Høgskolen i Sørøst-Norge

University College of South East Norway

FMH606 Master's Thesis

Title: Data Cloud Platform for Data Management, Logging, Control and Monitoring

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External Partner: National Instruments

Task Description:

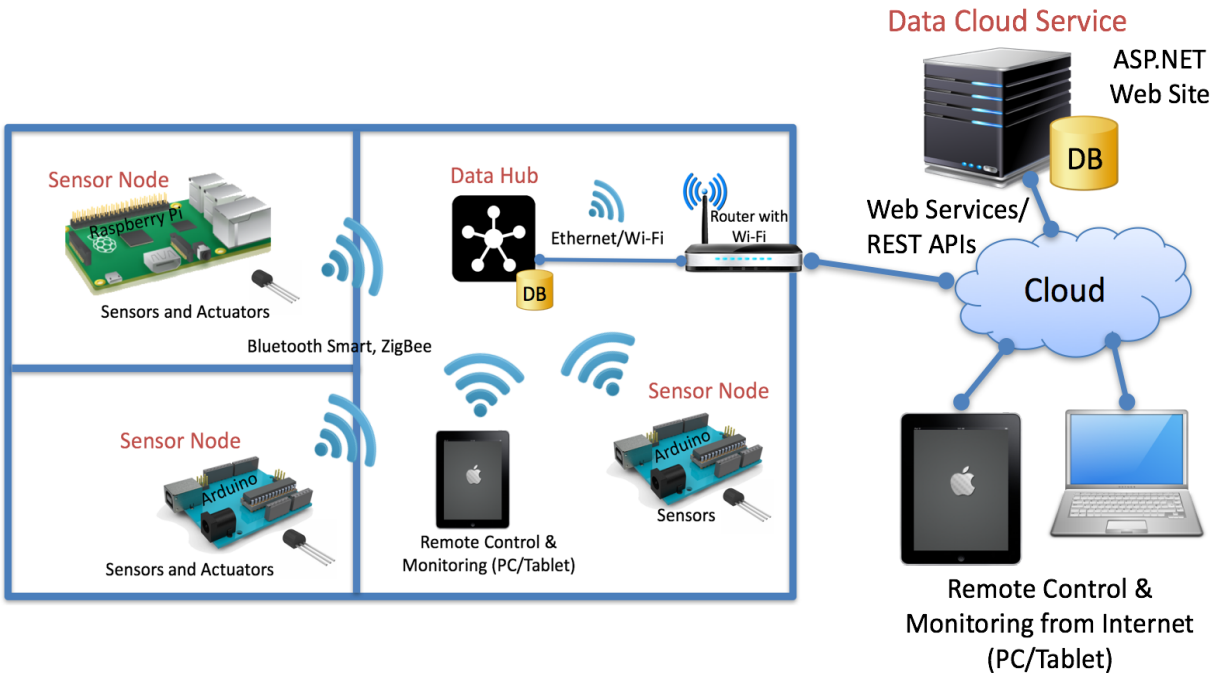
Analyze, Design and Development of a Platform for Data Management, Logging, Control and Monitoring. The Platform will have many Applications, such as Smart House/Home Automation solutions, Process Control, SCADA Systems, etc.

The main goal is to Design and Implement an Open Platform for Data Management, Logging, Control and Monitoring.

Programming Languages should be LabVIEW, Arduino Programming Language, C#, MATLAB.

The Platform should be easy to deploy and manage. Web Programming like HTML, JavaScript, ASP.NET, etc. are also of interest.

Data Cloud Platform for Data Management, Logging, Control and Monitoring Overview:



Some of the following topics should be investigated in this project:

1. General Overview of existing Solutions and explore **IoT Protocols** suitable (open APIs) for Home Automation Systems, e.g., IFTTT, X10, ZigBee, Z-wave, KNX, Bluetooth Smart, etc.
2. A "**Data Cloud Service"** for Data Management, Data Storage, Data Analysis and Data Collection shall be developed. A Database Server should be part of the Data Cloud Service for Management, Storage, Analysis and Monitoring of Data from multiple local "Data Hubs". The Data Cloud Service prototype should be installed on a server located at USN, in addition to a Microsoft Azure Server, but it should also be possible to deploy it other places.
   The development of the Data Cloud Service could consist of the following parts:
   - SQL Server Database for data storage.
   - Development of **Web Services/REST APIs,** both C# or LabVIEW can be used.
   - Development of a **ASP.NET Web Site** for Data Management and Monitoring.
3. A "**Data Hub"** for local collection of Data from multiple **"Sensor Nodes" (IoT Devices)** shall be developed. The Data Hub should also include a local Database for storage of Data. The "Data Hub" should support different open Protocols for communication with different "Sensor Nodes" (IoT Devices). The "Data Hub" can e.g., be an **Intel NUC** Computer, a **myRIO** unit from National instruments or a **Raspberry Pi 3** device. The "Data Hub" should be communicating with the "Data Cloud Service" using Web Services/REST APIs or other forms of standard APIs. The Hub should support different Wireless standards.
4. Explore **Sensors** (Indoor) that can be used with the Sensor Nodes, such as Temperature (℃), Humidity (%), CO_2 level (ppm), Noise level (dB), Ambient light (cd), Barometric Pressure ($mbar$), Motion sensor, Gas/Smoke sensor. Outdoor Sensor Nodes could also be considered.
5. Development of different embedded "**Sensor Nodes" (IoT Devices)** for collection data from Sensors and Control of Actuators. The Sensor Nodes shall send and receive Data from the Data Hub using Wireless Communication. The Data Hub will then communicate with the Data Cloud Service through the Internet Router. The "Sensor Nodes" should have a "professional" packaging with a protected case. It should also be battery powered. Battery, Sensors, etc. should preferably be inside the case. The Sensor Nodes can either connect to the "Data Hub" or directly to the "Data Cloud Service", depending of what kind of wireless protocols the "Sensor Nodes" are using. It's important that the "Sensor Nodes" are "embedded", meaning they are able to work without a PC connected to them.
6. Datalogging and Control from different **IoT Devices** ("Sensor Nodes") such as Arduino and **Raspberry Pi 3**, National Instruments myRIO, and USB based DAQ devices, etc. E.g., LabVIEW, LabVIEW LINX, standard Arduino Programming or Windows 10 IoT Core/C# can be used to program these devices.
   - **Especially, Raspberry Pi 3 and LabVIEW LINX should be explored** due to its embedded features.
   - **The new Bluetooth and Wi-Fi support for Raspberry Pi 3 should be explored.**
   - **The new Windows 10 IoT Core Anniversary Update should be explored**

7. Look into **Battery requirements** for the nodes and explore use of rechargeable batteries. Communication needs to be Low-Power since the "IoT Devices" should be placed around wirelessly with the use of only Battery Power. Explore new Wi-Fi and Bluetooth standards.
8. Explore **Wireless Communication**, such as Wi-Fi HaLow (IEEE 802.11ah), Bluetooth Smart (including next generation), XBee/ZigBee, together with e.g., Raspberry Pi, Arduino myRIO for Logging Sensor Data and Control of suitable Actuators in Smart Houses. The new Bluetooth and Wi-Fi support for Raspberry Pi 3 should be explored.
9. Use of **Data Dashboard for LabVIEW** App (https://www.ni.com/mobile/) for Monitoring and Control. Management and Monitoring should also be considered created from scratch using HTML, JavaScript, etc., which are connecting to the same Web Services.
10. Look into different **Security aspects** with IoT, Home Automation, etc.
11. A **Prototype** should be built into a **Suitcase** (2 units), including A Data Hub, pre-bundled Sensor Nodes with Sensors, such as Temperature (°C), Humidity (%), CO_2 level (ppm), Noise level (dB), Ambient light (cd), Barometric Pressure ($mbar$), Motion sensor, Gas/Smoke sensor. The packaging inside the suitcase should be and look "professional". A Sensor Node should also be installed in the Supervisors Office for surveillance of the Air Quality.
12. Integration of Weather Data from Weather Stations such as, e.g., Netatmo (https://www.netatmo.com) and general Web Services/REST APIs like "yr.no", etc.

Task Background: Data Logging and Monitoring is important in many aspects from Process Control, Automation Systems, Industry 4.0, Smart House and Home Automation Solutions, Internet of Things (IoT) Smart Cities, Smart Grid, Sensors (Cloud Computing and networks of data-gathering sensors), Bug Data, etc.

Student Category: IIA students

Practical Arrangements: None

Signatures:

Supervisor (date and signature):

Students (date and signature):