



**UNIVERSIDAD
NACIONAL DE
INGENIERÍA**

Facultad de
CIENCIAS



Design and implementation of the core level of a cross-platform based on Fog Computing

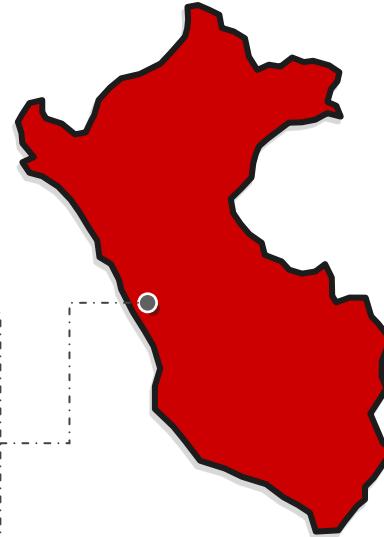
Felipe A. Moreno-Vera

Advisor: Prof. Manuel Castillo Cara

About me



Felipe A. Moreno
www.fmorenovr.com



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Context & Motivation

How to integrate multiple data sources?



Context

We identify the necessity of implement a real-time system to collect and process data:

- Sensor information
- Real-time data
- Dashboard

Motivation

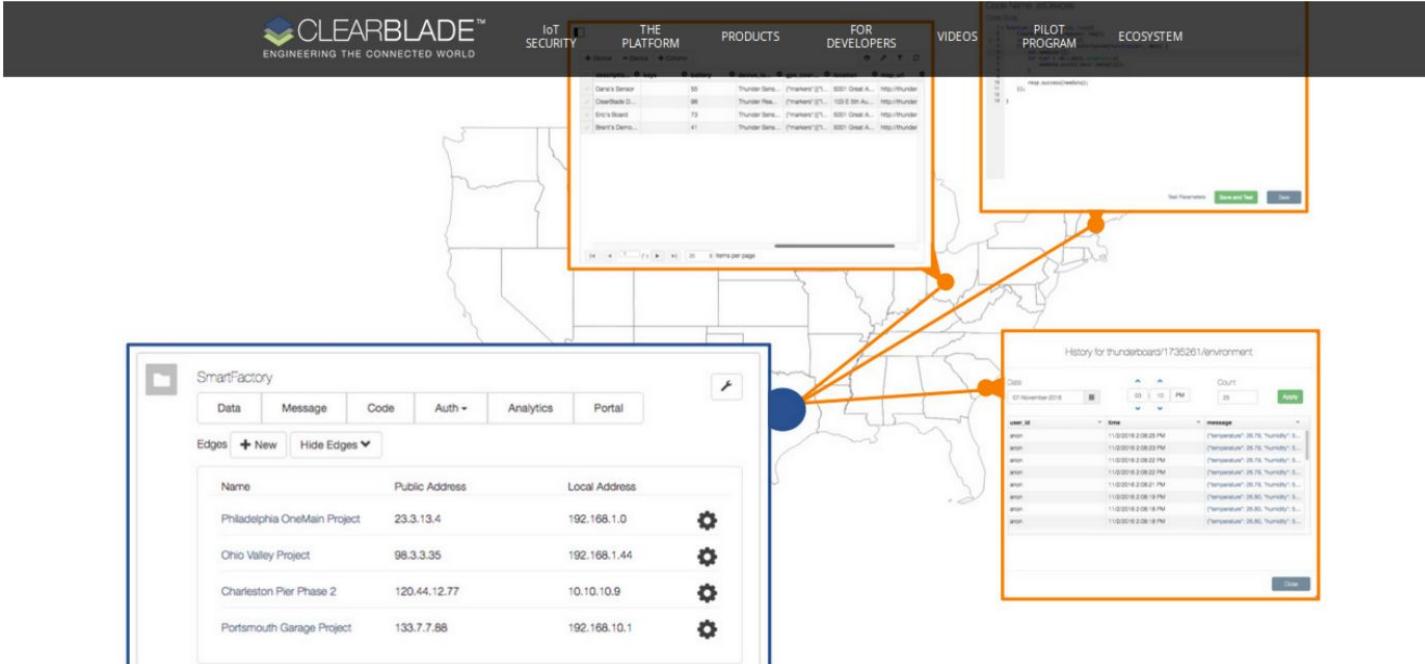
The motivation for which this theme was decided is due to the huge amount of software, libraries and frameworks that carry out this work using other technologies to obtain and update in a certain time (it could be time real), in addition to the great need for software that provides information in a friendly and easy-to-use manner.

Key contributions

- We **propose a methodology to analyze income data** from remote sensors.
- We **implement a Full Stack application** to process, clean, and show information sensed
- We **develop a dashboard to show** information in real-time.
- We **build an Fog-based architecture to sensing**, process, and track sensors data from different locations in real-time.

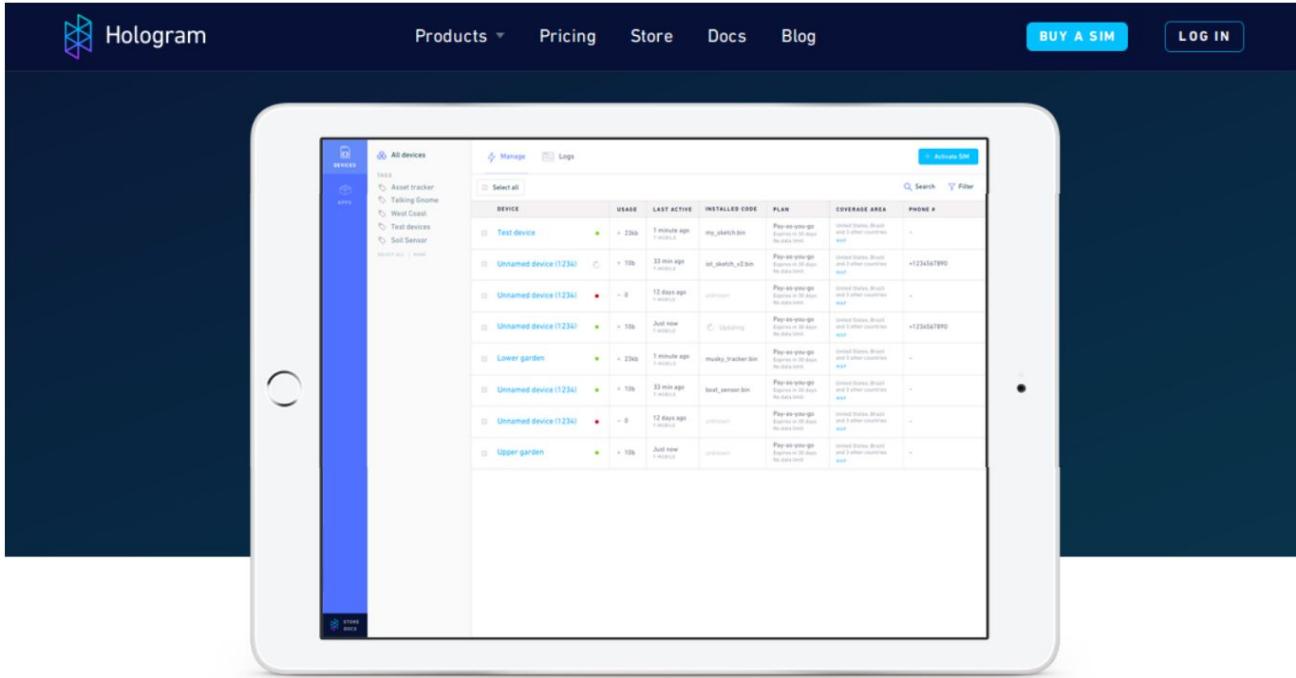
Related Works

ClearBlade



It is a web platform software which provides services on IoT using the MQTT protocol and SDK of development, it will notify you about changes (on off, data, connectivity) in the associated devices, that is, ClearBlade works as a Socket MQTT web broker.

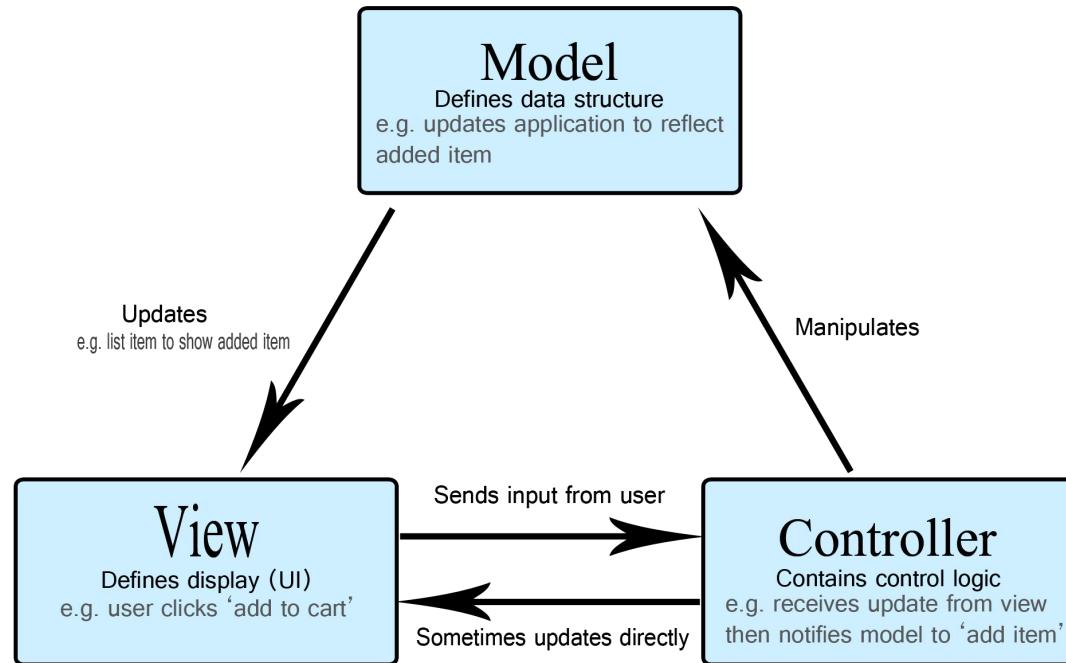
Hologram



It is a web platform software which provides services storage and connectivity such as bluetooth, wifi, and GSM, which they send it to their web platform, storing it for subsequently display the information obtained in your dashboard.

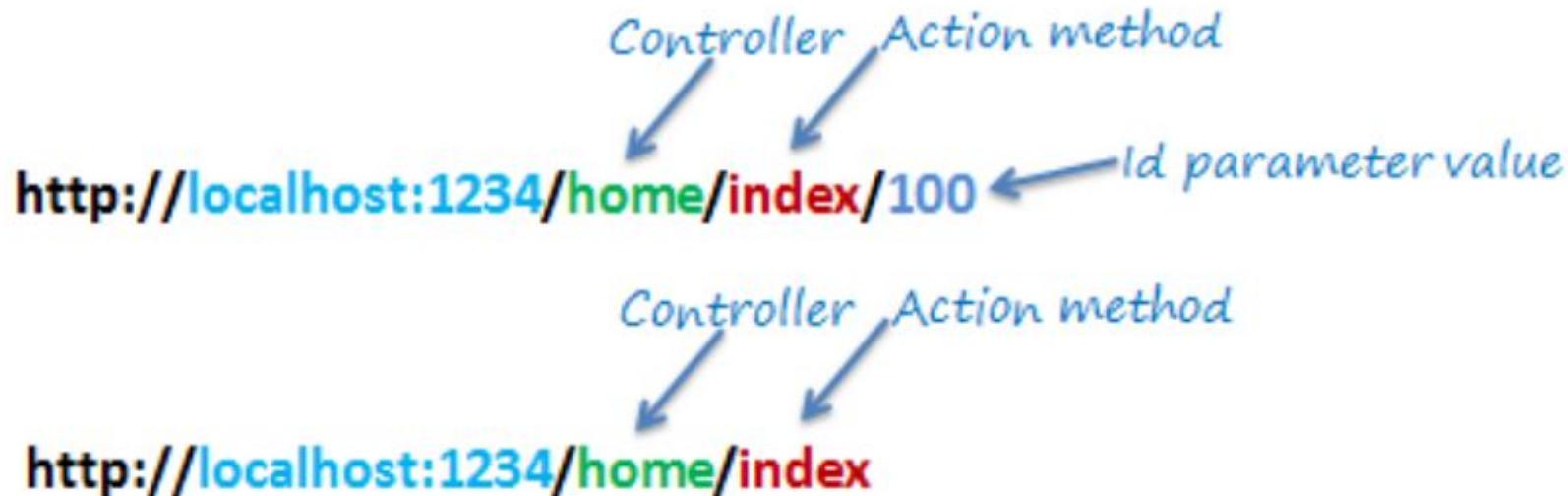
Technologies

Model-View-Controller (MVC)



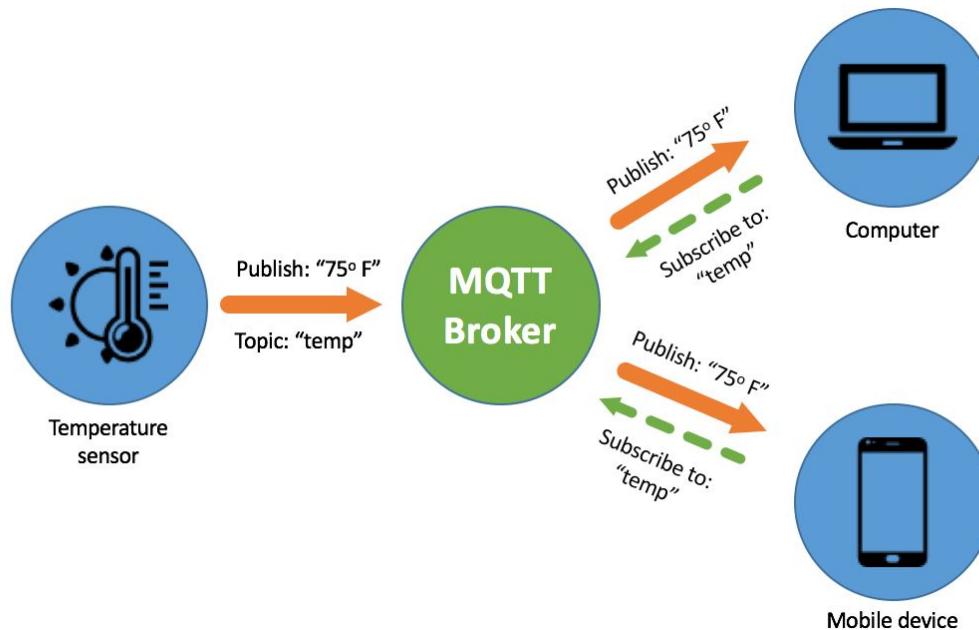
The pattern of development on which the design of the implementation of the web platform is MVC (model-view-controller).

HTTP: Routing in MVC



For the development of a platform, a library, a package or a project in general, it is best to save the modifications or corrections of errors as they appear during the implementation stage.

MQTT: Message Passing



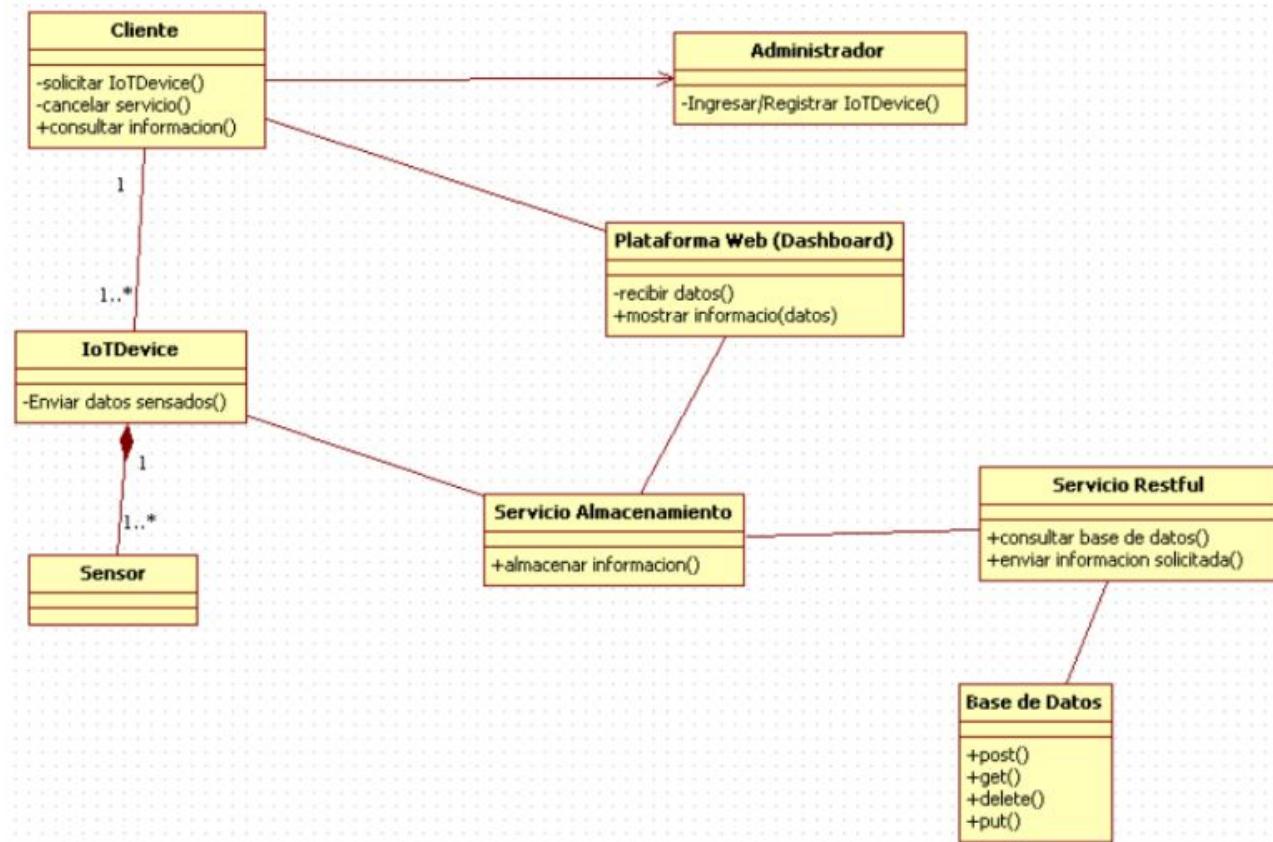
It is an object-oriented design pattern, where objects to a class instead of the class itself instantiating the object, used for web application implementation making calls to various components necessary for the functioning.

System Analysis

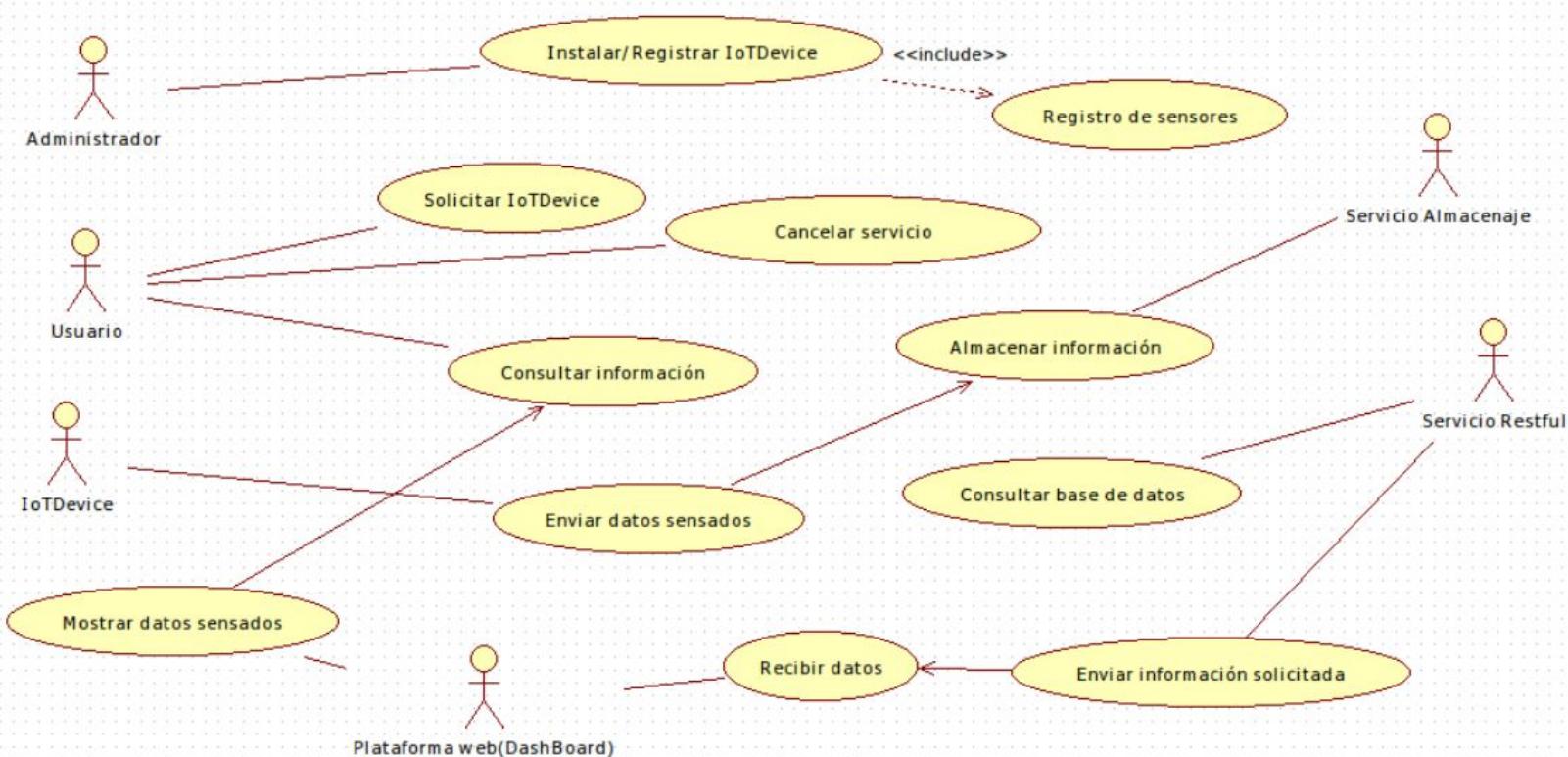
Definitions

- **Administrator** It is the actor in charge of the administration of the users. He is the only user who does not have IoT-Device registered.
- **User** It is the actor that has requested a service to the system, it is that is, it is aware of the sensed information displayed by the system depending on the devices that the same user have requested.
- **IoTDevice** It is the actor that sends the information that it captures from the sensors and sends them to the storage actor.
- **Dashboard** It is the actor in charge of displaying the information sensed and stored.
- **Restful** It is the actor that is in charge of performing and returning answers according to the requests of the actor dashboard, as well as also check the storage.
- **Storage** It is the actor in charge of storing the information

Classes diagram

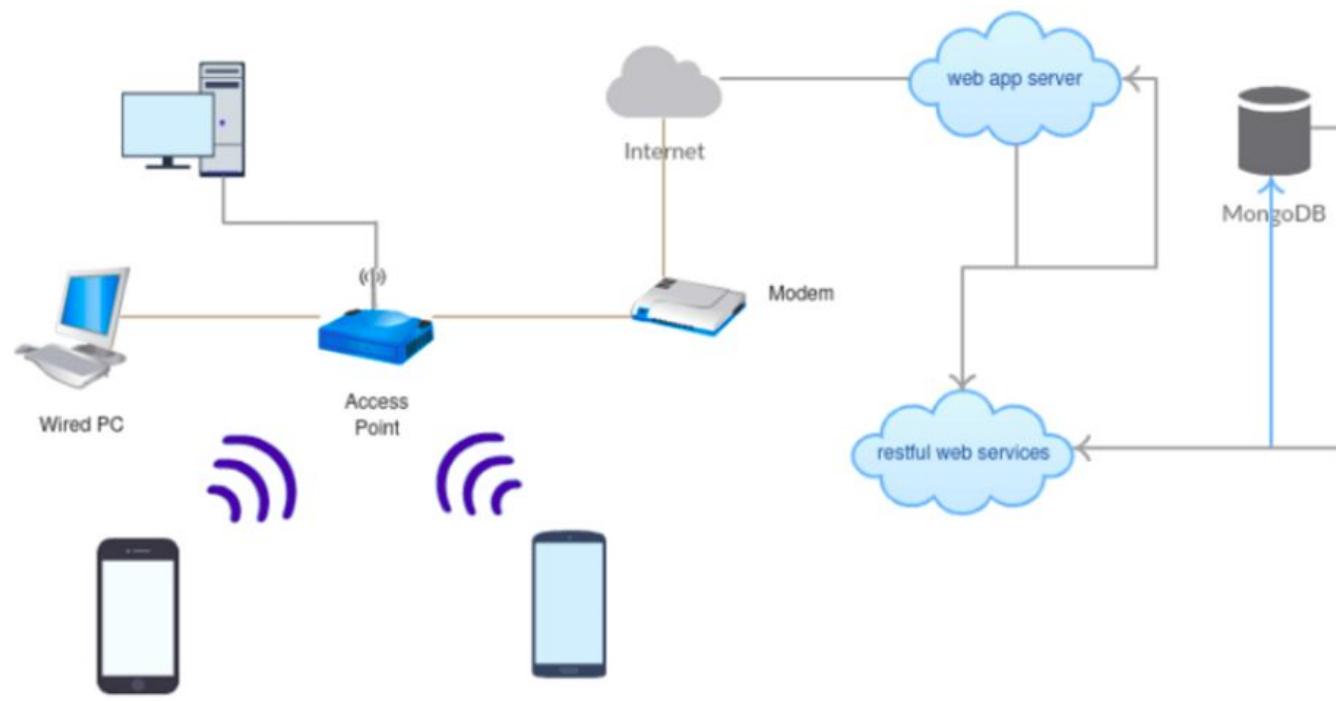


Case study diagram



Web Application

Fog architecture



Device information

The screenshot shows a web-based dashboard interface for device information. The title bar indicates the URL is `localhost:9395/index_dashboard.html#/dashboard/info/cansats`. The main content area is titled "Smart Cities - Dashboard" and "lista de Dispositivos". A breadcrumb navigation shows "Se encuentra en: > Dispositivos Info". On the left, a sidebar menu includes "ESTADISTICAS" (with "Inicio" selected), "Dashboard", "Info Dispositivos", "Info Sensores", "Charts", and "MAPAS" (with "Maps" selected). The central content area displays a table titled "Datos de Dispositivos" with the following data:

ID CANSAT	MODELO	UBICACION	LONGITUD	LATITUD	FECHA DE INSTALACION	HORA DE INSTALACION
C1001	verl	Zona 1	-77.0499641	-12.0166427	2016-05-09	21:44:10
C1003	verl	Zona 1	-77.0495435	-12.0173944	2016-09-20	13:44:10
C1004	verl	Zona 1	-77.0503843	-12.0157352	2016-05-09	21:44:10

The bottom of the page shows the URL `localhost:9395/index_dashboard.html#/dashboard/home/`.

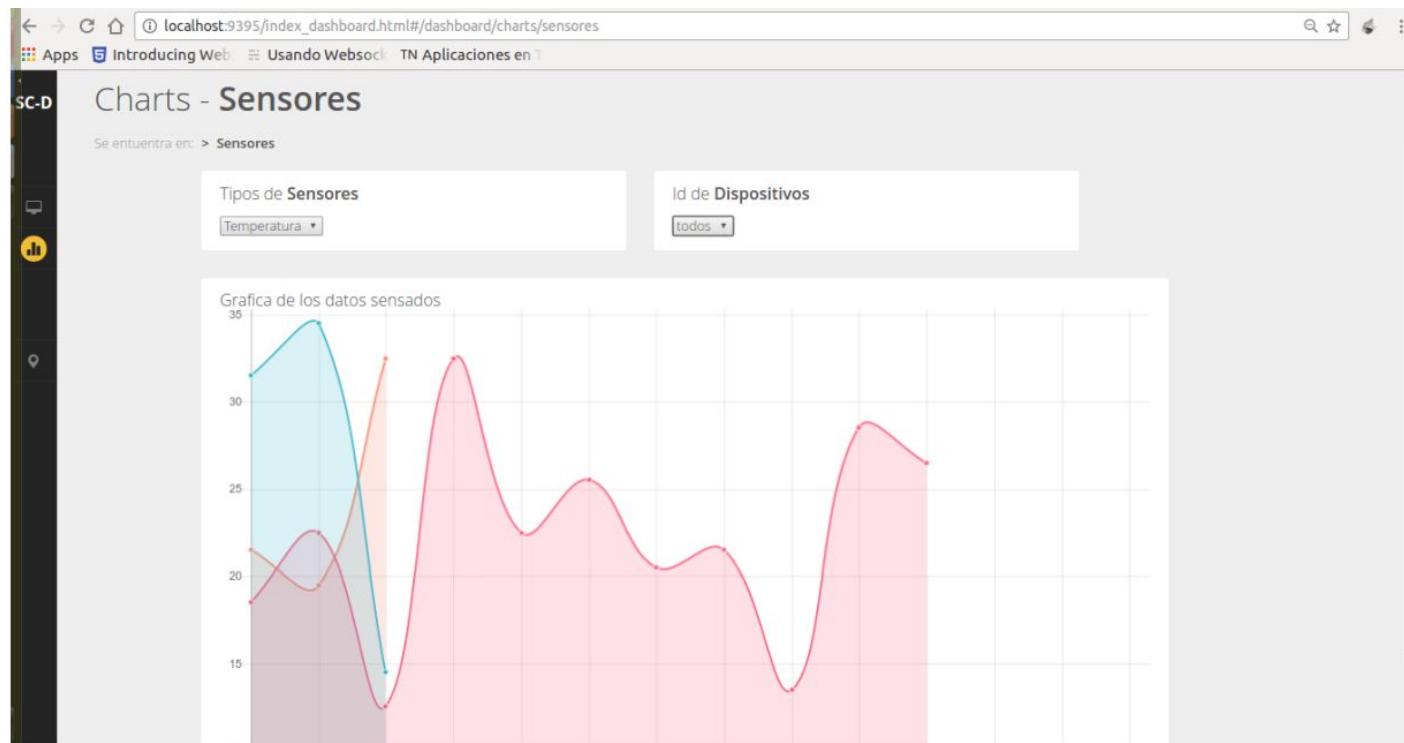
Device-sensors information

The screenshot shows a web application interface for managing device sensors. The left sidebar, titled "SC-D", contains navigation links: ESTADISTICAS, Inicio (selected), Dashboard, Info Dispositivos, and Info Sensores. Below these are Charts and MAPAS sections, each with a Maps link. The main content area is titled "Smart Cities - Dashboard" and "lista de Sensores". It shows the current location as "Se encuentra en: > Sensores Info". A table titled "Datos de Sensores" lists sensor details:

ID CANSAT	ID SENSOR	TIPO SENSOR	PREFIJO	UNIDAD	MODELO	FECHA DE INSTALACION	HORA DE INSTALACION
C1001	S50001	Temperatura	T	°C	T1	2016-05-09	21:44:10
C1001	S51001	Presion	P	Pa	PA1	2016-05-09	21:44:10
C1001	S52001	Monoxido	CO	ppm	CO1	2016-05-09	21:44:10
C1003	S50003	Temperatura	T	°C	T1	2016-05-09	21:44:10
C1003	S53002	Dioxido	CO2	ppm	CO2	2016-05-09	21:44:10
C1004	S53003	Dioxido	CO2	ppm	CO2	2016-05-09	21:44:10

The bottom status bar shows the URL "localhost:9395/index_dashboard.html#/dashboard/home/".

Device-sensors-type information



Sensor data

localhost:9395/index_dashboard.html#/dashboard/charts/cansats

SC-D

ESTADISTICAS

Inicio

Charts

Sensores

Dispositivos

MAPAS

Maps

Id de Dispositivos

C1003

Grafica de los datos sensados Temperatura

ID SENSOR	TIPO SENSOR	PREFijo	UNIDAD	MODELO
SS0003	Temperatura	T	°C	T1
SS3002	Dioxido	CO2	ppm	CO2

Grafica de los datos sensados Presion

Sensor locations

localhost:9395/index_dashboard.html#/dashboard/maps/cansats

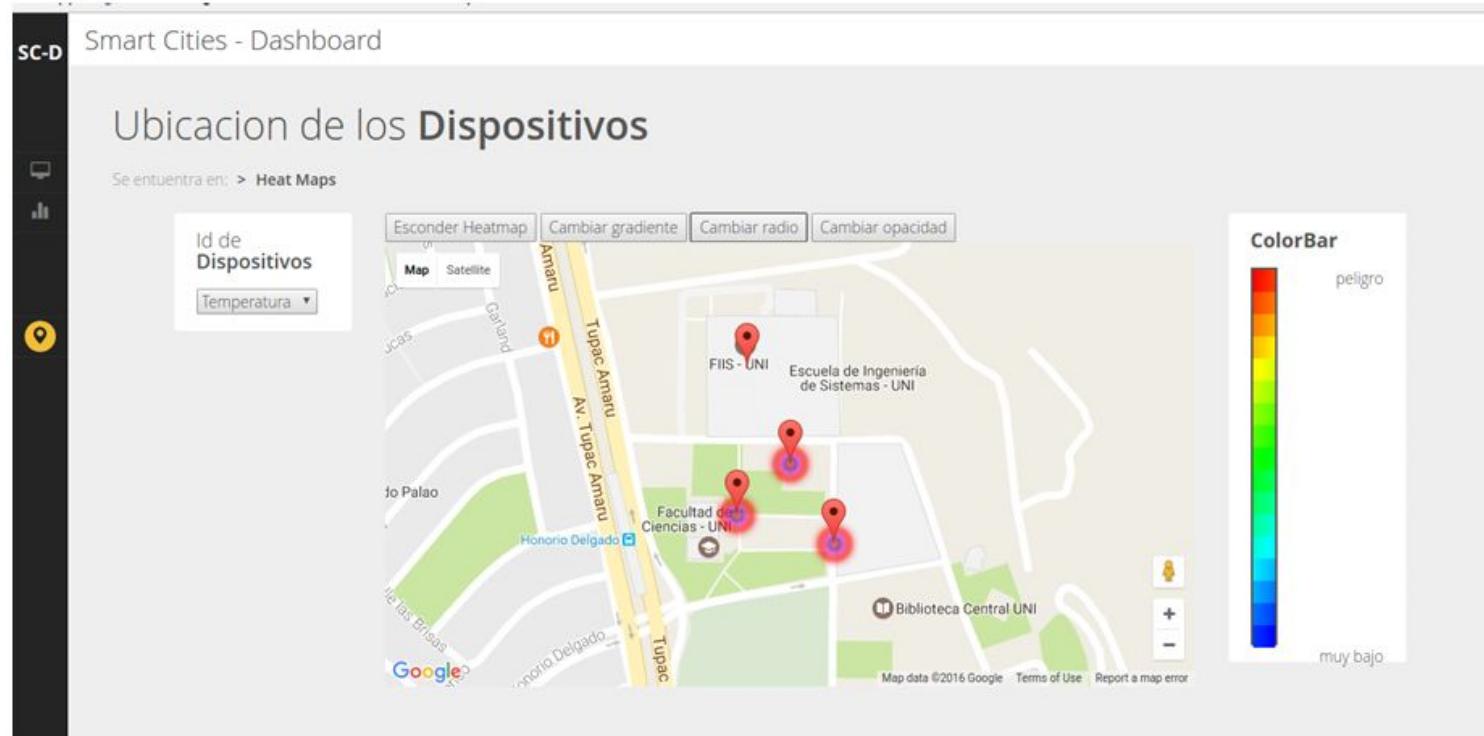
Smart Cities - Dashboard

Ubicacion de los Dispositivos

Se encuentra en: > Dispositivos Maps

The map displays the campus area of the University of National越来越高 (UNI) in Arequipa, Peru. It shows several buildings and landmarks, including the Facultad de Ciencias (Faculty of Sciences), Escuela de Ingeniería de Sistemas (School of Systems Engineering), and the Biblioteca Central (Central Library). Red location markers indicate the positions of various sensors or devices. The map includes street names such as Av. Tupac Amaru, Calle Las Violeteras, Calle San Lucas, Calle Las Brisas, Calle Ramirez Sicla, and Honorio Delgado. A legend in the bottom right corner provides controls for zooming and orientation.

Sensor heatmaps



Conclusions

Conclusions

- We were able to **design a fog architecture** to sensing information from remote devices.
- It is feasible to **implement middlewares** to process and clean information from remote devices.
- **Fog layer** helps to to **reduce the workload** of many devices.
 - It performs better than one central server such as cloud architectures.
 - We won't be able to test high network traffic in our tests, due to the lack of memory and RAM in our computers.
- It has **high availability** in receiving and processing sensor data in different formats, it is possible to **analyze** numerical values and create a real-time system for tracking.

Thanks! Any questions?
felipe.moreno@uni.pe

