1 Name of Use Case

Name of the Use Case	**IoT Patient Care**
Version No.	V0.1
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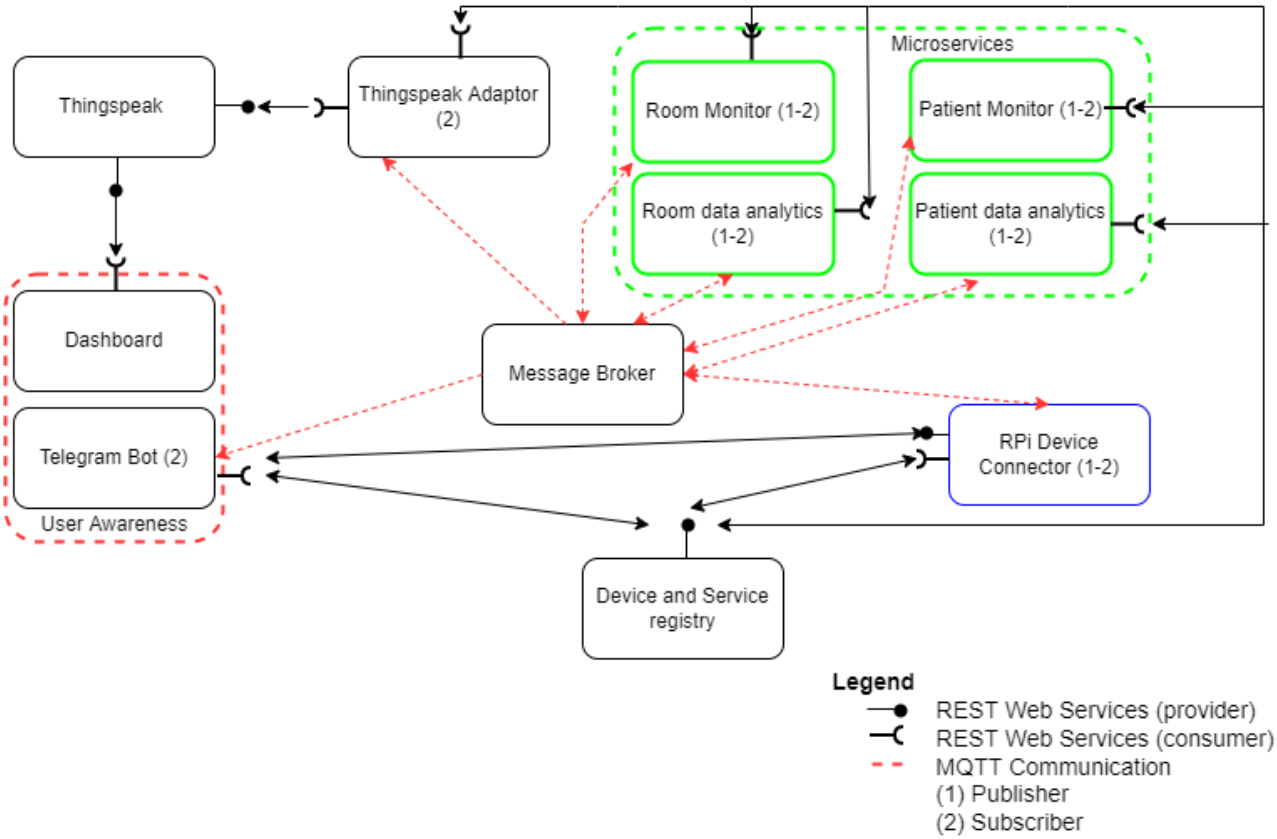
2 Scope and Objectives of Function

Scope and Objectives of Use Case	
Scope	The proposed platform aims to collect and analyse patients' data and manage their rooms.
Objective(s)	While medical staff assists patients, the IoT Patient Care will overseer patients' parameters and notify nurses about anomalies. It will also monitor room temperature, humidity and light and maintain them in desired range.
Domain(s)	Smart Building, Smart Health, Smart Nursing Home
Stakeholder(s)	Patients, Doctors, Nurses, Technicians
Short description	The proposed IoT platform aims to monitor heartbeat, body temperature and oxygen saturation of patients in a nursing home. The platform is also able to monitor and control temperature, humidity and light of the room. Anomalies are determined via data analysis of the last samples fetched from the sensors. In case of room parameters anomalies (e.g. temperature is to low) the platform can send commands to external devices (e.g. heating system of the room) to keep these parameters in the desired range. Nurses can interact with the system through a telegram bot. Each time there is a patient anomaly the system will send a notification to the caregiver, addressing the source of the problem (e.g. low saturation level, device disconnection). Both patient and room data will be stored and organized by a third part service and, ready to be shared with doctors and technicians.

3 Diagram of Use Case



4 Complete description of the system

The proposed IoT platform for patient and room monitoring follows the micro-services design pattern. It also exploits two communication paradigms: i) publish/subscribe based on MQTT protocol and ii) request/response based on REST Web Services.

The following actors have been identified and introduced:

- The **Message Broker** provides an asynchronous communication based on the publish/subscribe approach. It exploits the MQTT protocol.

- The **Device and Service Registry** works as service and device registry system for all the actors in the system. It provides information about end-points (i.e. REST Web

Services and MQTT topics) of all the devices, resources and services in the platform. It also provides configuration settings for applications and control strategies (e.g., list of sensors and actuators). Each actor, during its start-up, must retrieve such information from the Catalogue exploiting its REST Web Services.

- The **Raspberry Pi** connector is a *Device Connector*. The system is composed by one raspberry per room. Each raspberry is able to communicate via BLE with temperature and pulse oximeter sensors to provide information about patients in the room and is equipped with a temperature, humidity and light sensors in order to observe and control these parameters. It provides Rest Web Service to choose room parameters. It works as an MQTT publisher sending information about both patients and room (that will be further stored and analysed) and as an MQTT subscriber to receive actuation commands from the 'room monitor' actor in order to pilot actuators(e.g. heating and lights system)

Bisogna dare una descrizione high-level degli algoritmi da implementare per le analitiche (quelli evidenziati) specificando meglio obbiettivi, input e output.

- **Patient monitor** is a control strategy to manage patient's data depending of the value of the current parameters. It works i) as an MQTT subscriber to receive information on patients; ii) as an MQTT publisher to send notifications about anomalies

- **Room monitor** is a control strategy that manages the parameters in the room coming from the 'Room data analytics' microservice. It works i) as an MQTT subscriber to receive information on rooms parameters; ii) as an MQTT publisher to send actuation commands to IoT Devices.

- **Room data analytics** is a microservice that extracts information from the most recent samples of the room. Data analysis aims to inform the 'Room monitor' microservice about the current status, so that it can take countermeasures in case of a Room anomaly.

- **Patient Data Analytics** is a microservice that extracts information from the most recent samples of the patient. Data extraction aims to predict the probability of pathological condition in the patient (e.g. fibrillation).

- The **Thingspeak Adaptor** is an MQTT subscriber that receives measurements on patients , sensor status, and rooms and upload them on Thingspeak through REST Web Services.

- **Thingspeak** is a third-party software (https://thingspeak.com/) that provides REST Web Service. It is an open-data platform for the Internet of Things to store, post-process and visualize data.

- **Dashboard** exploits the Thingspeak Web Services to import plots about sensors status and patients and rooms data.

- **Telegram Bot** is a service to integrate the proposed infrastructure into a Telegram platform, which is cloud-based instant messaging infrastructure. It can :
  - receive warnings in case of anomalies (via MQTT)
  - register patients and their personal data (via Rest Web Service)
  - set desired room parameters