Smart Room Coziness Detection System Using Sensors

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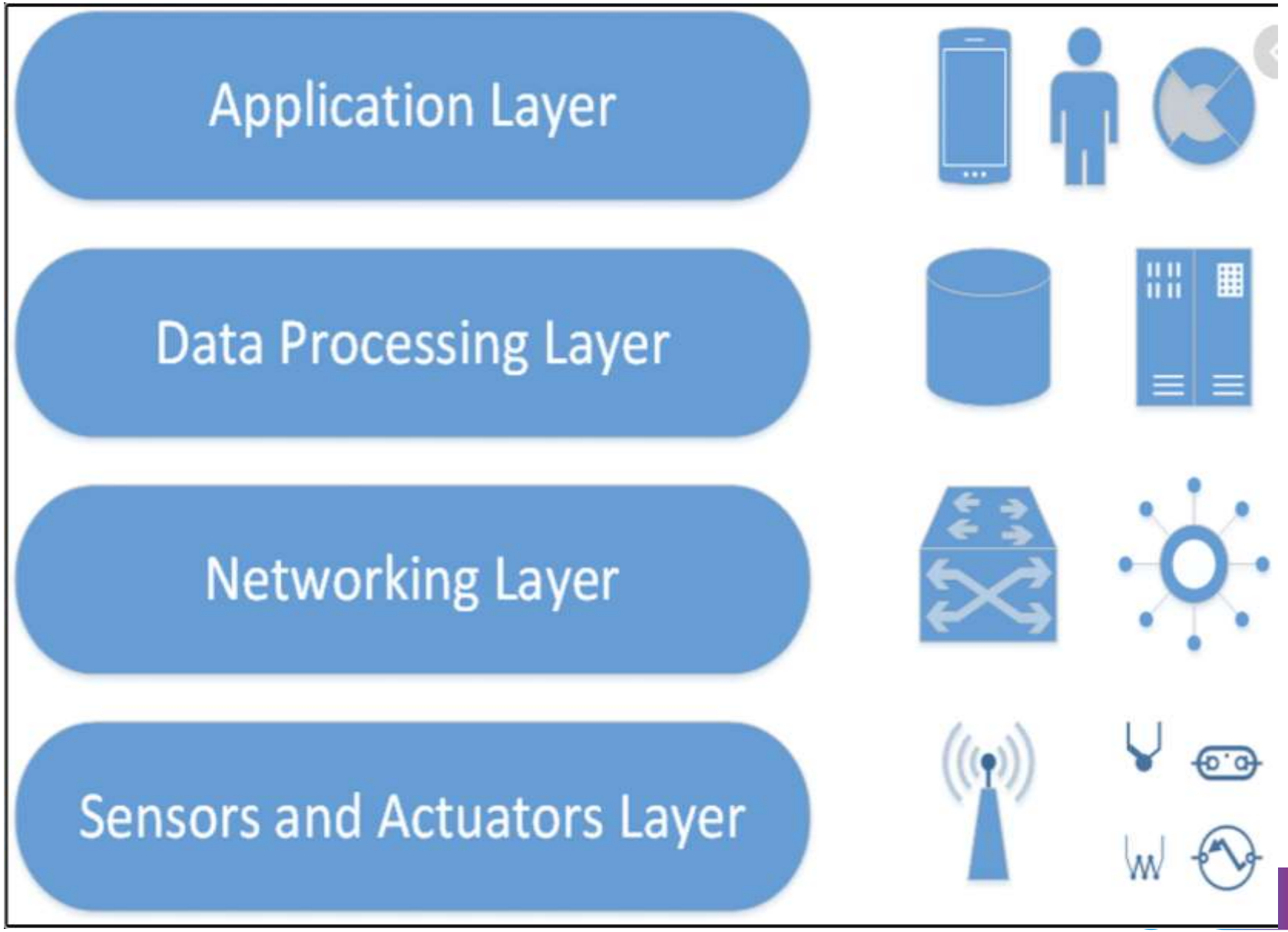
IOT ARCHITECTURE

- **APPLICATION – Smart Room**
- **Data Processing – Database & Cloud**
- **Network – MQTT**
- **Sensors – Arduino and Toolkit**



Sensors And Arduino

- Temperature Sensor
- Light Sensor
- Sound Sensor
- Arduino
- Raspberry Pi

Temperature Sensor

Light Sensor

Sound Sensor

Raspberry Pi 3

Arduino Uno

Programming Languages And Protocol Used

- MQTT
- Node-red
- MongoDB
- JavaScript
- HTML5 , CSS

Calculating Indices

- **Temperature Index**
- **Humidex Calculation**
- **Light Index**
- **Sound Index**

Temperature Index

Sensor_Value_Temp	Decision
<0	Freezing
0 - 14	Cold
15 - 24	Comfortable
25 – 55	Very Hot
>55	Intolerable & Dangerous

Source:
https://en.wikipedia.org/wiki/Room_temperature#:~:text=The%20American%20Heritage%20Dictionary%20of,(68%20%C2%B0F)%22

Calculating Indices(2)

- Temperature Index
- Humidex Calculation
- Light Index
- Sound Index

Humidex Formula:

- e = 6.11 * exp(5417.7530 * ((1/273.16) - (1/dewpoint)
  Dew point, Td = Temp - ((100 - H)/5.) | H = Humidity
  Humidex = Temp + 5/9 * (e-10) *(40 – 99)*

Humidex value	Degree of comfort	Cozy_Score
Under 15	Feeling cool or cold	50
From 15 to 19	No discomfort	90
From 20 to 29	Feeling of well-being	100
From 30 to 34	Feeling of greater or lesser discomfort	75
From 35 to 39	Rather great feeling of discomfort. Caution. Slow down certain outdoor activities.	25
From 40 to 45	Generalized feeling of discomfort. Danger. Avoid effort.	15
From 46 to 53	Extreme danger. Work stoppage in many areas.	5
Above 54	Imminent heat stroke (danger of death).	0

Source: http://www.meteo-mussidan.fr/hum.php

Calculating Indices(3)

- Temperature Index
- Humidex Calculation
- Light Index
- Sound Index

Light Index

Sensor_Value_Light	Decision	Cozy_score
0 - 9	Dark	10
10 - 199	Dim	50
200 – 399	Light	100
400 - 699	Bright	90
700- More	Very Bright	25

Source: https://arduinogetstarted.com/tutorials/arduino-light-sensor

Calculating Indices(4)

- Temperature Index
- Humidex Calculation
- Light Index
- Sound Index

Sound Index

Sensor_Value_Sound	Decision	Cozy_score
0 - 9	Quiet	100
10 - 199	Moderate	75
200 – 449	Noisy	50
450 - More	Intolerable	10

Experimented by our own

Coziness Calculation

Weights Given to each value

- **Weight_humidex = 0.4**
- **Weight_light = 0.3**
- **Weight_sound = 0.3**

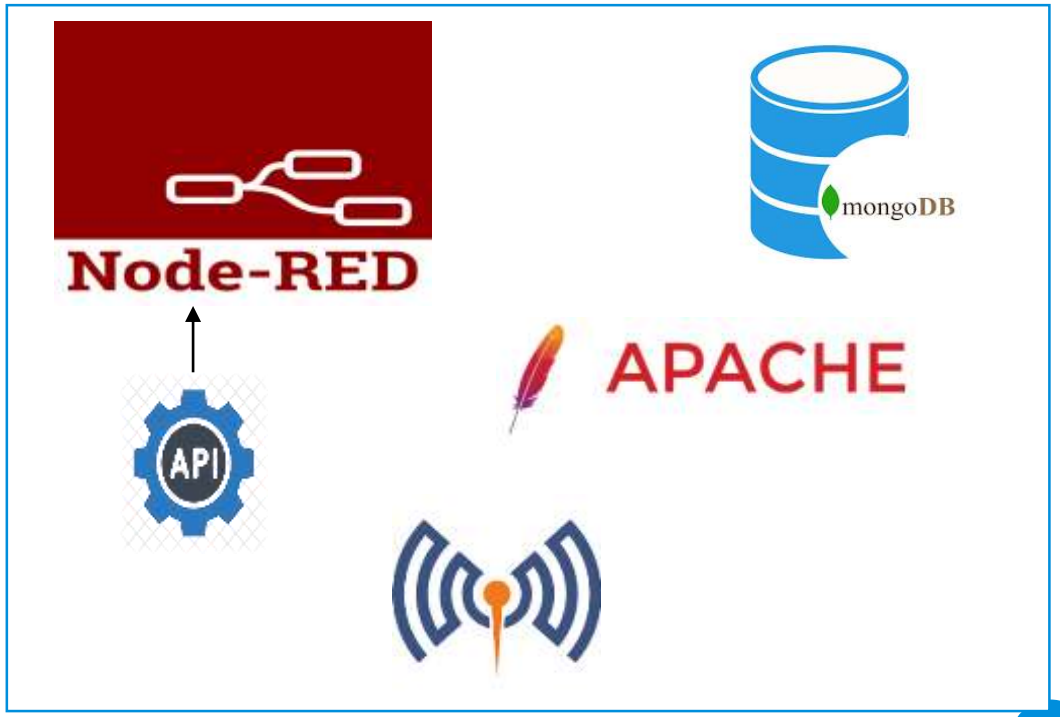
Coziness =

weight_humidex*cozy_humidex +
weight_light*cozy_light +
weight_sound*Cozy_sound

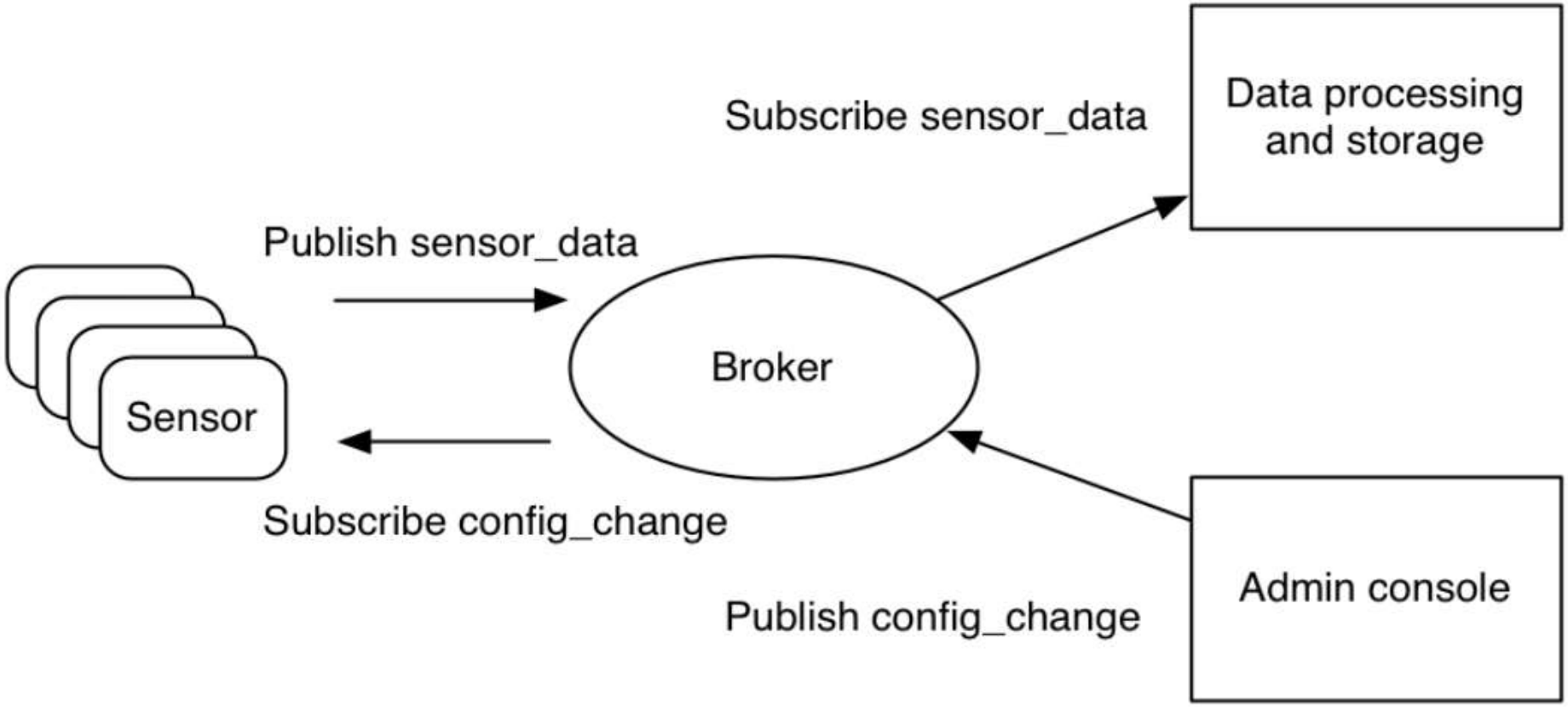
**This normalized score will be in between 0 - 100

Raspberry PI

- MQTT
- Node-red
- MongoDB
- JavaScript
- HTML5 , CSS



Why MQTT?


Subscribe sensor_data
Data processing and storage
Publish sensor_data
Broker
Sensor
Subscribe config_change
Admin console
Publish config_change

Why MQTT? (2)

- Lightweight and flexible
- Reliable Message Delivery
- Bi-directional Communications
- Support for Unreliable Networks
- Scale to Millions of Things
- Security Enabled

Data Processing – Database & Cloud

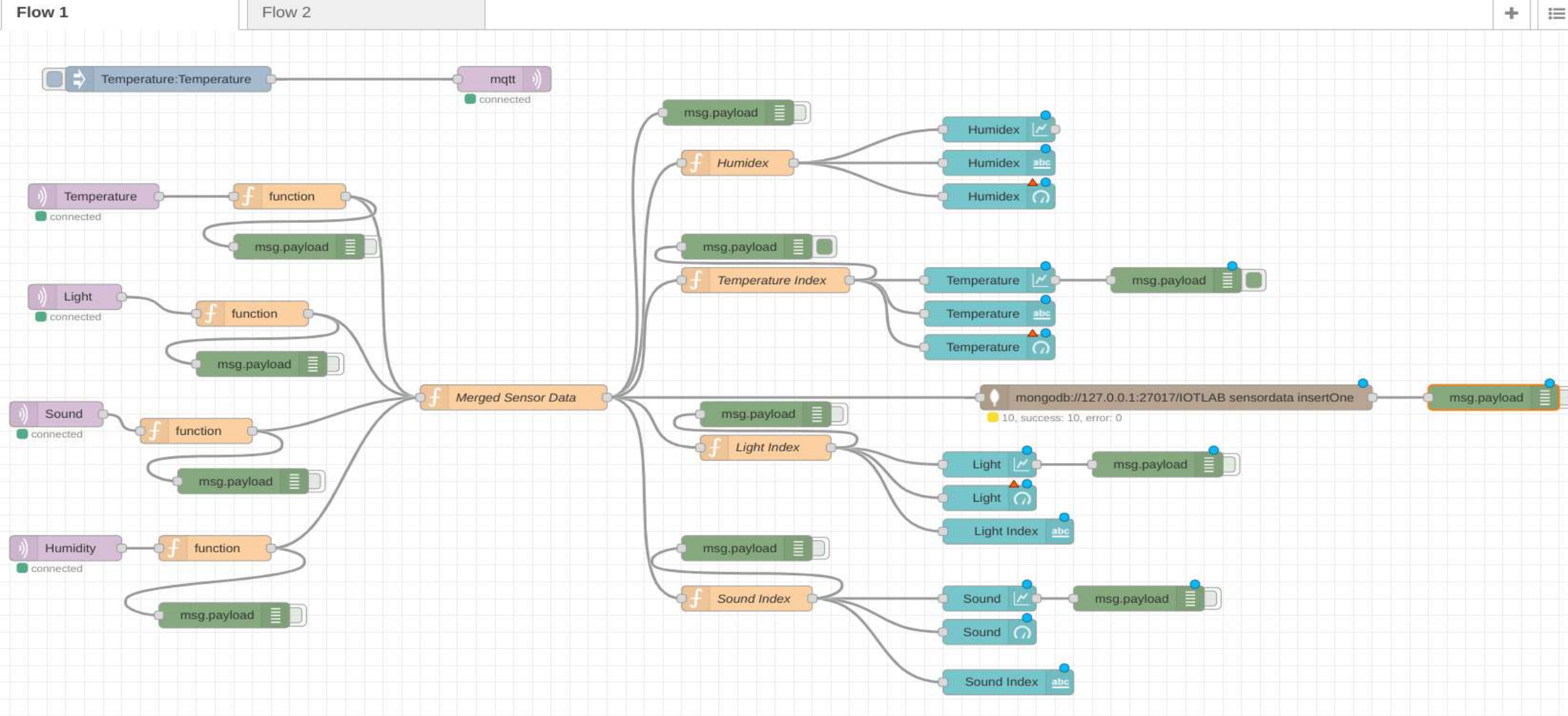
Mongo DB

Advantages

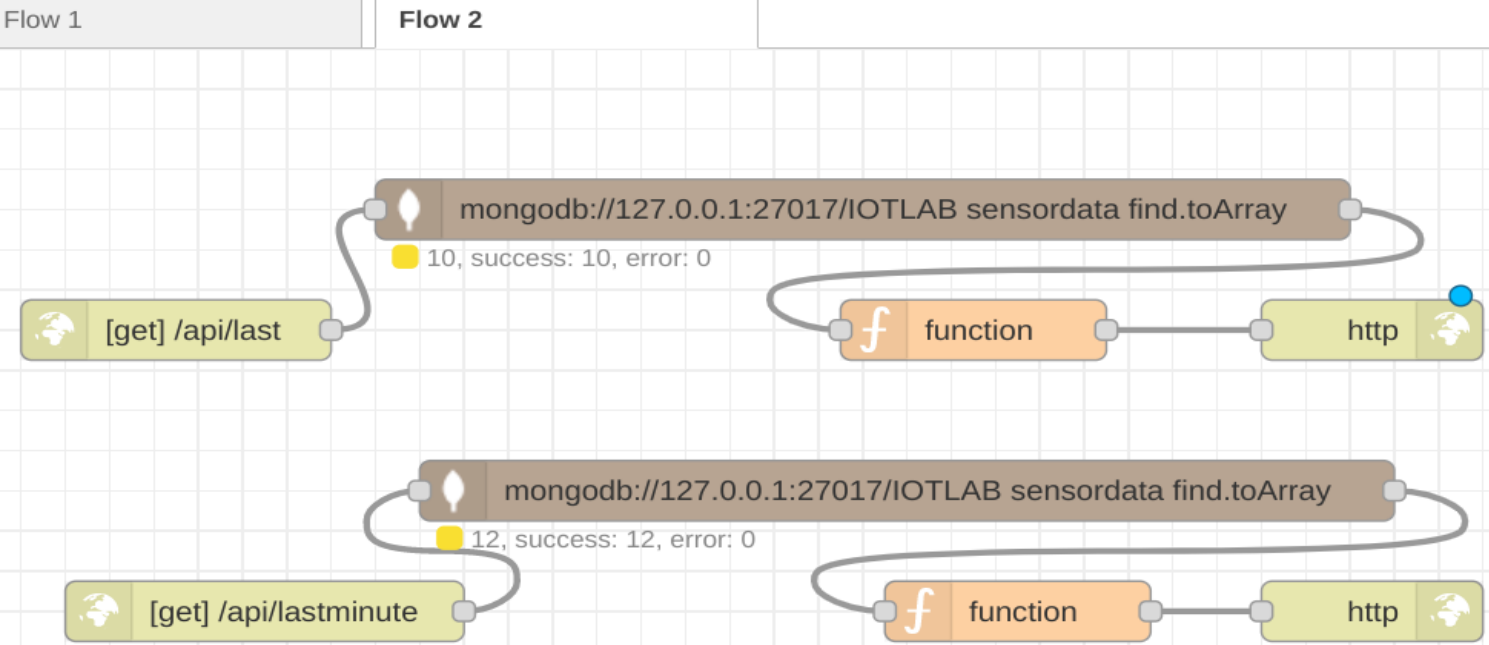
- Schema less − MongoDB is a document database in which one collection holds different documents
- Structure of a single object is clear.
- No complex joins
- Deep query-ability
- Tuning
- Ease of scale-out

Disadvantages

- MongoDB uses high memory for data storage.
- There is a limit for document size, i.e. 16mb.
- There is no transaction support in MongoDB.



Node-Red Flow

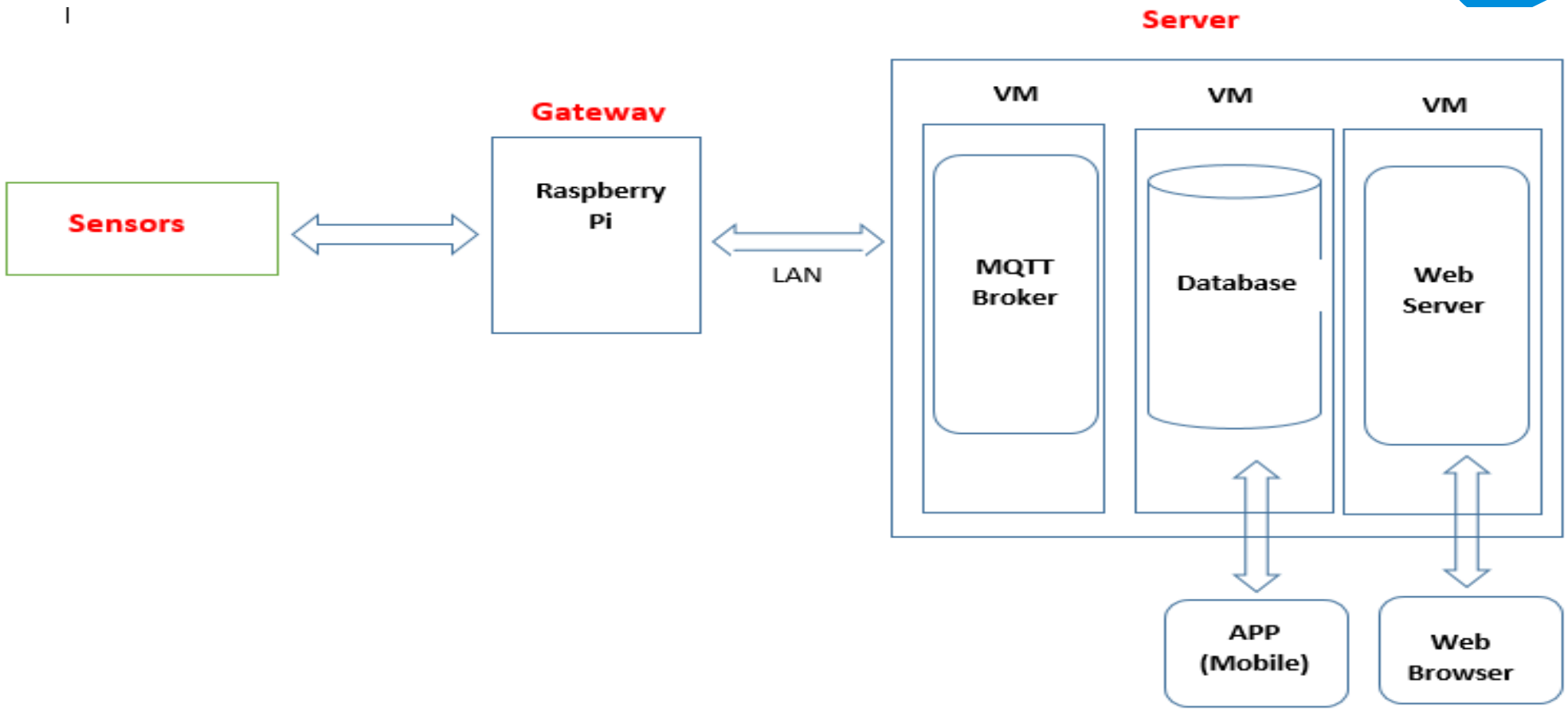


Node-Red Flow(API)

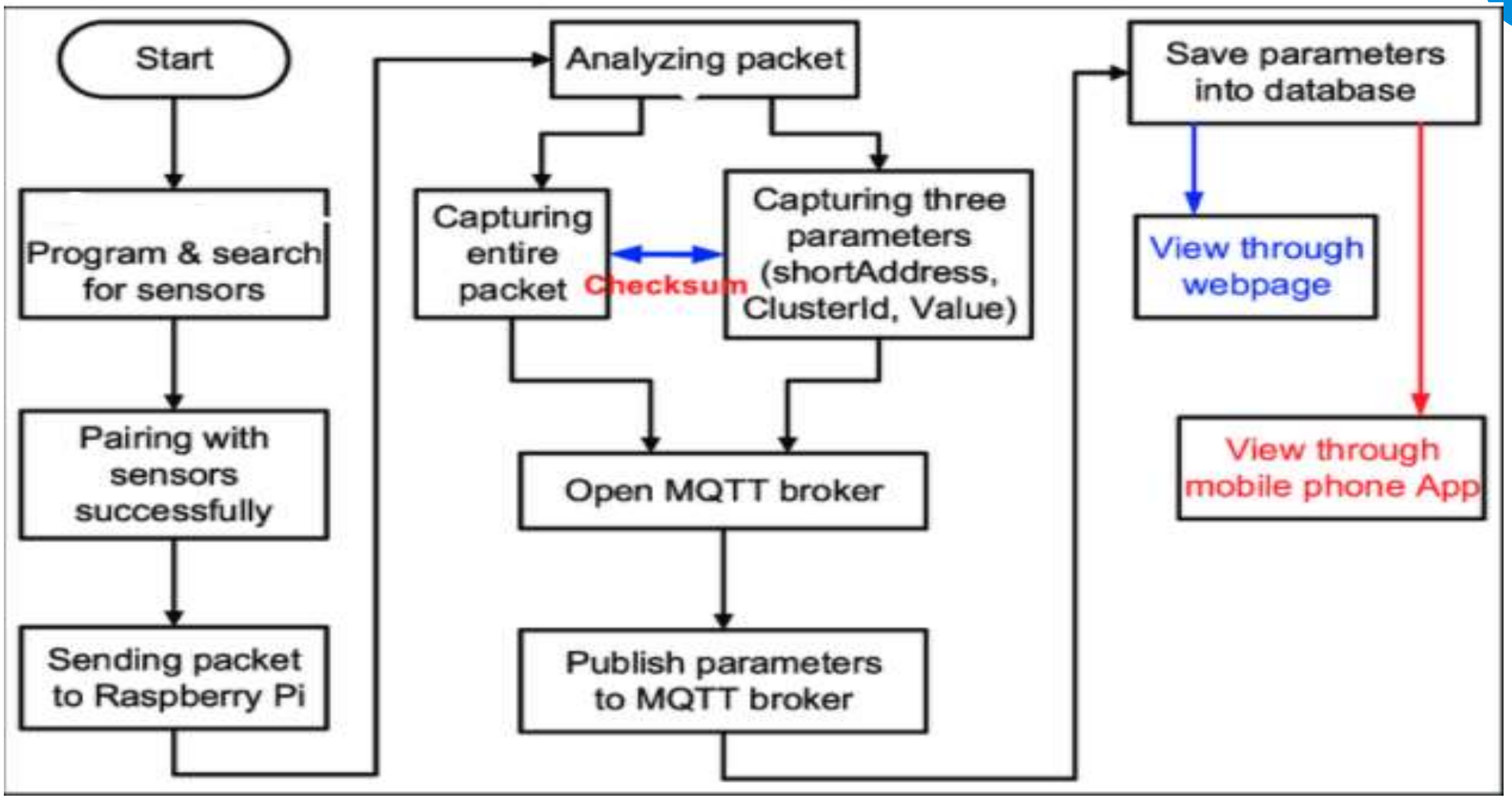

Charts
Humidex
54
40.5
27
13.5
0
20:48:00 20:50:00 20:52:00 20:54:00 20:56:00 20:58:00 21:00:00 21:02:00 21:04:00 21:06:00
Temperature
54
40.5
27
13.5
0
20:47:00 20:49:00 20:51:00 20:53:00 20:55:00 20:57:00 20:59:00 21:01:00 21:03:00 21:06:00
Light
700
525
350
175
0
20:05:00 20:15:00 20:25:00 20:35:00 20:45:00 20:55:00 21:06:00
Sound
450
337.5
225
112.5
0
20:05:00 20:15:00 20:25:00 20:35:00 20:45:00 20:55:00 21:06:00
Gauges
Humidex
3.823655036578068
0
Celsius
54
Temperature
7
0
Celsius
54
Light
213
0
units
700
Sound
0
units
450
Index
Humidex : Feeling cool or cold
Temperature : The room temperature is cold
Light Index : The room is Light
Sound Index : The Room is Noisy

Dashboard

Architecture Overview

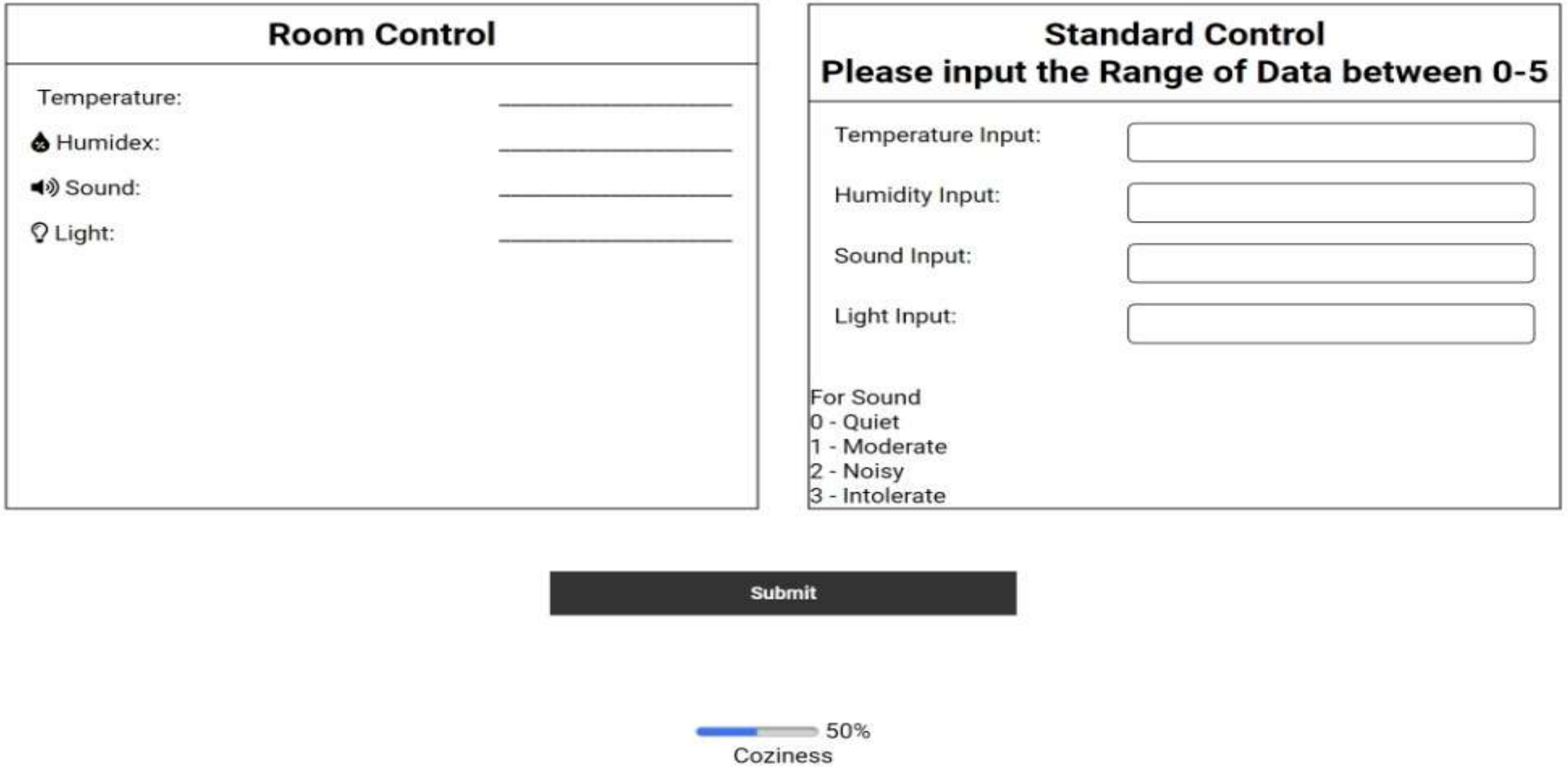


FlowChart


Start
Program & search for sensors
Pairing with sensors successfully
Sending packet to Raspberry Pi
Analyzing packet
Capturing entire packet
Checksum
Capturing three parameters (shortAddress, ClusterId, Value)
Open MQTT broker
Publish parameters to MQTT broker
Save parameters into database
View through webpage
View through mobile phone App

Challenges

- **Java 11** - Not supported in Raspberry Pi
- **Node-JS v1** - Mongo version not supported
- **Node-JS v2** - Mongo version not supported
- **MongoDB Cloud** – No Node Red flow to support the Mongo Cloud clustersMongo version not supported



UI for the client side

MERCI BEAUCOUP!