Smart Predictive Maintenance for Water Pumps with Recommendation System

Supervised by
Dr. Abdelmalek Zidouri

Team 122

Nussair Hroub | Computer Engineering
Hammad Al-Reshod | Electrical Engineering
Ahmad Al Haid | Computer Science
Abdullah Alroqi && Bader Alnimr | Industrial and Systems Engineering
Turki Alhomaily | Chemical Engineering

Problem Statement

Forecasting potential breakdowns in water pumps to allow for proactive maintenance actions to be taken, ensuring necessary repairs or replacements are conducted before the system experiences shutdowns. This proactive strategy not only reduces unexpected disruptions but also helps to lower maintenance costs, leading to enhanced efficiency and savings for the water supply infrastructure as a whole.

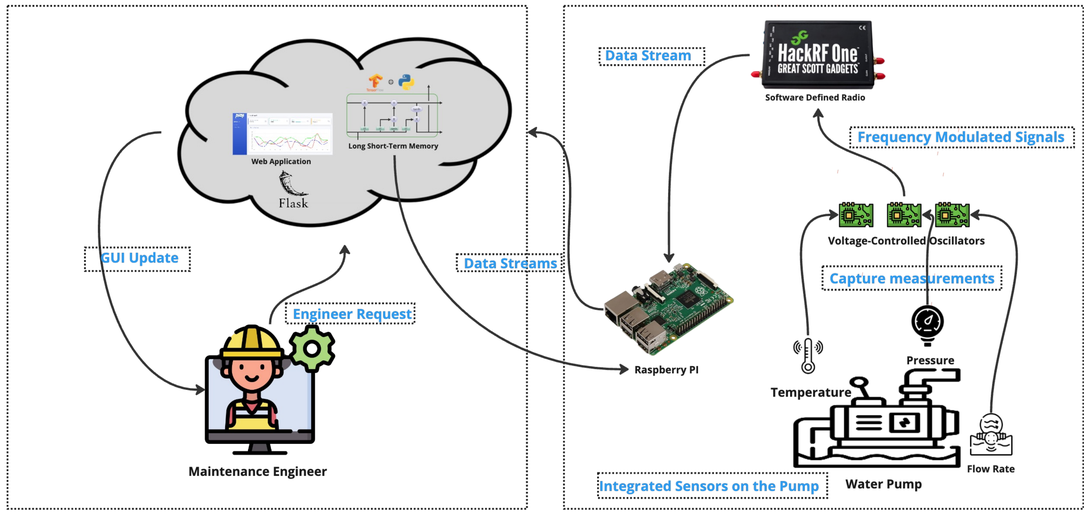
Constraints

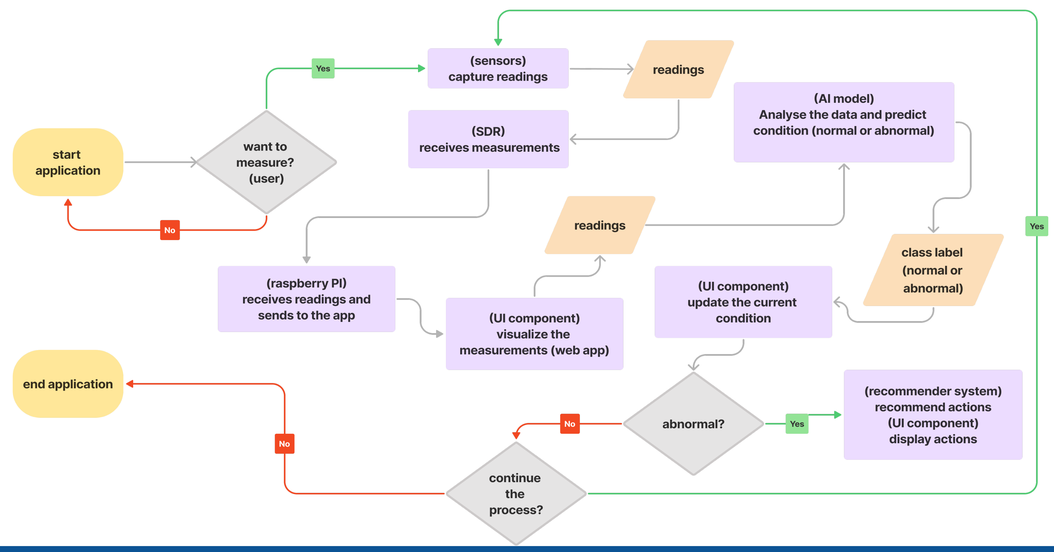
- High quality and large enough training dataset.
- Strict regulations about the use of SDRs.
- Need for a main supply source.

Target Specifications

Specification	Target
Prediction accuracy	> 80%
Inference time	< 3 secs
Time to display readings	< 10 Secs
Web readings match actual	> 90%
System tolerates wiring range	< 2m
Power consumption	< 20 W
Cost	< 6000 SAR

Prototype Design

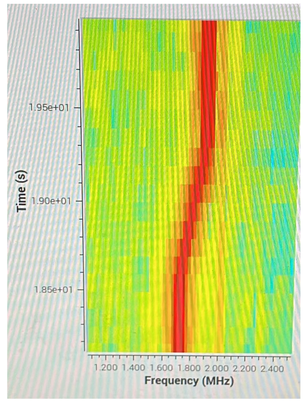


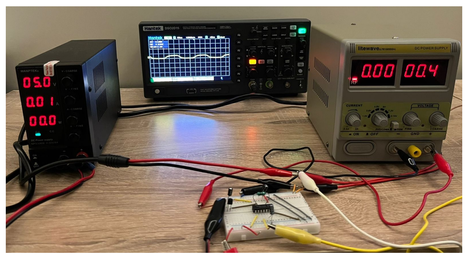


Project Impact

Context	Impact of Pump-Guardian	Related SWOT Aspects
Societal context	- Enhances water infrastructure reliability, reducing water shortages - Encourages the adoption of environmentally sustainable practices by preventing costly downtimes	- Strengths: Improved reliability of critical infrastructure, Increased operational efficiency - Weaknesses: Requires behavioral change for maintenance teams, Learning curve for new technology
Economic context	- Creates high-tech jobs in system development, installation, and maintenance - Expands market reach for predictive maintenance solutions in the $6 billion pump maintenance market	- Strengths: High-value job creation in tech and service sectors, Significant cost savings for clients - Opportunities: Job creation in manufacturing, marketing, and sales
Environmental context	- Reduces water waste and pump emissions through proactive maintenance - Minimizes environmental impact by preventing pump failures and leaks	- Strengths: Reduction of environmental impact due to fewer pump failures and leaks - Threats: Environmental regulations impacting production or deployment of predictive solutions

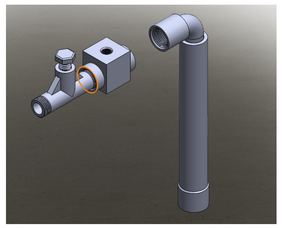
Results Validation

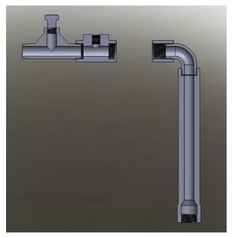




Figures 1 & 2: Less than one second (change input voltage)

Component	Power (W)
Raspberry pi	7
IC	0.1
SDR	2.5
Pressure Sensor	0.01165
Temperature Sensor	0.0003
Flow Rate Sensor	0.075
Total	9.68695





Conclusion

This work attempts to develop a modern predictive maintenance system using the recent advancements in the field of Artificial intelligence. The final goal of the system is to predict the possible failure of a pump before it actually fails, resulting in extra maintenance costs and a complete shutdown of services. By using various software and hardware components: Flask, Python, Tensorflow, SDRs, and Raspberry PI, we have designed and implemented a prototype to showcase the effectiveness of our system. Finally, our testing, validation, and feasibility analysis phases demonstrate the success of our system and its promise to be taken into further stages of deployment.