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Open IOT Service Platform Technology with Semantic Web

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ABSTRACT

This paper centers around how innovations adds to enhancing interoperability between IoT gadgets, and making effectively utilization of IoT gadgets. The proposed stage innovation gives semantic-based IoT data administrations, and semantic interoperability of IoT gadgets. This administration stage can be material to a great deal of semantic IoT administrations: gathering imperceptible data in genuine condition by brilliant gadgets, giving keen life benefits by sharing, taking an interest, circulating open detecting data.

Key words: Internet of Things, semantic technology, service platform, semantic interoperability, service ontology.

1. INTRODUCTION

Contingent upon the quick appropriation of wearable processing gadgets such like savvy, keen glasses and wristband-composed wellness tracker, we end up ready to appreciate an 'IoT(Internet of Things) based brilliant life' that can be associating web anyplace, whenever and any-gadget. Most cell phones have worked in an assortment of sensors, for example, encompassing light sensor, closeness sensor, worldwide situating framework, accelerometer, compass, and gyroscopic sensor. Particularly, ongoing created cell phones have contained progressively natural sensors, for example, temperature, stickiness and gauge. These sensors make things more astute and can make more astute applications, for example, human services applications, instructive substance and enlarged reality applications. Sensor is a standout amongst the most essential innovation components to make "web of things", as a result of it screen the condition of things and can expand its usefulness. In excess of nine billion gadgets around the globe are presently associated with the Internet, including PCs and cell phones. That number is relied upon to increment drastically inside the following decade, with assessments extending from quintupling to 50 billion gadgets to achieving one trillion. The Internet of Things can possibly make monetary effect of $2.7 trillion to $6.2 trillion every year by 2025 [1].

In like manner, numerous minor sensors and its applications are creating so as to address the issue of buyer who needs to know and share natural data encompassing them. Sensor system and IoT(Internet of Things) are center innovations in ecological checking, for example, air/water quality, radiation and traffic clamor. Valuable data assembled from sensor arrange turned into a data storehouse due to sensor systems were so firmly combined with sensor application as of recently. Sensor information portrayal designs utilized in these sensor systems is different, and can't comprehend the detecting quality's significance in different applications aside from their private application. Accordingly, detecting esteems and data must be shared and gave extra data to different applications.

To meet these necessities, this paper demonstrates the open semantic IoT benefit stage innovation that ensures the semantic interoperability of sensors or things' data and offer of these assets. This innovation permits sensor data entrance specialist co-ops and general engineers to grow progressively valuable IoT based applications and administrations effortlessly

2. SEMANTIC OPEN IOT SERVICE PLATFORM

Current IoT administrations require IoT applications to have learning of IoT middleware and sensors or sensor systems for getting to IoT assets. For instance, heterogeneous IoT middleware are difficult to be gotten to by applications since each IoT middleware has exclusive Application Programming Interface (APIs) and along these lines it is difficult to get to different IoT assets which specifically joined to various IoT middleware. Notwithstanding when the applications approach various IoT middleware, applications need to seek, gather, investigate and process the detected information independent from anyone else. These breaking points can be overwhelmed by giving bound together access strategy to IoT assets through heterogeneous IoT middleware. Figure 1 indicates current IoT benefit stage and open IoT benefit stage.

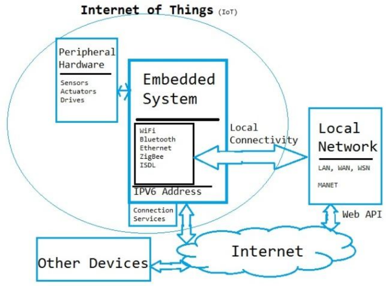

Figure 1: Current IoT Service Framwork and Open IoT Service Platform

In the current IoT benefit stage, every application has to realize how to get to heterogeneous IoT middleware and which IoT assets ought to be gotten to. In the open IoT benefit stage, every application does not have to realize how to get to heterogeneous IoT middleware nor which IoT assets ought to be gotten to. In the open IoT benefit stage, IoT application just demands to open IoT benefit stage and remaining handling is finished by the open IoT benefit stage. The open IoT stage changes over demand from applications into explicit demand for various IoT middleware. A definitive objective of the open IoT benefit stage is to furnish the application with the accompanying administrations;

•easy access to and utilization of the worldwide IoT asset and detected information

•easy association of IoT assets

•easy development and distribution of various pplication

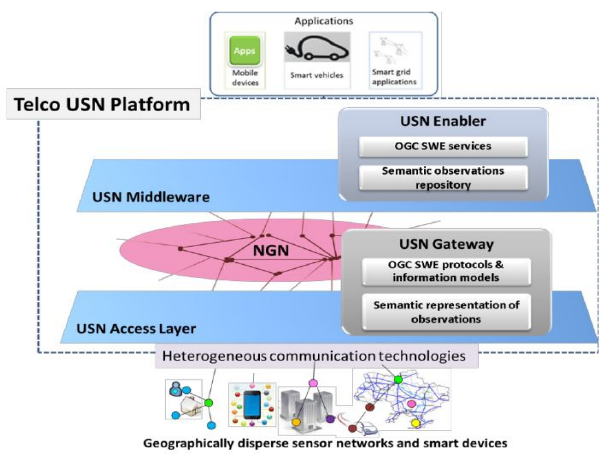

Figure 2: Functional Architecture of Semantic IOT Service Pltatform

The functional architecture of open USN service platform consists of open USN platform and heterogeneous USN middleware. The open USN platform consists of seven functional entities (FEs): interface FE, LOD linking FE, Semantic inference FE, Resource management FE, Semantic USN repository FE, Semantic query FE and Adaptation FE. The heterogeneous USN middleware are integrated into the open USN platform through the Adaptation FEs and USN resources and sensed data are shared with the other services through LOD linking FE.

A. Interface FE

Interface FE gives the capacities which empowers USN application to acquire open USN administrations as well as the detected information from the open USN benefit stage. Additionally, it underpins the capacities which permit foundation or support of associations or detachment as per the kind of a demand for information, and access control to deal with access rights for client verification and the utilization of administrations.

B.LOD Linking FE

OD connecting FE gives the capacities which empower clients to get to the USN assets and detected information on the planet by opening the USN assets and detected information produced from the open USN benefit stage to the LOD, and to give interface between outside LOD information and the USN assets and detected information from the open USN benefit stage. It likewise underpins the interface for inquiry about the USN assets and detected information in the LOD, and the capacities which permit the application and the board of arrangements that incorporate criteria about determination and distribution of information to open to the LOD.

C.Semantic Inference FE

Semantic deduction FE gives the derivation capacities dependent on the data descried in the philosophy outline and clients' guidelines by utilizing RDF information put away in the Semantic USN storehouse. Through the derivation capacities, the first crude information are handled into information with semantics, for example, setting information. The surmised information are refreshed into the Semantic USN vault and used in different administrations. Moreover, it gives the capacities to make various types out of examples and levels for derivation.

D. Resource Management FE

Asset the executives FE gives the capacities to issue and deal with the identifier and URI of USN asset, and to oversee mapping relations with the location of USN asset. Likewise, it bolsters the capacities which empower USN asset to be consequently enrolled in the open USN benefit stage when USN asset is associated in the system, for example, Internet, and applications to acquire and use data about USN asset. It gives the capacities which empower USN asset to effectively enlist its own status and association data. By utilizing this data open USN benefit stage will bolster organize association and portability of USN asset. Hence, it can bolster fitting and play capacities which empower the open USN benefit stage to powerfully utilize USN asset as USN asset which naturally associates with the open USN benefit stage and registers its own status and property data. It gives the capacities to scan identifiers of USN assets for performing inquiries which can give vital data to demands from applications. Now and again, it can give the capacities to arrange and deal with a consistent gathering on USN asset for fulfilling applications' administration demands. It might play out the capacities to make an asset aggregate as per applications' administration ask for and to oversee rundown of USN asset which has a place with the asset gathering. Additionally, it underpins the capacities to make, keep up and oversee data, for example, the reason for the asset gathering, producers, control with right, etc. It gives the capacities to deal with the lifecycle of every asset aggregate as indicated by the span of administration.

A. Semantic USN Repository FE

Semantic USN repository FE stores metadata of USN resources and sensed data collected from USN middleware for a certain period of time as a physical repository. Also, it provides API functions to query for inserting new data, searching, querying, and deleting stored data. When metadata of USN resources and sensed data are stored in Semantic USN repository, semantic USN repository FE translates them into RDF form according to predefined rules.

B. Semantic Query FE

Semantic query FE performs the functions to handle queries to USN middleware and USN repository for providing responses to applications' information requests. It consists of query analyser function, middleware query function and SPARQL query function. The query analyser function provides the functions to create queries by analysing intention of applications' requests, to translate the results of query process according to applications' message specifications, and to deliver the translated data to applications. It classifies requests from applications into query to middleware and query to USN repository. The query to middleware, which requests the sensed data from USN resource through USN middleware, is created according to APIs that USN middleware provides. The query to USN repository, which requests the USN resources and sensed data from the Semantic USN repository, is created by translating queries that applications request into SPARQL. The middleware query function performs the functions to send queries to USN middleware, and to collect the resulting data from USN middleware. It provides the functions to manage query status about lots of queries to USN middleware created from the query analyser function, and to deliver the data received temporarily or periodically from USN middleware to the Semantic USN repository FE. However, in some cases, like having a real-time sensed data request, the sensed data can be directly sent to the query analyser function. The SPARQL query function performs the functions to simultaneously handle lots of SPARQL queries created from the query analyser function, and to produce the outcome of query from the Semantic USN repository, and to deliver them to the query analyser function.

C. Adaptation FE

Adaptation FE provides the functions which handle the protocol and message for setting up connection with USN middleware and delivering queries and commands. It works as an interface for processing several types of data generated from heterogeneous USN middleware in the open USN service platform. It supports the message translation function to translate the generated data from heterogeneous USN middleware according to proper message specifications to deal with in the open USN service platform. It also provides the message routing function to deliver the translated data to corresponding FE (USN Semantic Repository FE, Resource management FE and Semantic query FE) of the open USN service platform in order to process requests.

EXAMPLE: SEMATNC SLEEP MANAGEMENT SERVICE Semantic-based sleep management service is described as an example service of the proposed semantic open IoT service platform. The semantic-based sleep management service architecture consists of two modules: the Sensor Data Collector and the Semantic Processor. The Sensor Data Collector is located in Adaptation FE and Semantic USN Repository FE, and Semantic Processor is located in Semantic Inference FE in the proposed platform. The Sensor Data Collector is the module for collecting sensor specification and sensor observation and translating sensor data(i.e., sensor data detected from healthcare sensors and environmental sensors) into semantic data(i.e., RDF, RDFS, and OWL). In detail, it has the Collector, which collect sensor data gathered from healthcare sensor networks(e.g., blood pressure, blood sugar, body temperature, snoring, sleep apnea) and environmental sensors(e.g., temperature, humidity, illumination, weather) and convert input data formatted the Sensor Web Enablement(SWE) O&M(Observation & Measurement) into JSON(JavaScript Object Notation) mainly used for exchanging information on Internet. Also, the Sensor Data Collector has the Semantic Translator, which performs translation jobs(i.e., semantic annotation) by annotating sensor data, using the sensor/event/context ontology model and the translation rules to provide more meaningful information. The Semantic Processor stores sensor observations in the Sensor DB based the HBaseTM which is a distributed, scalable, big data store and sensor specification translated by the Semantic Translator and private health information formatted the RDF in the Semantic Repository. It derive contextual knowledge from aggregated data, using the Context Reasoner which performs the ontology based inference. The service can query the derived contextual knowledge stored in the Semantic Repository, using the SPARQL(Sparql Protocol and RDF Query Language). Figure 3 shows an overall architecture of the sleep management service.

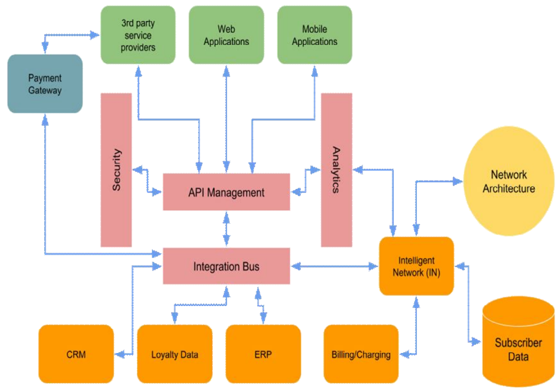

Figure 3: The overall architecture of the sleep management service

A. Semantic Ontology for Sleep Management Service

The rest the executives benefit is made out of a genuine occasion cosmology and administration area metaphysics in the proposed stage. The genuine occasion metaphysics implies a regularly connected philosophy which is autonomous with explicit administration space for depiction of sensor information itself and occasion information disconnected from sensor information and metadata. The administration space cosmology is worked to get setting information from sensor information or potentially occasion information as indicated by an explicit administration area, for example, human services. The genuine occasion cosmology comprises of 5 sub-ontologies, for example, asset, time, space, climate, network. The administration area philosophy likewise comprises of 5 sub-ontologies, for example, specialist, strategy, occasion, setting, benefit. Figure 4 demonstrates the structure of every cosmology.

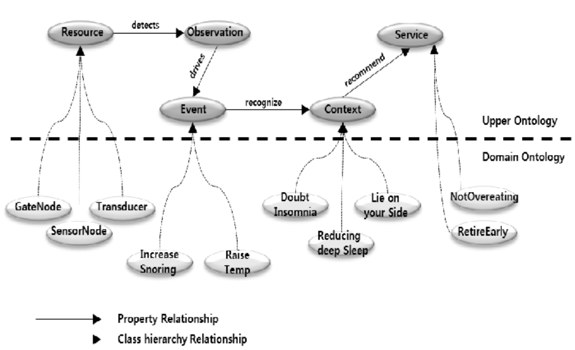

Figure 4: The Structure of Semantic Ontology for Sleep Management Service

Asset sub-metaphysics dependent on Semantic Sensor Network of W3C Incubator Group contains particular of different sensor and continuous sensor perception got from the administration. This sub-cosmology is separated into 2 sections: "Item" class and "ObservationValue" class. The "Item" class speaks to the particular of sensors and the "ObservationValue" class speaks to continuous sensor perception. Additionally, it identifies with space as sensor's position, time as sensor perception's detecting time, and occasion as data disconnected the sensor perception. Figure 5 demonstrates the structure of biomedical data.

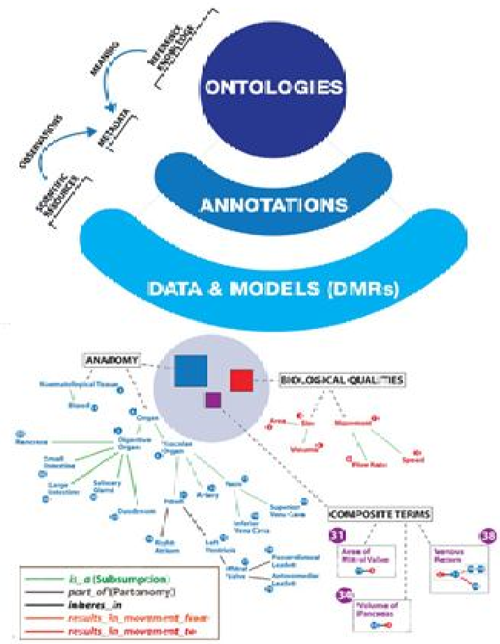

Figure 5: The Structure of Resource Ontology

Time sub-metaphysics dependent on OWL-Time ontology[4], which is standard philosophy on time, communicates onsistent time information got from sensor perception as discrete time- calculated data. SWRL has been designed for expressing relations between individualsof one or more ontology. However, some more is required to be used as transformation language. Model transformations are constructive in nature. Transformations create a target model from a source model. SWRL is not equipped with mechanisms for creating new individuals. Nevertheless, we can extend SWRL with this end, by incorporating a built-in called newURI for building URIs. On the other hand, some transformations can require to handle collections of OWL elements.

The following figure shows SWRL

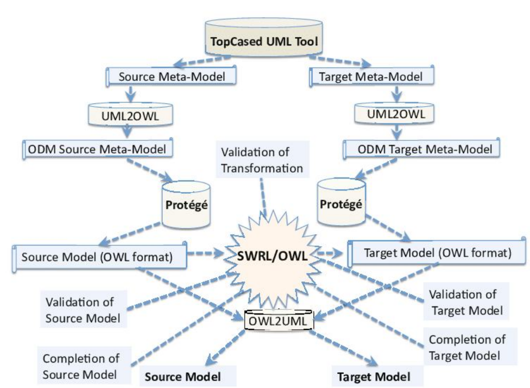

Figure 6: Integration with UML/OWL Tools

3. CONCLUSION

In this paper, we presents a semantic open IoT benefit stage which can bolster the semantic interoperability between different IoT gadgets, and The semantic-based rest the executives administration's client application program was produced on Android cell phone. Every administration offer the client with different administrations, for example, checking rest fulfillment, giving the accumulated sensor perceptions and examined rest design. This administration has demonstrated that the semantic based sensor detail and perception has advantage in the sensor's interoperability and administration adaptability on the proposed semantic open IoT benefit stage.

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