TOWARDS COMPUTATIONAL NOTEBOOKS FOR IOT DEVELOPMENT

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CONTEXT AND GOAL

Internet of Things (IoT) systems are **complex** to develop due to the co-existence of various kinds of devices, protocols, architectures, and programming languages.

IoT programmers could benefit from **interactive documentation** to edit and share textual explanations, code, dependencies, and terminal commands.

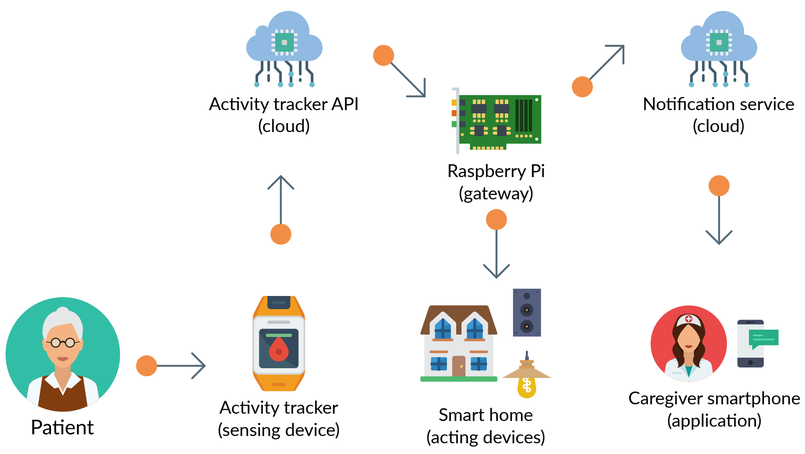
Computational notebooks support the construction and sharing of computational narratives: they consolidate text, executable code, and visualizations in a single document.

Are **computational notebooks** a feasible approach to support the development of **IoT systems**, mainly with prototyping and experimenting purposes?

USE CASE

To address the research question, we picked up as use case a prototype IoT system named **Emergency Quest (EQ)** with a typical IoT architecture: devices, gateways, cloud services, and applications.

EQ aimed at improving the quality of life for mild dementia or Alzheimer patients. It was developed as the final project of a university course.



Through a **wearable device**, the system monitors the stress levels, location, and activities performed by the patient. If the system detects that the patient becomes agitated, it will react deploying a **relaxing setup** with music and lighting.

Additionally, if the patient leaves a certain area, the system would warn her caregivers through notifications on their **smartphones**.

The implementation of this system requires: the use of **various languages**; the deployment of components that **keep running** on the **single-board computer**; the installation of **dependencies**; and the interaction with **third-party APIs**.

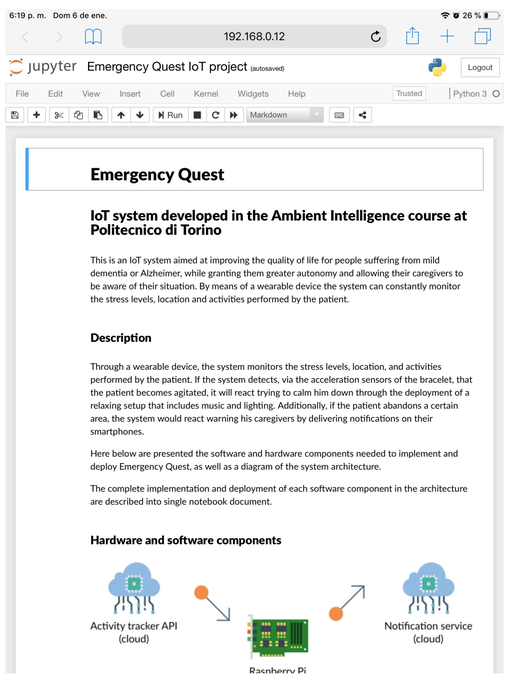
IOT NOTEBOOKS FEATURES

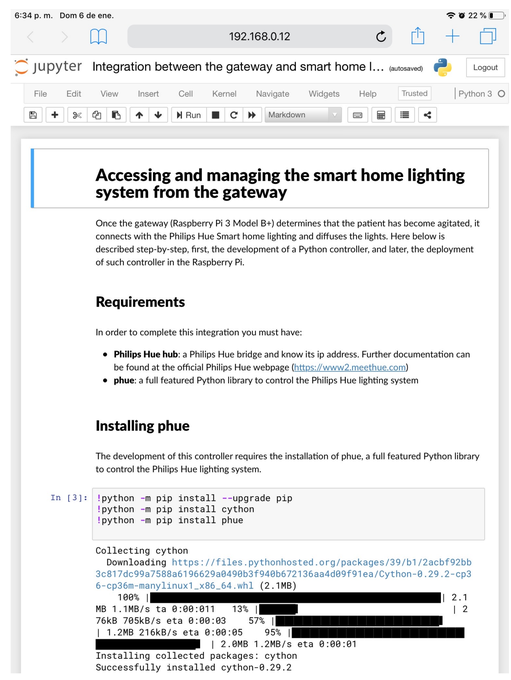
Upon the requirements stemming from the use case, we identified the **features** that, besides the ones that current computational notebooks support, an **IoT notebook** should provide:

Support multiple **programming languages**
Some code snippets should **remain on execution** (always-on nature of IoT systems)
The code must be executable on **external devices**
Support the specification and installation of **dependencies**
Support the **integration** of data coming from sensing devices or external platforms

VALIDATION

We implemented a prototypical IoT notebook by exploiting Jupyter and BeakerX.





FINDINGS

- Current computational notebooks **partially** satisfy the requirements of an IoT notebook.
- Special attention should be paid on how to smoothly execute the code snippets on low computational power **external devices**.
- New features should be introduced so users can handle **multi-file** projects and set the compulsory **execution order** of the snippets and their dependencies.

Future work: Design and develop a complete IoT-tailored notebook. Assess the benefits of a computational narrative in the context of IoT software development and prototyping through a **user study** with **novice developers.**