Real-Time decision support for aquaculture operations

Current situation

Piscada is a company working with solutions in automation and industrial IT combined with modern IT-solutions. The main product is a SCADA (Supervisory Control And Data Acquisition) platform used in multiple industries, buildings, aquaculture, industrial IoT, and other segments. Aquaculture solutions include feeding systems, camera solutions, sensor data and more.

Norwegian Aquaculture Industry is one of the fastest growing sectors with world leading technology and significant export revenues. There is a market for increasing knowledge and insights with new solutions and optimization of production processes using Piscadas Platform. Aquaculture operations are complex and requires different types of equipment, barges, feeding systems, boats etc.

These operations have different aspects like:

- Technical – Is the equipment operating within its limits? Do we have a hole in the feed pipe? Is a sensor faulty?
- Operational – Should we increase/decrease/stop feeding? Should we increase/decrease flow when transferring fish?
- Biological – What is the effect of transferring fish, stress level? What is the impact of net cleaning? Why is the appetite increasing/decreasing? Is the oxygen level affecting operations? Are we having a lice outbreak or algae bloom?

Operations are affected by multiple factors like:

- Equipment
- Methods – Processes, regulations
- Materials – Feed, fish, genetics, health
- Environment – Temperature, lice, current
- Personnel

Some of the factors are controllable, and it's challenging to know what parameters are most significant for each operation.

The focus and challenge for this project and master thesis is within one or more subjects:

- Identify correct target KPI's for the operation.
- Anomaly detection.
- Operation predictions.
- Adjustment recommendations for the current operation.

This project will use data from actual fish farms.

Data

Most data are stored as time series. Video may be used but only as a supplement in this thesis. Data collection is done in a real operational environment with fish. For initial tests a sample data may be used. Processing of data is possible using existing methods or using own algorithms in Python. Data are typically represented by data points in a big-data database. Data points are updated on change.


```
[
 {
  "ts": "2019-10-01 14:00:14",
  "v": 2
 }
]
```


Aggregated representation


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{
 "from": "2019-10-01T12:00:00Z",
 "to": "2019-10-01T13:00:00Z",
 "intervals": [
  {
   "ts": "2019-10-01 14:00:00",
   "avg": 8.749192222222222,
   "min": 2,
   "max": 34,
   "count": 283,
   "last_value": 9,
   "interval": "30m"
  }
 ]
}
```

Challenges

There are two main challenges which each may represent a master. Each challenge is divided into subtasks. Scope may be adjusted based on student subjects and interests. Most relevant operation to be studied is feeding operations.

Option 1: Operation classification and anomaly detection.

1. Identify correct target KPI's for the operation

A single operation relates to a set of parameters. These parameters can be classified and modelled as a system. By looking at multiple parameters, are we able to identify how they relate to each other? If an operation is marked as well done or poor, can we identify what parameters are influencing the most? How are uncontrollable parameters corresponding with controllable parameters?

2. Anomaly detection

By looking at the operation as a system, you should be able to classify different states. One challenge here can be to check If input parameters are fixed but output deviating from previous runs. Anomalies can be both positive and negative and should be classified.

Option 2: Operation prediction and recommendation.

1. Operation predictions

Performing operations affect multiple technical, biological and environmental parameters. Can we predict changes based on operations? An example could be, predicting changes in temperature, or pressure on physical equipment based on operational parameters.

2. Adjustment recommendations for the current operation.

While performing an operation, are we able to recommend changes? Are we operating outside recommended parameters? Are there risks involved? Is it possible to automate these changes?

Thesis scope

Scope may be adjustable, and tasks can be combined according to a closer definition of the task.

For more information contact:

Knut Drange
CTO – Aqua
Piscada AS

: 419 17 231
@ : knut.drange@piscada.com