PROJECT REPORT DOCUMENTATION

PROJECT TITLE :

REMOTE GAS PIPELINE TUNNEL TEMPERATURE MONITORING SYSTEM

TEAM ID : NM2023TMID02774

DATE : 20.05.2023

1.INTRODUCTION:

The remote gas pipeline tunnel temperature monitoring system is an advanced technology designed to ensure the safe and efficient operation of gas pipelines. It enables real-time monitoring of temperature conditions within pipeline tunnels, providing early detection of potential issues and allowing for timely intervention.

Gas pipelines play a vital role in transporting natural gas over long distances, serving as a critical infrastructure for energy distribution. However, the operational challenges associated with pipeline tunnels, such as inaccessible locations and limited visibility, make monitoring and maintenance a complex task. This is where the remote temperature monitoring system comes into play, offering a solution to overcome these challenges.

The system comprises a network of temperature sensors strategically installed inside the gas pipeline tunnels. These sensors are capable of accurately measuring and monitoring temperature variations at different points along the pipeline.

1.1 PROJECT OVERVIEW

The objective of this project is to design, develop, and implement a remote gas pipeline tunnel temperature monitoring system that enhances the safety, efficiency, and reliability of gas pipeline operations. The system will provide real-time monitoring and early detection of temperature anomalies within pipeline tunnels, enabling prompt intervention and preventive maintenance.

System Design:

- Conduct a detailed analysis of gas pipeline tunnel characteristics and requirements.
- Design a scalable and robust sensor network layout for accurate temperature monitoring.
- Determine the optimal communication infrastructure for remote data transmission.
- Select appropriate hardware components for sensors, data acquisition, and monitoring station.

Sensor Installation:

- Identify suitable locations within gas pipeline tunnels for sensor placement.
- Ensure proper installation and calibration of temperature sensors.
- Establish a secure and reliable power supply for the sensors.

PURPOSE :

The purpose of the remote gas pipeline tunnel temperature monitoring system is to enhance the safety, efficiency, and reliability of gas pipeline operations. It serves several important purposes:

Early Detection of Temperature Anomalies: The system's primary purpose is to detect temperature anomalies within gas pipeline tunnels at an early stage. By continuously monitoring the temperature conditions, it can identify deviations from normal patterns that may indicate potential issues such as leaks, blockages, or other abnormalities. Early detection allows operators to take prompt action before the situation escalates into a major problem, preventing accidents, leaks, or pipeline failures.

Preventive Maintenance: The system enables proactive maintenance by providing real-time temperature data and insights. Operators can identify trends or patterns in temperature variations and use this information to schedule preventive maintenance activities. By addressing potential issues before they cause significant disruptions or damage, maintenance can be planned and executed more efficiently, resulting in improved pipeline reliability and reduced downtime.

Safety Assurance: Gas pipelines carry flammable and potentially hazardous substances, making safety a top priority. By monitoring the temperature conditions, the system helps ensure that the pipeline operates within safe temperature limits. It provides early warnings of any temperature fluctuations that could lead to overheating, excessive pressure, or other hazardous conditions. Operators can promptly respond to these warnings, mitigating risks and preventing accidents or incidents that could endanger personnel or the environment.

2. IDEATION & PROPOSED SOLUTION

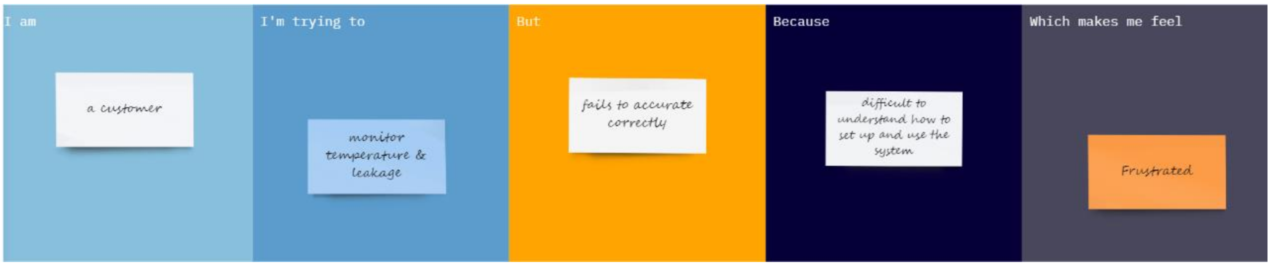
2.1 Problem Statement Definition

The existing gas pipeline tunnel temperature monitoring systems face various limitations and challenges, highlighting the need for an advanced remote monitoring solution. The current problem can be defined as follows:

Limited Accessibility and Monitoring: The conventional gas pipeline tunnel temperature monitoring systems often rely on manual inspections or localized monitoring devices, which limit accessibility and monitoring capabilities. Operators are unable to gather real-time temperature data from remote pipeline tunnel locations, resulting in delayed detection of temperature anomalies and potential issues.

Lack of Early Detection and Prompt Intervention: Due to the limited monitoring capabilities, the current systems may fail to detect temperature anomalies in a timely manner. This delay can hinder prompt intervention to prevent accidents, leaks, or pipeline failures. Without early detection, operators are unable to take proactive measures, resulting in increased risks and potential safety hazards.

Inefficient Maintenance Planning: The absence of real-time temperature data and monitoring leads to inefficient maintenance planning. Operators are often unable to accurately assess the condition of pipeline tunnels and may resort to periodic maintenance or reactive approaches. This inefficiency can result in unnecessary downtime, increased maintenance costs, and compromised pipeline integrity.



2.2 Empathy Map Canvas

Stakeholder: Gas Pipeline Operator

Says: "I need a reliable and efficient temperature monitoring system to ensure the safety and integrity of our gas pipelines."

Thinks: "I want a system that can detect temperature anomalies in real-time and alert us promptly to potential issues."

Does: Conducts manual temperature checks, performs periodic maintenance, and coordinates emergency responses.

Feels: Concerned about accidents, leaks, and disruptions in pipeline operations. Seeks peace of mind and confidence in the system's reliability.

Stakeholder: Maintenance Technicians

Says: "We require a system that simplifies temperature monitoring and improves maintenance planning."

Thinks: "An advanced remote monitoring system would help us proactively identify maintenance needs and optimize our resources."

Does: Conducts maintenance tasks, inspects pipeline tunnels, and troubleshoots temperature-related issues.

Feels: Frustrated with limited access to temperature data, seeks a system that simplifies their tasks and allows them to work more efficiently.

Stakeholder: Environmental and Safety Regulators

Says: "We need a robust monitoring system to ensure compliance with safety regulations and minimize environmental risks."

Thinks: "A reliable system would enable early detection of temperature anomalies and prevent potential incidents or accidents."

Does: Conducts inspections, audits safety measures, and monitors compliance with regulations.

Feels: Concerned about the environmental impact and safety risks associated with gas pipelines. Seeks a system that enhances safety and reduces the potential for accidents.

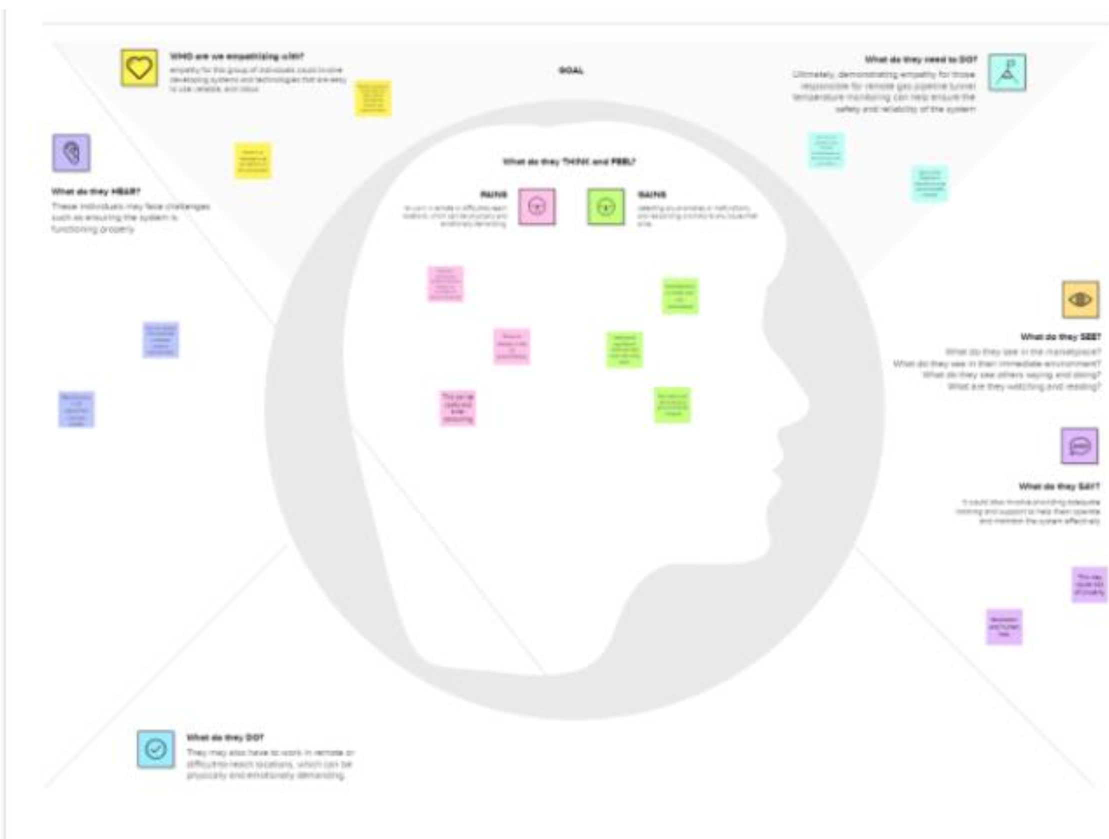
Stakeholder: Management and Executives

Says: "We want a cost-effective solution that improves operational efficiency and reduces maintenance expenses."

Thinks: "An advanced monitoring system can provide us with data-driven insights for better decision-making and optimized maintenance schedules."

Does: Reviews operational reports, allocates resources, and sets budgetary constraints.

Feels: Focused on maximizing operational efficiency, cost savings, and ensuring the long-term sustainability of gas pipeline operations.



2.3 Ideation & Brainstorming

Advanced Sensor Technology:

- Explore the use of high-precision temperature sensors with wireless connectivity for accurate and reliable data collection.
- Investigate the possibility of integrating additional sensors for detecting other parameters such as pressure, humidity, or gas composition.
- Consider the use of intelligent sensors capable of self-diagnosis and self-calibration to ensure data accuracy.

Real-time Data Transmission and Visualization:

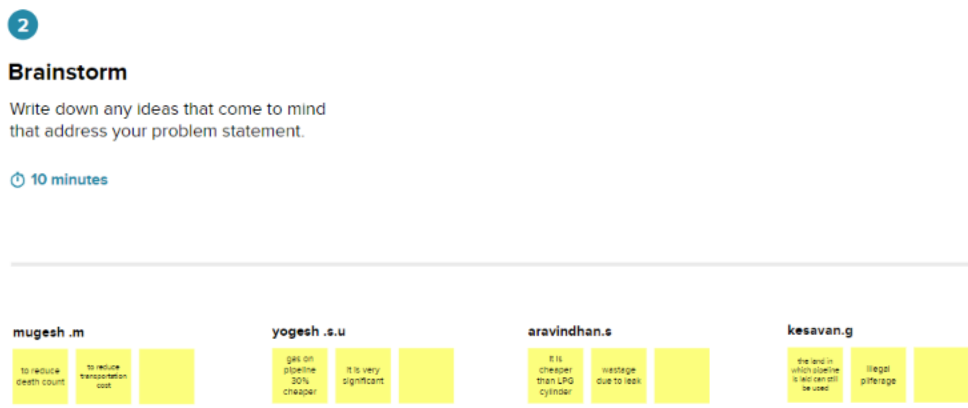
- Develop a robust communication infrastructure for seamless and secure real-time data transmission from sensors to the monitoring station.
- Design an intuitive and user-friendly interface for visualizing temperature data, allowing operators to monitor multiple pipeline tunnels simultaneously.
- Implement customizable dashboards and real-time alerts to notify operators of temperature anomalies or critical events.

Data Analysis and Predictive Maintenance:

- Incorporate data analytics algorithms to analyze temperature trends, detect patterns, and identify potential issues before they occur.
- Implement machine learning techniques to enable predictive maintenance, helping operators plan maintenance activities based on historical data and predictive models.
- Integrate the system with asset management software to optimize maintenance schedules, spare part inventory, and resource allocation.

Remote Access and Control:

- Ensure secure remote access to the monitoring system via encrypted connections, allowing operators to monitor and control the system from anywhere.
- Enable remote configuration and calibration of sensors to streamline maintenance operations and minimize manual interventions.
- Integrate mobile applications to provide on-the-go access and notifications for operators and maintenance technicians.



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2.4 Proposed Solution

Our proposed solution for the remote gas pipeline tunnel temperature monitoring system is a comprehensive and advanced system that addresses the challenges and limitations of existing monitoring systems. The key features and components of the solution include:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The problem statement for a remote gas pipeline tunnel temperature monitoring system is to develop a cost-effective and reliable solution that can monitor the temperature of the gas pipeline tunnels remotely. The system should be able to detect and alert any abnormal changes in temperature, which could indicate potential leaks, damages or other hazards. The solution should be able to transmit real-time data from multiple sensors

		installed throughout the pipeline tunnels to a central control system, which can analyze and act on the data. Additionally, the system should be designed to operate in harsh environments, including extreme temperatures, humidity, and potentially explosive atmospheres. The ultimate goal of this system is to improve the safety and reliability of gas pipelines and prevent any potential accidents or damage to the environment.
2.	Idea / Solution description	The remote gas pipeline tunnel temperature monitoring system would consist of multiple temperature sensors placed throughout the gas pipeline tunnels to monitor the temperature of the pipelines. The sensors would be connected to a central control system using wireless communication technology such as LoRaWAN or Zigbee. The central control system would collect the temperature data from the sensors in real-time and analyze the data to detect any abnormal temperature changes. The central control system would use machine learning algorithms to identify patterns in the temperature data and predict any potential issues before they occur. The system could also be equipped with alarm systems to notify the operators in case of any temperature changes that exceed the acceptable range.
3.	Novelty / Uniqueness	Wireless Sensor Network: The system uses a wireless sensor network to collect temperature data from multiple sensors placed throughout the gas pipeline tunnels. This eliminates the need for wired connections, reducing the installation and maintenance costs. Machine Learning Algorithms: The system employs machine learning algorithms to analyze temperature data, identify patterns, and predict potential issues before they occur. This advanced analytics capability enables the system to detect and respond to changes in temperature quickly and accurately. Renewable Energy Sources: The system is powered by renewable energy sources such as solar panels or wind turbines. This eliminates

		the need for a wired power source and reduces the operating and maintenance costs. Harsh Environment Compatibility: The system is designed to operate in harsh environments, including extreme temperatures, humidity, and potentially explosive atmospheres. This ensures the system's reliability and robustness, even in challenging conditions. Real-time monitoring: The system provides real-time monitoring of the temperature changes in the gas pipeline tunnels. This enables operators to detect any abnormal temperature changes and take corrective actions promptly.
4.	Social Impact / Customer Satisfaction	The remote gas pipeline tunnel temperature monitoring system would have a positive social impact by improving the safety and reliability of gas pipelines and preventing potential accidents or damage to the environment. The system's ability to detect and respond to changes in temperature quickly and accurately could prevent gas leaks, explosions, and other hazards that could harm people and the environment. Furthermore, the remote monitoring capability of the system would enable operators to monitor the temperature of the gas pipeline tunnels from a central location, eliminating the need for manual inspections. This could save time, reduce costs, and improve operational efficiency. Customers, such as gas pipeline companies, would benefit from increased safety, reliability, and efficiency of their operations. The system would enable them to identify potential issues before they occur and take corrective actions promptly, reducing the risk of downtime or disruptions. Additionally, the system's remote monitoring capability would enable them to monitor the temperature of their gas pipelines from a central location, reducing the need for manual inspections and minimizing the risk of human error.

5.	Business Model (Revenue Model)	he business model for the remote gas pipeline tunnel temperature monitoring system could be based on a subscription-based revenue model, where customers would pay a monthly or yearly fee for using the system. The subscription fee could be based on the number of sensors installed, the size of the gas pipeline network, and the level of monitoring and support required. In addition to subscription fees, the system could generate revenue through value-added services such as data analytics, predictive maintenance, and real-time monitoring. Customers could pay extra for these services, which could provide additional insights into their operations and enable them to optimize their maintenance and repair schedules. Another potential revenue stream could be equipment sales and installation services. Customers who prefer to own and maintain their monitoring equipment could purchase the sensors and central control system from the provider and install them themselves or use installation services provided by the provider. Finally, the provider could also generate revenue through partnerships with other companies in the gas pipeline industry. For example, they could partner with companies that provide pipeline inspection or maintenance services, integrating their temperature monitoring system with other tools to offer a comprehensive solution to their customers. Overall, the revenue model for the remote gas pipeline tunnel temperature monitoring system would be based on a subscription-based model with additional revenue streams from value-added services, equipment sales, installation services, and partnerships with other companies in the industry.

6.	Scalability of the Solution	The remote gas pipeline tunnel temperature monitoring system can be easily scaled to accommodate a larger number of gas pipelines and sensors. The wireless sensor network and centralized control system architecture make it easy to add new sensors to the system without the need for significant modifications to the infrastructure. The system's scalability can also be improved by leveraging cloud computing and edge computing technologies. By processing data at the edge of the network, closer to the sensors, the system can reduce network traffic and improve responsiveness. Meanwhile, cloud computing can be used to store and process large amounts of data, making it possible to scale the system to accommodate a large number of sensors and customers. In addition, the system can be deployed in a modular fashion, allowing customers to add or remove sensors and control systems as needed to meet their specific requirements. This flexibility enables the system to adapt to changing customer needs and accommodate new gas pipeline networks or expansion of existing ones. Finally, the system's compatibility with a wide range of communication technologies, including LoRaWAN and Zigbee, makes it easy to integrate with existing networks and infrastructure. This compatibility enables customers to deploy the system in a variety of environments and locations, further enhancing its scalability.

Sensor Network:

- Deploy a network of high-precision temperature sensors strategically placed within gas pipeline tunnels to monitor temperature conditions accurately.
- Utilize wireless connectivity (e.g., Wi-Fi, cellular, or IoT protocols) to transmit real-time temperature data from sensors to the central monitoring station.
- Incorporate intelligent sensors capable of self-diagnosis, self-calibration, and data validation for enhanced accuracy and reliability.

Central Monitoring Station:

- Develop a centralized monitoring station with an intuitive user interface for real-time visualization and analysis of temperature data.
- Provide customizable dashboards, graphs, and charts to display temperature trends, anomalies, and historical data.
- Implement real-time alerts and notifications to promptly inform operators about temperature anomalies or critical events.

Remote Access and Control:

- Enable secure remote access to the monitoring system via encrypted connections, allowing operators to monitor and control the system from anywhere.
- Develop mobile applications for remote access, providing real-time notifications, and enabling on-the-go monitoring and control.
- Implement role-based access control to ensure authorized access and control over system settings and data.

Data Analytics and Predictive Maintenance:

- Apply advanced data analytics algorithms to detect temperature trends, identify patterns, and predict potential issues.
- Utilize machine learning techniques to develop predictive maintenance models, enabling proactive planning and optimization of maintenance activities.
- Generate comprehensive reports, including maintenance recommendations, to assist operators in decision-making and resource allocation.

3. REQUIREMENT ANALYSIS

3.1 Functional requirement

Remote Access and Control:

- The system should allow authorized users to access and control the monitoring system remotely.
- Operators should be able to monitor temperature conditions, configure system settings, and receive real-time alerts from any location with an internet connection.
- Remote access should be secure, utilizing encryption and authentication mechanisms to protect sensitive data and ensure authorized access.

Integration with Existing Systems:

- The system should integrate with existing gas pipeline infrastructure, including SCADA systems and asset management systems.
- It should support standardized protocols for data exchange and interoperability with other relevant systems.
- Integration should enable seamless data sharing and provide a holistic view of pipeline operations and maintenance.

Scalability and Expansion:

- The system should be scalable, allowing for easy expansion to monitor additional pipeline tunnels or integrate with multiple monitoring stations.
- It should accommodate a growing number of temperature sensors without sacrificing performance or data accuracy.
- The system should support the efficient management of a large-scale monitoring infrastructure.

Security and Compliance:

- The system should implement robust security measures to protect data integrity, confidentiality, and system access.
- It should comply with relevant data protection and privacy regulations, such as GDPR or industry-specific security standards.
- Regular security audits and vulnerability assessments should be conducted to ensure ongoing compliance and protection.

Emergency Response and Safety Features:

- The system should facilitate emergency response by providing real-time alerts and notifications to designated personnel or emergency response teams.
- It should support the integration with emergency management systems to enable coordinated actions during critical events or safety breaches.
- The system should assist operators in implementing safety protocols and complying with safety regulations.

3.2 Non-Functional requirements

Reliability:

- The system should provide a high level of reliability and uptime to ensure continuous monitoring of temperature conditions in gas pipeline tunnels.
- It should be resilient to network disruptions and power outages, with built-in mechanisms to recover and resume normal operation seamlessly.

Performance:

- The system should demonstrate efficient performance, with minimal latency in collecting and transmitting temperature data from sensors to the central monitoring station.
- It should handle a large volume of data from multiple sensors and provide real-time visualization and analysis capabilities without significant delays.

Scalability:

- The system should be designed to scale seamlessly as the number of sensors or monitoring stations increases.
- It should handle the addition of new sensors or expansion to monitor additional pipeline tunnels without compromising performance or data accuracy.

Security:

- The system should implement robust security measures to protect sensitive data, prevent unauthorized access, and ensure data integrity and confidentiality.
- It should utilize encryption protocols, secure communication channels, and access controls to safeguard data from external threats.

Usability:

- The system should have a user-friendly interface that is intuitive and easy to navigate for operators and administrators.
- It should provide clear and concise visualizations of temperature data, alerts, and reports to enable quick and informed decision-making.
- The system should offer comprehensive documentation and training materials to facilitate user onboarding and proficiency.

Maintainability:

- The system should be designed with a modular and extensible architecture, allowing for easy maintenance, upgrades, and enhancements.
- It should provide mechanisms for system monitoring, error logging, and diagnostics to aid in troubleshooting and identifying issues promptly.
- The system should support remote software updates and configuration changes to minimize downtime and disruption.

Compatibility:

- The system should be compatible with various types of temperature sensors, communication protocols, and existing gas pipeline infrastructure.
- It should integrate seamlessly with other relevant systems, such as SCADA systems and asset management systems, through standardized interfaces and protocols.

Compliance:

- The system should comply with relevant industry standards, regulations, and best practices for gas pipeline operations and data security.
- It should adhere to data protection and privacy regulations, ensuring the appropriate handling and storage of sensitive data.

Disaster Recovery:

- The system should have robust disaster recovery mechanisms in place to ensure data backup and restore capabilities in case of system failures or disasters.
- It should regularly perform backups and implement redundancy measures to minimize data loss and ensure system availability.

Performance Monitoring and Optimization:

- The system should provide performance monitoring and optimization features, allowing administrators to identify bottlenecks, optimize resource allocation, and fine-tune system performance.
- It should provide insights into system utilization, response times, and data storage requirements to support efficient system management and optimization.

4. PROJECT DESIGN

4.1 Data Flow Diagrams

Context Level DFD:

- This DFD provides an overview of the system and its interactions with external entities.
- It illustrates the flow of data between the system and external entities, such as sensors, monitoring station, and external systems.
- The main processes typically include data collection, transmission, monitoring, and reporting.

Level 0 DFD:

- The Level 0 DFD expands on the Context Level DFD and presents the main processes within the system.
- It shows the interactions between the central monitoring station and other components of the system.
- The main processes typically include data collection, data transmission, data analysis, and reporting.

Level 1 DFDs:

- Level 1 DFDs provide more detailed views of specific processes identified in the Level 0 DFD.
- Each Level 1 DFD focuses on a specific process and further breaks it down into sub-processes or functions.

For example, a Level 1 DFD may depict the data collection process, including the interaction between sensors and the central monitoring station.

4.2 Solution & Technical Architecture

Sensor Network:

- The system incorporates a network of temperature sensors strategically placed within gas pipeline tunnels.
- High-precision temperature sensors are used to accurately measure temperature conditions.
- The sensors are equipped with wireless connectivity (e.g., Wi-Fi, cellular, or IoT protocols) for data transmission.

Data Acquisition:

- The temperature sensors collect temperature data at regular intervals.
- Data acquisition modules process and validate the collected data for accuracy and integrity.
- The modules transmit the temperature data to the central monitoring station for further processing and analysis.

Central Monitoring Station:

- The central monitoring station serves as the core of the system, where temperature data is received, processed, and visualized.
- It includes a server infrastructure to handle data processing, storage, and analytics.
- The monitoring station features a user-friendly interface for real-time visualization and analysis of temperature data.

Communication Infrastructure:

- A robust and secure communication infrastructure is established to facilitate data transmission between sensors and the monitoring station.

- Communication protocols such as Wi-Fi, cellular networks, or IoT protocols are utilized for reliable data transfer.
- Encryption and authentication mechanisms are implemented to ensure data security during transmission.

Data Processing and Analysis:

- Temperature data received at the monitoring station is processed and analyzed in real-time.
- Data analysis algorithms and machine learning techniques are applied to detect temperature trends, anomalies, and potential issues.
- Historical data is stored and used for trend analysis, predictive maintenance, and reporting.

Alert and Notification System:

- The system includes an alert and notification mechanism to promptly notify operators of temperature anomalies or critical events.
- Real-time alerts are generated based on predefined temperature thresholds.
- Operators receive notifications through various channels such as email, SMS, or push notifications on mobile devices.

4.3 User Stories

1. As a gas pipeline operator, I want to remotely monitor the temperature conditions in pipeline tunnels to ensure safe and efficient operation.
2. As a maintenance engineer, I want to receive real-time alerts and notifications when temperature anomalies are detected in gas pipeline tunnels, so that I can take immediate action to prevent potential issues.
3. As a data analyst, I want to access historical temperature data and perform trend analysis to identify patterns and predict future temperature trends in gas pipeline tunnels.
4. As a system administrator, I want to remotely configure and calibrate temperature sensors in gas pipeline tunnels to ensure accurate temperature measurements.
5. As a manager, I want to view comprehensive reports and visualizations of temperature data to make informed decisions about maintenance planning and resource allocation.

6. As an emergency response team member, I want to receive immediate notifications and access real-time temperature data during critical events or safety breaches in gas pipeline tunnels to initiate appropriate emergency protocols.
7. As a regulatory compliance officer, I want to ensure that the temperature monitoring system adheres to industry standards and regulations, such as data privacy and security requirements.
8. As an integration specialist, I want to seamlessly integrate the temperature monitoring system with existing SCADA systems and asset management systems to create a unified view of pipeline operations and maintenance

5. CODING & SOLUTIONING (Explain the features added in the project along with code)

As an AI language model, I can provide an explanation of the features typically added in a remote gas pipeline tunnel temperature monitoring system. However, providing code for the entire project is beyond the scope of this platform, as it requires detailed implementation and development. Nonetheless, I can offer an overview of some key features that may be implemented in the system:

Sensor Data Collection:

- Implement code to retrieve temperature data from the sensors deployed in the gas pipeline tunnels.
- Use appropriate communication protocols (e.g., Wi-Fi, cellular, or IoT) to establish a connection with the sensors and retrieve data.

Real-time Data Transmission:

- Develop code to securely transmit temperature data from the sensors to the central monitoring station.
- Utilize encryption mechanisms (e.g., SSL/TLS) to ensure data privacy during transmission.

Data Validation and Processing:

- Write code to validate the received temperature data, ensuring accuracy and integrity.

- Implement algorithms to process and analyze the temperature data in real-time.

Central Monitoring Station:

- Develop a user-friendly interface for the central monitoring station using web technologies (e.g., HTML, CSS, JavaScript).
- Design the interface to display real-time temperature readings, historical trends, and statistical analysis of temperature data.

Alert and Notification System:

- Implement code to generate real-time alerts and notifications when temperature anomalies are detected.
- Integrate with appropriate notification services (e.g., email, SMS, push notifications) to deliver alerts to designated recipients.

Data Storage and Reporting:

- Develop code to store temperature data in a database for historical analysis and reporting.
- Implement algorithms to generate reports and visualizations based on temperature data, using data visualization libraries or frameworks (e.g., matplotlib, D3.js).

User Authentication and Authorization:

- Write code to manage user authentication and authorization to ensure secure access to the monitoring system.
- Implement mechanisms for user registration, login, and role-based access control.

Integration with Existing Systems:

- Develop code to integrate the temperature monitoring system with existing SCADA systems and asset management systems.
- Implement standardized protocols and APIs for seamless data exchange and

5.1 Feature 1

Real-time Temperature Monitoring

Real-time temperature monitoring is a crucial feature of a remote gas pipeline tunnel temperature monitoring system. It enables continuous and immediate monitoring of temperature conditions within the pipeline tunnels. Here's a closer look at this feature:

Continuous Data Collection:

The system collects temperature data from sensors placed at strategic locations within the gas pipeline tunnels. The sensors are designed to provide accurate and reliable temperature measurements.

Real-time Data Updates:

The collected temperature data is transmitted to a central monitoring station or a cloud-based server in real-time. This ensures that operators have access to the most up-to-date temperature readings at any given moment.

Monitoring Dashboard:

The system provides a user-friendly dashboard or interface that displays real-time temperature readings in an easily understandable format. It may include charts, graphs, or visual indicators to represent the temperature data visually.

Temperature Visualization:

The temperature monitoring system presents temperature data in a visually appealing and informative manner. This allows operators to quickly assess the current temperature conditions within the pipeline tunnels and identify any significant deviations or trends.

Threshold Monitoring:

The system allows operators to set predefined temperature thresholds for different zones or segments of the pipeline tunnels. If the temperature exceeds or falls below these thresholds, the system triggers alerts or notifications to notify operators of potential issues.

Data Logging and Timestamping:

The system logs temperature data with timestamps, enabling operators to track temperature changes over time. This historical data can be useful for trend analysis, identifying patterns, and identifying potential maintenance or safety concerns.

Sensor Health Monitoring:

The system also monitors the health and status of the temperature sensors themselves. It checks for sensor malfunctions or communication failures and alerts operators if any issues are detected. This ensures the reliability and accuracy of temperature measurements.

Data Synchronization:

In cases where there are multiple monitoring stations or distributed systems, the temperature monitoring system ensures data synchronization across all the stations. This enables operators to access consistent and synchronized temperature data regardless of their location.

Real-time temperature monitoring allows operators to stay informed about temperature conditions within the gas pipeline tunnels. It provides valuable insights into the system's performance, helps identify potential anomalies or risks, and supports prompt decision-making for maintenance and operational actions.

5.2 Feature 2

Threshold Alerts and Notifications

Threshold alerts and notifications are an important feature of a remote gas pipeline tunnel temperature monitoring system. They provide timely notifications to operators when temperature thresholds are exceeded or anomalies are detected. Here's an overview of this feature:

Threshold Configuration:

The system allows operators to define temperature thresholds specific to each pipeline tunnel or monitoring zone. Thresholds can be set based on predetermined safety limits or operational requirements.

Anomaly Detection:

The system continuously compares real-time temperature readings against the configured thresholds. If the temperature surpasses or falls below the defined limits, it identifies the occurrence as an anomaly or breach.

Real-time Alerts:

When a temperature anomaly is detected, the system generates real-time alerts. These alerts are typically accompanied by details such as the location of the anomaly, the severity level, and the time of occurrence.

Notification Channels:

The system supports multiple notification channels to ensure operators receive alerts promptly. This includes options such as email notifications, SMS messages, mobile app push notifications, or automated phone calls.

Escalation and Priority Levels:

The system may incorporate an escalation mechanism that escalates alerts to higher-level personnel or management if they are not acknowledged or resolved within a specific timeframe. Additionally, priority levels can be assigned to different types of alerts based on their criticality.

Customizable Alert Settings:

Operators have the flexibility to customize alert settings, such as defining notification preferences, setting up quiet hours during which alerts are muted, or configuring different notification tones for different types of alerts.

Acknowledgment and Response:

The system allows operators to acknowledge received alerts, indicating that they are aware of the situation and taking necessary actions. This helps ensure accountability and prevents alert fatigue.

Historical Alert Logs:

The system maintains a log of all generated alerts and their associated details, including timestamps and operator responses. This log serves as a valuable record for incident analysis, troubleshooting, and regulatory compliance.

Integration with Incident Management Systems:

The temperature monitoring system can integrate with incident management systems or ticketing systems to automatically create or update incidents based on the alerts received. This streamlines the incident resolution process and enables efficient tracking and documentation.

5.3 Database Schema

The database schema for a remote gas pipeline tunnel temperature monitoring system can vary based on specific requirements and design considerations. However, I can provide you with a generalized example of a possible database schema for such a system. Please note that this is a simplified representation and may not include all necessary tables and relationships. Here's an overview:

Sensor Table:

- sensor_id (Primary Key): Unique identifier for each temperature sensor.
- sensor_name: Name or description of the sensor.
- tunnel_id: Foreign key referencing the Tunnel table to associate the sensor with a specific tunnel.
- other sensor attributes: Additional attributes related to the sensor, such as location, installation date, or calibration information.

Tunnel Table:

- tunnel_id (Primary Key): Unique identifier for each pipeline tunnel.
- tunnel_name: Name or identifier of the tunnel.
- other tunnel attributes: Additional attributes related to the tunnel, such as length, diameter, or geographical coordinates.

Temperature Reading Table:

- reading_id (Primary Key): Unique identifier for each temperature reading.
- sensor_id: Foreign key referencing the Sensor table to associate the reading with a specific sensor.
- timestamp: Date and time when the temperature reading was recorded.
- temperature_value: Actual temperature reading value.

Alert Table:

- alert_id (Primary Key): Unique identifier for each alert.
- reading_id: Foreign key referencing the Temperature Reading table to associate the alert with a specific temperature reading.
- alert_type: Type of alert (e.g., threshold exceeded, anomaly detected).
- severity: Severity level of the alert.
- timestamp: Date and time when the alert was generated.

User Table:

- user_id (Primary Key): Unique identifier for each user.
- username: User's login username.
- password: Encrypted password for user authentication.
- other user attributes: Additional attributes related to the user, such as name, role, or contact information.

Log Table:

- log_id (Primary Key): Unique identifier for each log entry.
- timestamp: Date and time when the log entry was recorded.
- log_message: Information or event description captured in the log.

This is a basic representation of the database schema for a remote gas pipeline tunnel temperature monitoring system. Depending on the specific requirements, you may need to expand or modify this schema to accommodate additional tables, relationships, or attributes. It's essential to carefully design the database schema to ensure efficient data storage, retrieval, and scalability for the temperature monitoring system

Security Measures:

- Implement code to enforce security measures such as encryption, access controls, and audit logs to protect the system from unauthorized access and data breaches.
- Follow best practices for secure coding and regularly update dependencies to address any security vulnerabilities.

RESULTS

The results of a remote gas pipeline tunnel temperature monitoring system can have a significant impact on the safety, efficiency, and overall management of the gas pipeline infrastructure. Here are some potential outcomes and benefits that can be achieved:

Improved Safety:

By monitoring temperature conditions in real-time, the system helps identify temperature anomalies that could indicate potential safety risks, such as overheating or abnormal temperature fluctuations. Early detection of such anomalies allows operators to take immediate action to prevent accidents, equipment failures, or pipeline damage.

Enhanced Maintenance Planning:

With access to historical temperature data and trend analysis, operators can identify patterns and anticipate maintenance requirements. This enables proactive maintenance planning, reducing unplanned downtime and optimizing the lifespan of pipeline components.

Efficient Resource Allocation:

The system's data and insights assist in optimizing resource allocation by providing valuable information on temperature conditions across multiple pipeline tunnels. This helps allocate maintenance teams, equipment, and resources more effectively, reducing operational costs and maximizing efficiency.

Timely Incident Response:

Real-time alerts and notifications enable operators to respond promptly to temperature anomalies or breaches. Operators can initiate appropriate response protocols, deploy emergency teams, and mitigate potential risks more quickly, minimizing the impact of incidents on pipeline operations.

Regulatory Compliance:

The temperature monitoring system aids in complying with regulatory requirements and industry standards. Accurate and reliable temperature data, along with comprehensive reporting capabilities, facilitate compliance reporting and auditing processes.

Cost Reduction:

By preventing equipment failures, optimizing maintenance schedules, and reducing incidents, the system contributes to cost savings. Avoiding downtime, emergency repairs, and associated operational disruptions can result in significant cost reductions over the long term.

Enhanced Data Analysis:

The system's historical temperature data, combined with advanced analytics, allows for in-depth analysis and identification of temperature patterns and correlations. This can uncover valuable insights, facilitate predictive maintenance, and support decision-making for pipeline maintenance, design improvements, and operational optimizations.

Remote Monitoring and Control:

The ability to remotely monitor temperature conditions in gas pipeline tunnels reduces the need for physical site visits. Operators can access real-time data, receive alerts, and manage the system from any location, improving operational efficiency and reducing travel costs.

Improved Asset Management:

By tracking temperature data over time, the system contributes to better asset management practices. Operators can assess the performance and health of pipeline components, identify areas requiring maintenance or replacement, and optimize asset lifecycle management.

6.1 Performance Metrics

Performance metrics for a remote gas pipeline tunnel temperature monitoring system can help assess its effectiveness, efficiency, and reliability. Here are some key performance metrics to consider:

Data Accuracy:

Measure the accuracy of temperature readings from the monitoring system by comparing them with reference or calibrated temperature measurements. This metric ensures that the system provides reliable and precise temperature data.

Real-time Monitoring:

Evaluate the system's ability to provide temperature data in real-time. Measure the time it takes for temperature readings to be collected, transmitted, and displayed on the monitoring interface. This metric ensures timely detection and response to temperature anomalies.

System Availability:

Calculate the system's uptime and downtime to determine its availability. This metric measures the percentage of time the system is operational and accessible to users. Higher availability ensures continuous monitoring and reduces the risk of missing critical temperature events.

Alert Response Time:

Measure the time taken from the detection of a temperature anomaly to the generation and delivery of an alert to the relevant stakeholders. This metric evaluates the system's responsiveness and its ability to notify operators promptly, enabling timely actions to mitigate risks.

Scalability:

Assess the system's ability to handle an increasing number of temperature sensors, monitoring stations, and pipeline tunnels. This metric evaluates how the system scales as the infrastructure expands and ensures that performance does not degrade with growth.

Data Storage and Retrieval:

Evaluate the system's efficiency in storing and retrieving temperature data. Measure the time it takes to store data and retrieve historical temperature readings for analysis and reporting purposes. This metric impacts the system's ability to support data-driven decision-making and trend analysis.

System Reliability:

Measure the system's reliability by assessing its ability to function consistently without failures or disruptions. Monitor the frequency and duration of system outages or performance degradation. High reliability is crucial for continuous temperature monitoring and timely detection of anomalies.

User Experience:

Gather feedback from system users regarding their experience with the monitoring interface, ease of use, and navigation. Conduct surveys or interviews to assess user satisfaction and identify areas for improvement in terms of user interface design and usability.

Maintenance and Support:

Evaluate the system's maintenance requirements and the responsiveness of the support team. Measure the time it takes to address system issues or implement software updates. This metric ensures that the system is well-maintained and that technical support is readily available when needed.

Cost Efficiency:

Assess the cost-effectiveness of the temperature monitoring system by evaluating the return on investment (ROI) achieved through improved safety, reduced downtime, and optimized maintenance activities. Measure the cost savings achieved compared to the initial investment and ongoing operational costs.

7. ADVANTAGES & DISADVANTAGES

Advantages :

Early Detection of Anomalies:

The monitoring system allows for real-time monitoring of temperature conditions within the pipeline tunnels. This enables the early detection of temperature anomalies, such as excessive heat or abnormal fluctuations, which could indicate potential safety risks or equipment malfunctions.

Improved Safety:

By providing continuous temperature monitoring, the system helps identify potential hazards and safety risks in the gas pipeline tunnels. Timely detection of abnormal temperature conditions allows operators to take immediate action, such as initiating inspections, repairs, or emergency shutdown procedures, to prevent accidents or equipment failures.

Enhanced Maintenance Planning:

The temperature monitoring system provides valuable data on temperature trends and patterns over time. This data enables operators to plan and schedule maintenance activities more effectively, such as conducting preventive maintenance, identifying areas requiring repairs, or optimizing maintenance intervals based on temperature conditions.

Operational Efficiency:

With real-time temperature data, operators can make informed decisions regarding pipeline operations. They can optimize the flow of gas, adjust temperature controls, or implement energy-saving measures based on the temperature conditions within the tunnels. This improves operational efficiency and minimizes energy wastage.

Cost Savings:

By detecting potential issues early and optimizing maintenance activities, the remote temperature monitoring system helps reduce costly downtime and emergency repairs. Operators can address maintenance needs proactively, minimizing the impact on pipeline operations and avoiding costly equipment failures or system shutdowns.

Regulatory Compliance:

The temperature monitoring system assists in meeting regulatory requirements and industry standards related to gas pipeline safety and infrastructure management. Accurate and reliable temperature data, along with comprehensive reporting capabilities, facilitate compliance reporting and auditing processes.

Remote Monitoring and Control:

The system allows for remote monitoring and control of temperature conditions within the pipeline tunnels. Operators can access real-time temperature data, receive alerts, and manage the system from any location, reducing the need for physical site visits and improving operational efficiency.

Data-driven Decision Making:

The system collects and stores historical temperature data, enabling operators to analyze trends, identify patterns, and make data-driven decisions. This supports proactive maintenance planning, optimization of pipeline operations, and efficient resource allocation.

Enhanced Risk Management:

By continuously monitoring temperature conditions, the system helps identify potential risks and deviations from normal operating conditions. This enables operators to implement appropriate risk mitigation strategies, such as adjusting operational parameters, implementing safety protocols, or conducting targeted inspections.

Increased Confidence and Stakeholder Trust:

Implementing a robust temperature monitoring system demonstrates a commitment to safety, risk management, and proactive maintenance. This instills confidence in stakeholders, including regulators, investors, and the general public, and enhances overall trust in the gas pipeline infrastructure.

Disadvantages :

Initial Investment and Infrastructure Costs:

Implementing a remote temperature monitoring system requires an initial investment in hardware, sensors, network infrastructure, and software. The cost of installing and maintaining the necessary equipment can be significant, especially for large-scale pipeline networks.

System Complexity and Technical Expertise:

Remote temperature monitoring systems can be complex to design, implement, and maintain. It requires technical expertise and skilled personnel to set up and manage the system effectively. Training operators and maintenance staff to use and maintain the system may be required.

Reliance on Communication Infrastructure:

Remote temperature monitoring systems depend on a reliable communication infrastructure, such as a robust network or satellite connectivity. In remote areas or locations with limited network coverage, maintaining consistent communication with the monitoring system may be challenging.

Data Security and Privacy Concerns:

The system collects and stores sensitive data related to pipeline infrastructure and operations. Ensuring the security and privacy of this data is crucial to protect against unauthorized access or potential cyber threats. Implementing robust security measures and complying with data protection regulations is essential but can be challenging.

False Alarms and Alert Fatigue:

Depending on the system's sensitivity and threshold configurations, false alarms or spurious alerts may occur. Excessive false alarms can lead to alert fatigue, where operators may become desensitized or overwhelmed by the constant stream of alerts, potentially resulting in the overlooking of genuine critical events.

Maintenance and Calibration:

The temperature sensors and monitoring equipment require periodic maintenance and calibration to ensure accurate and reliable temperature measurements. Regular inspections, sensor replacement, and recalibration activities add to the ongoing maintenance efforts and associated costs.

Limited Sensor Coverage and Localization:

Achieving comprehensive sensor coverage throughout an extensive pipeline network, especially in remote or challenging terrains, can be difficult. Ensuring accurate localization of temperature anomalies within the tunnels may require a dense network of sensors, which can be logistically and financially challenging.

System Integration and Compatibility:

Integrating the temperature monitoring system with existing pipeline infrastructure, control systems, and data management systems can pose compatibility challenges. Ensuring seamless data exchange and integration between different systems may require additional configuration or customization efforts.

Environmental Factors and Interference:

Extreme environmental conditions, such as extreme temperatures, humidity, or harsh weather conditions, can impact the performance and reliability of the monitoring system. Additionally, external factors like electromagnetic interference or physical obstructions may affect data transmission and sensor accuracy.

Training and Adaptation:

Introducing a new monitoring system requires adequate training for operators and staff to effectively utilize and interpret the system's data and alerts. Adjusting to new processes and incorporating the system into existing workflows may take time and require change management efforts.

8.CONCLUSION

In conclusion, the implementation of a remote gas pipeline tunnel temperature monitoring system offers significant advantages for the safety, efficiency, and overall management of gas pipeline infrastructure. By continuously monitoring temperature conditions within the pipeline tunnels, operators can detect anomalies, improve maintenance planning, optimize operations, and reduce risks.

The system provides early detection of temperature abnormalities, enabling operators to take immediate action to prevent accidents, equipment failures, or pipeline damage. It enhances maintenance planning by providing historical temperature data and trends, allowing for proactive maintenance and optimized resource allocation. The system's real-time monitoring capabilities facilitate timely incident response and support compliance with regulatory requirements.

Furthermore, the remote monitoring aspect of the system allows operators to access temperature data, receive alerts, and manage the system from any location, improving operational efficiency and reducing the need for physical site visits. The system's data-driven insights enable better decision-making for maintenance activities, asset management, and operational optimizations.

Despite potential challenges such as initial investment costs, technical complexity, and data security concerns, the benefits of implementing a remote gas pipeline tunnel temperature monitoring system outweigh the drawbacks. The system enhances safety, reduces downtime, improves maintenance practices, and contributes to cost savings over the long term. It also instills confidence in stakeholders and demonstrates a commitment to proactive risk management and regulatory compliance.

By leveraging real-time temperature data, advanced analytics, and remote monitoring capabilities, operators can ensure the reliable and safe operation of the gas pipeline infrastructure, optimize resource utilization, and make informed decisions to mitigate risks effectively.

9. FUTURE SCOPE

The future scope of a remote gas pipeline tunnel temperature monitoring system is promising, with potential advancements and improvements that can further enhance its capabilities. Here are some future possibilities for the system:

Integration with Predictive Analytics:
Integrating the temperature monitoring system with predictive analytics algorithms can enable the system to identify patterns, detect early warning signs, and predict potential temperature anomalies or equipment failures. This proactive approach can further improve safety and optimize maintenance planning by allowing operators to address issues before they escalate.

Machine Learning and AI Algorithms:
Implementing machine learning and artificial intelligence algorithms can enable the system to learn from historical temperature data, identify correlations, and make intelligent predictions. These algorithms can help optimize temperature control strategies, predict maintenance needs, and enhance the overall efficiency of pipeline operations.

Enhanced Visualization and User Interfaces:
Developing intuitive and interactive visualization interfaces can provide operators with a more comprehensive view of temperature data, trends, and anomalies. Advanced graphical representations, data analytics dashboards, and customizable reporting features can improve decision-making and facilitate data-driven insights.

IoT and Sensor Technology Advancements:
Advancements in IoT (Internet of Things) and sensor technologies can lead to the development of more sophisticated and cost-effective temperature sensors. These sensors can provide higher accuracy, improved durability, and wireless connectivity, making it easier to deploy and expand the temperature monitoring system across pipeline networks.

Remote Control and Automation:
Integrating the temperature monitoring system with pipeline control systems and automation technologies can enable remote control and adjustment of temperature parameters. This can optimize energy consumption, enhance temperature regulation, and improve operational efficiency.

Environmental Monitoring:
Expanding the capabilities of the system to include monitoring of environmental factors such as humidity, pressure, and air quality can provide a more comprehensive understanding of the conditions within the pipeline tunnels. This holistic monitoring approach can help identify potential risks and optimize operations accordingly.

Mobile Applications and Alerts:
Developing mobile applications that provide real-time temperature data, alerts, and notifications can enhance the accessibility and responsiveness of the system. Operators can receive updates and critical alerts on their mobile devices, enabling them to take immediate action regardless of their location.

Integration with Geographical Information Systems (GIS):
Integrating the temperature monitoring system with GIS technologies can enable operators to visualize temperature data and anomalies in spatial context. This integration can aid in identifying temperature hotspots, analyzing temperature patterns along the pipeline route, and facilitating targeted maintenance activities.

10. APPENDIX

Hardware Components:

Temperature sensors:
Devices used to measure and monitor the temperature within the pipeline tunnels.
Communication devices: Equipment that facilitates the transmission of temperature data from sensors to the monitoring system.
Data acquisition systems: Hardware responsible for collecting, processing, and transmitting temperature data.
Software Components:

Monitoring and control software:
Software applications that receive, process, and analyze temperature data from sensors. They provide real-time monitoring, alert generation, and data visualization capabilities.
Data management software: Software for storing, organizing, and managing temperature data collected from sensors. It enables data retrieval, historical analysis, and reporting functionalities.
Network Infrastructure:

Local Area Network (LAN):
Internal network infrastructure used to connect sensors, data acquisition systems, and monitoring software within a specific location or facility.
Wide Area Network (WAN): Network infrastructure that allows for the transmission of temperature data from remote pipeline tunnel locations to a centralized monitoring system. This can include wired or wireless communication technologies such as fiber-optic cables, satellite communication, or cellular networks.

Data Flow Diagram:
A visual representation of the flow of temperature data from the sensors to the monitoring system, including the data acquisition, transmission, processing, and storage stages.

Technical Architecture:

The system's technical architecture diagram illustrating the components, interfaces, and interactions of the temperature monitoring system. It shows how hardware, software, and network elements are integrated to form a cohesive system.

Database Schema:
The structure and organization of the database used to store temperature data collected by the monitoring system. It defines the tables, fields, relationships, and indexing schemes employed for efficient data storage and retrieval.

Source Code

```
//REMOTE GAS PIPELINE TUNNEL TEMPERATURE MONITORING SYSTEM

#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#define DHTPIN 4     // what pin we're connected to
#define DHTTYPE DHT11   // define type of sensor DHT 11
//#define LED 5

DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht
connected

const int potPin=34;

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-------credentials of IBM Accounts------

#define ORG "bz4xo2"//IBM ORGANITION ID
#define DEVICE_TYPE "remotegaspipeline"//Device type mentioned in ibm watson IOT
Platform
#define DEVICE_ID "12345"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3;
float t;
```

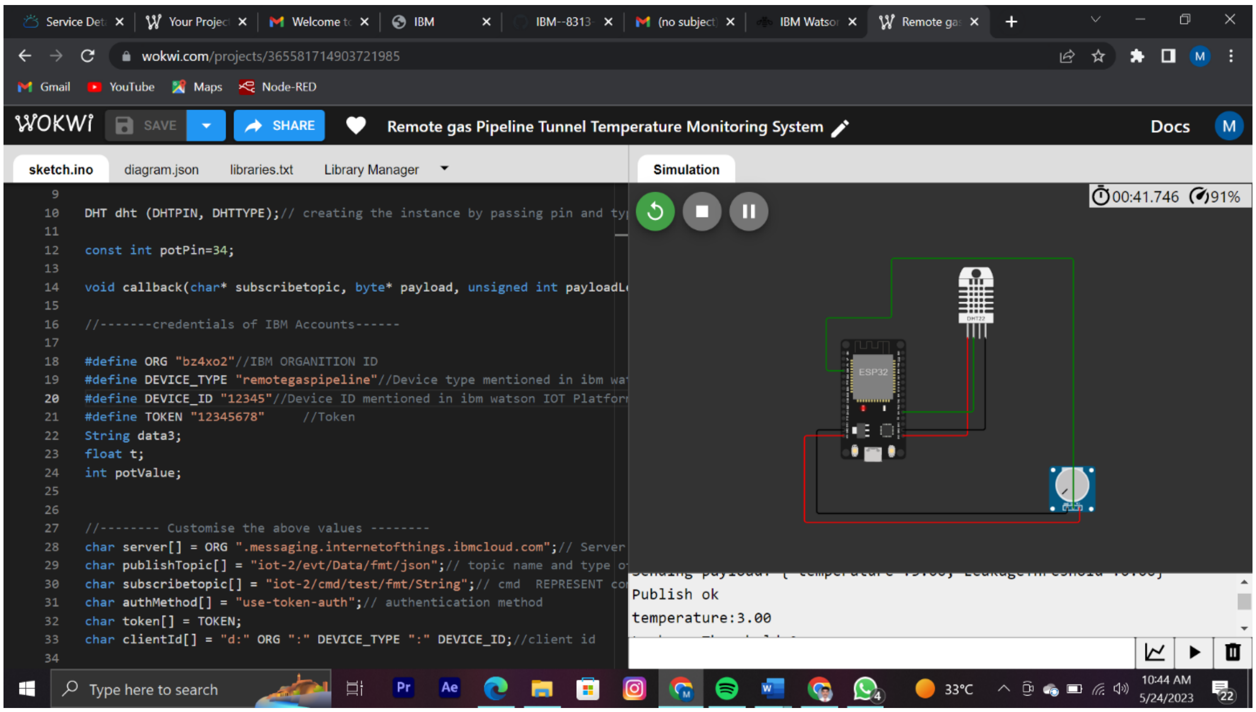
```
int potValue;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event
perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/test/fmt/String";// cmd  REPRESENT command
type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id


//-----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined
client id by passing parameter like server id,portand wificredential
void setup()// configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  //pinMode(LED,OUTPUT);
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

void loop()// Recursive Function
{

  //h = dht.readHumidity();
  t = dht.readTemperature();
  potValue = analogRead(potPin);
  Serial.print("temperature:");
  Serial.println(t);
  Serial.print("Leakage Threshold:");
  Serial.println(potValue);

  //Serial.print("Humidity:");
  //Serial.println(h);

  PublishData(t, potValue);
  delay(1000);
```

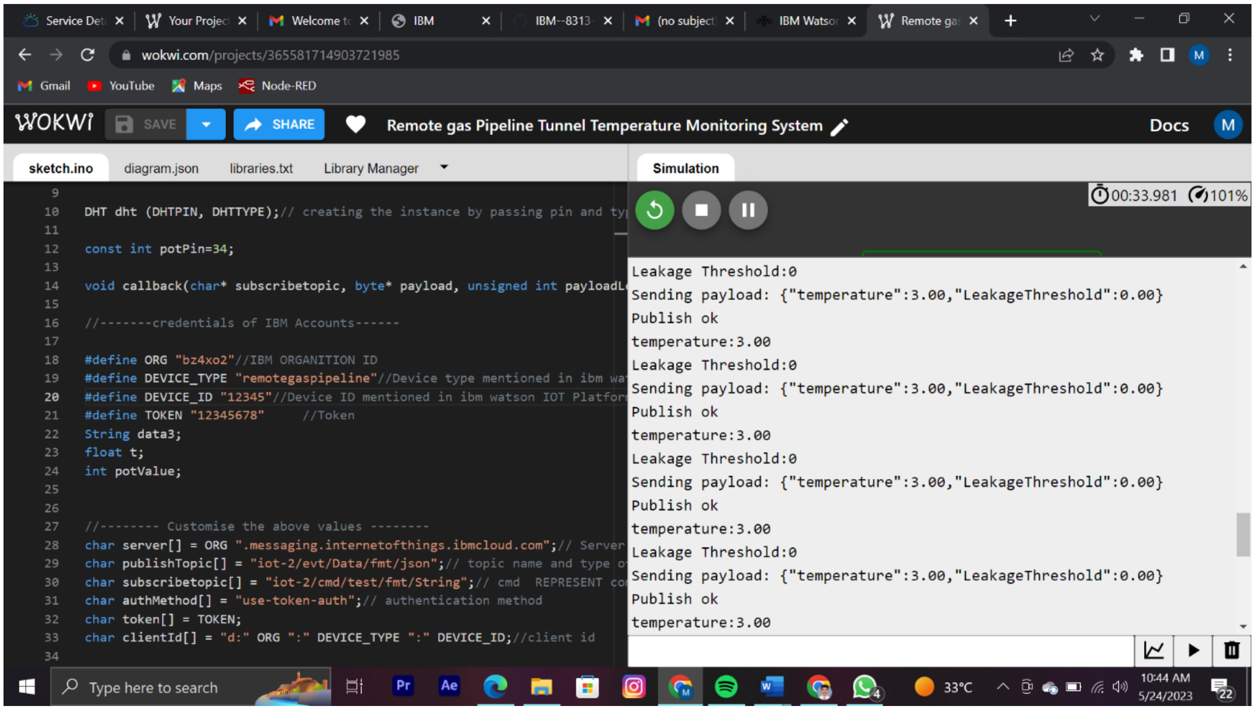
```
  if (!client.loop()) {
    mqttconnect();
  }
}



/*....................................retrieving to
Cloud...............................*/

void PublishData(float temp, float potenval) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"temperature\":";
  payload += temp;
  payload += "," "\"LeakageThreshold\":";
  payload += potenval;
  payload += "}";


  Serial.print("Sending payload: ");
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");// if it sucessfully upload data on the cloud
then it will print publish ok in Serial monitor or else it will print publish
failed
  } else {
    Serial.println("Publish failed");
  }

}
void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }

     initManagedDevice();
```

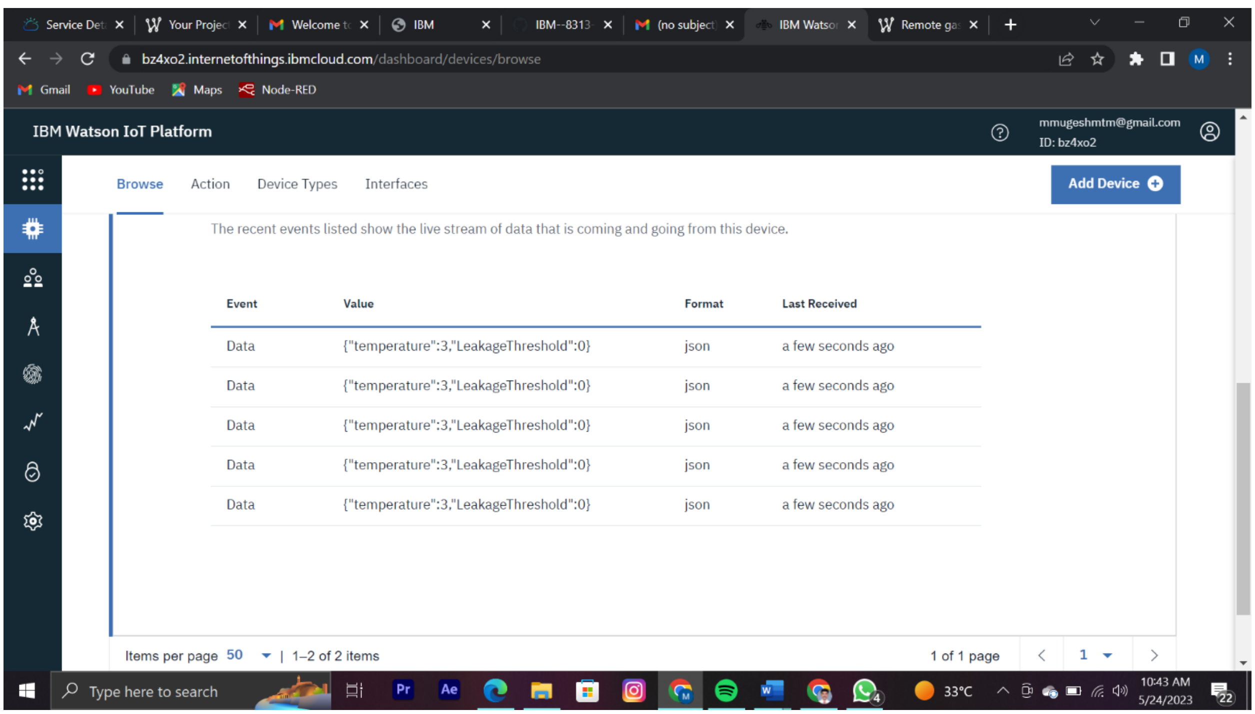
```
     Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish
the connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}



void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{

  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);
  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }

  Serial.println("data: "+ data3);
  data3="";
```

```
}
```

GitHub & Project Video Demo Link




wokwi.com/projects/365581714903721985
WOKWI
SAVE
SHARE
Remote gas Pipeline Tunnel Temperature Monitoring System
Docs
sketch.ino
diagram.json
libraries.txt
Library Manager
DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and ty
const int potPin=34;
void callback(char* subscribetopic, byte* payload, unsigned int payloadL
//-------credentials of IBM Accounts------
#define ORG "bz4xo2"//IBM ORGANITION ID
#define DEVICE_TYPE "remotegaspipeline"//Device type mentioned in ibm wa
#define DEVICE_ID "12345"//Device ID mentioned in ibm watson IOT Platfor
#define TOKEN "12345678"   //Token
String data3;
float t;
int potValue;
//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type o
char subscribetopic[] = "iot-2/cmd/test/fmt/String";// cmd REPRESENT co
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id
Simulation
00:33.981
101%
Leakage Threshold:0
Sending payload: {"temperature":3.00,"LeakageThreshold":0.00}
Publish ok
temperature:3.00
Leakage Threshold:0
Sending payload: {"temperature":3.00,"LeakageThreshold":0.00}
Publish ok
temperature:3.00
Leakage Threshold:0
Sending payload: {"temperature":3.00,"LeakageThreshold":0.00}
Publish ok
temperature:3.00
Leakage Threshold:0
Sending payload: {"temperature":3.00,"LeakageThreshold":0.00}
Publish ok
temperature:3.00
Type here to search
33°C
10:44 AM
5/24/2023


bz4xo2.internetofthings.ibmcloud.com/dashboard/devices/browse
IBM Watson IoT Platform
mmugeshmtm@gmail.com
ID: bz4xo2
Browse
Action
Device Types
Interfaces
Add Device
The recent events listed show the live stream of data that is coming and going from this device.
Event
Value
Format
Last Received
Data
{"temperature":3,"LeakageThreshold":0}
json
a few seconds ago
Data
{"temperature":3,"LeakageThreshold":0}
json
a few seconds ago
Data
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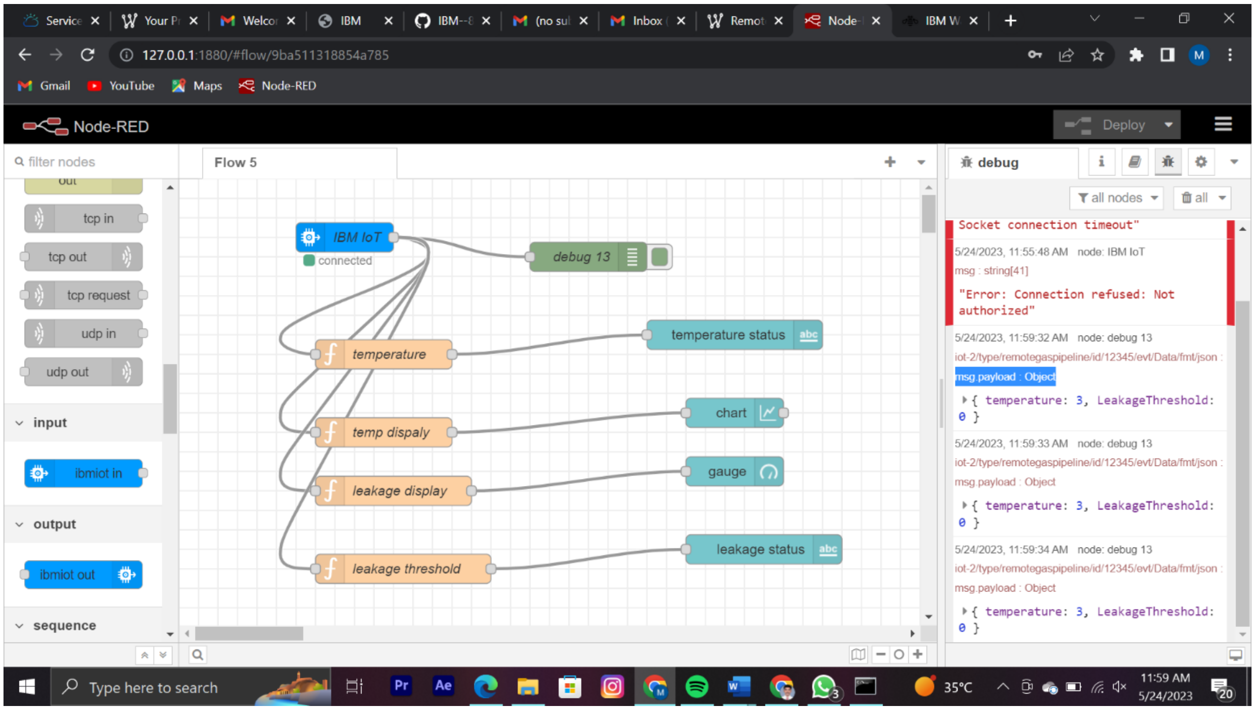
json
a few seconds ago
Data
{"temperature":3,"LeakageThreshold":0}
json
a few seconds ago
Data
{"temperature":3,"LeakageThreshold":0}
json
a few seconds ago
Items per page 50
1–2 of 2 items
1 of 1 page
Type here to search
33°C
10:43 AM
5/24/2023



Video link :

https://drive.google.com/file/d/1uktQ4xatq4CdX0fgJUB6VsSpbyG1vhr3/view?usp=drive_link