GR-45

Framework for Collecting Data from specialized IoT Device

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Introduction

- The Internet of Things (IoT) is the most significant and blooming technology in the 21st century.
- IoT has rapidly developed by covering hundreds of applications in the civil, health, military, and agriculture areas.
- IoT is based on the collection of sensor data through an embedded system, and this embedded system uploads the data on the internet. Devices and sensor technologies connected over a network can monitor and measure data in real-time.
- The main challenge is to collect data from IoT devices, transmit them to store in the Cloud, and later retrieve them at any time for visualization and data analysis.
- All these phases need to be secure by following security protocol to ensure data integrity. This work presents the design of a lightweight and easy-to-use data collection framework for IoT devices.

Motivation

- In this research, we want to evaluate the effectiveness of collecting real-time, synchronous, and stream data from specialized IoT devices.
- Currently, we can find IoT devices everywhere, and it is difficult to find a platform that allows researchers, teachers, and students to easily collect and visualize that data for further analysis.
- The idea is to have a framework that can be adjusted to any specialized sensor, that records stream data, for fast data collection.
- This project will help in a vast range of sectors that utilize data from sensors, for example healthcare, manufacturing, smart homes, among others.

Applications

Healthcare - From personal monitoring devices to hospital tracking systems, connected devices caregivers and caretakers use rely on sensor data.

Manufacturing - IoT sensors are used to ensure workplace safety. create a favorable environment for the peak performance of factory equipment, monitor worker productivity, and prevent machinery breakdown by pairing IoT with predictive analytics.

Agriculture - Smart solutions are used to monitor farming sites in real-time, forecast the likelihood of natural disasters and their impact on crops.

Smart homes - In the last five years, the smart home market has exploded. Smart thermostats have become a commonplace item for households. These tools heavily rely on data, captured by temperature sensors.

Transportation - Aside from autonomous vehicles, there's no lack of smaller-scale connected applications.

Proposed Architecture

Our framework consists of collecting data from sensors and sending them to Cloud storage securely and in real-time for further processing and visualization.

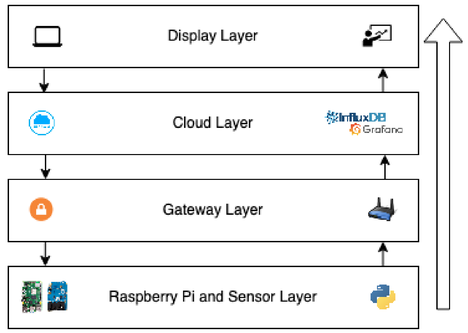

Fig: Architectural framework for collecting data from IoT devices

- The base of the architectural stack consists of Raspberry Pi and sensors that gather information from the physical world (via sensors) and manipulates it while interacting with gateway layer.
- The gateway layer routes and forwards this data collected from the raspberry Pi to the cloud layer for storage and processing. Lastly, Display layer (Grafana) retrieve all the data from the cloud and show in the dashboard.

Materials & Method

- The Framework consists of a set of sensors (e.g pressure sensors, vibration sensors, temperature sensors, etc.), a computer board (e.g Raspberry Pi), a Cloud Server, a Gateway, Secure Protocol, Python Programs, and a powerful data visualization tool.
- The framework can extract the data from the sensor using python code. The extracted data is sent to a Cloud (HPC Cloud) in real-time by following HTTPS security protocol and storing it in a powerful stream-data database (Influx DB).
- Then, the framework provides real-time data points monitoring using a powerful data visualization tool named Grafana by showing up-to-date sensor data that is refreshed every five or fewer seconds.

Fig: Data visualization using Grafana

Results & Further Work

Fig: Prototype consist of Raspberry Pi4 connected to a BMP180 pressure sensor that transfers the data using a 12C Shield digitizer.

- With our initial prototype, we were successfully able to collect sensor data indefinitely into the cloud server using a raspberry PI.
- We have conducted experiments to collect data from a pressure sensor to understand the variability of the application of pressure from hands, fingers, and objects (like pencils, markers, etc.).
- We also successfully collect real-time data from a temperature sensor that continuously runs for several days in order to measure the variability of the temperature over time. We applied multiple diverse techniques to increase the temperature of the environment (like place direct light over the sensor) to evaluate the increasing and decreasing temperature.
- With these results, we believe that it is possible to conduct multiple research studies in the healthcare, smart homes, agriculture, and manufacturing sectors.

Conclusion

In this work, we motivate the need for a versatile and robust data collection framework for IoT system. We have built a real-time and easy-to-use framework for collecting data securely. In future, we want to evaluate the effectiveness of collecting real-time, synchronous, and stream data along with performance benchmarks.

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