# Predictive Maintenance of Gabčíkovo Hydropower Plant

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## ANNOTATION

The initiative to enhance the efficiency and reliability of the Gabčíkovo Hydropower Plant (Gabčíkovo HPP) has led to the development of a project focused on implementing predictive maintenance strategies. This project, submitted to the APVV agency for research and development support [1], is a collaboration between the Institute of Robotics and Cybernetics at the Slovak University of Technology in Bratislava and Vodohospodárska Výstavba, štátny podnik (Water Construction Company, state enterprise). The project's main objective is to utilize process data acquired from the plant's sensors to develop and implement predictive maintenance models and algorithms.

## KEYWORDS

Predictive Maintenance, Neural Networks, Big Data Analysis, Hydropower Plant, Machine Learning

## 1. INTRODUCTION

Currently, the Gabčíkovo Hydropower Plant operates several process stations that gather sensor data. This data is stored in a centralized database, allowing for retrospective analysis and visualization. The implementation of predictive maintenance aims to harness this data to anticipate equipment failures and optimize maintenance schedules, thereby reducing downtime and maintenance costs.

## 2. METHODOLOGY

The predictive maintenance system integrates data analytics, machine learning, and sensor technology to predict the likelihood of equipment failures. By analyzing historical and real-time data, the system can identify patterns and anomalies, facilitating proactive maintenance planning. This approach is supported by a robust Data Warehouse (DWH) system, which aggregates operational parameters from various plant components using the IEC60870-104 protocol, centralized at the SICAM A8000 unit of Gabčíkovo HPP.

The technological platform for the DWH system is based on the D2000 Enterprise software, managed by the company INSEKO. This platform supports extensive real-time data processing and archiving, running on Oracle Linux 8 and PostgreSQL v14 for high security, reliability, and performance.

## 3. SUSPECTED RESULTS

The project is structured into several phases, beginning with the design of data analysis tools (6 months), followed by the creation of predictive maintenance models (12 months), and the development of algorithms (12 months). The final phase involves testing these systems in real-world conditions at the Gabčíkovo plant (6 months).

Preliminary tests of predictive maintenance algorithms have shown promise in laboratory settings, demonstrating the system's potential to improve operational efficiency, extend equipment lifespan, and reduce unexpected breakdowns.

## 4. DISCUSSION

The transition from a theoretical concept to practical application involves significant technological advancements, including the development of both hardware and software components tailored to the specific needs of a hydroelectric plant. The predictive maintenance system is expected to operate at a TRL (Technology Readiness Level) of 7, indicating a system prototype demonstration in an operational environment.

## 5. CONCLUSION

Upon successful implementation, the predictive maintenance system at Gabčíkovo HPP could serve as a model for other hydroelectric plants, showcasing the benefits of integrating advanced data analytics and machine learning techniques into maintenance strategies. The project's outcomes are poised to enhance plant productivity and competitiveness by maximizing uptime and optimizing resource allocation.

## 6. REFERENCES

*[1] Agentúra na podporu výskumu a vývoja (Agency for research and development support), On-line: https://www.apvv.sk/.*