# Improving IOT Application Layer Benefits through Context-Aware Module Information Feedback

**Chih-Ming Chang**

**School of Innovation and Entrepreneurship Academy, Shaoguan University, Shaoguan 512005, China.**

***Abstract:*** Today, the Internet of People in the past has evolved into the Internet of Things (IoT), forming a ubiquitous network environment. IoT enables all smart objects to communicate with each other through the Internet, achieving a network of interconnection between things. Since the foundation of IoT is still on the Internet, the main purpose of this research is to explore the feedback provided by context-aware applications and sensor information in the IoT environment. In addition, an IoT-based Mobile Commerce model (IoTMC) for the IoT is proposed in this research. The main purpose of the IoTMC is to integrate the technology of IoT and the information of related users in mobile commerce into a model. Through the IoTMC model, so as to enhance the benefits of IoT application layer.

***Keywords:*** Internet of Things; Context Aware; Information Feedback

## 1. Introduction

With the change of network type, the improvement of information technology, and the innovation and diversified application of network services, people are now always connected, as the processing capacity and storage capacity of smart terminal equipment are continuously improved in this era of Always Connect. Nowadays, as a derivative of Internet of People, which used to be human-oriented, Internet of Things is guided by Thing (IoT), in forming a ubiquitous network environment [3]. The environment of Internet of Things integrated many information technologies with various wireless sensing networks and different intelligent devices and domains to further extend coverage to every object in life, forming a huge network [7]. The relevant information of each intelligent object in IoT can be applied to business activities. Therefore, Internet of Things is not only a simple expansion of the Internet or communication network, but also the ability to collect more abundant data through the connection between objects.

Since Internet of Things still relies on the Internet, the main purpose of this study was to explore the application and feedback of collected information with context-aware sensing devices in the connecting network of Things and to propose a mobile business model suitable for IoT environment, that should implement the IoT technology in the mobile business environment. In addition, this study focused more on the situational awareness technology of sensory information and would always calibrate the setting of equipment to the feedback information from consumers, hoping to analyze the shopping habit, types and behavior of the consumers from the tracking of their actions. Thus, so as to enhance the benefits of IoT application layer.

The mobile business model used in this study was called "IoT-based Mobile Commerce Model (IoTMC), which is a model for investigating the combination of Internet of Things technology and mobile commerce, as to provide diversified services to consumers. In the study, a context-aware module would be built into IoTMC, and the application and information feedback of the context-aware module were further explained. Since information is one of the key points in the IoT environment, this study would focus on the discussion of situational awareness technology for sensing information, including the discovery of practical demand and benefit evaluation, that the way the relevant technologies were embedded

and so as to enhance the benefits of IoT application layer.

# 2. Literature Review

## 2.1 Internet of Things (IoT)

In 2005, it was established by the International Telecommunication Union (ITU) and officially coined the term, "Internet of Things" in the report with a definition. In the era of networking, beyond interpersonal communication through the network and obtaining of information or object through the Internet, the network environment allowed objects in communication with each other by the combination of the Internet and various wireless communication/sensory networks [5]. Sensory devices, such as RFID, Zigbee, infrared sensor (IR), global positioning system (GPS), WiFi and UMTS, are all connected through the Internet, and information exchange and communication are carried out according to Protocol; thus, realizing intelligent identification, positioning, tracking, monitoring and management [8]. These objects can operate and exchange data remotely, which no longer limits the development of Internet of Things to the RFID technology.

According to ITU's definition, the development of Internet of Things is divided into three dimensions: Time, Place and Thing. In other words, anyone can connect with any objects at any times and at any places, and with the continuous development of Internet of Things, it also includes three directional categories, namely, Human to Human, Human to Thing and Thing to Thing [5]. After the relevant technologies were developed, IBM proposed the concept of "Smart Planet" in 2008, which defined as connecting objects through the network and applying smart technologies and services to objects by embedding sensors into various objects to achieve an universally connected environment for objects to transmit information to each other, forming the so-called "Internet of Things".

Internet of Things means "making objects intelligent by implanting various micro-sensing chips on them." Then, with the help of wireless network connection, the information of objects can be shared, and the dialogue between people and objects and the communication between objects can be realized, where everything people come into contact with in life can automatically report their status to communicate both with objects and people.

In terms of operation, Internet of Things can be roughly divided into three layers, which are described as follows. (1) The first of all layers is the "perception layer", consisting of sensing elements for primary equipment of data collection. The main tasks of the perception layer include identifying objects and collecting information of various sensory sources. (2) The next is the “networking layer” to establish information transmission and message processing based on the existing mobile communication network or the Internet. (3) The top layer is the "application layer", which refers to the combination of social needs and demands to fully implement the smart system in life. In other words, the application of Internet of Things in various sectors will be based on using the aforementioned layers in life.

## 2.2 Context Aware

The concept of context awareness was first suggested by Schilit and Theimer in 1994 for such application in software. The term, context awareness, is defined as an active user application that can detect and respond to changes in the user's environment. It means that relative response measures can be taken according to the environmental changes (e.g. Time and place) of the users in action to adapt to the changing environment [6]. In other words, under the characteristic that human beings can move, the geographical location of users will change continuously according to time and place, and many needs of users will usually take relative response measures in adaptation to this continuously changing environment. Therefore, it is imperative for users to be aware of the surrounding context-aware devices and services, to obtain timely personal information according to their location [1].

Dey defined context awareness as: a context-aware system for providing relevant information or services to users that such correlation is based on the user’s intent [4]. Context-aware system enables information service or adapts method to quickly provide expandability to correctly provide users with timely and appropriate information, as a way to gather and disperse information freely. Dey also proposed that the context-aware function must be able to support the following three points: (1) providing information or services to users; (2) automated execution of services for users; and (3) attach situational

information to the original data, and allow advanced query of these situational information based on the labeled content [4].

Therefore, users will have various context factors due to the information on time, location or situational characteristics. In terms of users' personal needs, the application of context awareness will also give rise to different applications and behavioral differences. According to Chen and Kotz, various factors of context awareness could be categorized into four groups, of which the second category is the user's context, including information on user's location, record, preference, proximity and etc. [2], to be used as feedbacks of the user's surrounding situation for context awareness.

Under Internet of Things, the context can be processed from the collected information of sensing components; thus, providing consumer-related context awareness service.

This study focused on the application of context-aware technology, the processing of perceived information and the construction of context-aware modules in an Internet of Things environment, as well as the relevant processing of perceived information, so as to enhance the benefits of IoT application layer.

# 3. Context Aware Module

As discussed in this study, the setting of monitoring equipment can be calibrated accordingly to the feedback information of consumer shopping and behavior, that in hope of these information, their habit, types and behaviors.

In the IoTMC model, the context awareness module mainly determines the sensed information and consumer behavior, as well as processing any feedbacks, to enhance the benefits of IoT application layer. The structure of the context awareness module of the IoTMC model is shown in Fig. 1.

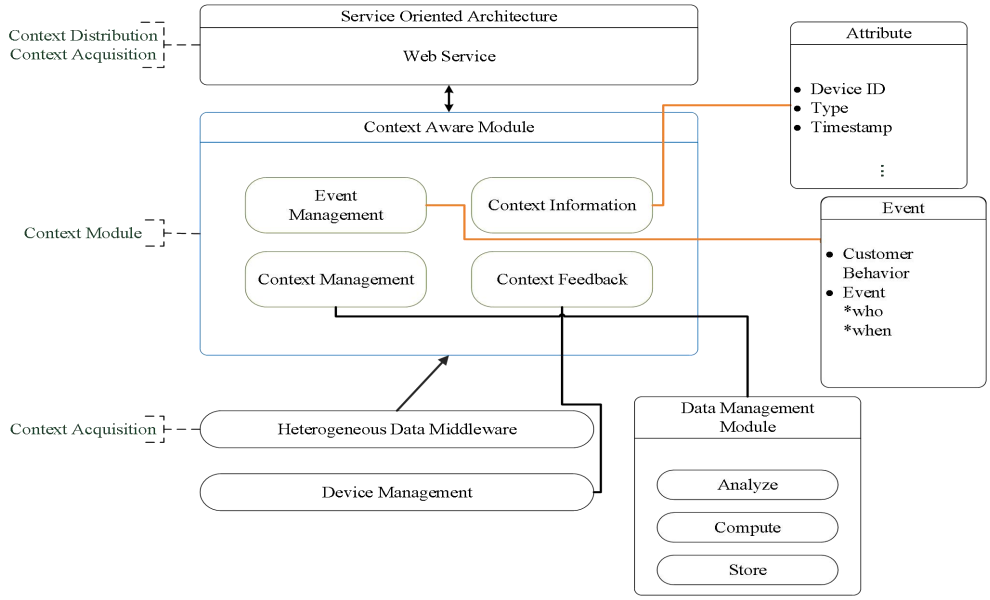


Figure 1 Context Awareness Module Structure Diagram of IoTMC Model

The context-aware module proposed in this study mainly deals with context-aware application in three phases. The Service Oriented Architecture (SOA) in this study was mainly a network interface and customer management structure at the entry of IoTMC for consumers, where they can register and receive all services provided by all IoTMC modules, accordingly to the identity of consumers.

Context Acquisition phase: This phase included two parts of sensing information acquisition. (1) The first part involved a preliminary processing of sensing information by the heterogeneous data middleware. It was a process of obtaining sensing information from the component of sensor layer, from which the network could perceive the consumer's behavior.

(2) In the second part, the consumer's behavior could also be obtained from the sensing information of the web in the service-oriented architecture. Through the use of all services provided in IoTMC by consumer, the information fed back of consumer's shopping behavior and pattern when operating smart mobile device on web service, consumer's desired service

need could be determined and different information could then be provided accordingly to the identity of consumer.

Context Awareness phase: It mainly processed information of all situations, including:

(1) Event Management: The system would determine the consumer's behavior and the handling of event according to the individual's action. The event management component would get an understanding of the consumer's information, such as previous shopping records, habit and types when using a smart mobile device.

(2) Context Information: The component would primarily identify attributes or properties of sensed information from the sensing devices. The attributes of obtained information could be learned from the context information component, including the type of sensing device of the data, the type of information and the time, which could serve as the determinant factors for the context information module to process and identify the service required.

(3) Context Management: The obtained information would be analyzed, calculated and stored by the Data Management Module in the context management component. Therefore, the data management module could support processing the relevant context-aware messages, which could be integrated into the information required by consumers through the components of the data management module.

(4) Context Feedback: It included the feedback of information from the sensing devices, allowing adjustment of settings and the merchandise promotional strategy, as a way to improve the service processing of IoTMC model web application.

Context information release or distribution phase: The context-aware information service in the IoTMC model was provided through service-oriented architecture module, where the context information was released to consumers.

The context-aware application module discussed in this study focused on the information acquisition and feedback information of the sensing devices to adjust the settings, as to enhance the benefits of IoT application layer.

# 4. Conclusion

With the advancement of information technology, people's lives are gradually changing to a world of constantly connected network. Due to the realization of IoT technology, the future life will form a world in which people and things or things and things are always transmitting information and communicating with each other.

In the study, when establishing the context-aware module while investigating the IoTMC model, it mainly functioned to process information and determine consumer behavior, as well as processing any feedbacks, as to enhance the benefits of IoT application layer.

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