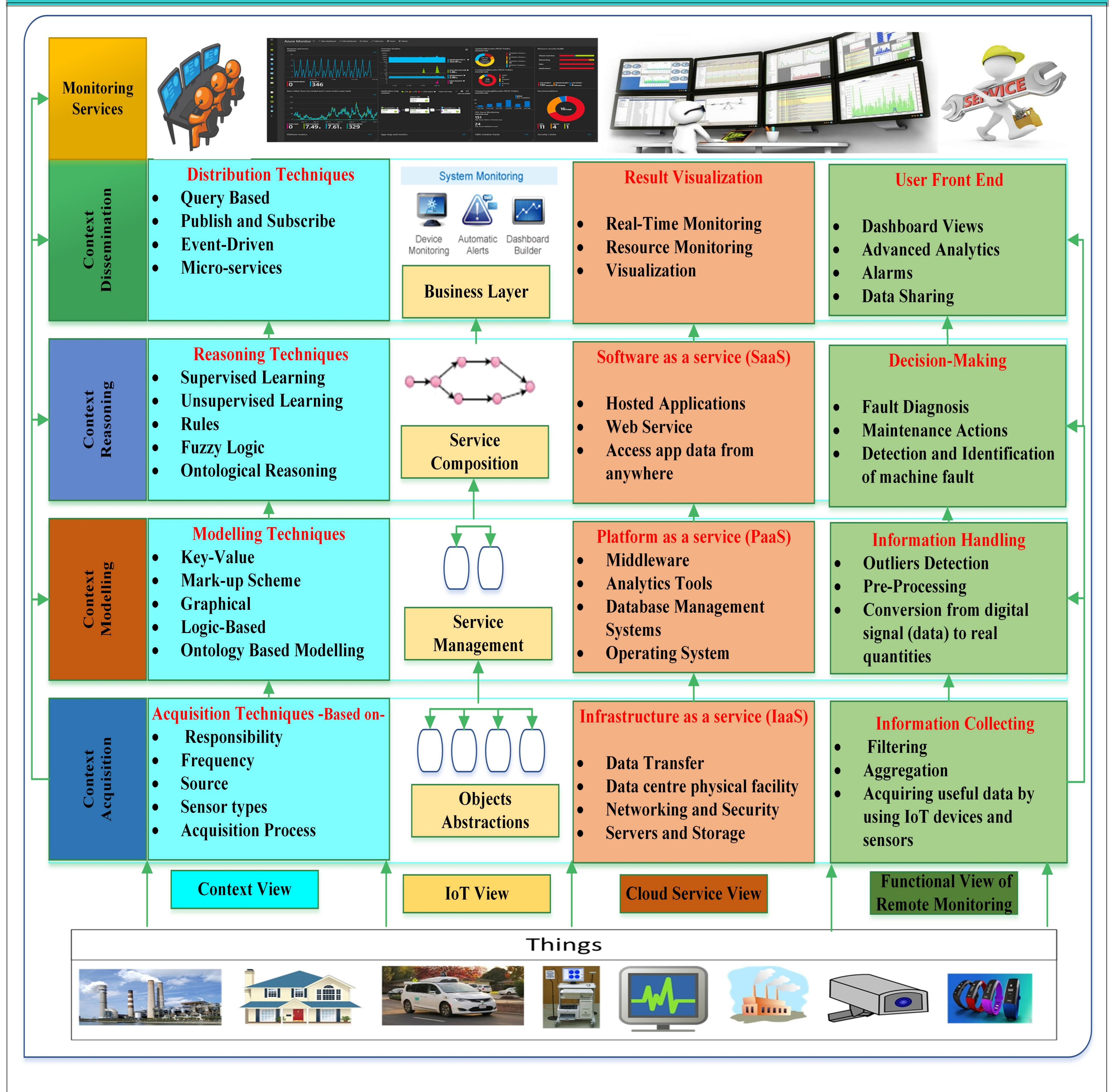Context View | IoT View | Cloud Service View | Functional View of Remote Monitoring

Things

7- Research Gaps

- While substantial research efforts have been devoted to context lifecycle management in IoT-enabled computing, little attention has been given to translate these advances to tangible progress in remote monitoring services.

- Recent research has presented several solutions that are used in specific scenarios, therefore, difficult to apply in other situations.

8- Conclusions

- The integration of context management in the development of remote monitoring services is vital and important for handling some of the well known Big Data 'V' Challenges (Volume, Veracity, Variety), and incorporate both data and domain knowledge.

- This framework will directly help companies to leverage the value of IoT and Big Data to provide new maintenance services capabilities.

9- References

- Perera, C., Zaslavsky, A., Christen, P. and Georgakopoulos, D. (2014) 'Context Aware Computing for The Internet of Things', IEEE Communications Surveys & Tutorials, 16(1), pp. 414–454.

- Al-Fuqaha, Ala. Guizani, Mohsen. Mohammadi, Mehdi. Aledhari, Mohammed. Ayyash, M. (2015) 'A survey on Internet of Things', IEEE Communication Surveys & Tutorials, 17, No 4.