Canary Project Final Summary

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CANARY is an advanced, AI-powered portable system designed to improve safety in underground environments such as mines, tunnels, and utility infrastructures. It continuously monitors environmental and structural conditions, including gas levels, temperature, air pressure, humidity, vibration, and ground movement. Unlike traditional safety systems, CANARY not only detects hazards in real time but also analyzes trends and predicts potential failures, enabling proactive risk prevention through alerts, alarms, and SOS signals.

The system consists of a handheld device used by workers and engineers, a centralized processing system, and an external database for storing collected data. Sensor data is transmitted from the field device to the core system, where it is processed using risk assessment and alert management modules. The system architecture follows a layered, event-driven approach that incorporates Repository and Client-Server styles, allowing for efficient data flow, real-time responsiveness, and scalable system design.

The primary goal of CANARY is to enhance underground safety while reducing operational and financial risks. By providing early hazard detection and predictive insights, the system enables users to take preventive action before dangerous conditions escalate. This reduces the likelihood of injuries, fatalities, and costly project disruptions. In addition, centralized data storage supports historical analysis and predictive modeling, improving long-term planning and infrastructure management.

Underground industries rely heavily on stable and safe environments for operations such as resource extraction, transportation, and energy distribution. However, these environments are inherently difficult to monitor and prone to hidden dangers such as toxic gases, structural failures, flooding, and equipment malfunctions. Existing systems are often reactive and insufficient for early hazard prediction, as demonstrated by past disasters. CANARY addresses this gap by introducing continuous monitoring combined with predictive analytics.

The system leverages modern technologies, including real-time operating systems for edge processing, AI/ML frameworks for predictive analysis, database systems for data storage, and visualization tools for dashboards. It is designed to integrate with existing platforms and comply with safety and regulatory standards. User involvement, particularly from engineers and safety personnel, plays a critical role in refining system requirements, validating functionality, and ensuring usability.

From a deployment perspective, CANARY operates as a distributed system, with sensors collecting data in the field, a central server performing processing and storage, and client devices providing user interfaces. This architecture supports real-time communication and efficient system coordination across all components.

In the short term, CANARY provides immediate hazard detection and alerting capabilities. In the long term, it aims to reduce accidents, improve operational efficiency, and establish a new standard for underground safety. By transforming hazard detection from reactive to proactive, CANARY enhances both worker safety and organizational reliability.