Earlham COLLEGE

HYPERLEDGER

Fault Tolerance for IoT using Blockchain

How healthcare is the ideal application

ABSTRACT

Currently, IoT systems in healthcare mirror the systems in other fields; as such many IoT systems in this field will rely on hubs in order to facilitate control of embedded devices. Given the critical importance of the data in healthcare there is a need to ensure that health focused IoT networks contain hubs which are working correctly and able to offset the failure of other hubs. This research will explore the application of a blockchain algorithm to such systems to provide fault tolerance for IoT hubs. In the end the research should show whether this application is appropriate for blockchain. And additionally, it should show how such an implementation compares to more traditional methods of detecting faults.

INTRODUCTION

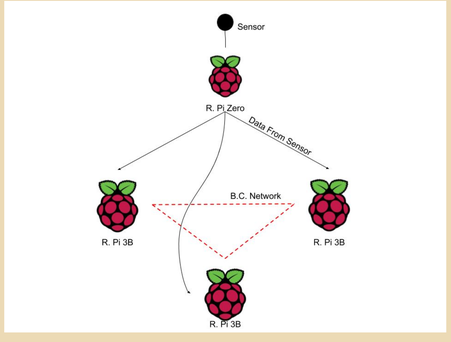
Hubs for Internet of Things devices do not at present have suitable fault tolerance methods.

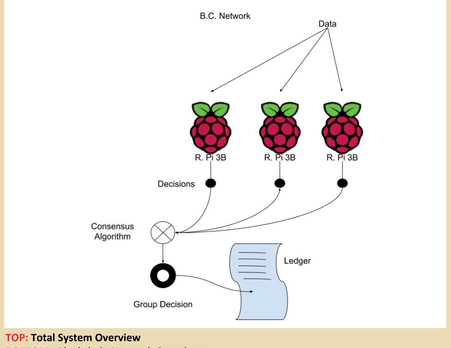
The primary methods of fault tolerance for sensor devices is redundancy.

The project aims to provide a similar level of fault tolerance for IoT hubs while maintaining acceptable performance.

This fault tolerance will make use of a blockchain network which requires consensus from the participant hubs for a decision to be made as opposed to a single hub making an independent decision.

Based on a positive evaluation the project should prove that the usage of a blockchain consensus algorithm and permanent ledger provide acceptable fault tolerance for IoT hubs which would have its most immediate use in the healthcare sector.





TOP: Total System Overview
BOTTOM: Blockchain Network Overview

SYSTEM DESIGN

- 1 Raspberry Pi Zero
- 3 Raspberry Pi 3Bs
- Temperature Sensor
- Hyperledger Fabric

The system makes use of a temperature sensor connected to a Raspberry Pi Zero functioning as a single device.

Data is sent from this device to the Raspberry Pi 3Bs which will be peers in the Hyperledger blockchain network.

This data will represent transaction proposals.

Each of these Raspberry Pis will make a decision as to whether the sensor data is acceptable or not

The decisions will be passed as endorsement responses to be evaluated against the endorsement policy.

A successful endorsement represents system consensus.

The result, whether successful or not, will be recorded on the ledger while only a successful endorsement will change the state of the ledger.

METHODOLOGY

The proposed solution will be a strongly connected network of devices, which will act as hubs, receiving data from an Internet of Things device.

Each hub will make a determination as to whether the received data is normal or abnormal, and will communicate their decision through a blockchain network.

The blockchain implementation will use a consensus algorithm to make a group decision.

Should abnormalities be found during the consensus process this will indicate that the system considers one or more hubs faulty and worthy of closer inspection.

The blockchain ledger can be analyzed for patterns in results which may indicate that devices are compromised

EVALUATION

The results from this system will be evaluated based on primarily on time and accuracy.

Faults will be fed to the hubs from the sensor at rates of 0%, 0.1%, 1%, & 10% of data points.

Additionally, faults will be introduced to one or more of the hubs at the same rates to simulate compromised hubs.

An analysis of the ledger will give an indication as to the accuracy of fault detection in both the sensors as well as the hubs.

The length of time required to process a data point will also be measured.

Beyond these two metrics it may also be useful to measure the network throughput.

The initial comparisons for the values measured for time will be against a system where sensor data is passed to a single hub and evaluated.

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