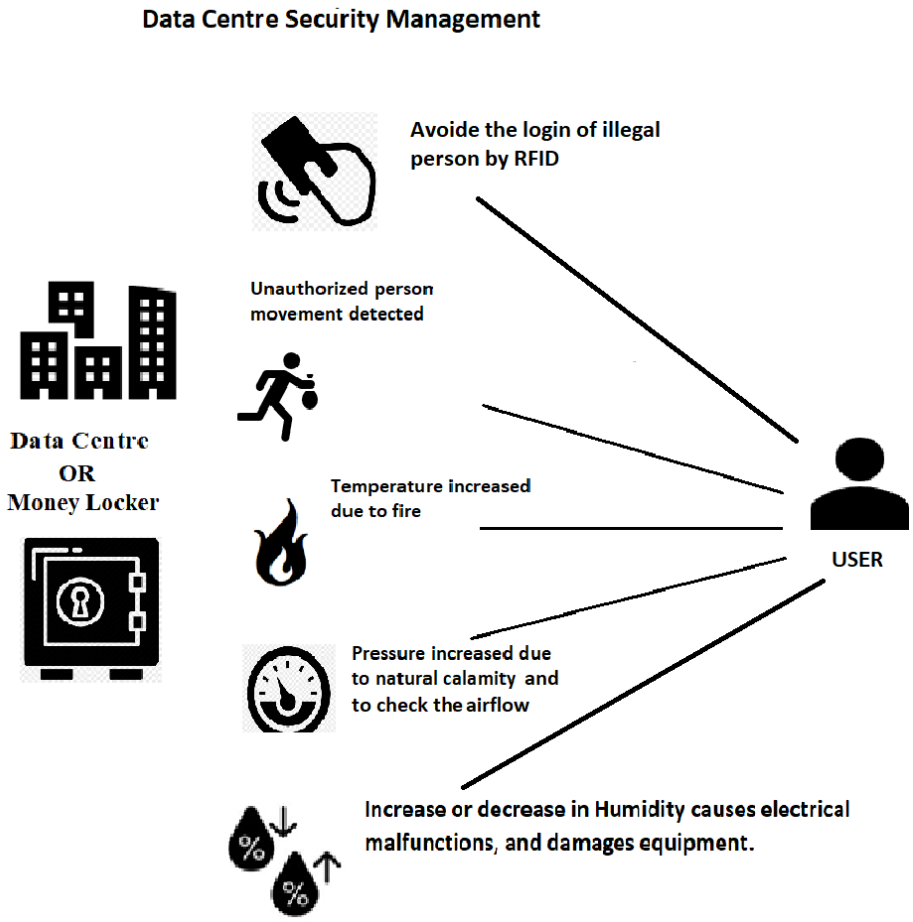
SCENARIO:

Data centre or Money locker is a place, which needs high safety and security. The main application of our project is “Data Centre Security Management”. In this scenario, we are considering some conditions for the security of the Data Centre. The main variables of the scenario includes:

- unauthorized person detection
- avoid the login of illegal person
- indication of high temperature (fire)
- variations of natural calamities and airflow like pressure detection
- electrical malfunctions and damage of equipment recognition(humidity)



Here, we need to receive the information whether unauthorized person access the data centre or money locker, illegal person login the data centre, has the temperature gone high due to fire, or has there been high pressure due to natural calamity, or electrical malfunctions and damage of equipment due to increase or decrease in humidity . If any of these or all of these occurs, we need an alert or notification. In order to give solution to our scenario, the necessary hardware components and software requirements are:

Hardware Requirements:

1. Raspberry Pi
2. ESP32
3. DS18B20 One-Wire Digital Temperature Sensor
4. Pressure and Humidity Sensor (BME 280)
5. Motion Sensor (PIR sensor)
6. RFID reader and card
7. 4 channel Relay board
8. Buzzer
9. RGB led
10. Micro USB power supply
11. 4.7k resistor
12. Breakout Board
13. Female-to-Male Jumper Wires 2 x Male-to-Male Jumper Wires
14. PC

Software Requirements:

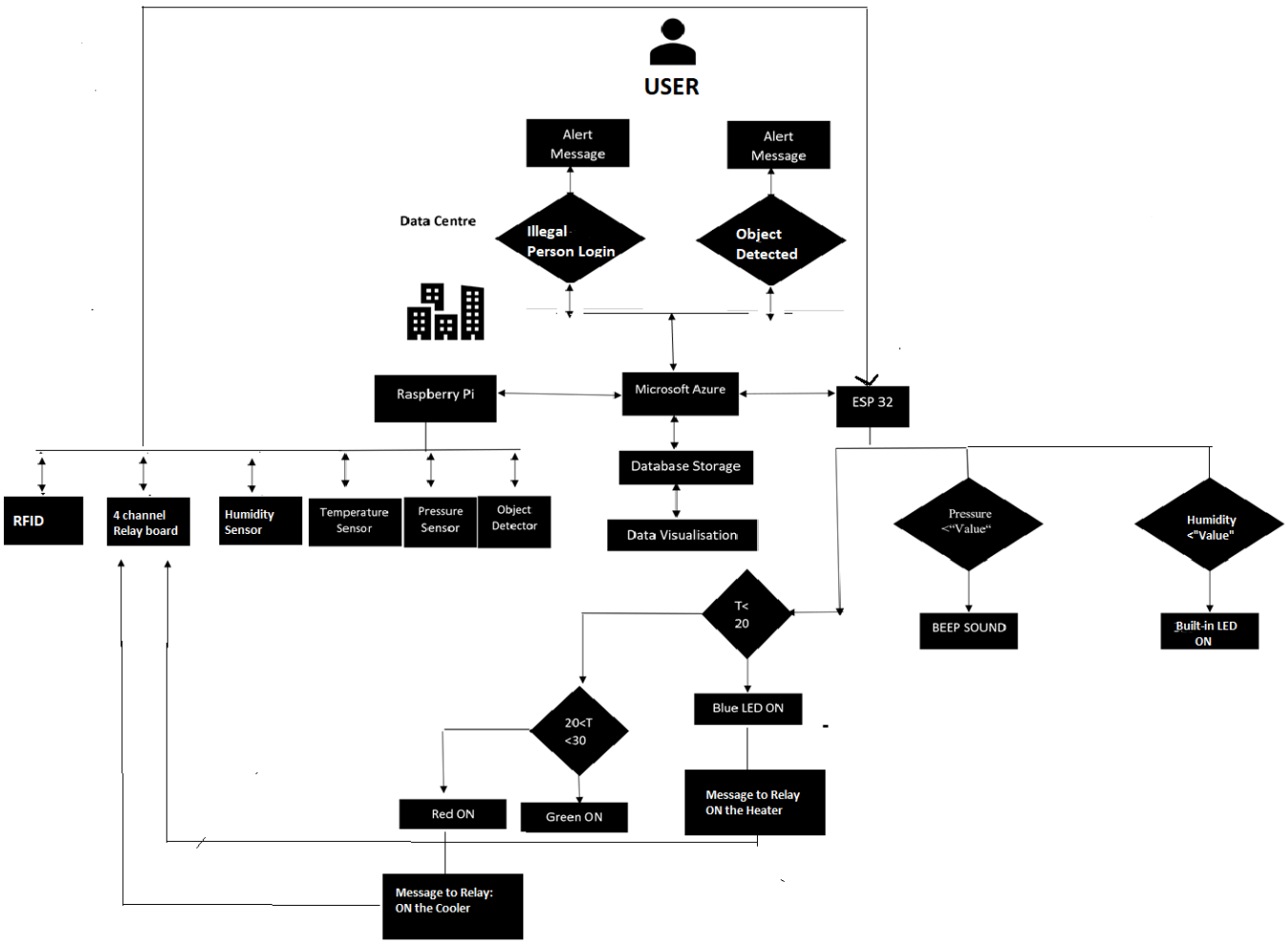
1. Putty and VNC portal
2. Arduino software
3. Microsoft Azure
4. Power BI
5. Visual Studio

For this scenario to achieve, we have considered the conditions like:

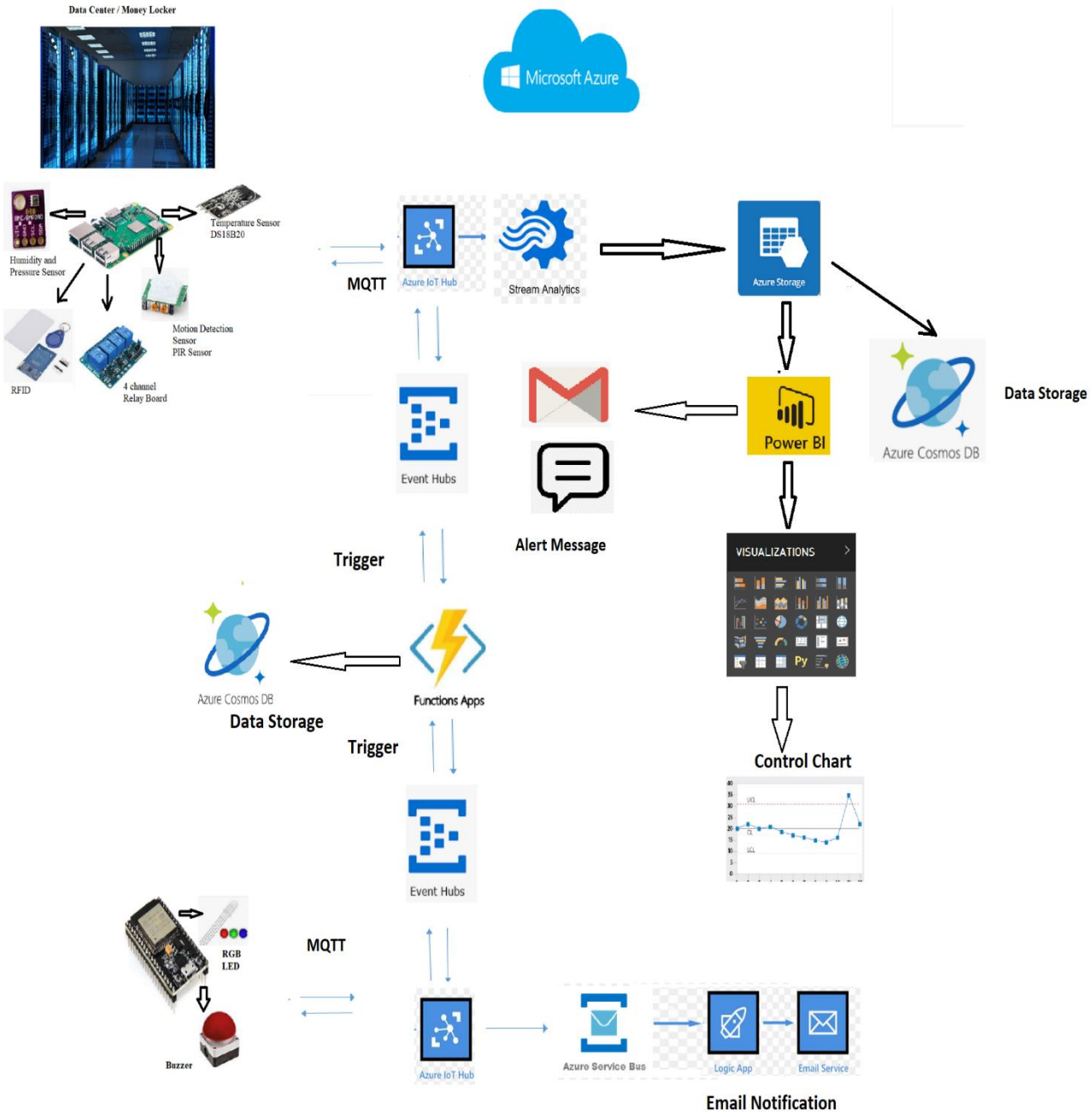
- Login of illegal person gives an Alert message to users Email.
- Temperature lies between 20 to 30 in Raspberry pi-> Green LED ON in ESP32(This temperature is chosen to show demo)
- Temperature less than 20 in Raspberry pi -> Blue LED ON in ESP32
- If Blue LED is ON in ESP32, ON the Heater in Raspberry Pi (Relay)
- If the Heater is ON, confirmation message to ESP32
- Temperature greater than 30 in Raspberry pi -> Red LED ON in ESP32
- If Red LED is ON in ESP32, ON the Cooler in Raspberry Pi (Relay)

- If the Cooler is ON, then confirmation message to ESP32
- If the Pressure is above the given condition, Buzzer is ON else OFF.
- If any object is detected by motion sensor then Alert Message to Email.
- If the Humidity is above the given condition, Builtin LED ON in ESP32 else OFF.

Overall Flow Chart



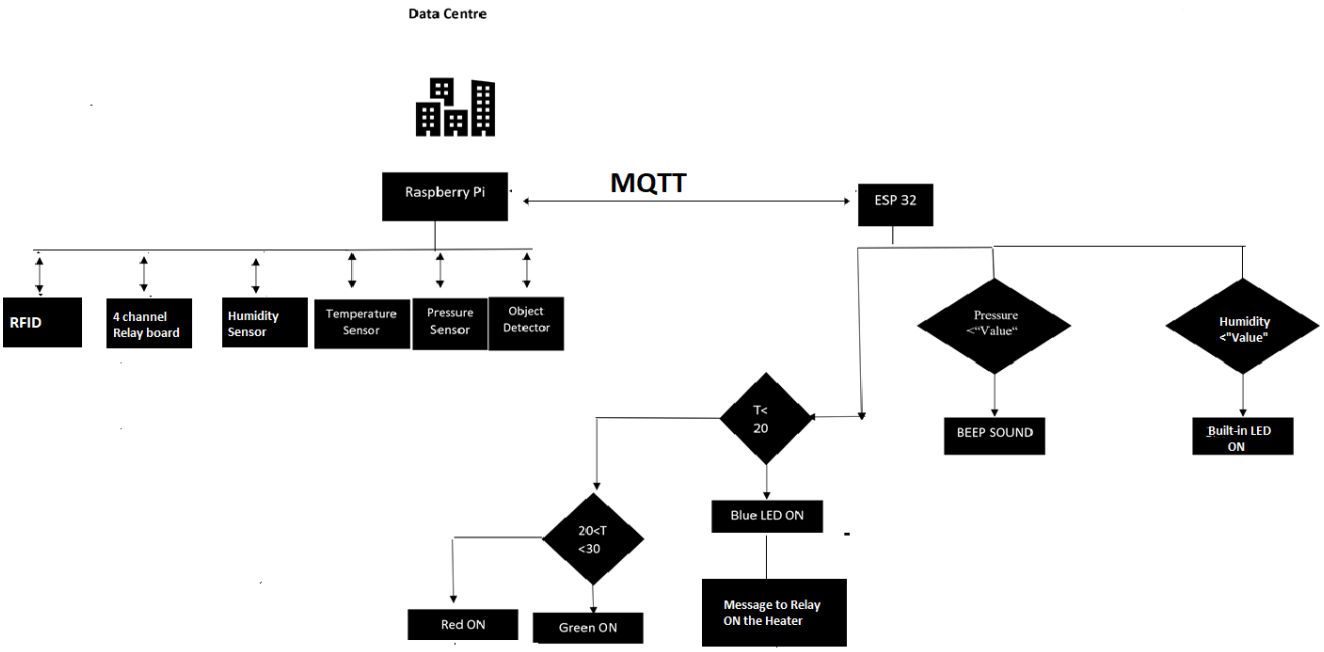
Block Diagram



- Raspberry pi and ESP 32 enabled with sensors are directly connected to IOT hub . IOT hub in turn is connected with event hub end point
- Event hub endpoint is connected to function apps where several logics required for this project is implemented.
- Funtion app forwards the sensors values from pi to ESP 32 and controls the ESP sensors based on Raspberry Pi's sensor values .
- The ESP 32 triggered by Pi's commands performs tasks and sends the acknowledgement to Pi via function app . Then the pi performs task of switching relay and sends back the acknowledgement
- Meanwhile the function app also sends data from devices to Cosmos DB and service bus .
- The service bus enables email alerting .
- For data visualisation Power Bi is used. This is connected via IOT hub . Power BI is enabled from stream analytics which can also be used to store data in Cosmos DB.
- In order to have control over dashboard, alert message system is introduced in Power BI and control charts.

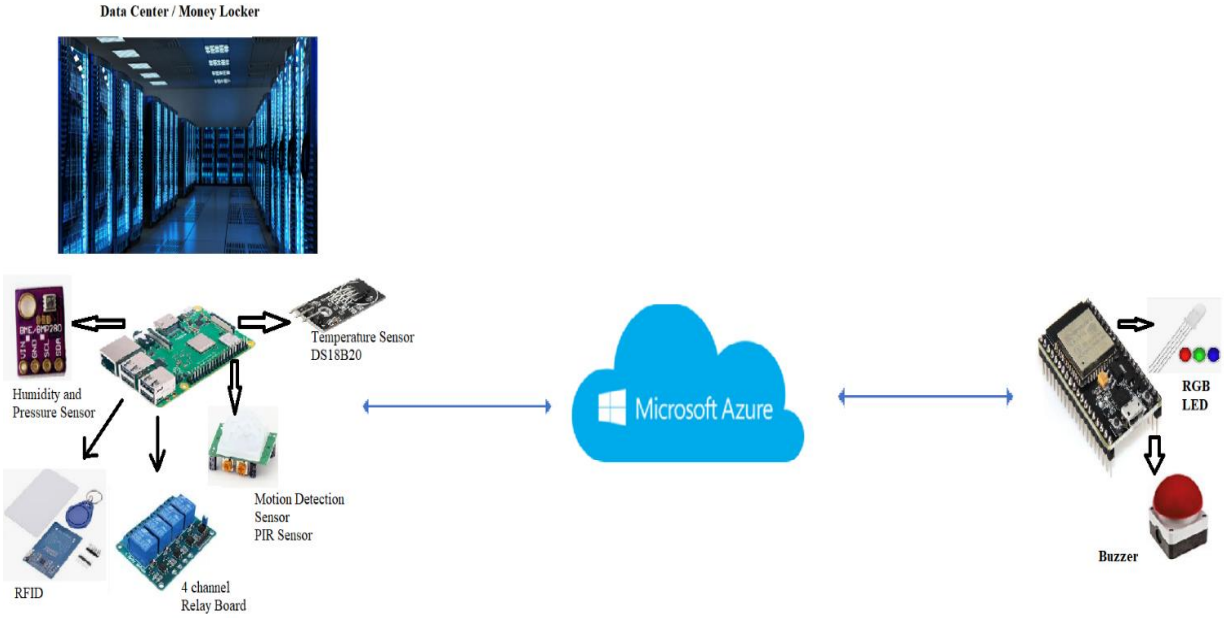
The above scenario is divided into following tasks:

Establish a system that uses MQTT as communication protocol



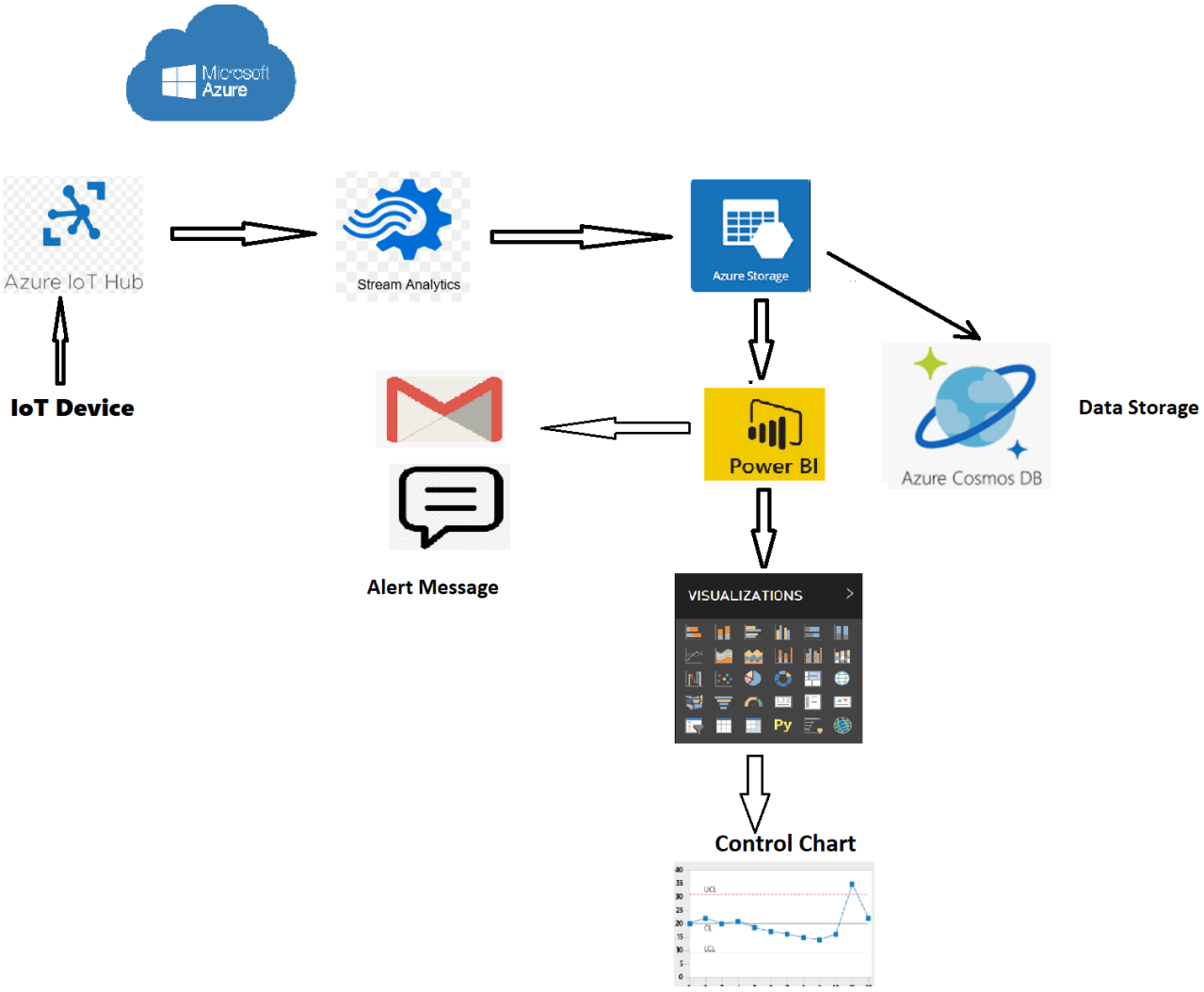
- In this task, Raspberry Pi and ESP32 communicates by the local broker MQTT protocol.
- The sensor values measured by Raspberry Pi, sends it to ESP32 by MQTT. Based on the conditions necessary actions occur in ESP32 as shown in figure above

Data Transmission to Azure via MQTT



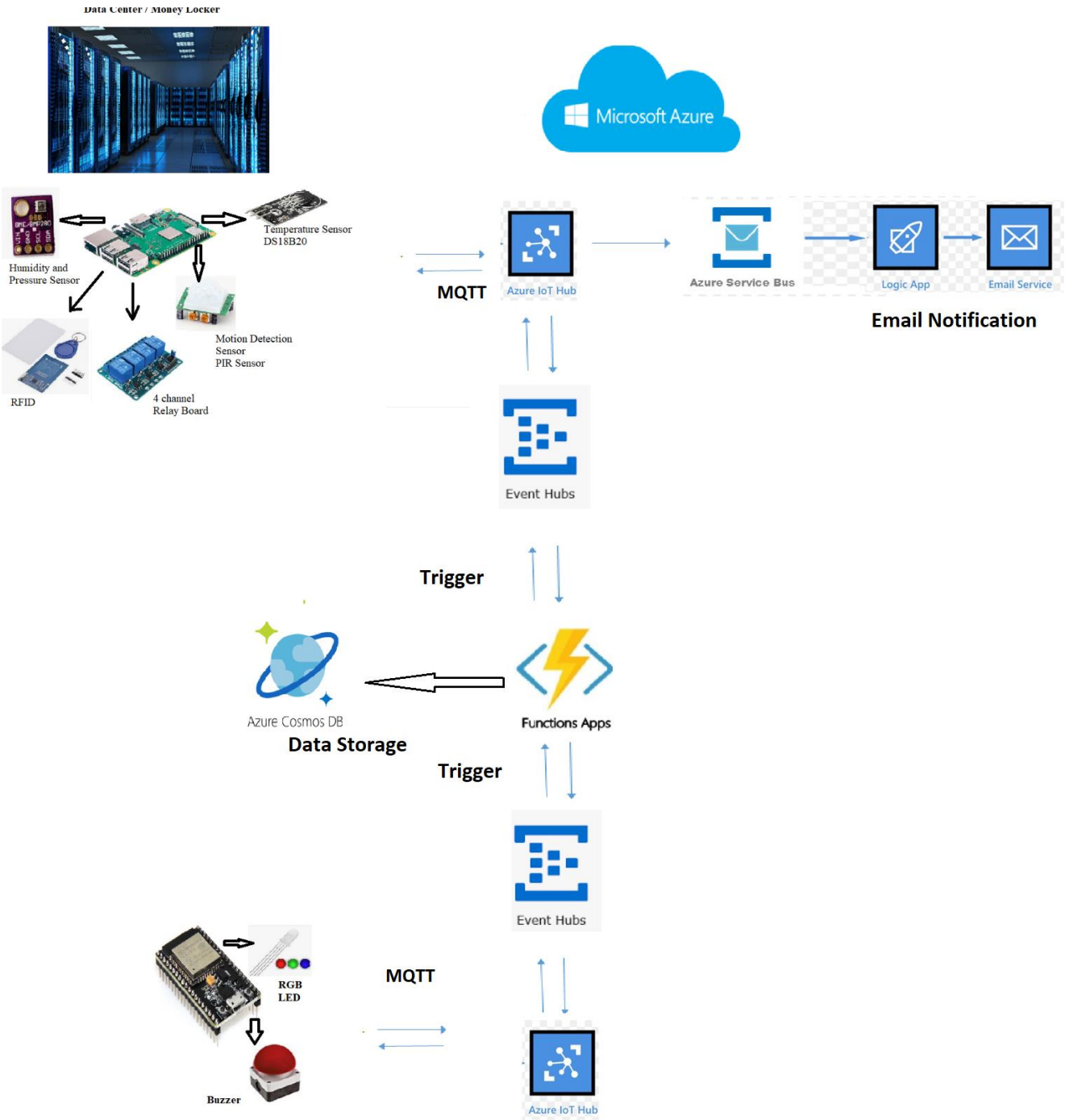
- In this scenario, necessary SDKs for iothub is installed, in order to have communication between iot devices and Azure.
- After installing all necessary SDKs, through iot device created in iot hub of Azure communication is built and messages are sent between Raspberry PI, ESP32 and Azure.

Data transmission to Azure via MQTT, Saving the data in a database on Azure Dashboard to show charts and graphs and to control the devices, visualization and controlling



- Visualization of graph and charts can be done by Power BI
- The state of the devices can also be seen in Power BI
- The different tiles like cards, charts, line charts, bar and column charts are used to visualize the device data like temperature , pressure and object movement detection
- Control charts for Power BI done by configuring upper and lower bounds. Power BI can check all the variations like temperature or pressure in normal condition or critical condition.
- Alert messages are sent when login of unauthorized person, object detection and when the Cooler is ON based on the response from ESP32
- The data obtained from all sensors are stored from stream analytics in Azure storage by Cosmos DB
- We can visualize all the data stored with timestamp for all sensors in Azure.

Response System: Establish a communication between the different devices by sending message or alert from Azure.



In order to establish a response system directly from Microsoft Azure, we are utilizing logic app and email services from azure. In our scenario, if the object detects, then we are sending an alert message to user. This allowed to identify and address the issue before the user of the system notice them.

The sensor values sent from Raspberry Pi are triggered by iot hub in function app. According to the conditions mentioned below, the response can be visualized in ESP32. Then the response sent from ESP32 can be seen in Raspberry Pi. Hence bi-directional communication is established.

- Raspberry Pi sends temperature sensor values to Microsoft Azure, if the temperature sensor values are less than 20, then Microsoft Azure sends message to ESP32 to ON Blue LED, which is showed. Then message to ON the Heater will be sent to Azure and Azure sends it to Raspberry Pi via MQTT and again the confirmation message will be sent to ESP32 saying Heater is ON.
- Temperature sensor messages sent by Raspberry Pi is above 30, then ON green LED, in the same way the, ESP32 sends the messages back to Azure to ON the Cooler and from Azure to Raspberry Pi, then the confirmation message will be sent to ESP32 saying Cooler is ON
- If temperature is above 30, then Azure send message to ESP32 to ON Red LED
- Raspberry Pi sends pressure values to Azure, If Pressure is above ”certain value”, then Azure sends message to ESP 32 to make Beep sound. The message “ Beep sound is detected” sends ESP32 to Azure and back to Raspberry Pi
- If Humidity value is above certain value, then the built-in pin in ESP32 is set ON