AIR QUALITY ANALYSIS IN TAMILNADU

ABSTRACT:

Air Pollution is the crucial Air pollution is the crucial type of ecological direct effect on ecological balance and harms human health. The growing economy of a country is actually leading to its atmosphere. According to WHO, Air contamination ruin around seven million persons worldwide in a year. Also, WHO determines that the global populations (99%) breathe air contains dangerous pollutants exceeding the WHO guideline limit. The acceleration of industrialization, the fast expansion of urbanization, and the status of urban air effluence has become worst, which badly impacts living environment and health. This deep case study focuses mainly upon the major causes and pollutants in TamilNadu, Chennai for more than a decade covering the urban, rural, coastal and industrial area. This recommended work explores and inspects the air pollutant levels of Chennai across different geographical locations from spatiotemporal perspective. And, this suggested big data analytics framework intends air pollution analytics and verdicts related to people affected with various diseases influenced by the components of ambient air fineness. Innovative and creative method of managing challenges of big data gathered from Satellites, weather and sensor of CPCB, NEERI and Meteorology department of various parts of chennai over the decade to be formed using Hadoop distributed Architecture incorporating Machine learning systems. The outcome of such analytics will be beneficial to the society conveying significant

recommendations to the government to manage the air pollution crisis and the findings pinpoints the causes of pollution.

INTRODUCTION:

Air supplies us with oxygen which is essential for our body to live. Air is 99.9% of Nitrogen, Oxygen, Water vapors and inert gases. Air pollution may be described as contamination of the atmosphere by gaseous, liquid, or solid wastes or by-products that can endanger human health and welfare of plants and animals (Meenakshi and Elangovan 2000). Although some pollutants are released by natural sources like volcanoes, coniferous forests, and hot springs, the effect of this pollution is very small when compared to that caused by emissions from industrial sources, power and heat generation, waste disposal, and the operation of internal combustion engines (Avnish and Mayank, 2010). Fuel combustion is the largest contributor to air pollutant emissions, caused by man, with stationary and mobile sources equally responsible.The air pollution problem is encountered outdoor as well as indoor.The major pollutants which contribute to outdoor air pollution are sulfur dioxide, carbon monoxide, nitrogen oxides, ozone, total suspended particulate matter, lead, carbon dioxide, and toxic pollutants (Barman et al.2008). The air quality in India now appears to be even worse with one new study finding that excess pollution is reducing the life expectancy of 660 million Indians by 3.2 years, on average.In India, pollution has become great topic of debate at all levels and especially the air pollution because of the enhanced anthropogenic activities such as burning fossil fuels, i.e. natural gas, coal, oil to power industrial process and motor vehicles. Among the harmful chemical compounds the burnings put into atmosphere are Carbon monoxide (CO), Nitrogen oxides(NOX),Sulfur dioxide (SO2) and tiny solid particles including lead from gasoline additives.

IMPORTANCE OF AIR QUALITY ANALYSIS:

Improve air quality – monitoring helps to identify areas with poor air quality and the pollutants responsible for it. This information can be used to implement air pollution control measures to improve air quality. monitor compliance with regulations – the main benefits of air quality monitoring is that it helps us to ensure that the air we breathe is safe. monitor climate change – By monitoring these changes, air quality monitoring can help to identify the impact of climate change on air quality and take action to mitigate it. support research and development – collected data on air quality is a unique source of inspiration for research and development of new pollution control technologies that have the potential to reduce emissions from industrial sources. protect health – why is air quality monitoring important? Pollution has been linked to a range of health problems, including respiratory and cardiovascular diseases. Air quality monitoring can help to identify areas where the air is polluted and take action to protect public health.

METHODS OF AIR QUALITY ANALYSIS:

Air sampling is one of the most important and difficult steps in the surveillance of air pollution.These techniques are include,

- **Filtration**
- **Electrostatic precipitation**
- **Thermal precipitation**
- **Gravitational settling**
- **Centrifugal separation**
- **Impingement.**

PREVENTION:

Air pollution can be prevented by advocating the use of public transport and carpooling. It can also be controlled by avoiding wastage of electricity and practicing reuse and recycling of compatible products.

- ❖ **Usage of public transport and carpooling**
- ❖ **Switching off the lights when they’re not in use**
- ❖ **Reusing and recycling products**
- ❖ **Avoiding the burning of garbage and smoking**
- ❖ **Avoiding the use of firecrackers**

EXISTING:

There are many small, but critical sources of air pollution in our homes and neighborhoods. Such sources — vehicles, construction equipment, lawn mowers, dry cleaners, backyard fires, and auto-body shops — are located where we live and work. Total emissions from these smaller but widespread sources are significantly greater than all the industrial sources in the state combined.

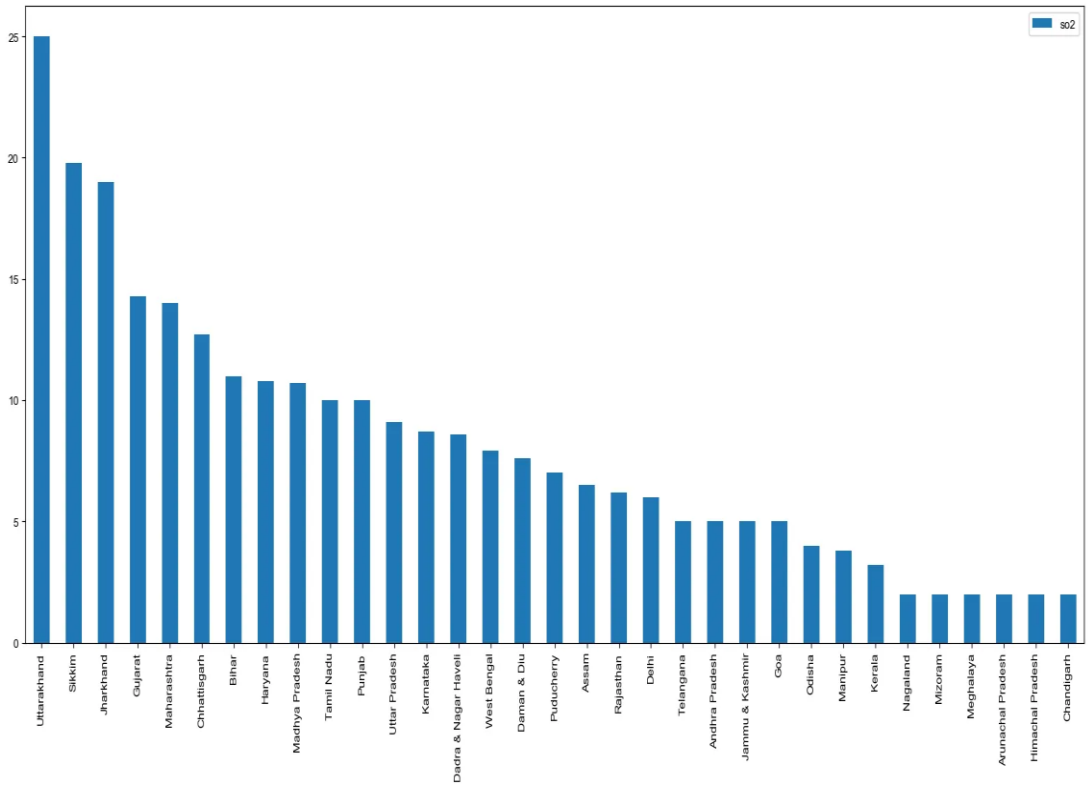
- **Drive your car less:** Vehicle exhaust is a major source of air pollution in Minnesota. Carpool. Bike. Bus. Telecommute. Electric vehicles. How could you burn less fuel?
- **Keep your car in good repair:** Fix exhaust and oxygen sensor problems ASAP. Check your tire pressure monthly; under-inflated tires have been shown to lower gas mileage, particularly at lower speed.
- **Turn off your engine:** An idling engine creates a hot spot of pollution. Buses and big trucks produce particularly unhealthy exhaust. Parents and teachers can help their schools and daycares develop and implement no-idling policies.
- **Don't burn your garbage:** Burning your household garbage is dangerous to your health and our environment, and generally against the law in Minnesota. If you're still using a burn barrel, wood stove, or fire-pit for your trash, contact your county about arranging for trash hauling services.
- **Limit backyards fire in the city:** Smoke from backyard fires can cause unhealthy conditions for hundreds of people, especially during stagnant weather conditions.

- **Plant and care for trees:** Trees filter pollutants and absorb carbon dioxide. Trees also release oxygen into the atmosphere and help cool our homes.
- **Switch to electric or hand-powered lawn equipment:** Gas-powered engines like those on lawnmowers and leaf or snow blowers often lack pollution control devices. An hour running a lawn mower can produce nearly the same amount of pollution as a 100-mile car trip! Use hand-powered or electric lawn care equipment instead.
- **Use less energy:** Choose efficient appliances and heating systems. Get an energy audit and follow the advice. Turn off electrical stuff you are not using. It all adds up.
- **Become a champion for clean air:** Direct local businesses, city offices, and school districts toward programs that can help them reduce air pollution and become more sustainable.
- GreenStep Cities: City and county officials governments can help by passing local ordinances, creating incentives for beneficial behaviors, and promoting and educating residents on best practices.
- Small business assistance: The Small Business Environmental Assistance Program helps Minnesota businesses comply with environmental rules, reduce wastes and emissions, and reduce regulatory obligations.
- Minnesota GreenCorps: An AmeriCorps program coordinated by the MPCA places members with organizations around the state to address environmental issues, including air quality. Nonprofit, government and school districts are eligible to host members to work on qualified projects.

PROPOSED:

Air pollution is the single largest environmental health risk in the EU and causes significant damage to ecosystems. As part of the European Green Deal's zero pollution ambition, on 26 October 2022 the Commission tabled a proposal for a revision of the Ambient Air Quality Directives. **The proposed directive would set air quality standards for 2030 that are more closely aligned with the Word**

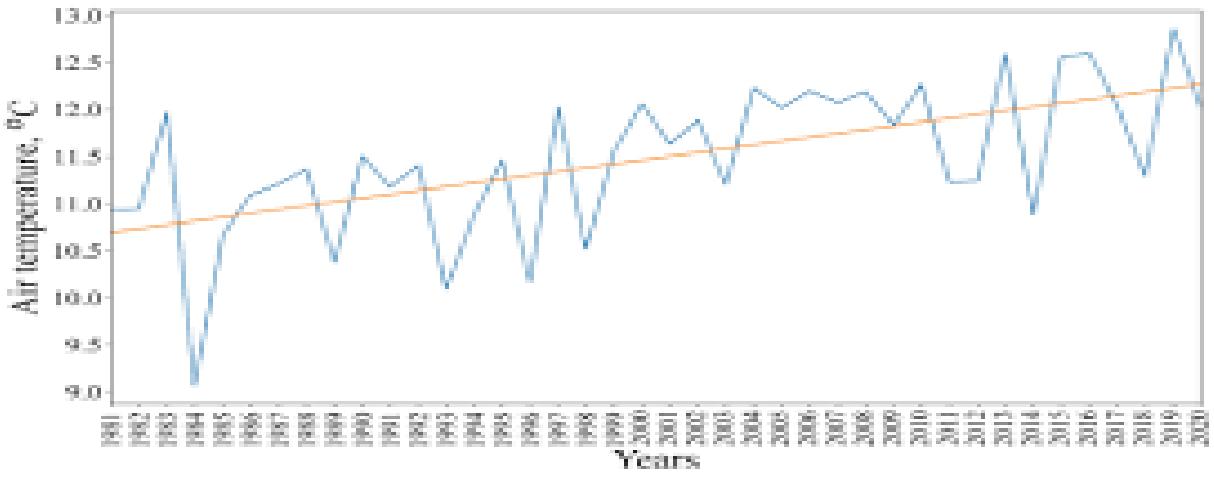
Health Organization's recommendations, as updated in 2021. It would also include a mechanism for the standards' regular review based on the latest scientific information. To achieve them on time, the Member States would have to establish air quality plans ahead of 2030. Provisions on air quality monitoring and assessment would be updated, including through new requirements for monitoring pollutants of emerging concern, such as ultrafine particles.Stakeholders have had mixed reactions to the proposal. NGOs call for full alignment with the WHO guidelines by 2030 at the latest, and for penalties in case the 2030 deadline is missed. Industry representatives insist on the need to meet current standards first, before aiming for higher ones.In Parliament, the Committee on the Environment, Public Health and Food Safety (ENVI), responsible for the file, adopted its report on 27 June 2023. The report, which raises the level of ambition of the proposal, awaits a vote in plenary during September. If adopted, it will form Parliament's position for future negotiations with the Council, which has yet to agree on a general approach.



PROGRAM:

```
#Define pollutants and their colors pollutants = ["co", "no", "no2", "o3", "so2", "pm2_5", "pm10", "nh3"]

 pollutant_colors = px.colors.qualitative.Plotly

 # Calculate the sum of pollutant concentrations total_concentrations = data[pollutants].sum()

# Create a DataFrame for the concentrations concentration_data = pd.DataFrame({ "Pollutant": pollutants, "Concentration": total_concentrations })

 # Create a donut plot for pollutant concentrations fig = px.pie(concentration_data, names="Pollutant", values="Concentration", title="Pollutant Concentrations in Delhi", hole=0.4, color_discrete_sequence=pollutant_colors)

 # Update layout for the donut plot
fig.update_traces(textinfo="percent+label")
fig.update_layout(legend_title="Pollutant")

 # Show the donut plot fig.show()
```

OUTPUT:

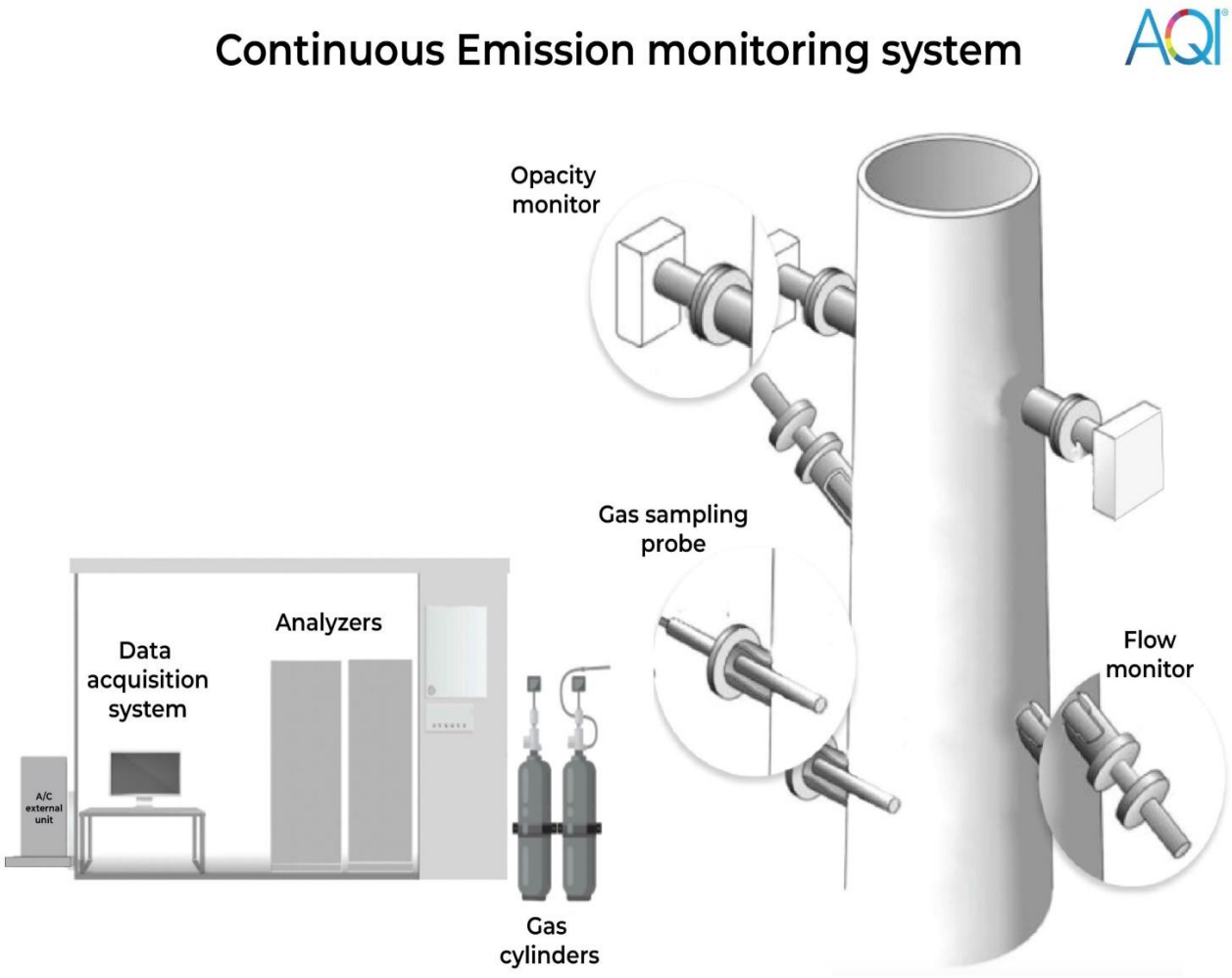


SYSTEM REQUIREMENTS:

1. **Ecotech Instruments India Pvt. Ltd.:** A prominent manufacturer of environmental monitoring instruments, including ambient air quality monitoring systems. They offer a range of products to measure various pollutants like PM2.5, PM10, SO2, NO2, CO, O3, and more.
2. **Envirotech Instruments Pvt. Ltd.:** Envirotech is a leading manufacturer and supplier of environmental monitoring instruments, including ambient air quality monitors. They provide advanced solutions for real-time air quality monitoring.
3. **Horiba India Pvt. Ltd.:** Horiba is a global company with a presence in India, offering a range of environmental monitoring solutions, including ambient air quality monitoring systems.
4. **Ecotech Instruments (India) Pvt. Ltd.:** Another division of Ecotech Instruments focused on providing high-quality ambient air quality monitoring solutions.
5. **MNM Environmental Consultants Pvt. Ltd.:** MNM offers a wide range of environmental monitoring instruments, including ambient air quality monitoring systems, to measure various pollutants and parameters.
6. **Vasthi Instruments Pvt. Ltd.:** Vasthi specializes in providing environmental monitoring solutions, including ambient air quality monitors, gas analyzers, and dust monitors.
7. **Apzem India Engineering:** Apzem manufactures ambient air quality monitoring systems and gas analyzers to measure pollutants in the atmosphere.
8. **Emtici Engineering Ltd.:** Emtici Engineering provides environmental monitoring instruments, including ambient air quality monitoring systems, for various industrial applications.
9. **SPM Instrument India Pvt. Ltd.:** SPM Instrument offers a range of environmental monitoring solutions, including ambient air quality monitors and dust monitors.
10. **Met One Instruments India Pvt. Ltd.:** Met One Instruments is known for its high-quality air quality monitoring instruments, including ambient air quality monitors and particulate samplers.

Air Quality Monitoring or Testing Required?

Air Pollution is the introduction of Chemicals, Particulates or other Harmful materials into atmosphere causes/damage to living organism/Built Organism. Air pollutants are added in the atmosphere from a variety of sources that change the composition of the atmosphere and affect the biotic environment.The concentration of air pollutants depends not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions. The sources of air pollutants include vehicles, industries, domestic sources and natural sources.



SYSTEM DESIGN:

The system consists of two parts: software and hardware platforms[14]. The software platform is a functional module based on a B/S architecture that conducts data acquisition, data analysis and processing, data visualization, data trend analysis, air pollutant interpolation analysis, and data early warning. The hardware platform is a wireless sensor network, which includes a motherboard and data acquisition board.

Hardware platform design:

Since the platform is a sensory platform, the hardware system adopts a modular design, which was mainly applied to the design and development of the motherboard and data acquisition board. With an ARM processor as the core, the IPv6 protocol is embedded in each sensor node to operationalize the data acquisition and upload functions.

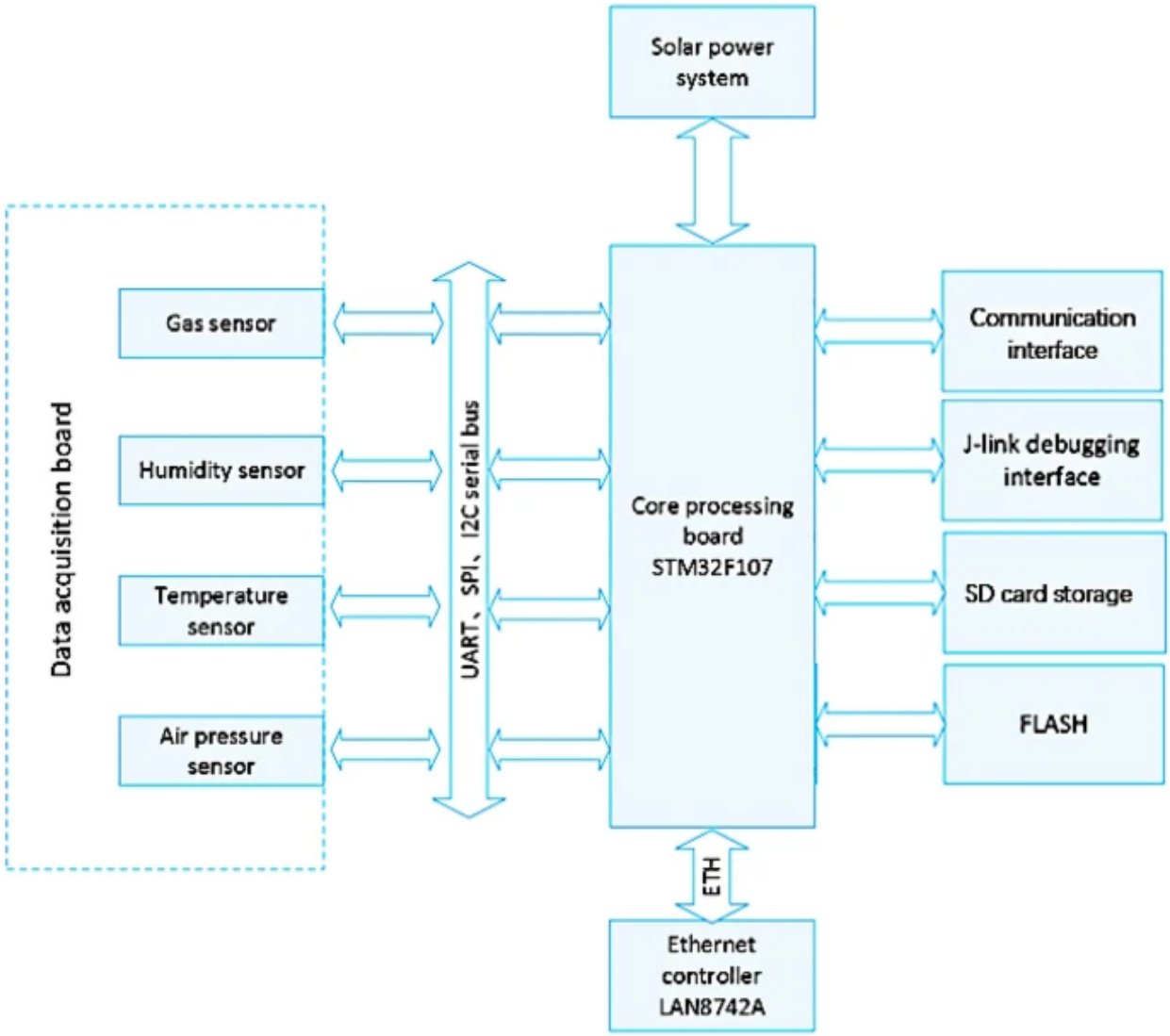
Motherboard

The motherboard is the core component of a wireless sensor, and it is composed of a charging management unit, power conversion unit, clock management unit, network interface, J-Link component, data storage unit, network interface, and signal transceiver. With the STM32F107 chip as the core, the IPv6 protocol is embedded to control the acquisition and storage of data in field environments and is responsible for the communication between wireless sensors and servers.

Data acquisition board

Air quality is monitored by a series of air pollutant concentration indexes, so equipment must be used to connect different sensors and equipment[15]. For different sensor types, the acquisition board requires various connection modes to interact with the motherboard. Therefore, the data acquisition board is separated from the

motherboard to improve the universality and scalability of the whole system. The separately designed digital acquisition board connects to each type of sensor. For example, a digital sensor is the communications interface between the sensor and the processor provided by the data acquisition board; an analog sensor is a functional component provided by the data acquisition board to connect the final amplified or converted data with the processor when the sensor signal needs to be amplified and converted, and the output pulse sensor is used to shape the pulse signal output by the sensor.



Software platform design

The overall framework of the monitoring and early warning platform for air pollutants with high space–time accuracy based on IPv6 is shown in Fig. 1. The platform is divided into the data acquisition module, the data analysis, and processing module, and the data visualization and early warning module.

Data acquisition module

The design and implementation of the data acquisition module require a 4G communication network to implement data uploading, and a wireless sensor network collector terminal implements data forwarding through an embedded system.

1. First, the data are accepted and stored in the local buffer through the socket interface, and the completely agreed message data are accepted
2. Then, the sensor mark position is analyzed corresponding to the data, and the data are converted behind the data position, according to whether the corresponding sensor has data (0 means no data, 1 means data)
3. According to the agreed resolution factor of each acquisition parameter, different parameters are multiplied by different resolution factors, and then, the data-bind with the equipment after the corresponding equipment ID is resolved.
4. To ensure the readiness of the data, the calibration equipment is installed at the near-ground position, and the accuracy of the data collected by the sensors is updated by comparing the collected and analyzed data.

Data analysis and processing module

The data analysis and processing module analyze the collected data, and the current TCP connection node is message data obtained

through the socket interface. For different acquisition factors, data are arranged according to whether the corresponding data collector has data, and then, the data format is filled after the flag bit. The data bits have already agreed to the arrangement rules in the data analysis part, and each bit represents a different data sensor. To save the stored message length, the collected data are filled after the flag bit; otherwise, they are not filled.

DATASET:

LOCATION	STATE	AOI_US	PM2.5	PM10	TEMP	HUMIDITY
TANJORE	moderate	93	32	69	32	57
TIRUNELVELI	good	42	10	36	32	61
TRIPUR	moderate	62	4	78	30	64
THIRUVANAMALAI	poor	115	41	79	32	57
TUTICORIN	good	38	4	34	32	60
VELLORE	good	50	12	28	31	66
VALPARAI	moderate	70	21	53	32	56
TRICHINOPOLY	moderate	91	18	23	30	60