Phase 2

Project title: Air Quality Monitoring

Idea in Brief:

The idea is establishing the "sensi-Air quality monitor" (name of the product) in the rush junctions of crowded city, the sensi air quality monitor, take readings of particulate matter (PM 10 and PM 2.5), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ammonia (NH3), and lead (Pb). The obtained resulted data is substituted in a standard formula

$$AQI = \frac{pollutant\,data\,reading}{standard} \times 100$$

Where the corresponding standards are specified

Pollutant	Averaging period	Air NEPM Standard
$PM_{2.5}$	24 hours	25 micrograms per cubic meter(µg/m3)
PM_{10}	24 hours	50 micrograms per cubic meter(µg/m3)
Carbon monoxide	8 hours	9.0 parts per million (ppm)
Nitrogen dioxide	1 hour	0.08 parts per million (ppm)
Ozone	8 hours	0.065 parts per million (ppm)
sulphur dioxide	8 hours	0.08 parts per million (ppm)
ammonia	8 hours	9.0 parts per million (ppm)
lead	1 hours	0.08 parts per million (ppm)

The obtained AQI is sent through wi-fi to the cloud, in addition to this the AQI data is also shared via Bluetooth, the cloud further compares the data with the standard AQI range and gives the user interface the result as follows

❖ 0-50: This range defines air quality as good as it shows minimal or no impact on health.

❖ 51-100: This is a satisfactory air quality range and it can show effects such as breathing difficulty in sensitive groups.

❖ 101-200: The range shows moderate air quality with impacts such as breathing discomfort for children and elderly people,

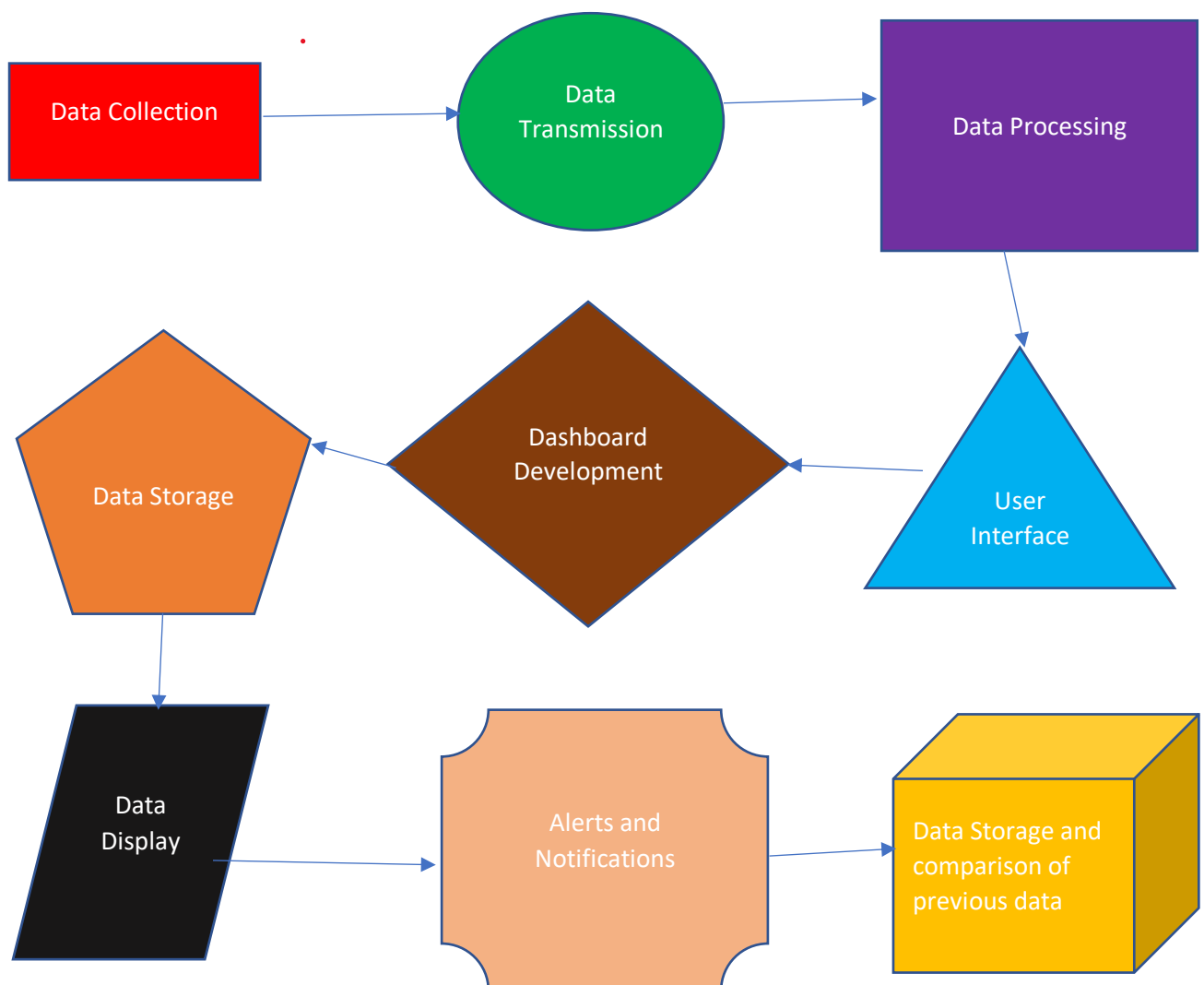and people already suffering from lung disorders and heart disease.

❖ 201-300: AQI falling in this range communicates that the air quality is poor and shows health effects on people when exposed for the long term. People already suffering from heart diseases can experience discomfort from short exposure.

❖ 301-400: This range shows very poor air quality and causes respiratory illness for a longer duration of exposure.

❖ 401-500: This is the severe range of AQI causing health impacts to normal and diseased people. It also causes severe health impacts on sensitive groups.

The AQI data of each day is stored in cloud and based on this data weekly and monthly air quality report is provided

Block Diagram for working:

```
┌──────────────┐         ╭──────────────╮        ┌──────────────┐
│   Data       │────────▶│    Data      │───────▶│    Data      │
│  Collection  │         │ Transmission │        │  Processing  │
└──────────────┘         ╰──────────────╯        └──────────────┘
                                                         │
                                                         ▼
      ⬠ Data              ◆ Dashboard              ▲ User
        Storage    ◀────── Development  ◀────────   Interface

        │
        ▼
   ▱ Data            Alerts and          ▨ Data Storage and
     Display  ──────▶ Notifications ─────▶ comparison of
                                           previous data
```

Design of Product:

Sensors used:

- Electrostatic sensors for particulate matter: They use an electrostatic field to attract particles. The number and size of particles collected on the sensor's surface are used to estimate PM2.5 and PM10 concentrations.
- Electrochemical CO Sensors for Carbon monoxide: These sensors use a chemical reaction that occurs at an electrode when CO is present. The resulting current is proportional to the CO concentration.
- Ozone Sensors: Ozone sensors typically use electrochemical or ultraviolet (UV) absorption principles to measure ozone levels.
- Gas Sensitive Semiconductor Sensors for Nitrogen di Oxide and Sulphur di Oxide: These sensors rely on the change in electrical conductivity of a semiconductor material when exposed to NO_2 andSO_2.
- Metal Oxide Sensors for ammonia: Some metal oxide sensors can detect ammonia by measuring changes in electrical resistance.
- Atomic Absorption Spectrometers sensors for lead: These analytical instruments are used for more complex lead detection, often in laboratory settings. They work by measuring the absorption of specific wavelengths of light by lead atoms.

Combining the 6 sensors:

The 6 sensors are placed in a combat box like environment, power supply for all sensors. This may involve using a power source such as batteries, a power adapter, or other suitable options. ESP8266 microcontrollers are used to collect data from the different sensors. Each sensor may require specific signal conditioning, such as

amplification or analog-to-digital conversion, to ensure accurate readings. Each sensor is calibrated to ensure its measurements are accurate and reliable.

Communication and Data Transmission:

- Include communication interfaces (e.g., Wi-Fi, Bluetooth, or wired connections) to transmit the collected and processed data to a display or a remote data storage system.

- MQTT protocol is also used in the communication of data from sensor to cloud.

Creation of user Interface and maintaining History of data collected:

Using UI tool, the design of interface is made and the software is programmed using PYTHON language, the interface is coded in a manner that daily AQI updates is available with the history AQI of the previous days.

Need for sensi air quality monitor:

Public Health:

Poor air quality can lead to respiratory problems, cardiovascular issues, and other health problems. Monitoring helps identify pollutants and their levels, allowing authorities to take action to protect public health.

Environmental Protection:

Monitoring helps track pollutants that harm the environment, such as greenhouse gases, which contribute to climate change, and pollutants that harm ecosystems and wildlife.

Emergency Response:

Monitoring can detect sudden spikes in pollutants, such as during industrial accidents or wildfires, prompting quick responses to protect people and the environment.

Public Awareness:

Publicly available air quality data can inform individuals about the current air quality in their area, allowing them to make informed decisions, such as avoiding outdoor activities on days with poor air quality.

Impact of sensi air quality monitor:

Air pollution is a fact of life for many urban communities. With the World Health Organization estimating that ambient air pollution is responsible for 4.2 million deaths per year, community air quality monitoring projects are a vital part of preventing widespread health issues. Guard against pollutants and harmful particulate matter with trusted air quality monitoring systems designed to educate and effect positive change

The air pollution monitoring paradigm is rapidly changing due to recent advances

1.The development of portable, lower-cost air pollution sensors reporting data in near-real time at a high-time resolution.

2. Increased computational and visualization capabilities.

3.wireless communication/infrastructure. It is possible that these advances can support traditional air quality monitoring by supplementing ambient air monitoring and enhancing compliance monitoring.

Influence of the product in market:

Affordability slower adoption of advanced technologies and shortage of trained personal personnel or expected to restrain the growth of market especially in developing countries.

Market growth driven by a supportive government regulation for air pollution monitoring and control and ongoing initiatives toward the development of environment friendly industries.

Emerging markets such as China , India, Brazil, South Korea, Russia are offering high growth opportunities for player operating in this market.