Assistenzsystem für Quadrocopter

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by

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Walldorf, der 16.09.2016

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Abstract

Nowadays, in the Digitial Age, businesses have to adopt to the newest technologies in order to remain at the top. One of the most recent and significant techical developments is termed the Internet of Things or short *IoT*. This topic involves the digitalization of standard business workflows and processes in order to automate and improve them in a substantial amount.

The software manufacturer SAP is headquartered in Walldorf, Germany. Since the buildings are broadly geographically spread, shuttle services are offered to travel between the locations.

This study is therefore motivated by the research question, to which extend a digitial transformation of the shuttle service is practical and whether beneficial effects would be visible. In order to assess the possible impact of an IoT driven transportation system this study proposes a prototype that not only covers the relevant requirements but it is also implemented and tested under real conditions.

The findings uphold the prediction that the innovation of the shuttle services leads into a wide range of advantages that are indicated by the developed Proof of Concept. The basic concepts of its architectural design are also applicable on other topics such as public transportation in general.

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1 Introduction

SAP is a multinational corporation that develops enterprise software to manage business operations and customer relations. [**?**] The company is headquartered in Walldorf, Germany with the nearby location St. Leon Rot. As a result the site is distributed among 27 buildings which are partially not within walking distance. Therefore a shuttle service is offered in order to simplify traveling between the offices.
The service currently works similar to public transportation: the shuttles have a strict schedule as well as designated stops. Furthermore it is possible to request a shuttle at the reception in some buildings. The drivers are therefore called by telephone and may dynamically adjust their routes if they are available.
Even though this is a plausible concept, it is to be taken into consideration that it is currently barely ever used as it is too inconvenient for most people. Despite this, the otherwise strict schedule causes a number of significant problems such as long waiting times. Thereby it is highly ineffective that the drivers are heading towards stops where possibly no one is waiting. Moreover, if many people are simultaneously looking for a shuttle and additional ones are necessary, the drivers have to autonomously communicate with each other to make enough cars available. As a consequence, this process can be very time-consuming for the passengers.

1.1 Motivation

The objective of this study is to investigate the possible effects of an extension of the shuttle services with smart devices and IoT solutions. This process involves the use of the Internet of Things concept by connecting the cars, drivers and passengers with smart devices such as sensors and smartphone applications.

One of those devices is a beacon installed in the interior of the shuttles as well as in waiting areas in each building. A Beacon is a small wireless device continuously transmitting a basic radio signal. Most commonly this signal is picked up by nearby smartphones using Bluetooth Low Energy technology. **[?][?]** Moreover, technical data like current speed, acceleration or fuel consumption are constantly being sent to the SAP Vehicle Insights backend in real time which is explained in section **??**. The transmission is realized with a small device that is attached to the Controller Area Network *(CAN)* bus interface of the cars. This dongle sends the data over a mobile Internet connection.

The shuttles shall be solicited with the passenger application sending a request to the backend. There it is processed and forwarded to the driver showing him where he may pick them up. In order to have an overview and to administrate the workflow, a real-time dashboard is to be developed with current User Interface *(UI)* technologies. The data that is gathered by the different devices is persitent in a database and may be analyzed in the backend. As a result, the extrapolated information could help to optimized the shuttle service, possibly leading towards lower waiting times, reduced distances driven and a lower fuel consumption overall.

1.2 Structure

This paper is composed of three chapters. The first section describes the fundamental principles of the Internet of Things. Moreover it examines SAPs IoT strategy and its components that are important for the further course of this thesis.
The following section is introducing technical as well as non-technical requirements. Moreover it involves the design and implementation of the architecture for the Proof of Concept *(PoC)*. In this context, the decisions for and against the utilization of software structures and elements are justified.
The next chapter is comprised of the realization of the Java interface which evaluates the stability and therefore the applicability of this component. Based on that, the implementation details are elucidated extensively. Notably, this section also explains how the component has been tested, validating that it is reasonable to use it as a core element in the architecture.
The last part outlines this paper in order to analyze and evaluate the results. As a conclusion this chapter contains a prospect on how shuttles services may be further optimized in the future. It also includes a reflection about the advantages the digital transformation offers in comparison to the existing model in order to measure to which extend the architecture is practical.

2 Fundamentals

This chapter introduces the fundamentals of the Internet of Things. Moreover, it also comprises an overview about the IoT strategy of SAP. In this context, core components such as the HANA Cloud Platform, SAP HANA and SAP Vehicle Insights are explained.

2.1 Internet of Things

2.1.1 Digitizing businesses with IoT

3 Software Architecture

3.1 Requirements

3.2 Implementation

3.2.1 Actual Setup

3.2.2 WebSockets

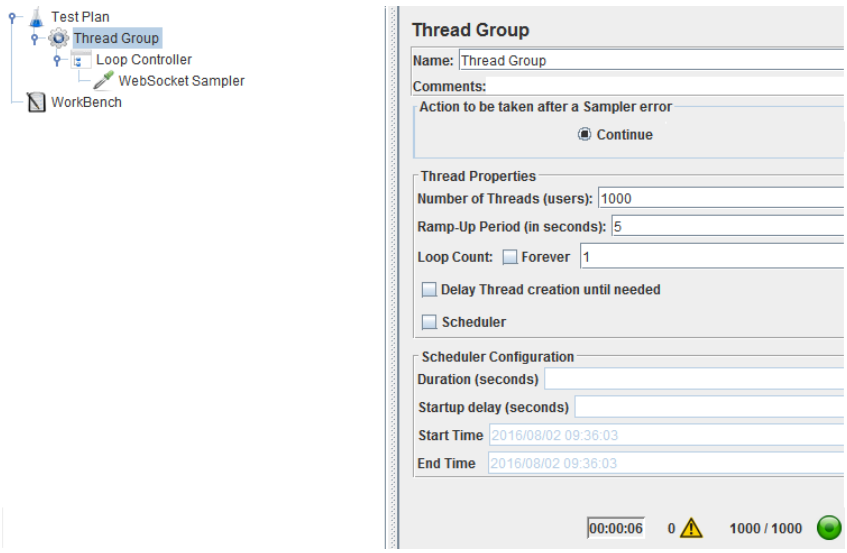

Figure 3.1: jMeter testing

4 Evaluation

4.1 User Experience

4.2 Conclusion

All things considered, the project proofed that the use of IoT technology was able to enhance the shuttle service. The room for optimization is significant especially with high amounts of data gathered by the smart devices.
The proof of concept was successfully designed and implemented manifesting the practicability of the underlying idea. With immense amount of data about the shuttles, almost any aspect may be innovated.
Currently this is limited by the absence of sensors and smart devices to gather more detailed information such as weather data. Prospectively a connection to the outlook calendars of SAP employees could help to predict when shuttle requests are most likely.
However, the fields of application for IoT are principally everywhere. The digital transformation allows new business models to come up and can raise existing ones to the next level. Similarly, there is much room for improvement for the shuttle service sector. The introduced architecture creates a good basis and can be further extended with more smart devices and better analytical operations in the backend, in order to innovate the service more than ever.