Datacollection And Fault Tolerant Design Of Iot Devices Over A Distributed Network System

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Abstract: In a world, where connecting and communicating with devices have never been more in need, The Internet of Things thereby has a demanding need for a strategy of a design to ensure the communication between these devices is reliable, maintainable and scalable. Having many permutations and combinations of possibilities of devices and solutions offered to world, this paper addresses a solution with a working use case to design the system, check for reliability, throughput, maintainability, scalability and address the issues in the current system and how this design will help to overcome those issues.

Keywords: IoT, Internet of Things, 6lowpan devices, DataDistribution,Blooming,Cloud,BigData,DataAnalytics.FaultTolerance, Throughput, Sensors.

I. INTRODUCTION

This paper provides a design and implementation and a use case to solve a problem in data distribution of devices. Considering the increase in the IoT devices in leaps and bounds these days, it is hard not to ignore the usage of these devices. Recent study suggests that the IOT devices people buy lot of these devices but fail to implement and solve the problem. Though they seem to be providing with many advantages. They also pose a potential problem in the world to ensure data collection and distribution over Fault tolerance in the low powered network devices such as 6lowpan protocol devices.

II. THE SYSTEM

A. Design

The design of the system is simple and is mostly observed in daily lives. It is called the bloomer-collector pattern. Like a flower field in the meadows. The flowers bloom and the collector collects the flowers and shifts to a secure location for processing. Likewise, the Data being transmitted from the bloomers, typically emitting the data to the nearest collector. Each collector is responsible for a finite number of bloomers. When the event blooms at the device. The collector collects the event, typically some kind of json object with data and stores with the collector. Once a typical threshold is reached then the collector send the cumulative information to a central server that is processing the logic of all the data that is supplied by the collectors.

B. Nomenclature

1. DataPoint: A data point in the system is the main data that needs to be evaluated by the system. A datapoint is a single entity, either a String or a JSONObject A data point in the system never has two values. In the requirement of multiple data points the values are embedded in a JSONObject given they are driven by a JSON schema at the server side.
2. Bloomer: A bloomer is a IoT Device that emits the events periodically.
3. Collector: A collector is a more reliable device that is responsible for a finite number of bloomers. The data emitted by the bloomer is collected by the collector.
4. Central server: A Central Server is the server that is responsible for collectors. All the data points in the collectors are sent to the Central server.

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C. Reliablility.

In the terms, of reliability, the monitoring of the bloomers is taken care by the individual collectors. Each collector is set a TTL value of some seconds depending on the use of the product. The TTL value will be the time in which a scan of all the bloomers is ran to check for the stability of the system. Given that the stability of the system is down at any point of time, it is the responsibility of the monitoring team to check of any hardware or the software issues. Regarding the data reliability, again depending on the concentration of the bloomers, the average values of the data sent by the bloomers is recorded.

Avg. value at the collector (ci) = (b1+b2+…+bn)/n

Similarly, median and mode values can be calculated at the collectors. The DataAnalysis on the system is done at the server side. The Collectors follow a Single Responsibility Principle that is, to collect the data and report to the nearest server. The Server than logs the data to the database. Depending on the use case analytics are applied.Median value at the collector = Average of the Data point in the middle (even number of data points) or the middle data point, given the data points are arranged in the increasing or decreasing order. Mode of the given data points is the frequently repeated data.

D. Fault Tolerance

Fault tolerance in the system is identified by the monitoring done by the collectors on the bloomers. If the System identifies that a certain bloomer say bi is down in the period of the blooming, then there is a need of manual replacement of the given bloomer. The data transmission in the system may also contribute to the system FaultTolerance. In such case, where the system does not receive and data from the bloomer that one of the 3 strategies might be applied on B_i

a. Forced bloom

A forced blooming is strategy is applied on the system, when there is a need to collect from the bloomer, in this case the data point at the collector is heavily dependent and is coupled with the system. The system tries to send the data to the collector with the data point as the last known reliable data point. In this case the average value of the system may defer substantially from the mean, indicating the value is a false alarm.in the longer run, this bloomer needs to be repaired as early as possible to avoid huge devaitions of data points in the system.

b. Induced bloom

An induced blooming is done, when the collector doesnot depend very much on the datapoint of the bloomer but is important to log the details and what caused the bloomer to go down. There for the bloomer is ask to restart remotely if the device is operated on a 6lowpan else the system is targeted for a mean value datapoint blooming instead of the last known value of the bloomer. Hence the datapoint at the bloomer maintains a reliability good state of the data being collected at the collector, in turn ensuring minimum variance at the central server.

c. Null bloom

A null bloom happens when the bloomer is down and the system is not so dependent on the bloomer. Hence at the time of blooming, the collector receives a null data or no data. The data is validated at the central server depending on the type of data receivedand the correlation between the data and the fault tolerance strategy present in the central server end the system ignores the values being inserted. hence maintaining good data points for data analysis

E. Conclusion

The Strategy provides a use case solution and an enhancement over the current solution. This solution solves a problem with the strategy of blooming. Blooming is a term where the IOT based on Node js will Bloom the events, basically emit the events onto a socket. Each bloomer(IOT Device detects and emits the data to the nearest stable server as a json object.) Example Json Object. {“magnitude”:”6.7”, “depth”:”300m”,”date”:”20-07-2015”}. The json object is backed up by the json schema driven . this will make sure that the backward compatibility is ensured using the version tag of json schema.

III. Expirement and computation

A. Prototype

The prototype was built using 3 rasberry pi based node censors supporting cylonjs. Cylon is a node falvor of JavaScript library that is used a bloomer. Small Vibrations simulating the earth quakes were simulated and the sensor read on to the simulations continuously. The data was emited to a nearby collector. The collector inturn had all the monitoring of the bloomers.

IV. Formulae

A. Data Reliability vs number of collectors.

$$DataReliability \propto Collectors$$

Formula 1: Data reliability to the number of collectors present in each region. The data collected is directly proportional to the number of collectors present in the whole “System”.

B. *Data Reliability at a Collector say C_i vs Healthy Bloomer*

$$DataReliabilityatCi \propto \sum Bi(healthy)$$

Formula 2: The relation between the data correctness at a collector to the Bloomers in the region of the collector C_i

V. Figures

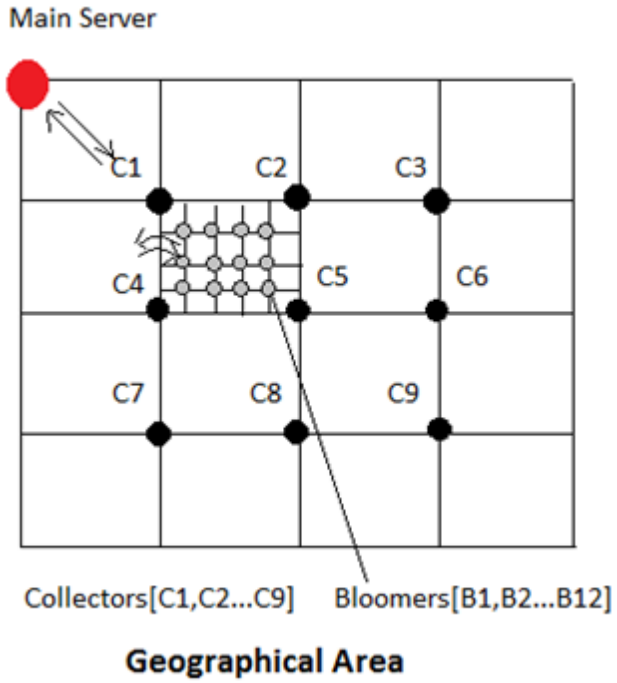

Figure 1:*Represents the Geographical representation of an IoT Driven system with the design*

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