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A Study of Distributed Middleware Architecture for Sensor Web

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Abstract. Sensor web is a part of a larger IoT. Sensor Web encompasses a network of sensors where information shared by one sensor can be shared and used by other sensors. The goal of the sensor web is basically the collection of various types of information from wireless sensor networks (WSN). Wireless sensor networks are used in many fields nowadays. The main challenge of the WSN's is data integration and data provision for the applications using the data. WSN's consists of heterogeneous sensor devices; the data collected from these heterogeneous devices is used by many web applications. In this paper a middleware module is proposed that serves as an abstraction layer between the WSN and the rest of the system.

Keywords: Wireless Sensor Networks, Internet of things

1 Introduction

Wireless Sensor Networks have become very popular among researchers. Vast amount of research has been conducted in different areas like medical institutions, traffic control, ubiquitous environment, and environmental monitoring. WSN's face a number of challenges one of which is filling the gap between the high level applications accessing the sensor data and the low level complexities of the WSN infrastructure. To address this issue several researchers have developed a middleware approach that offers easy access to the heterogeneous sensor data making the applications unaware of the low level hardware framework.

The goal of service oriented computing is to provide accessibility to services. This is done through different standard protocols thus hiding the underlying details of implementation and infrastructure. This helps achieve interoperability, loose coupling, and heterogeneity support [1].

To fulfill the design and implementation issues of WSN applications a novel approach is to include a middleware. There are different middleware approaches for WSN as described in [2] [3]. These approaches help in offering important functions for different applications such as efficient software installation and data aggregation.

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A lot of researches have been conducted on different facets of the middleware. For example [2] has conducted a survey on the ongoing research in service oriented middleware, and GWSN a middleware is designed for WSN applications to support the maintenance of WSN applications in [1].

In this study the sensor middleware is designed such that it connects directly to the sensor emulator or the actual sensor network. It has the drivers to connect real sensors and gets the sensing data from the sensor nodes. Next, middleware using its sensor drivers steadily collects sensor data from sensor network. The client may then request the sensor web provider to get sensing data for selected sensors and may view it.

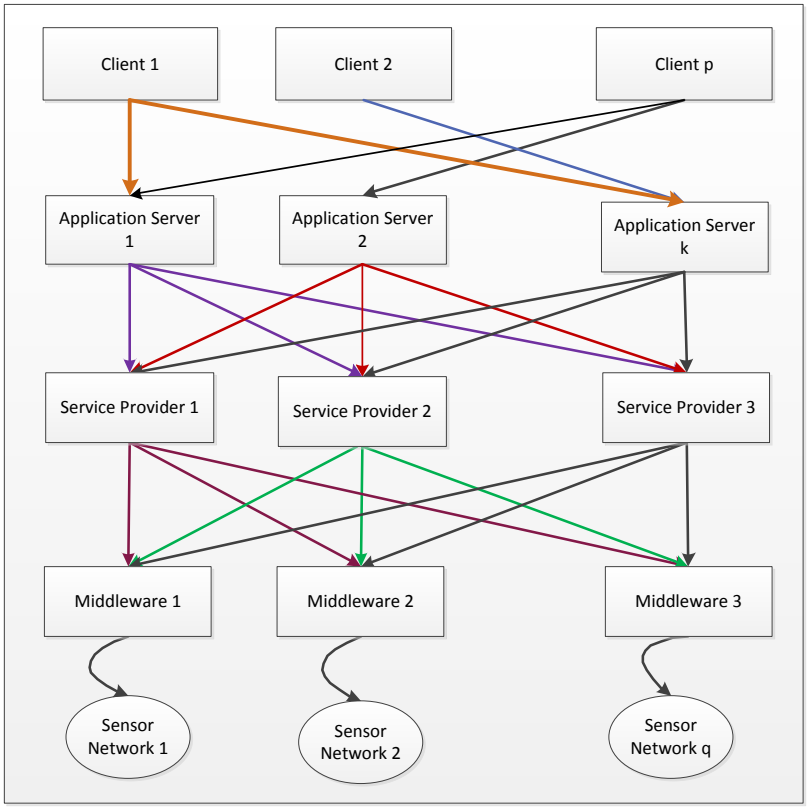

Fig. 1. Proposed Sensor Web architecture based on distributed middleware

2 Proposed Architecture

This section presents two architectures that illustrate the differences between the previous and the existing architectural style of the sensor web in the proposed system based on the middleware. It shows the flow of communication between the modules. It also gives a brief explanation of the pros and cons of both the architectures.

Fig 1 show the proposed Sensor Web architecture based on distributed middleware. It is a layered architecture. The first layer is called the physical layer which consists of sensor networks. Each sensor network has different sensor nodes connected to each other. The second layer is the middleware layer which consists of middleware. Each sensor network has its own middleware module and all these middleware's are connected to each other. This provides transparency of information. The different sensor data collected from each sensor network can be shared and used by the higher modules of the system.

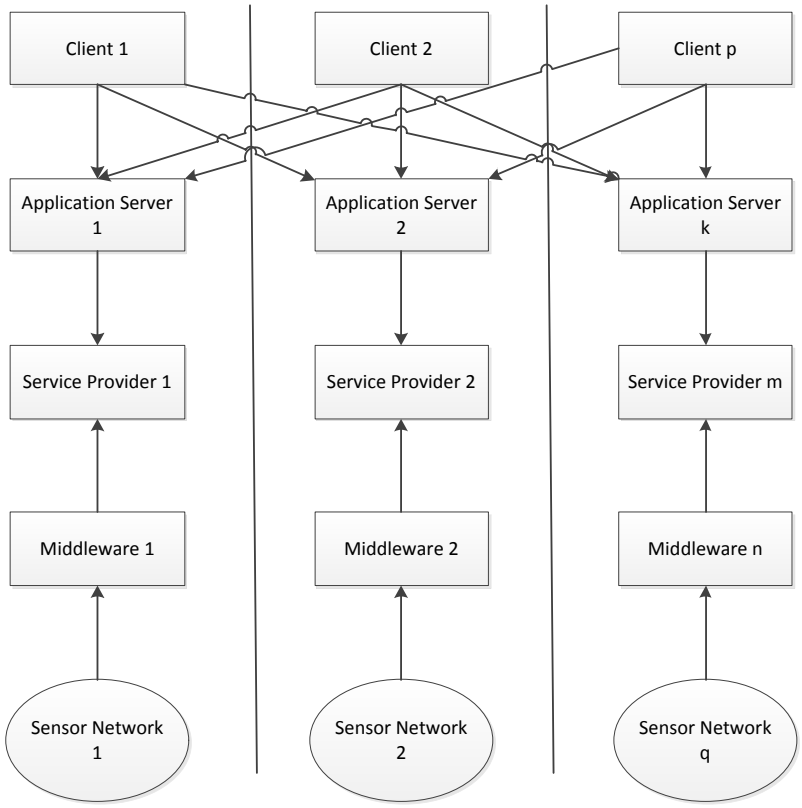

Fig. 2. Previous sensor web architecture based on middleware

The third layer is service layer. This layer consists of separate sensor service provider for each sensor network. Sensor data from middleware module is stored in the repository of the sensor service provider. The fourth layer is application layer. It consists of application servers that provides interface for data viewing. The application server can connect directly to the service provider of any sensor network to collect sensor data. The last layer is the client layer which consists of the client applications.

Fig 2 show the previous sensor web architecture based on middleware. It also consists of five layers i.e. physical layer, middleware layer, service layer, application

layer and client layer. This architecture does not provide interconnections between the low level modules. Each module is connected to its own sensor network. The sensor data from all the heterogeneous devices is integrated at the application layer. The application server integrated sensor data according to the requirement of the client. Thus this architecture creates an overhead at the application layer and makes the data communication difficult.

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3 Conclusions

This paper focuses on the sensor web middleware, its architecture, design and the functionality it offers. Sensor Middleware is the component which directly connects to the sensor emulator or the actual sensor network. It has the drivers to connect real sensors and gets the sensing data from the sensor nodes. The senor middleware design is covered in detail by presenting a series of diagrams. Each diagram explains the functionality provided by the middleware in a different context.

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