Modeled Sensor Database for Internet of Things

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Abstract

This paper will propose a system which store modeled sensor data instead of storing raw sensor data. In this system we will capture the behavior of sensor data at a particular time period. This reduces the data storage requirement and decreases issues of data redundancy. The proposed system is sensor independent. The user can retrieve the data models for any desired application. This will save the time and human efforts for designing the data models for required applications. It is very much easy to extract the data from these models for the analysis of IoT applications. The input, processing and output operations can be done using the data from the sensor data models.

Keywords: Sensors, Data, Database, Model, Internet

I. INTRODUCTION

Nowadays Internet of Things (IOTs) is used globally, as it reduces human work. It is also understood that it produces a lot of data from time to time. It implies the same for sensors. Sensors produce raw data which is stored in the database. There is a possibility that the raw data is redundant which creates issue of storing the data. So there is a need to upgrade the existing system by producing data models for a particular timestamp. This paper will help in developing a system which store modeled sensor data instead of storing raw data. The data models developed are mathematical polynomial models that fit a typical data set.

There are various types of sensors and they function differently. For example, agricultural applications will have temperature, humidity and light sensors. Temperature Sensors calculate the hotness or coolness of an object. The functionality of the sensors is the voltage that read across the diode. If the voltage increases, then the temperature rises and there is a voltage drop between the transistor terminals of base & emitter, they are recorded by the sensors. If the difference in voltage is amplified, the analog signal is generated by the device and it is directly proportional to the temperature. The temperature can be measured by four measurement scales and they are divided into different degree units by using temperature sensors. The metric Celsius scale is used by the measurement scale and they start from zero. The Fahrenheit temperature sensing uses the Rankin scales and these scales are absolute scales. The Rankin scale measures the absolute zero as the 492 degrees Rankin. Temperature sensor determines the absolute zero measurements as close to the minus 46 degrees Fahrenheit. Humidity Sensors work by detecting changes that change electrical currents or temperature in the air. There are three basic types of humidity sensors: Capacitive, Resistive and Thermal. These sensors monitor minute changes in the atmosphere in order to calculate the humidity in the air.

Also medical devices have sensors that measure heart rate, blood pressure, and other body functions. Therefore, the data obtained from different sensors can be miscellaneous. This data is so large that it creates storage requirements as well as it might be redundant. It also affects the performance of the system as the database will be heavily loaded with different datum. Therefore, this paper will provide the solution for IOT applications that can resolve the problem of large and complex IOT data.

II. ARCHITECTURE & WORK FLOW

The sensors gather information of their environment on a regular basis. Thus a large number of data readings are generated every day. And therefore, it is becoming difficult to store, manage and analyze this large volume of data. As a solution to this, we will develop a system for these data readings that converts raw data points into data models and also storing this large number of models still requires huge amount of space.

We are moving from a time where there are millions of devices are connected to a network today to a time where there will be billions of devices connected to this network. We need to create a hierarchical structure that makes query processing easier by creating a logical flow between IOT objects.

The user has to specify what IOT object they want to search. The IOT objects consists different kinds of information sensing devices such as speedometers, rain gauges, microphones, and many more that have variety of sensors like automotive sensors, environmental sensors, acoustic and sound sensors etc.

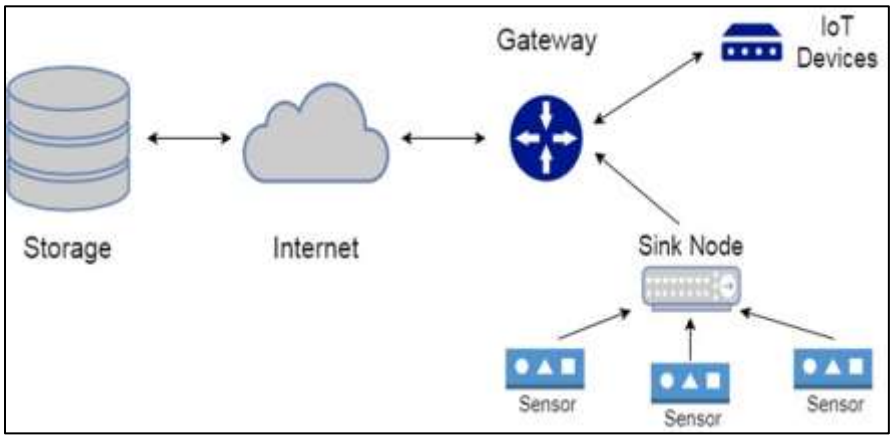

Fig. 1: System Architecture

Our model-based IoT database is a database management system built for IoT objects and their various sensors. It presents a set of relational database operations that helps in creation of the database and solves complex data queries. When a user enters any query, it is parsed by the query processor. The query service module builds the query according to the query parameters and sends the query request to the database service module. The database service module holds the database logic and sends the query statements to the query engine. The index established in the index module will be utilized to retrieve the requested data. After the desirable data is obtained from the database, the query engine sends the records to the result transformer that presents the query results in a format easy to use by the user [4].

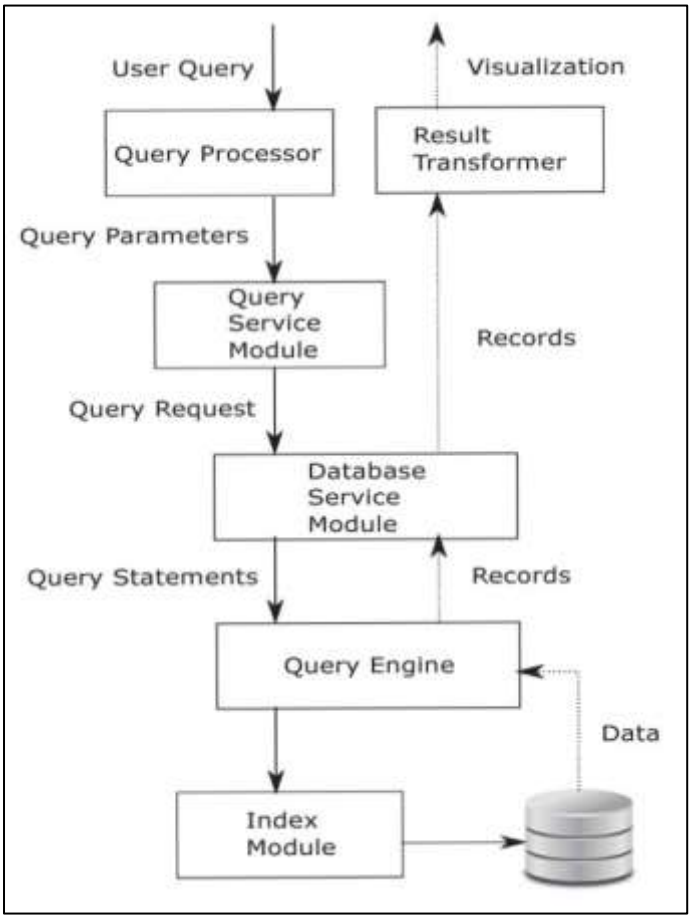

Fig. 2: IOT Database Architecture

The Database will consist of a table having 4 attributes. The field names such as objectID, location, timestamp, and dataModel are the attributes of this relation where timestamp is the primary key stating that each record will be uniquely identified by timestamp [4]. In other words, no two records can have the same timestamp [4]. Hence, by knowing the timestamp of a particular object, we can retrieve its objectID, location, and data model.

Sample Record = (object ID, location, timestamp, data Model)

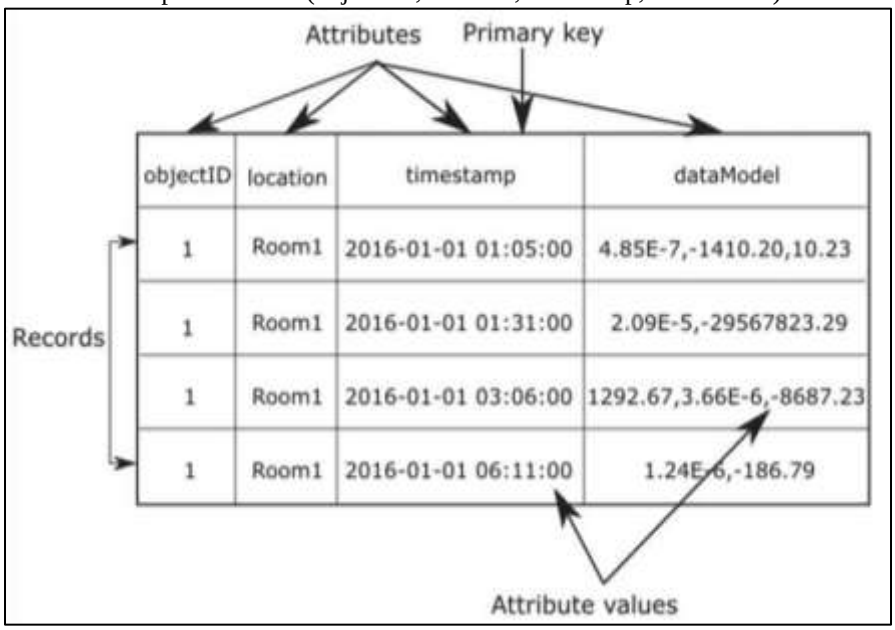

Fig. 3: Sample of Database Schema.

III. APPLICATIONS

This system is useful to analyze the behavior of various sensors. As the use of IOT is increasing exponentially, use of sensors in IOT applications is also increasing. Furthermore, as the production cost of sensors is very inexpensive, large numbers of sensors are stationed in the environment to get thorough information about the surroundings.

This system is designed in such a way that it analyzes the working of sensors at a particular time and stores the data in form of models. This helps in reducing storage requirements in the database.

It can also be used to analyze the temperature and humidity changes for longer timestamps.

It can also be used for Monitoring Weather stations, Soil monitoring, Animal tracking and monitoring, Water quality.

IV. ADVANTAGES

The advantages of such a system are:

1) Space required is less as we store models of data instead of raw data.
2) No Data Redundancy.
3) Faster Machines as the database is not heavily loaded.
4) Low Cost.
5) Accurate Results Obtained.
6) Predictions can be done (eg: Temperature & Humidity Sensor).

V. DISADVANTAGES

The disadvantages of such a system are:

1) Data Models require more space if the sensor data is in bulk quantity.
2) As timestamps increase the storage space also increases.
3) Predictions might differ if the hardware is of poor quality.

VI. SOFTWARE & HARDWARE REQUIREMENTS

A. *Software Requirements:*

– Python: Python is a simple and minimalistic language, easy to learn. It is free and open source high level language. It has been ported to many platforms. It is Extensible and Embeddable.

– NoSQL Database: It is the description of all possible data and data structures in a relational database. It can scale to handle more data. It is Highly Distributable. It can be used to store information without any schema design.

B. Hardware Requirements:

– Raspberry PI: It offers better power management. It has 40 pin connector. It has built in WiFi and Bluetooth facility.
– Sensors: It is a device which converts one type of energy into another. It shows the functional relationship between physical input and electrical output. It provides accuracy, linearity and proper bandwidth of i/o signals.

VII. CONCLUSION

In this way the system will help the user in storing the raw data obtained from sensors in the form of sensor data models. More number of sensor data models are storing in the database. The user will be using the desired sensor data model from the database for required application of Internet of Things.

VIII. FUTURE WORK

As future work, more robust algorithms can be created to segment data into more accurate models using a set of mathematical functions other than the polynomials of higher degrees such as logarithmic functions. Finding the most probable model efficiently will also help the system save energy.

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