1 Name of Use Case

Name of the Use Case	IoT Platform for Smart Glucose Monitor
Version No.	v 0.2
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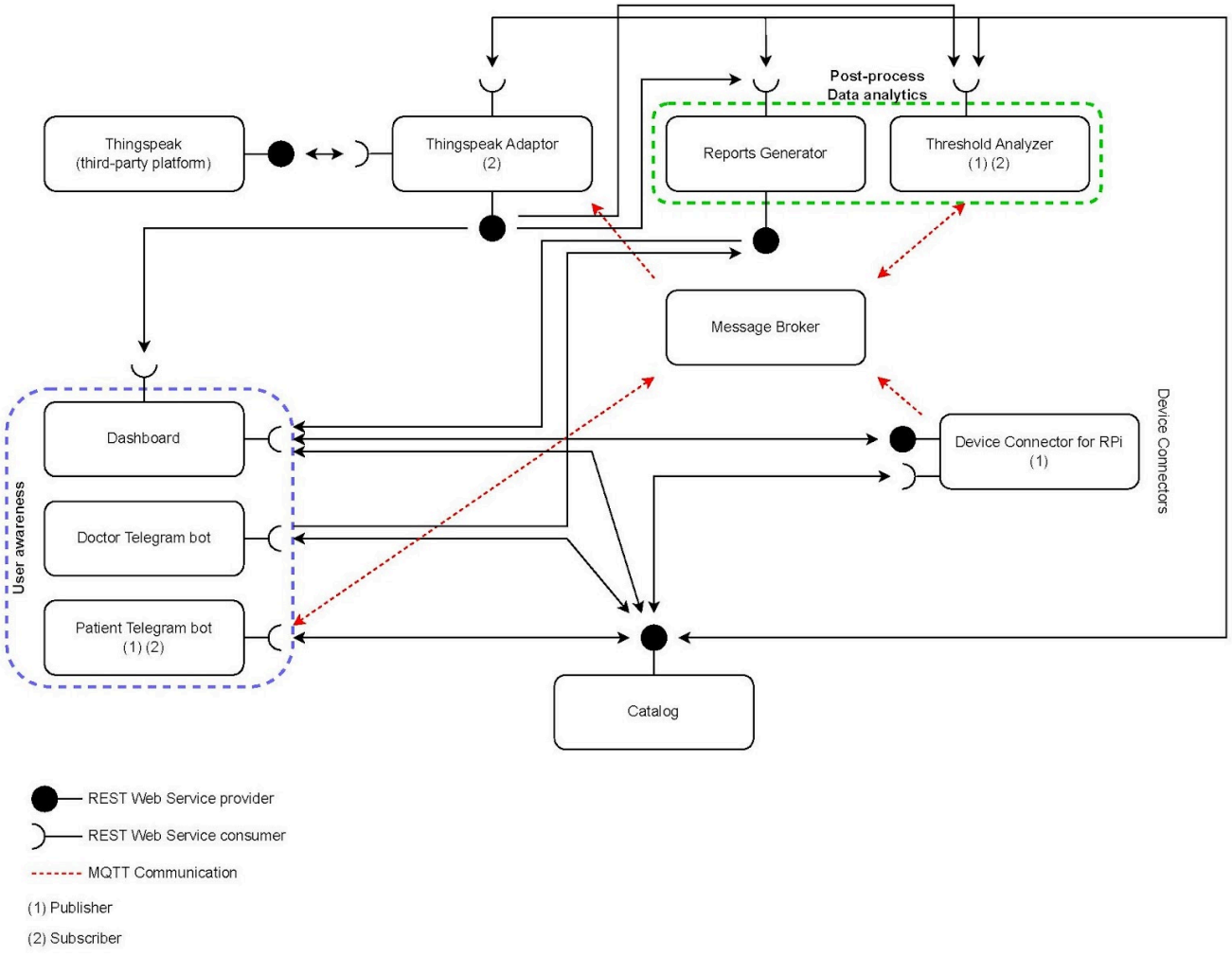
2 Scope and Objectives of Function

Scope and Objectives of Use Case	
Scope	The project aims at facilitating the lives of Type 1 Diabetes (insulin-dependent) patients by integrating IoT technologies. The platform provides real-time glucose monitoring, data analysis, and management strategies for patients and healthcare professionals.
Objective(s)	The expected outcome is a system designed to: ● Enable accurate glucose level measurements; ● Provide real-time alerts and notifications for insulin requirements; ● Offer personalized insulin dosage recommendations based on user data; ● Allow seamless data storage, visualization, and providing information to both patients and doctors; ● Enhance user engagement through interactive tools like a Telegram bot and a dashboard.
Domain(s)	Hospitals, Healthcare
Stakeholder(s)	Doctors, Patients, Caretakers
Short description	The proposed IoT platform aims at improving glucose management for diabetic patients. It integrates a blood glucose sensor as an IoT device to monitor glycemia in real-time. The sensor publishes data via MQTT to the post-processing system, which employs a glucose threshold algorithm to notify users if insulin is required. It also suggests insulin dosages through a Telegram bot. The platform utilizes user-specific data from a patient database, including demographics and target glucose levels, to customize recommendations. Users can input meal information (e.g., before eating) to refine insulin dose calculations. All data is seamlessly transmitted via a REST API, ensuring interoperability. Additionally, the platform offers a dashboard displaying a time-series of glucose levels, the amount of insulin provided to each patient and key statistical metrics to provide users with comprehensive insights into their health. Summarizing, the main features it offers are: • real-time glucose monitoring via MQTT; • personalized insulin dose recommendations; • REST API for secure data exchange and integration; • meal-related input for dose adjustments; • a user-friendly dashboard for glucose trends and metrics; • report generation for any time frame to help doctors optimize treatment plans;

3 Diagram of Use Case



4 Complete description of the system

The proposed IoT Platform for a Smart Glucose Monitor follows the microservice design pattern. It also exploits two communication paradigms: i) publish/subscribe based on MQTT protocol and ii) request/response based on REST Web Services.

In this context, ten actors have been identified and introduced in the following:

- The **Message Broker** exploits the MQTT protocol in order to provide an asynchronous communication based on the publish/subscribe approach.
- The **Catalog** works as a service and a 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. thresholds, list of

sensors). The Catalog provides REST Web Services to allow for such information to be retrieved by each actor during its start-up and whenever it is required.

- The **Raspberry Pi Connector** is a Device Connector that integrates into the platform raspberry pi boards. Each Connector is equipped with a glucose level sensor in order to measure a patient's glycemia. It provides real-time data about the patient's blood glucose level through REST Web Services. In addition, the same data is shared periodically as the device connector works as an MQTT Publisher.

- The **Threshold Analyzer** is a control strategy designed to monitor a patient's blood glucose levels and provide actionable feedback to maintain stable glycemia by managing event related thresholds (pre and post meal). It functions as both an MQTT subscriber and publisher, subscribing to the glucose level topic in order to receive real-time data and publishing feedback useful for the patient when needed. Additionally, it leverages REST web services to access essential information from the Catalog and the ThingSpeak Adaptor for its calculations.

- The **Reports Generator** is a service designed to generate reports from stored data, offering valuable insights for various purposes: identifying patterns of poor glycemic control, evaluating patient adherence to prescribed regimens, and enabling evidence-based adjustments to therapy plans. The service functions both as a provider and a consumer of REST Web Services in order to provide the report to the Dashboard and to retrieve raw historic data on blood glucose levels from the Thinkspeak Adaptor.

- The **Thingspeak Adaptor** is an MQTT subscriber that receives measurements on glucose levels and meals notification of the patient and uploads them on Thingspeak through REST Web Services. It also provides the Threshold Analyser and the Report Generator with the information needed (the last time the patient has eaten and the glucose historical data of the patient, respectively) and updates the Dashboard information through REST Web Services.

- **Thingspeak** is a third-party software used to store Time-Series information of the system and information about the meal status and the total insulin provided to each patient. It implements REST Web Services to provide the needed information to the Thingspeak Adaptor when requested.

- The **Dashboard** allows the visualization of real-time data from the IoT devices by exploiting REST Web Services provided by Raspberry Pi. Moreover, it exploits REST Web Services provided by Thingspeak to import plots about glycemia measurements and those provided by Reports Generator to view reports that have been generated.

- The **Patient's Telegram Bot** is a user interface service that allows the patient to communicate with the system so as to receive useful feedback to adjust glycemia(e.g. take a given amount of insulin), as well as to provide information to the threshold analyzer(e.g. current meal condition). It is both a MQTT publisher and subscriber to provide meal information and receive system alerts.

- The **Doctor's Telegram Bot** is a user interface service that exploits REST Web Services to enable the doctor to initialize and update patient parameters in the catalog, as well as to request reports from the Report Generator.

5 Desired Hardware components (only among those we can provide)

1.

Device Name	Quantity	Needed for…