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Handling IoT Messages in a Broker Using Electronic Pedigree System.

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Abstract

An IoT system have the ability to transfer data over a network without human-to-human or human-to-computer interaction. An IoT system consists of interrelated computing devices, objects, animals or people with unique identifier. Day by day the devices participate in the IoT system increases. In an electronic pedigree system, small-sized but a massive amount of electronic pedigrees in the XML format will be generated, stored, and retrieved. There is a disadvantage, when storing the pedigrees in the xml file format within HDFS. To solve the storage problem of massive electronic pedigrees in HDFS, by adding some mechanisms such as prefetching and remerging. It is not easy to handle a large volume of web based messages with various size display on the client side. So here mainly focused on an IoT system architecture and Shortest Processing Time(SPT) scheduling algorithm and it can stabilize the response messages from the heterogeneous devices per each client request effectively.

Introduction:-

Internet of Things (IoT) is a recent communication model that visualize a near future, in which the objects of daily life will be provided with microcontrollers, transceivers for digital communication. And also use suitable protocol stacks (Sutaria et al (2013)) for seamless communication between heterogeneous devices, becoming a fundamental part of the Internet.

From the concept of pedigree system of people and animals in the real world, the electronic pedigrees (EPCglobal et al (2007)), (C. C. Tan et al (2006)), (M. Harrison et al (2006)) which contain the traces of objects in the Internet of Things (IoT for short), can be recorded, signed and verified, then used to anti-counterfeit (EPCglobal et al (2007)), (C. C. Tan et al (2006)). In an electronic pedigree system to ensure the integrity of electronic pedigrees uses digital signatures is an important technology of the Internet of Things. An electronic pedigree storage broker (EPSB) is required to manage electronic pedigrees and allow clients to access electronic pedigrees which they search for in the system.

Small and XML formatted are the two key features of electronic pedigrees. For example, when a product is produced, only one piece of Initial Pedigree (W. Han et al (2012)) will be generated and signed, in a KB-sized file.

The paper proposes a three tier architecture by adding a broker in between IoTdevices and IoTclients and an approach to improve performance of storing and accessing massive small XML in Hadoop, it reduces the metadata work at NameNode and improve the efficiency of accessing small XML files. Considering the small files as characteristics of electronic pedigrees, add some features such as remerging and prefetching mechanism. Remerging or combining the small xml files into large one which belongs to same envelope to reduce the file number then build internal index for each large file and using prefetching mechanism, which can speed up the accessing of small xml files.

Related Works:-

Main enabling factor of Internet of Things promising paradigm is the integration of several technologies and communications solutions. The authors in (Zanella et al (2014)) describes that identification and tracking technologies, wired and wireless sensor and actuator networks, enhanced communication protocols (shared with the Next Generation Internet), and distributed intelligence for smart objects are just the most relevant. As one can easily imagine, any serious contribution to the advance of the Internet of Things must necessarily be the result of synergetic activities conducted in different fields of knowledge, such as telecommunications, informatics, electronics and social science. In such a complex scenario, this survey is directed to those who want to approach this complex discipline and contribute to its development. Different visions of this Internet of Things paradigm are reported and enabling technologies reviewed. What emerges is that still major issues shall be faced by the research community.

Ubiquitous smart environments, equipped with low-cost and easy-deployable wireless sensor networks (WSNs) and widespread mobile ad hoc networks (MANETs), are opening brand new opportunities in wide-scale urban monitoring. Indeed, MANET and WSN convergence paves the way for the development of brand new Internet of Things (IoT) communication platforms with a high potential for a wide range of applications in different domains.

The authors in (H. Ning et al (2011)) shows that a typical IoT system links many small sensors/actuators in a common network, and many architectures have been proposed to create IoT environments. An IoT architecture is modeled after the human nervous system, referred to as the man-like nervous (MLN) model. Functioning like a human brain and spinal cord, a management and centralized data center (M&DC) manages many distributed control nodes in the IoT network. This analogy is helpful in the implementation of IoT in its current development environment.

As systems grow in size and complexity, (A. Gluhak et al (2011)) present new technological challenges. A survey of testbeds in IoT systems can be classified and assessed by certain evaluation indicators. From a structural perspective, a two-tier system is easy to set up, but becomes increasingly difficult to manage as it scales up in size because of hardware limitations in the device tier. Adding a gateway device to produce a three-tier architecture can increase system extensibility.

Meanwhile, the use of specially designed client-side applications reduces service inflexibility and portability, giving way to web-based technologies for installation-free application development at the client end. To reduce development complexity and raise management efficiency, a variety of components in the system should be classified first. In (R.J.C. Nunes, et al (2004)), the system features 4 levels of management and each device belongs to one level. However, multi-level management seems unnecessary for most simple environments, and flat management can increase the intuitiveness and efficiency of system development and implementation.

Currently, there are two mainstream topics in IoT: numbering and identification, and sensor networks. In (M. Zorzi et al (2010)), discuss both of these topics and their associated requirements, including IoT system heterogeneity for which the system should be able to integrate many types of devices, technologies and services. Another key area of research focuses on system connectivity in the context of enabling communication to various (potentially wireless) devices. Effective communication management requires confirming information delivery while avoiding system overconnectedness which reduces manageability.

System Architecture:-

In an IoT environment, many electronic devices with sensing capabilities and wireless links are increasingly applied for seamless communication. The wireless communication and embedded interactions are being for effective future IoT domain. But the devices may support different kinds of communication protocols they are from different manufactures. It made some difficulties when integrating among heterogeneous devices.

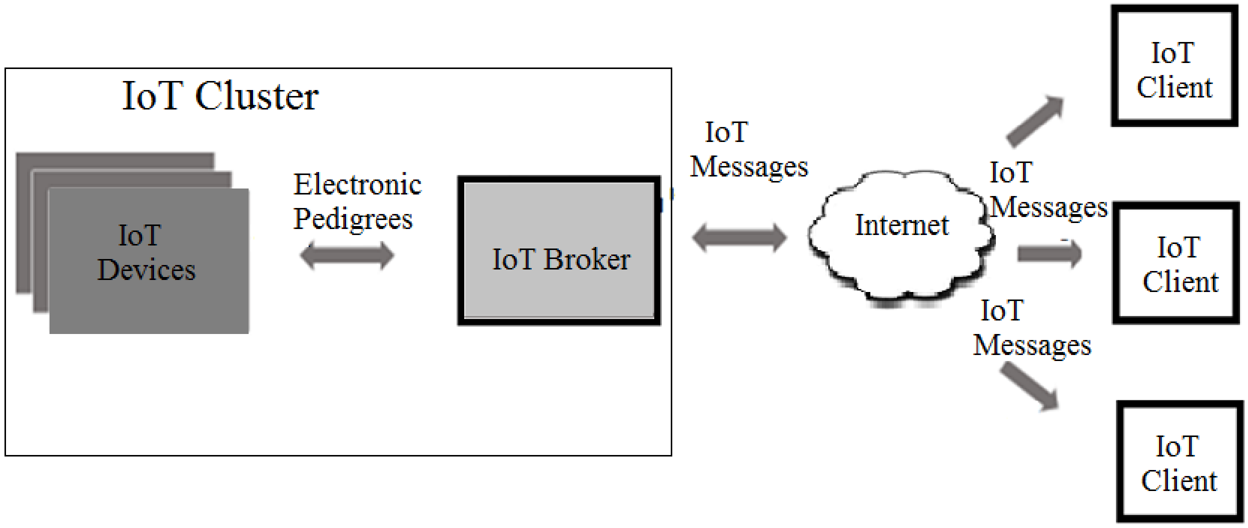

Figure 1: System Architecture

Here focus on a system architecture shown in Figure 1 for building the IoT environment. The basic element, called an IoT cluster. An IoT cluster are clustering the IoT devices and these devices are connected to broker. IoT devices are connected to IoT client via broker. Transfer the data from IoT devices in broker as electronic pedigree system and stored in the xml format.

A. Elements Inside an IoT Cluster:-

Different applications may involve different types of appliances. For example, an environmental sensing system may include a gas sensor which are sensitive to intensity of gases and a smart phone which gives location of the user via GPS application. Classifying all components used in the aggregation system which reduces the integration complexity shown in Figure 2, which are classified here as Sensor, Broker, IoTclients.

1) Sensor: Sensor is an input device used to gather information (e.g., gas, temperature, humidity, etc.) from the real environment.
2) Broker: Broker acts as a central coordinator to bridge Sensor and Actuator through communication Media. Broker collects the sensed data, processes it and presents it in readable and visualized forms.
3) IoT clients: Clients send requests to the broker and receive responses from broker.

IoT Message Scheduling:-

In a real-time IoT system (F. Cottet et al (2002)), different messages from a variety of IoT devices are regularly sent back to the IoT client per requests from the IoT client. In a HTTP based request/response model, the transmission is synchronized such that every periodic request from a client should wait till the server respond to the previous response. Message requests should be well scheduled to secure the reliability of response messages. Using queue theory, scheduling algorithm improve the message stability from IoT clients.

A. Shortest Processing Time Scheduling Algorithm:-

The algorithm (Jenq-Shiou et al (2014)) proposes Shortest Processing Time Scheduling. Let r be the number of devices, assume there are r types of different devices, generating r types of messages. The requesting period denoted as Pk is defined as the period the client side submits the request message to the k-th type of device. The service time denoted as Sk is defined as the average duration starting from the moment when the request message is received by the k-th type of device to the moment when the response message is transmitted to the client. The maximum period denoted as Uk is defined as the maximum responding period the k-th type of device can support. Pk≥Uk because the requesting period is the maximum responding period at least for each device. The request/response property of the message for the k-th device can be portrayed as M(Pk,Sk,Uk); with a requesting period Pk, an average service time

Sk, maximum responding period Uk. The arrival rate and the service rate of the message for the k-th device are respectively represented by $\lambda k=1/Pk$ and $\mu k=1/Sk$ respectively and its corresponding traffic intensity is shown in

$$\rho k = \frac{\lambda k}{\mu k}\frac{Sk}{Pk}$$

Thus obtain the overall traffic intensity ρk, which should be less than one, as shown in

$$\rho k = \frac{\lambda k}{\mu k}\frac{Sk}{Pk} < 1$$

1) Initially, a minimum responding period was given to the requesting period for all devices. That is $Pk = Uk$ for $k = 1, 2, \ldots, r$.
2) The requesting period will progressively be increased by the ratio of the minimum responding period.
3) The traffic intensity of each type message will be recalculated by the new value of the requesting period, and the property set of all types of messages is rearranged according to the new traffic intensity value.
4) The evaluation of the overall traffic intensity is then repeated and, until the loop ends, the final system traffic intensity will be less than 1.
5) That is, the periods for all types of messages should be adjusted longer to make the re-calculated system traffic ρ.

Conclusion:-

For a traditional IoT system a two tier architecture is implemented. In this paper, introduce a broker in between the server and client for converting two tier to three tier architecture and also handling IoT messages using electronic pedigree system in Hadoop. The data stored in the broker as pedigrees and it is in the xml format. It improves the speed of retrieving and accessing of data from the broker. There is a system architecture, which shows the data access as pedigrees and send as IoT messages from broker. And also use an SPT scheduling algorithm for stabilizing the requests and responses between IoT clients and broker, since it is a web based messages. Using the priority queue model, each IoT message is considered as an arrival message that in the server's system queue. So electronic pedigree system in Hadoop will improve the speed of accessing and retrieving the data from the broker.

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