A Quality Model for IoT Service

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Abstract. In this paper, We focuses on suggestion to Quality model of IoT Services which are popularly used in the characteristics defined in the quality model of IoT Services. In order to achieve this purpose, we propose Quality model for IoT Services. These technologies involves utilization and mobility in addition to quality characteristics in existing software, application of ISO 9126 is not perfect when evaluating a Quality model. This paper proposes a security set out in ISO25000 quality factors and assessment of the existing traditional software application of ISO 9126 quality model. We suggested new quality model for IoT Services by quality attribute in ISO 9126. We validated that the proposed model can be realized it was applied to evaluate the 4 elements and added security in Metrics. The quality model for IoT Services using the IS-QM proposed in this paper it can be measured relatively accurately.

Keywords: QoS model · IoT Services · Internet of Things · Quality attribute · Software Quality

1 Introduction

Internet of Things (IoT) is the computing environment to provide valuable services by interacting with various IoT Services, where diverse devices are connected within the existing internet infrastructure and through intelligent social applications. A Quality model for Software applications acts as a framework for the evaluation of attributes of an applications that contribute to the quality model. It is important every relevant software applications quality characteristic is specified and evaluated whenever possible using validated or widely accepted metrics. It is necessity to customize a quality model to identify acceptance criteria and evaluate a particular application domain; IoT applications. A natural consequence of the trends would be to manage the quality of IoT Services. However, measuring the quality of IoT Services is considerably different from measuring the quality of conventional software systems. Because IoT Services is a complex fusion of a variety of technologies such as wireless network, embedded, sensor and connectivity. For instance, ISO 9126 which is a representative quality model is mainly for conventional software, not addressing the IoT characteristics. That is the quality attributes and metrics in ISO 9126 would largely inappropriate in measuring the quality of IoT Services. We suggested new quality model for IoT Services by quality attribute in ISO 9126. We validated that the proposed model can be realized it

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Fig. 1. IoT services

was applied to evaluate the 4 elements and added security in Metrics. We proposes a security set out in ISO25000 quality factors and assessment of the existing traditional software application of ISO 9126 quality model. In this paper, we intend to propose a security set out in ISO2500 quality model to identify characteristics of quality factors which are quality attributes, criteria and metrics evaluate a particular IoT Services (Fig. 1).

2 Related Works

A Quality model has been studied by many researchers in conventional software. ISO/IEC 9126 is not perfect when quality of IoT services. The Quality model can analyze IoT contexts and employ methods to compute the value of QoS which acts as a metric for service evaluation and selection. But most previous work focused on the RFID network protocols, middleware, devices reliability, safety and cost, etc. Evan Welbourne deployed these applications in the RFID Ecosystem and conducted a four-week user study to measure trends in adoption and utilization of the tools and applications as well as users' qualitative reactions [1].

In [2], the author constructed another AHP QoS model based on IoT global etc. were considered but users' feedback like user preferences was often ignored.

Simple Performance Analysis of Multiple Access RFID Networks Based on the Binary Tree [3] This simplifies tremendously the derivation of the analysis, still preserving its validity in an average sense. scalable RFID network simulator is developed with OPNET 11.0 and implements the binary tree collision arbitration protocol. The results obtained with simulator are very complexity. Performance evaluation is conducted for tag read latency and read efficiency as a function of link parameters defined in ISO/IEC 18000-6 Type C standard [4] But this ISO9126 is difference for application quality evaluation. Reference [5] first proposed a QoS model of grey decision-making from the view of IoT Global Infrastructure and built an adaptive service framework. In [6], a quality evaluation technique of RFID middleware according to ISO/IEC 9126 standard and EPC global middleware quality factors was built by simple AHP. It really provided an idea of simplifying complicated evaluation factors in IOT. ISO 9126 is an international standard for the evaluation of product quality [7]. This standard provides three aspects for evaluating software products; internal quality, external quality and quality in use. And, there are sixteen characteristics for three types of qualities. However, this standard focuses on evaluating quality of conventional products.

Hence, it is required that the standard is customized and extended to evaluate the quality of IoT Services.

3 Characteristics of IoT Services

IoT Services reveal non-conventional features which are not typically presented in conventional software systems. it is as in the following.

3.1 Participation of Hardware Devices

In IoT, things are required to be actively participating in various activities, exchanging information and making intelligent decision. IoT devices are equipped with various intelligent devices to ensure safety, security and high performance of IoT devices. Mobile devices are equipped with small buffers but have to deal with IoT services that generate a huge volume of data Hence, an IoT Services consists of two types of elements; typical software components and hardware devices/components. In the design and implementation of IoT applications, the presence of hardware devices should be considered.

3.2 Collaboration Model with IoT Devices

A software application typically consists of multiple *business processes*, also called *workflow*, *collaboration*, *orchestration*. In IoT Services, collaborations could include the hardware functionality of IoT devices. For example, the *Drone-based Parcel Delivery System* by *Amazon* includes the parcel pick-up service and flying service of *Drone* devices. The collaborations of an IoT Services should consider the hardware functionality as well as conventional software collaboration.

3.3 Mobility and Connectivity

It refers to the application capability for device mobility the correctness of the information processing in different stages of a process. This characteristic is merely used in the web application and particulary in IoT services. Connectivity characteristics refers to the ease of user's quick and efficient connect to information of IoT services. The mobility could result in various faults; loss of control due to out-of-sight movement or flight, unstable wireless network connection when leaving the current network zone, and physical collision while moving.

3.4 Monitoring for IoT Devices

Remote monitoring for smart devices attached to networks can support multiple functions including Automatic Meter Reading, gas heating and context-awareness.

Through smart devices, carriers can provide more real-time and precise services. It has a characterized that connectivity to the objects for control. An IoT device can controls flow of the each data through a collaboration device.

3.5 Limited Resources

The resource types of IoT devices can be battery, network communication facility, memory, and computation power. For example, flight Drone has a limited battery and memory, leaving the current network zone. IoT devices suffer from a limited battery lifetime and dominates energy consumption. Energy Efficiency can be increased by wisely adjusting transmission power. Hence, there is a need for solutions that will limit the energy consumptions of such IoT devices such as wearable device, smart watch.

3.6 Security and Certification

For the security and collaboration of IoT device become a participation of device that they need the process can be exact service of device. Among collaboration of device for the security from intermediate extortion can be need to authentication procedure of precise device. In the cause of prevent intermediate extortion can be need to designed consideration of the authentication algorithm. Figure 2 shows that the characteristics of IoT Services and each criterion is defined in this section.

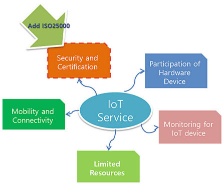

Fig. 2. Characteristics of IoT services

4 Quality Attributes and Metrics

The characteristics defined in the previous section become the basis for deriving the quality model of IoT Services. That is, we define quality attributes for evaluating IoT Services by considering the impacts of the identified characteristics on the quality of IoT Services.

4.1 Quality Attributes for Evaluating IoT Services

Each characteristics of IoT Services has a set of associated quality factors. Figure 3 shows how the quality attributes of the evaluating IoT services affect the selection of

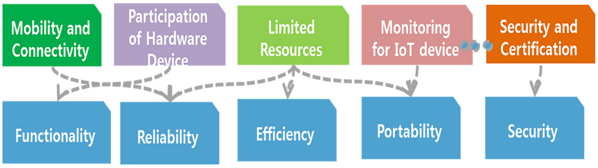

Fig. 3. Mapping characteristics to quality attributes

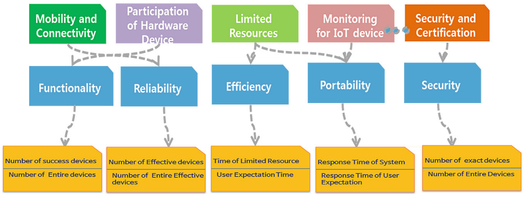

Fig. 4. Main Factor characteristics to quality metrics

quality factors. Figure 4 shows the factor characteristics to quality metrics, and each criterion is defined in this section.

4.1.1 Metric Suite for the Quality Model

In this section we provide a set of representative metrics for the criteria like all quality models, the set of proposed metrics here may be extended or tailored for each organization. Hence, the proposed set of attributes should serve as the foundation and a starting point for tailoring and enhancement.

4.1.2 Metrics for Functionality

Metric for Functionality: this metric measures the degree of functional connection to IoT service, as follows. X = A/B, where A is the number of correctly accessibility related to functionality of characteristics for IoT services is applicable to, and B is the total number of functional accessibility in the IoT domain. The Range of X is 0..1, and the value 1 is the best since the functionality of such a application can be accessed to all functional items in the IoT domain. The higher the metric value has wider range of accessibility.

4.1.3 Metrics for Reliability

Metric for Reliability: The metric measures how the without seamless each IoT application connection as follows: X = A/B, where A is the number of input items which check for valid data, and B is the number of total input items which could check for valid data.

The Range of X is 0..1, and the value 1 is the best. Although practically data will have a value that is high due to validation data.

4.1.4 Metrics for Efficiency

Metric for efficiency: The metric measures the efficiency appropriate time and resource behavior. X = A/B, where A is the time of limited battery utilization, and B is the time of user requirement time and resource. The Range of X is 0..1, and the value 1 is the best, The time and resource utilization describes for instance processing times and throughput rate, while resource behavior means the amount of resource used and the duration of use.

4.1.5 Metrics for Portability

Metric for conformance: The metric measures the degree of change to relevant environments. X = A/B, where A is the number of system response request which can be customized, and B is the user expected response requirements number can be changed relevant environment system as a sensory data creative value in the IoT Services. The Range of X is 0..1, and the value 1 is the best, response request number for heterogeneous system such as a sensory data through IoT Services is higher for system utilization.

4.1.6 Metrics for Security

Metric for conformance: The metric measures the degree of change to relevant environments. X = A/B, where A is the number of Exact device which can be customized, and B is the entire device can be accessed relevant environment system as a sensory data creative value in the IoT services. The Range of X is 0..1, and the value 1 is the best, the number of exact device is close to precision to system such as a exact data through IoT Services is higher for system accessibility.

4.1.7 Sum of IoT Service Metrics

Using the proposed a set of factors and criteria, one can compute the overall quality of a IoT Service as follows. Let Fi be the ith factor defined in IS-QM, and therefore the range of i is 1..5. Let Cij be the jth criterion of the Fi, and Fi has 2 to 5 criteria as shown in Fig. 4. For example, C2, 3 will be the customizability criterion for the reliability factor. Then the composite value, Q Fi for the factor Fi is defined as:

$\mathrm{Q\,F}_i = \frac{\sum_{j=1}^{n} Cij}{n}$ where n is the number of criteria in $F_{i.}$

Depending on the domain and purpose, often different weight on F_i and let (W1 + W2 + W3 + W4 + W5) be equal to 1. Then, the overall quality of a functions can be computed as follows, and the range of overall quality will be 0..1, which is same as a single percentage representation.

$$IS - QM = \sum_{i=1}^{5} wi * qi$$

In order to apply the proposed IS-QM effectively, a quality evaluation process, instruction and a set of templates should also be defined. As shown in Table 1, Weight for the quality attributes such as high(0.3), medium(0.2) and low(0.1) would be represented. The IS-QM model has value 1, the number 1 is evaluated with high quality.

Table 1. Weight for the Quality attributes

Quality attributes	Weight
Functionality (Func)	Medium (0.2)
Reliablity (REL)	High (0. 3)
Efficiency (Eff)	Medium(0.2)
Portability (Por)	Low (0. 1)
Security (Sec)	Medium(0.2)
SUM	1

5 Conclusion

In this paper, we showed identified main characteristics of IoT services, and derive a practical quality model for IoT services, IS-QM. The IoT Services is a complex fusion of a variety of technologies such as wireless network, embedded, sensor and connectivity. Because these technologies involves utilization and mobility in addition to quality characteristics in existing software, application of ISO 9126 is not perfect when evaluating IoT services. We suggested new quality model for IoT Services by quality attribute in ISO 9126 and ISO25000. We defined five quality factors, criteria, and five metrics (Func, Rel, Eff, Por, Sec) that can be effectively used to derive the overall quality of IoT Services. The effectiveness of the quality model for evaluating IoT Services through quality attribute-based metrics were validated. the quality model for IoT services using the IS-QM proposed in this paper it can be measured relatively accurately.

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