GR-182

IoT Clusters Platform for Data Collection, Analysis, and Visualization Use Case

Abstract

- Internet of Things (IoT) offers unique technologies in improving human conditions and knowledge in many domains such as personal health care, environmental monitoring, home automation, smart mobility, and Industry
- first research was to develop an IoT Clusters Platform for Data Collection, analysis, and visualization.
- The platform comprises hardware parts with Raspberry Pi and Arduino clusters connected to multiple sensors.
- The clusters transmit data collected in real-time to microservices-based servers where the data can be accessed and processed.
- we are implementing a study case for a field used by the platform. Thus, we are implementing an environment monitoring technology base on weather data.
- we will use this data to find patterns in weather changes using Machine and Deep learning techniques since these environmental data come from a designated area.
- Data collected during this research and the IoT platform are available on campus for students to use for their class projects or future research.
- This study case is a needed step in the IoT Clusters Platform for Data Collection, Analysis, and Visualization research project

Introduction & Motivation

- Our objective is to offer a reliable platform to support data collection, transmission, and visualization for Kennesaw State Students and researchers.
- Also, we are developing this platform to create an efficient data collection system, relatively cheap to implement and easy to deploy in any part of the world.
- We built a platform that provides material and technology for onsite and different data collection schemes.
- We used microservices technology for scalability and flexibility to align with our objectives
- Design a straightforward framework and cost less to implement for people researching climate and environmental monitoring.

Materials and Methods

- The platform has an inventory of 20 Raspberry Pis 4 (RP4) mounted in clusters of 6 devices. Each RP4 is connected to a server and has a secure data transfer preconfigured. We have 2 Pi servers that host a web server for virtual hosts. We also propose 20 Arduinos and 150 sensors, from temperature to cameras and motion sensors.
- We have a Tow Raspberry Pi server that the host can access using APIs on the software side. They monitor the cluster via a website, and the data transmission rate can be updated from the website directly. We are using WebSockets for RP4 monitoring. We can look for each device in the network status. We have built a JavaScript program to establish data transmission canals from devices to servers. We also have python scripts with data transfer in the code to Maria Databases.
- Also, we implemented every server (web server, Influx DB servers, Grafana servers) using a microservices paradigm with a docker engine. Each server is a container in a Docker engine. Containers communicate together using Docker compose and Docker swarm orchestration system.

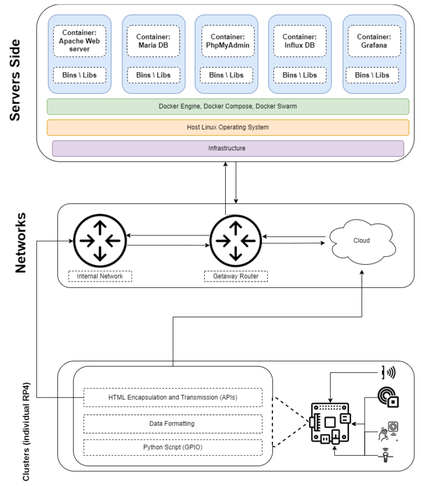

Figure 1 – Platform Architecture

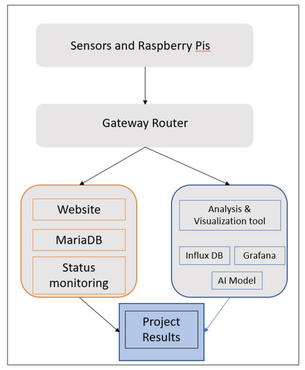

Figure 2 - Data Transfer Process

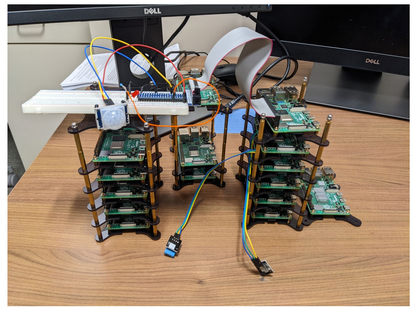

Figure 3 – Clusters Pictures

Figure 4 – Data Collection and Visualization Graphs

Results & Further Work

- We are already working with students in the CSSE department on a data collection project using Raspberry Pis and sensors for their class project. We have a functional platform prototype, currently collecting data from various sensors, from temperature and humidity for weather monitoring to Heartbeat Sensor for health and soil sensors for agriculture. All collected data is sent to our servers via the internet remotely, where they can be stored for future processing and visualization
- We have successfully implemented multiple data collection scenarios, and we are currently testing the platform hardware (Raspberry Pi and sensors) in an open field. We will also have a data collection campaign in the summer with Environmental Engineers from the Civil and Construction Engineering Department to study the water quality of rivers around metropolitan Atlanta.
- The materials and methods we carefully selected to implement this system make research affordable and data collection efficient with remote servers built with microservices. Such a platform is built to become a data collection framework; thus, people can implement their own based on our processes. We evaluate the cost of implementing such a data collection system compared to what we have available on the market.
- We want to propose an efficient and relatively cheap model of data collection systems that can be used in countries to monitor environments and the Global Warming effect has on the climate. In the future, we are looking to develop a framework for data collection and visualization based on this project.
- The framework will provide an advanced system based on IoTs and Raspberry Pis, and it will use a microservices framework that we are developing for analysis. The framework will help save costs on heavy, costly, and not energy-efficient devices.

Figure 4 - Raspberry Pis Monitoring Graphs

Conclusions

- We want to prove that IoT devices can be a powerful tool for research and monitoring in multiple fields.
- The data collection platform is available as a service for students and professors. It is free to use, and we always support users.
- The material used for the platform is simple, flexible, scalable, and robust because of the combination of multiple technologies.
- This platform can help automate many on-field tasks for researchers because of its cloud platform.
- In the future, we are looking to improve the platform's efficiency, develop more microservices technology and conduct more on-field tests of our platform.

Acknowledgments & References

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