AMBIENT ROOM MONITORING -LARGE CLASSROOM

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DEVELOPERS PROJECT DOCUMENT

PROBLEM STATEMENT :

Design, develop and deploy an IoT system that collects data that can be used for energy management and improving comfort levels in a large classroom.

PURPOSE OF THE SYSTEM :

Nowadays huge amounts of energy are used in lighting, air conditioning and sound systems of large classrooms (H-105). To reduce energy wastage, systems can be automated based on the number of people present and surrounding factors. Also, the project focuses on improving the comfort level while at the same time saving energy. This project aims at using multiple low-cost sensors like light, CO2, sound, pressure, temperature, and humidity to estimate the conditions and adjust the air, sound and light systems accordingly. Nowadays huge amounts of energy are used in lighting, air conditioning and sound systems of large classrooms (H-105). To reduce energy wastage, systems can be automated based on the number of people present and

surrounding factors. Also, the project focuses on improving the comfort level while at the same time saving energy. This project aims at using multiple low-cost sensors like light, CO2, sound, pressure, temperature, and humidity to estimate the conditions and adjust the air, sound and light systems accordingly.

OVERVIEW OF THE SYSTEM:

The system consists of a 2-circuits, and central communication server which work with each other seamlessly to monitor different parameters in a classroom. Thanks to analytics that are updated in real-time, concerned stakeholders can visually see the advantages of this system and compare it with the regular manual control.

SYSTEM REQUIREMENTS:

- Constant power source
- Constant access to Wi-Fi

SYSTEM SPECIFICATIONS:

- ESP8266

- T6713 CO2 SENSOR
- BH1750 LIGHT SENSOR
- MAX4466 SOUND SENSOR
- DHT22 TEMPERATURE HUMIDITY SENSOR
- BME280 PRESSURE SENSOR
- LOGICAL CONVERTER
- OneM2M Server:- http://onem2m.iiit.ac.in:443/webpage
- Thingspeak channels:- https://thingspeak.com/channels

STAKEHOLDERS:

- Dr. Sachin Chaudhari
- TA Adarsh Pal Singh
- Our Team:
    - Rishabh Daga
    - Divanshi Gupta
    - Raghav Saboo

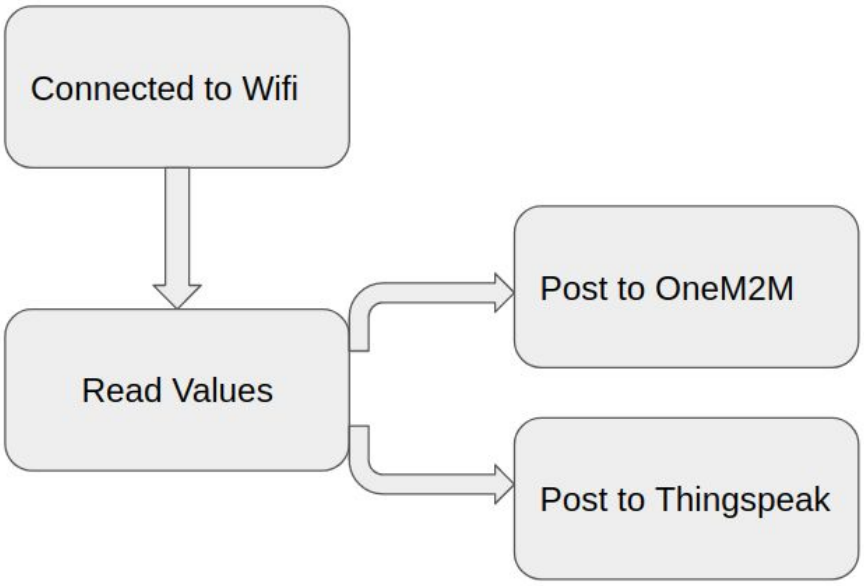
DESIGN ENTITIES :

- ESP8266

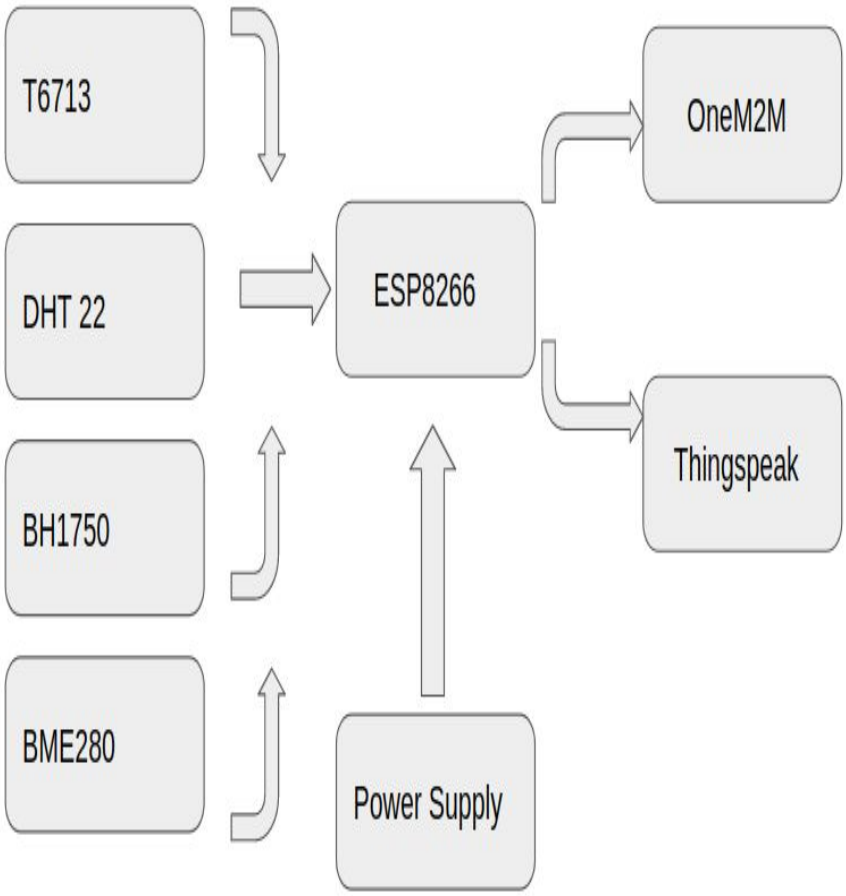
- T6713 CO2 SENSOR
- BH1750 LIGHT SENSOR
- MAX4466 SOUND SENSOR
- DHT22 TEMPERATURE HUMIDITY SENSOR
- BME280 PRESSURE SENSOR
- LOGICAL CONVERTER

DESIGN DETAILS :

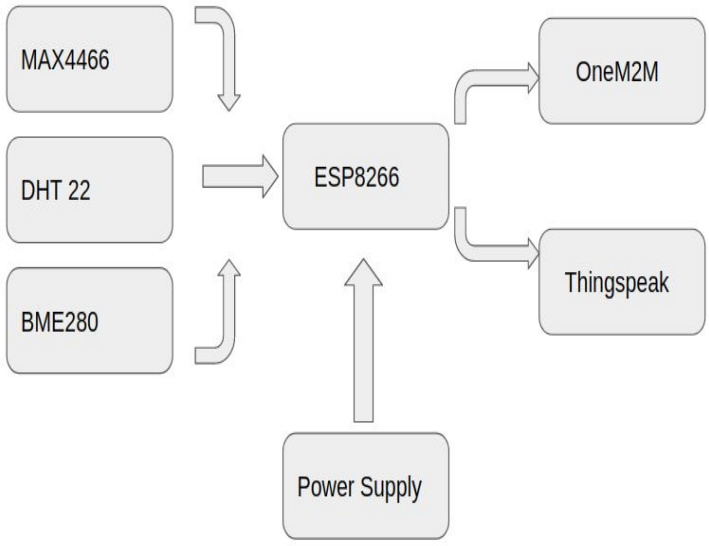
- CONCEPTUAL FLOW:



- ENTITY INTERACTION:
    - 4 SENSOR NODE



- 3 SENSOR NODE



OPERATIONAL REQUIREMENTS:

- SYSTEM NEEDS:

  A power supply is needed to keep ESP8266 functional all the time. Wifi is needed to upload the data on the site so that observations can be made and analysis can be done.

- UI DESIGN:

  We have used thingspeak as a medium to convert our raw data of the given different nodes into different types of graphs.

USER OR OPERATIONAL DOCUMENT

OBJECTIVE AND SCOPE :

Nowadays huge amounts of energy are used in lighting, air conditioning and sound systems of large classrooms (H-105). To reduce energy wastage, systems can be automated based on the number of people present and surrounding factors. Also, the project focuses on improving the comfort level while at the same time-saving energy. This project aims at using multiple low-cost sensors like light, CO2, sound, pressure, temperature, and humidity to estimate the conditions and adjust the air, sound and light systems accordingly. Nowadays huge amounts of energy are used in lighting, air conditioning and sound systems of large classrooms (H-105). To reduce energy wastage, systems can be automated based on the number of people present and surrounding factors. Also, the project focuses on improving the comfort level while at the same time-saving energy. This project aims at using multiple low-cost sensors like light, CO2, sound, pressure, temperature, and humidity to estimate the conditions and adjust the air, sound and light

systems accordingly.

PRODUCT OPERATIONAL REQUIREMENTS:

- Operating Environment: All those operating systems that support Arduino IDE
- Power: Minimal(3.3V) but continuous power is required by the ESP8266 to remain in functional mode always.
- Other Interfaces:
    - OneM2M:- This is a network interface where all the readings of the given sensors are posted.
    - Thingspeak: this is the channel where different types of visualization for the given raw data is done.
    - WiFi:- This again is an interface which is required for the ESP8266 to get connected to the server to post the data

SYSTEM WORKING MODEL

- Base State: In the base state, we are pushing the data to the OneM2M server and thingspeak channel but we are operating the room manually
- Working State: In the Working state, we are pushing the data to thee OneM2M server and thingspeak channel but we are operating the room this time on the basis of the reading received and the average values collected over a large period of time

IoT PROJECT COMPONENTS

HARDWARE SPECIFICATIONS – DEVICES:

- NodeMCU
  - Operating System: XTOS
  - CPU: ESP8266 (Single-board Microcontroller)
  - Memory: 128 Kilobytes
  - Storage: 4 MBytes
  - Power: USB
  - Input : 16 GPIO pins

- BME 280 PRESSURE Sensor:
  - Input Voltage : 1.71V-3.6V
  - Pressure Range: 300-1100hPa
  - Pressure Accuracy : ± 1 hPa
  - Altitude Range : 0-44330 ft
  - Altitude Accuracy : ± 1 m

- MAX4466 SOUND Sensor:

- Input Voltage : 2.4V-5.5V
- AVOL : 125dB Gain

- BH1750 LIGHT Sensor :
  - Measurement Range: 0-65535 lx(Lux)
  - Input Voltage: 3.3V-5V
  - Accuracy: ±20%

- T6713 CO2 Sensor :
  - Method: Non-Dispersive Infrared (NDIR), gold plated optics, diffusion sampling (with Telaire's Patented ABC Logic Self Calibrated Algorithm)
  - Measurement Range: 0-5000 ppm
  - Input Voltage: 4.5V-5.5V
  - Accuracy : 400-5000 ppm ± 30 ppm + 3% of reading
  - Response Time : < 3 minutes for 90% step change typical
  - Sampling Rate: Every 5 seconds

- DHT Sensor :
  - Input Voltage : 3V-5V

- Measurement Range :
  - Humidity: 1relative humidity
  - Temperature : -40 to 80℃
- Accuracy :
  - Humidity : 2-5%
  - Temperature : ±0.5°C

COMMUNICATION :

We have made two different kinds of nodes over here, one of them is a 3 sensor node and the other one is a 4 sensor node. These Sensors senses different parameters and send the data to thingspeak and OneM2M through ESP8266

- 3 sensor node: it has DHT22,BME280, MAX4466 sensors
- 4 sensor node: it has T6713,DHT22,BME280,BH1750 sensors

SOFTWARE SPECIFICATIONS:

- OneM2M Server
- ThingSpeak
- EagleCAD
- Fusion360

DATA HANDLING MODEL :

All the nodes were deployed in H-105 to sense the different given parameters

INTEGRATION FRAMEWORK

ESP8266 board has inbuilt wifi connectivity. The data measured by MCU is sent to OneM2M server and Thingspeak using WIFI connection provided by IIIT.

DATA VISUALIZATION / ANALYSIS FRAMEWORK:

We are sending data measured from a sensor on Thingspeak from our ESP8266 board where we are showing the data in the form of the graph for all sensors given in a node