Project title:	Cloud-based Machine Health Monitoring and Prognosis
Research team:	Dazhong Wu, Connor Jennings, Jannis Terpenny (PSU)
Industry collaborators:	IME at PSU
Thrust area:	Intelligence
Current TRL:	Estimate current TRL score – 3
Final TRL:	Estimate final (completed project) TRL score – 6
Project type:	Proposed
Start date:	08/01/2016
Completion date:	07/31/2017
Percent complete:	0%
Budget:	$50,000
IAB funding:	$50,000
Other funding:	$0

Industrial Relevance

- Problem: It has been very challenging for manufacturers to predict remaining useful life of machinery in real-time as well as perform proactive maintenance actions.
- Solution: A data-driven and scalable prognostic framework that integrates machine learning and cloud computing has the potential to collect large volumes of real-time streaming data and create predictive models in real-time.

Problem Statement

Manufacturers aim to minimize unexpected machine down times by predicting mechanical failures and performing proactive maintenance actions. However, existing prognostic systems are not capable of monitoring the conditions of large-scale distributed manufacturing systems as well as collecting and analyzing high-speed, large-volume heterogeneous data. The objective of this project is to create a prognostic framework for intelligent maintenance using machine learning and cloud computing.

Approach and Method

This project will integrate parallel machine learning and cloud computing. The data acquisistion system and cloud-based machine learning technique are described in Figures 1, 2, and 3.

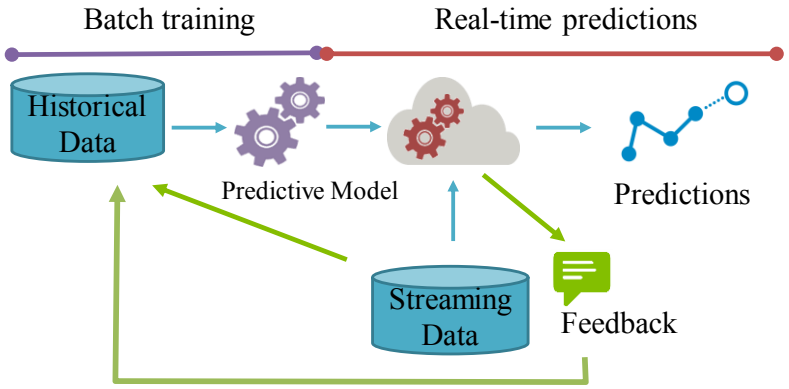

Figure 1 Real-time prediction

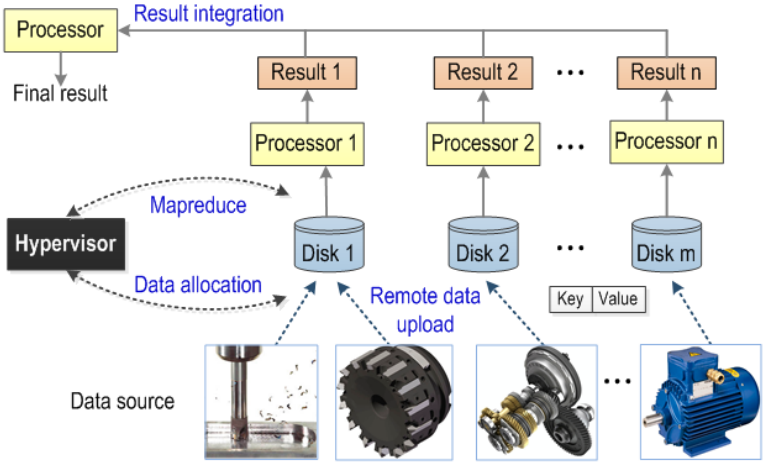

Figure 2 Cloud-based machine learning

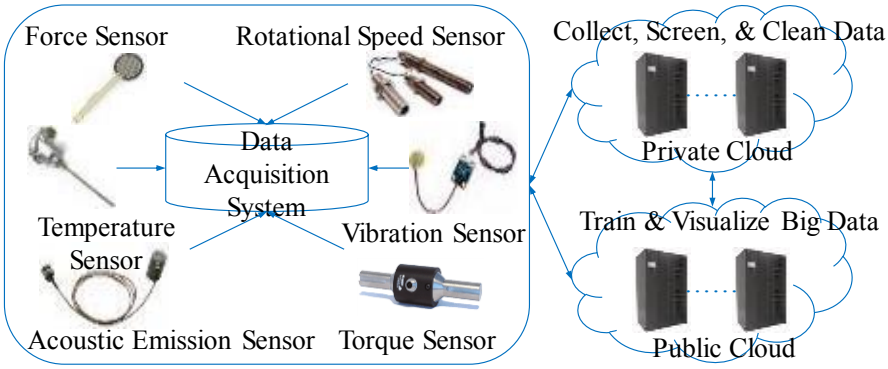

Figure 3 Data acquisition

Deliverables and Benefits

Two deliverables of the proposed project include:

- A cloud-based data acquisition system that integrates a wireless sensing system with a cloud computing infrastructure;
- A cloud-based machine learning algorithm that processes real-time streaming data and generates big data analytics.

Potential application areas

The potential application areas include:

- Manufacturing
- Automotive
- Aerospace
- Power generation
- Transportation

Project Plan and progress

The Gantt Chart of the proposed project is as follows:

Research Tasks	2016		2017		
	8 - 10	11 - 12	1 - 3	4 - 6	7 - 8
Develop a cloud-based sensing system					
Collect real-time streaming data					
Develop parallel machine learning algorithms					
Test the parallel machine learning algorithms					
Demonstration and documentation					

Current State of Practice and Research

- Physics-based prognostics – Predict system performance using a mathematical representation of the physical behavior of degradation processes. However, physics-based methods require deep and complete knowledge of system behaviors which is typically not readily available for many applications.
- Model-based prognostics – Predict system performance based on probability distribution. The limitation of model-based prognostics is that one has to assume that the underlying process follows certain probability distribution.

How Ours is Different

- Real-time streaming data processing and big data analytics
- Scalable and high performance computing
- More accurate prediction without complete knowledge of physical behaviors