CASANOVA

LAS REALISATION AND DEVELOPMENT OF IOT APPLICATION PROJECT

M1 IoT

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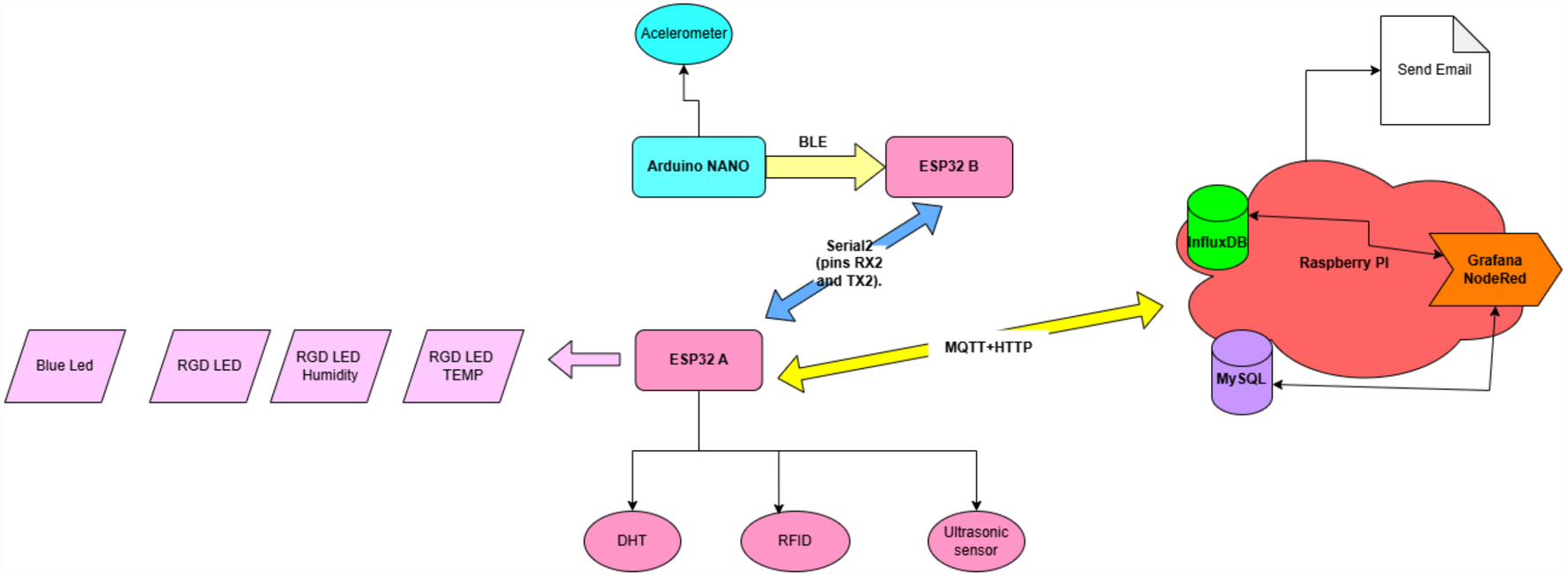
BACKGROUND

The main idea of the CASANOVA project is to develop an IoT-based communication and control system using microcontrollers such as ESP32 and Arduino Nano, along with various sensors and protocols, to enable real-time data exchange. The ESP32 acts as the main controller, managing sensors for temperature and humidity data (DHT), an RFID card reader, and an ultrasonic sensor. The Arduino Nano collects acceleration data and communicates with the ESP32 via Bluetooth Low Energy (BLE). The ESP32 publishes DHT data to a topic using the MQTT protocol, which the Raspberry Pi subscribes to for data retrieval. Additionally, the ESP32 sends HTTP POST requests to the Raspberry Pi for specific tasks, such as RFID validation, and the Raspberry Pi responds via HTTP.

The system incorporates Grafana for visualizing DHT data and monitoring the number of accesses, InfluxDB for storing DHT data, and MySQL as the database for saving the IDs of authorized RFID cards. Node-RED is used to design and manage the data flows within the system.

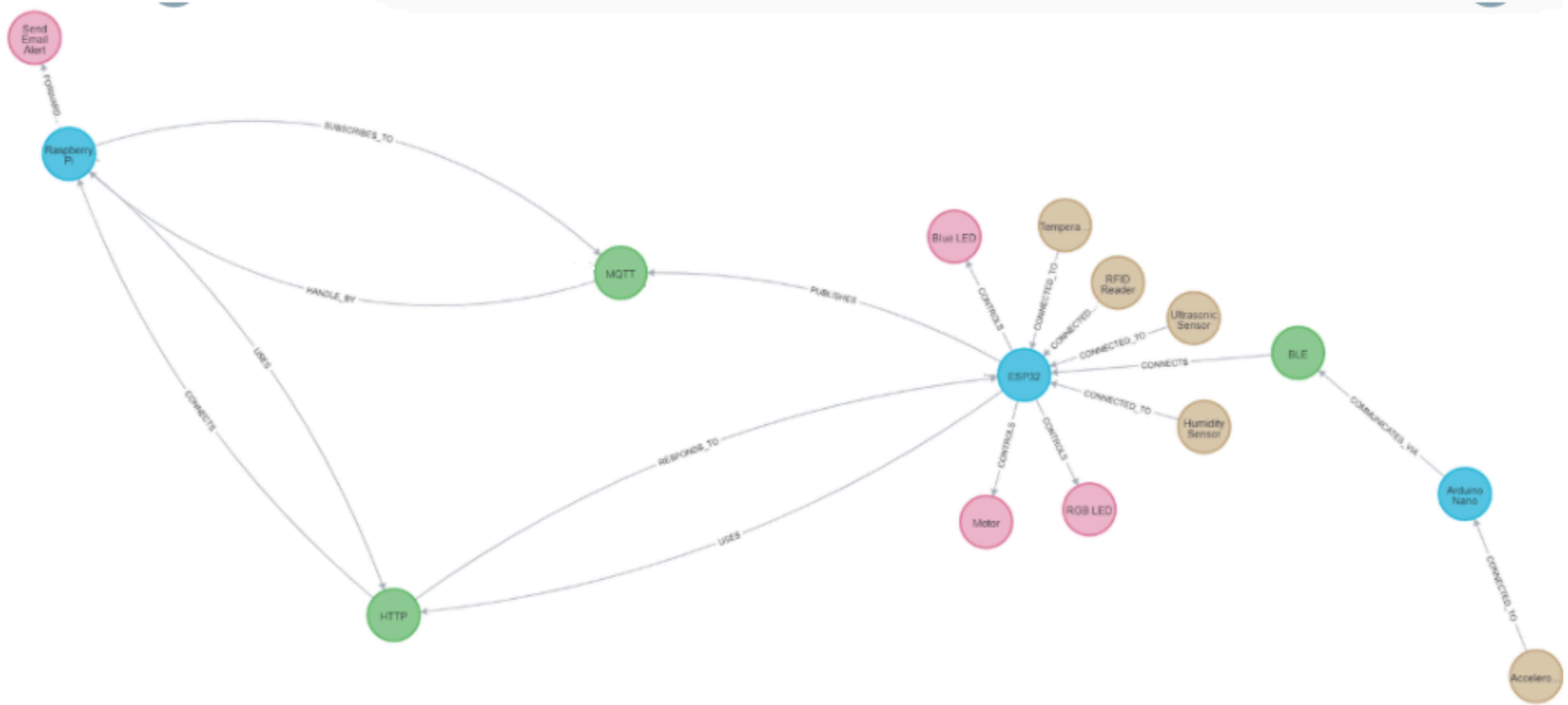
Automation features include controlling an RGB LED to indicate whether the door is open or closed, another RGB LED to simulate a warning if the temperature is too low, and cooling if the temperature is too high. This project demonstrates a cohesive IoT system capable of efficient real-time monitoring, data visualization, and dynamic automation.

ARCHITECTURE



For CASANOVA project we used Raspberry Pi as server

KNOWLEDGE GRAPH



NODES:

1. **BLUE CIRCLES (DEVICES): MICROCONTROLLERS AND SERVER**
2. **GREEN CIRCLES (PROTOCOLS): COMMUNICATION METHODS .**
3. **BEIGE CIRCLES (SENSORS): PHYSICAL SENSORS**
4. **PINK CIRCLES (ACTIONS): OPERATIONS TRIGGERED BY DEVICES**

ARCHITECTURE ANALIZATION

- **Arduino Nano**
- Collects acceleration data using an Accelerometer.
- Communicates with the ESP32 via Bluetooth Low Energy (BLE).

ESP32-B :

- COMMUNICATES WITH THE ARDUINO NANO OVER BLUETOOTH LOW ENERGY (BLE).
- RELAYS DATA FROM THE ARDUINO NANO TO ESP32-A USING SERIAL2 (PINS RX2 AND TX2).

ESP32-A:

- Manages sensors: DHT (Temperature and Humidity), RFID Reader, and Ultrasonic Sensor.
- Publishes DHT data and receives data via MQTT to/from the Raspberry Pi.
- Sends HTTP POST requests to the Raspberry Pi for RFID validation and receives responses.
- Actuators:
  - RGB LED: Indicates door status.
  - Blue LED: Simulates a warning when the temperature is too low.

Actuators:

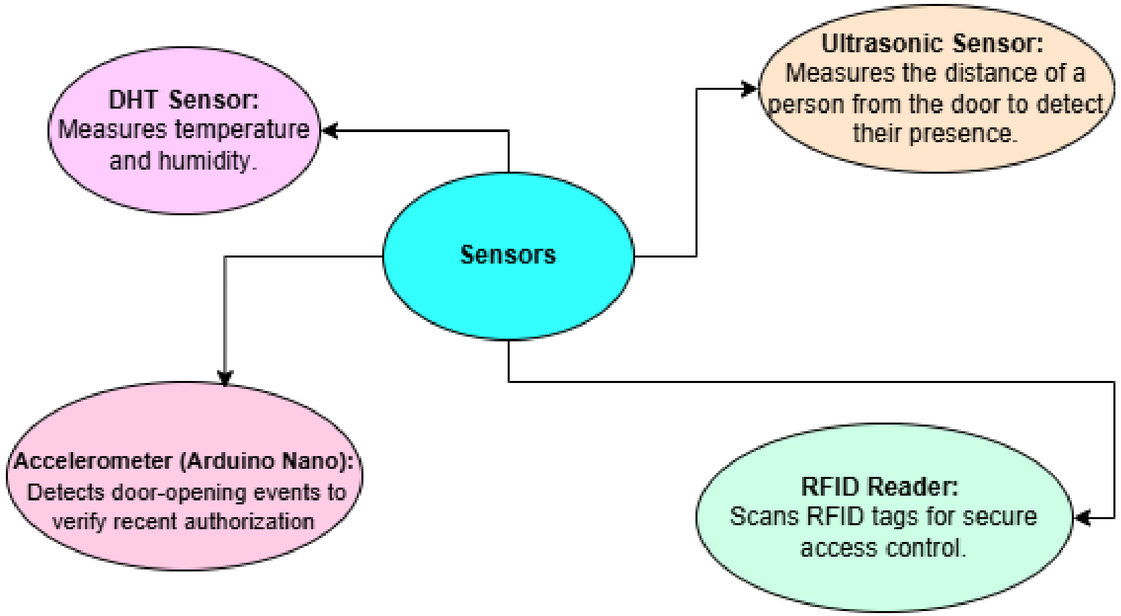
- Connected to ESP32:
- RGB LED: Indicates door status.
- RGB LED TEMP: Simulates a warning when the temperature is too low or too high.
- RGB LED HUMIDITY:Show the humidity status if is low/high

Raspberry Pi

- Serves as a server and handles MQTT communications.
- Stores DHT data in InfluxDB for visualization and MySQL for storing RFID card IDs.
- Visualizes data using Grafana and processes automation flows via Node-RED.
- Sends Email Alerts based on conditions.

SENSORS AND COLLECTED DATA

The project collects real-time data from various sensors and devices, processes it locally, and ensures efficient communication between components using appropriate protocols. The system optimizes bandwidth and power consumption by processing data locally before transmission.



ESP32:

TEMPERATURE AND HUMIDITY SENSOR ⇒ DHT11

RFID READER ⇒ SCANNED RFID TAG DATA

ULTRASONIC SENSOR ⇒ DISTANCE TO OBJECT/PERSON

ARDUINO NANO:

ACCELEROMETER ⇒ AXIS DATA (X, Y, Z)

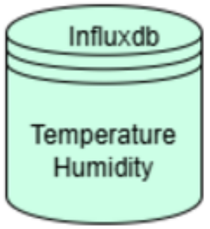
3 main protocols used:

1.MQTT

2.HTTP

3.BLE

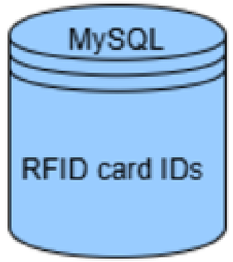
DATA STORAGE



- **InfluxDB:**
  - Stores time-series sensor data (temperature, humidity, motion).
  - Includes sensor type, timestamp, and value for querying and analysis.

MYSQL:

- STORES RFID CARD IDS FOR AUTHENTICATION.
- VALIDATES ACCESS BY COMPARING SCANNED RFID DATA WITH STORED IDS.



GRAFANA:

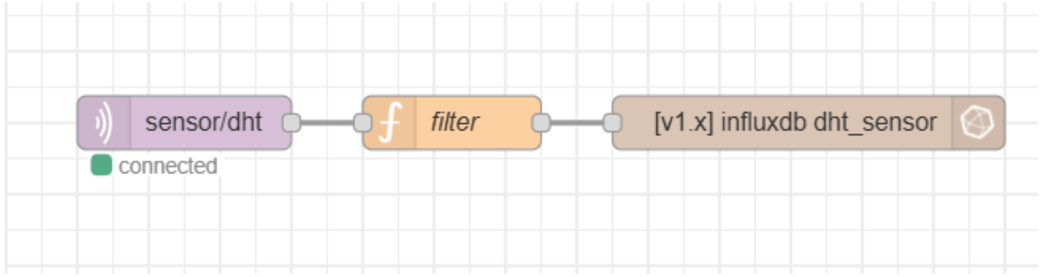
- VISUALIZES DATA FROM INFLUXDB THROUGH REAL-TIME DASHBOARDS.

DATA PROCESSING:

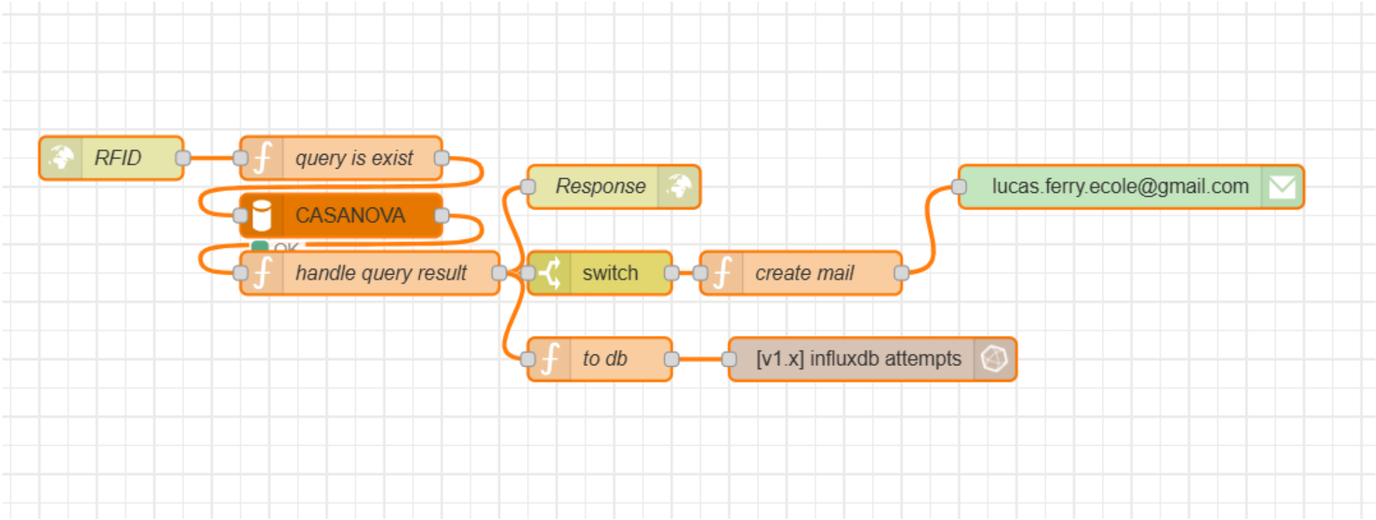
1.LOCAL PROCESSING:

- PERFORMED ON THE RASPBERRY PI SERVER.
- DATA IS ENRICHED WITH METADATA (E.G., TIMESTAMPS, DEVICE IDS) AND EVALUATED FOR CONDITIONS LIKE TEMPERATURE THRESHOLDS,HUMIDITY THRESHOLDS ETC
- **ACTIONS:**
- ALERTS ARE TRIGGERED IF PREDEFINED CONDITIONS ARE MET (E.G., TEMPERATURE > 30°C).

PROCESSING



Flow1-Sendind data to Influxdb ,sepearting the topics



Flow2:To check the uid in mySQL db if it is correct ,and send email alters

VISUALIZATION

THANK YOU