INTELLIGENT SOLUTIONS

For Your Smart Factory

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www.futuremain.com
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01. Introduction

Introduction of Futuremain & ExRBM
Make the Next-Generation Factory with Futuremain.

We are confident that we have the best of engineering & IT technology in our field.

01. TOP Engineering Company, Specializes in analyzing and diagnosing data generated from machinery.

Our fundamental strength is that we have know-how accumulated more than 35 years in the field of analyzing and diagnose data from diverse engineering industry. We have many clients and references including domestic power plants and large corporations.

02. We invented automatic faults diagnosis solution by using advanced ICT& A.I technology.

Developed the world’s first predictive maintenance solution to automatically monitor and diagnose initial faults itself, by using advanced ICT and A.I technology to traditional factory.
### Domestic & Overseas Reference

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
<th>Site/Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>LG</td>
<td>LG / MAPTA PHUT PLANT, THAILAND</td>
<td>Vibration Diagnostics and Correction of Gas Compressor</td>
</tr>
<tr>
<td>62</td>
<td>LG</td>
<td>LG / CHANGSHU L&amp;M PAPER COMPANY, CHINA</td>
<td>Vibration Analysis and Estimation of Drive Units in Paper Mill</td>
</tr>
<tr>
<td>63</td>
<td>DAELEIM</td>
<td>DAELEIM / KAYAN, SADUI ARABIA</td>
<td>Vibration Diagnosis for Decanter Centrifuges</td>
</tr>
<tr>
<td>64</td>
<td>DAELEIM</td>
<td>DAELEIM / JUBAIL, SAUDI ARABIA</td>
<td>Vibration Analysis and Correction of FD Fan</td>
</tr>
<tr>
<td>65</td>
<td>DAELEIM</td>
<td>DAELEIM / KAYAN, HDPE SAUDI ARABIA</td>
<td>Equipment Condition Assessment and Diagnosis of Reactor Agitators in HDPE</td>
</tr>
</tbody>
</table>

+290 Over 290 of the different engineering field experience  
35yr Machine data analyze and fault diagnose during the 35 years

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>HYUNDAI</td>
<td>HYUNDAI / MESAID, QATAR</td>
<td>Equipment Fault Diagnostics and Correction of FinFan Air Cooler</td>
</tr>
</tbody>
</table>
History Of Futuremain

2019. May. Acquired ‘INNOBIZ’ certification (Certificate of technology innovation company)
2019. Mar. Selected as one of the Top 100 Innovators in the era of 4th Industrial Revolution.
2018. Sep. Received a commendation from the Ministry of Trade, Industry and Energy.
2017. Apr. Awarded the Grand Prize Winner in Korea Patent Competition
2016. Mar. ICT Convergence Product Quality Certification
2016. Jul. Selected Outstanding Start-up Company

...
## Business Areas

### Engineering Service

- ✓ Asset Reliability Evaluation Service
- ✓ Collect and Analysis Big-Data from Rotating Machinery
- ✓ Diagnose faults and find out Causes & Solutions
- ✓ Noise & Vibration Measurement and Diagnosis / Structural Analysis
- ✓ Educating Techniques of Vibration Analysis (ISO 18436-2, Level I,II,III)

### Advanced IT Convergence Service

- ✓ Smart Factory Platform
- ✓ Predictive Maintenance Solution
- ✓ Providing Smart Maintenance & Repair Engineering Platform
- ✓ Suppling Augmented Reality Service using Wearable Device.
- ✓ Offering Wireless Sensor, High-Technology Product
- ✓ Invented Machine Lifespan and Fault Prediction Algorithm developed by A.I Technology
The way engineers work in factory...

1. Various Sensors: Collect massive data

2. Data Acquisition System: Transfer Data to the Server

3. CMS, VMS Solution: analyze & diagnose
   → What a person should do.

Data

Server

Massive Data

Engineer, manager...
Conventional Machine management System (CMS)

OMG!!!
Too Much Data
to Analyze...

Data

Data

Data

Data

Data

Maintenance engineer

Data collecting time: 100m/sec ~ 5min
ExRBM
(Expert’s Reliability Maintenance Solution)

ExRBM applied with 2,200,000 Big-data and A.I (ANN + Expert System) algorithms combined with causes of machinery’s faults and environmental factors based on the over 35 years of expertise in the diagnosis engineering field.
1. **ExRBM System Architecture**

ExRBM enables you to not only collect data of the machinery, but also performs the precise analysis for diagnosing the fault of machine, resulting in the optimum management of the machinery and the predicting preservation.

**✓ Existing CMS**
- Collect critical data using various sensors

**✓ ExRBM**

**Automatic Faults Diagnosis and Evaluation of Machinery Conditions**
- Real-time condition monitoring.
- Real-time Evaluation of machine by ISO standards.
- Automatic calculation of machine’s fault frequency.
- Early stage faults detection. (unattended diagnosis)
- Provide big-data Statistical function
- One-click report function

![Diagram showing the flow of data from sensors to ExRBM system and finally to a smart device.]
2. ExRBM Overview

Predictive maintenance engineering solutions specialize in optimal machinery management. It can be used with existing vibration monitoring solutions.
Futuremain's Smart Factory Solution ExRBM is a differentiated machinery optimization management and diagnostic solution that provides accurately diagnose the faults in machinery through precise analysis of frequencies using vibration and other data as well as quantitative values.

3. **ExRBM Main Function: Condition Monitoring**

- **Real time Machine Monitoring**
  - Provides Alerts 4-stage of machine condition by ISO Standard.
- Evaluation of machinery condition for each sensor point
- Real-time monitoring
- Alarm if machine’s condition is in abnormal
- Identify what fault has occurred in the system
- Quickly diagnose machine faults with one-click diagnostic function.
- Provide recommended solutions for faults
- Show real-time data trend graph
4. ExRBM Main Function: **Automatic Faults Diagnosis**

Automatic diagnose the fault of each sensor of machine.

Provide root causes and countermeasures for faults that occur, and it makes possible that quick maintenance.

One Click Automatic Faults Diagnosis
02. _______
Diagnostic Capability
ExRBM is applicable to all installations where vibration data is generated, such as, rotating, reciprocating machinery etc.

### Applicable Machinery

<table>
<thead>
<tr>
<th>Motor</th>
<th>Turbine</th>
<th>Generator</th>
<th>Pump</th>
<th>Fan</th>
<th>Blower</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Motor</td>
<td>Water turbine</td>
<td>alternating current dynamo</td>
<td>Turbo Pump</td>
<td>Airfoil blade</td>
<td>Ring Blower</td>
</tr>
<tr>
<td>stepping motor</td>
<td>Steam turbine</td>
<td>Induction generator</td>
<td>circle pump</td>
<td>Mult-Airfoil fan</td>
<td>Roots Blower</td>
</tr>
<tr>
<td>brushless motor</td>
<td>Gas turbine</td>
<td>MHD generator</td>
<td>Volt type pump</td>
<td>airflow fan</td>
<td>high speed</td>
</tr>
<tr>
<td>induction motor</td>
<td>direct drive turbine</td>
<td>Single pole generator</td>
<td>Turbine Pump</td>
<td>Radial and axial</td>
<td>turbo blower</td>
</tr>
<tr>
<td>reversible</td>
<td>parallel turbine</td>
<td></td>
<td>...</td>
<td>type fan</td>
<td>...</td>
</tr>
<tr>
<td>motor</td>
<td>wind turbine</td>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compressor</th>
<th>Agitator</th>
<th>Extruder /Mixer</th>
<th>Gear Box</th>
<th>Belt</th>
<th>etc…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reciprocating</td>
<td>Tank Agitator</td>
<td>Twee Mixer</td>
<td>Any type of Gear box</td>
<td>V belt</td>
<td>Tooling Machine</td>
</tr>
<tr>
<td>compressor,</td>
<td>Propeller type</td>
<td></td>
<td>...</td>
<td>Flat belt</td>
<td>CNC machine</td>
</tr>
<tr>
<td>Screw compressor,</td>
<td>Turbine type</td>
<td></td>
<td>...</td>
<td>...</td>
<td>Industrial robot</td>
</tr>
<tr>
<td>Turbo compressor,</td>
<td>Streamlined type</td>
<td></td>
<td>...</td>
<td>...</td>
<td>Lift machine</td>
</tr>
<tr>
<td>Vane compressor,</td>
<td>Liquid type</td>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Rotary Tooth Compressor</td>
<td>...</td>
<td></td>
<td>...</td>
<td>...</td>
<td>Any type of machine</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
<td>...</td>
<td>...</td>
<td>occurred vibration</td>
</tr>
</tbody>
</table>
## Comparison with Global Product

<table>
<thead>
<tr>
<th>Main functions</th>
<th>SKF</th>
<th>Smart Signal</th>
<th>Eta PRO</th>
<th>ExRBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Faults diagnosis function</td>
<td>No Auto-diagnosis function (Only just exports data to analyze)</td>
<td>No Auto-diagnosis function (Depend on Eta PRO’s diagnosis function)</td>
<td>Total 15 major faults diagnosis available</td>
<td>Total 85 major faults diagnosis available</td>
</tr>
<tr>
<td>3. Stage of capture the abnormal symptom</td>
<td>P2</td>
<td>P2</td>
<td>P2 or P3 (Temp.)</td>
<td>P1</td>
</tr>
<tr>
<td>4. Specialized in</td>
<td>Real-time collection and transmission of machine data</td>
<td>Trend analysis of vibration</td>
<td>diagnosis of 15 major faults</td>
<td>Alert early alarm and diagnose about 85 initial machine faults</td>
</tr>
</tbody>
</table>
Comparison with Global Product

**Eta PRO vs ExRBM:**
Possession of faults diagnosis data

**EtaPRO Predictor monitors these faults:**
- Cavitation
- Eccentricity
- Instability
- Gear wheel faults
- Pole position faults
- Resonances
- Rubbing
- Winding shorts

**ExRBM monitors these faults:**
- Abnormal Explosion (4 Stroke Cycle Engine)
- Angle Misalignment
- Bearing Cage Faults
- Bearing Faults(BPFI)(BPFO)(BSF)
- Beat
- Belt Frequency
- Belt Resonance
- Bent Shaft
- Blade Pass Frequency
- Blade Resonance
- Cavitation
- Cocked Bearing
- Couple Unbalance
- Coupling Faults
- Deformation
- Distortion
- Dry Whip
- Dynamic Unbalance
- Eccentric Rotor
- Eccentric Sheave
- Electrical Faults

*Total 15 diagnostic data*

‘**Futuremain**’ has five times more faults diagnosis data than 'Eta Pro'

→ Identify all abnormal signal caused by machine without any missing parts, and diagnose the faults very promptly, and provide proper countermeasures.

*Total 85 faults diagnosis data pattern applied*
03. __________

Case Study

Detail Review of the Case Study
# Our Clients

<table>
<thead>
<tr>
<th>Field</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea Power plant &amp; Energy</td>
<td>Predictive maintenance &amp; AR Platform System</td>
</tr>
<tr>
<td>Chemical</td>
<td>Auto diagnosis and Monitoring System for Chemical Factory</td>
</tr>
<tr>
<td>Chemical</td>
<td>Auto diagnosis and Monitoring System for Extruder &amp; Compressor</td>
</tr>
<tr>
<td>Chemical</td>
<td>Rotating Machinery optimization &amp; prediction System</td>
</tr>
<tr>
<td>Electronic</td>
<td>Rotating Utility Machinery optimization System</td>
</tr>
<tr>
<td>Electronic</td>
<td>Rotating Machinery optimization &amp; prediction System</td>
</tr>
<tr>
<td>Shipbuilding &amp; Marine</td>
<td>Ship Monitoring and Fault Automatic Diagnosis System</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Machinery monitoring and Early fault diagnosis system</td>
</tr>
</tbody>
</table>
Case Introduction 1. (Chemical plant)

Faults Diagnostic results

<table>
<thead>
<tr>
<th>Machine</th>
<th>Loop Reactor Circulation Pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1201</td>
<td></td>
</tr>
</tbody>
</table>

**Faults**
1. [2070] Bearing Faults (BPFI)(BPFO)(BSF)
2. 
3. 

**Root Causes**
1. Worn by excessive load or high-speed rotation.
2. Improper lubrication or oil selection
3. Improper bearing Selection
4. Improper installation or poor preload
5. Bearing defects due to electrolytic corrosion

**Maintenance Recommendation**
1. Proper selection and installation of bearings
2. Reduce overload and operate at rated speed and constant speed.
3. Prevention of water or foreign matter in advance
4. Remove axis voltage and shaft current
5. Immediate replacement of faulty bearings

Fault diagnosis result
P-1201 Loop Reactor Circulation Pump
: Actual Data & FFT analyze
Case Introduction 1.

Verification Results: Bearing Faults

In this case, the bearing fault was correctly diagnosed as soon as 'ExRBM' was installed in the reactor circulation pump where the bearing failed.

\[ \rightarrow \text{Normal Bearing} \quad \text{(Pump Non-drive side)} \]

\[ \rightarrow \text{Fault Bearing by ExRBM detected} \quad \text{(Pump Drive side)} \]
Case Introduction 2.

ExRBM Diagnosis Results: Partial Rubbing
Case Introduction 2.

Verification Results: Partial Rubbing

'ExRBM' diagnoses and reports from the initial stage of the fault (about 3-4 months ago) and alerts you whenever the fault is advanced and changes to another fault, allowing the machine manager to respond.

1st Alarm from ExRBM (about 3 month before) → 2nd Alarm (2 month before) → 3rd Alarm (3-4week before) → 4th Alarm (about 1week before)

Air Gap Unbalance (Early Stage fault) → Partial Rubbing (Faults) → Rubbing (Failure) → Insulation Burning Failure (Unacceptable)
P-1202 Loop Reactor Circulation Pump
: Actual Data & FFT analyze
Case Introduction 3. (Petrochemical plant)

Reciprocating Compressor Diagnosis Service

ExRBM System Setup in Saudi Arabia

Compressor Measurement Point

ExRBM: Predictive Maintenance Solution
Case Introduction 3.

The graph above identifies the causes of plant faults through data separation from one sensor through Futuremain's ‘30-parameter separation’.

Engineers can easily analyze machinery faults using the analytical tools provided by ExRBM.
Thank you.
**Patent & Certifications**

Futuremain is uniquely positioned to diagnose faults data of machine automatically.

- The machinery management solution belongs to the smart factory value chain APPLICATION group, and Futuremain leads the market for predictive maintenance solutions.
- Succeeded in localizing and sale the machinery maintenance solution.
- Selected as a technology innovation company. (INNOBIZ Certification, Selected as one of the Top 100 Innovators in the era of 4th Industrial Revolution)

<table>
<thead>
<tr>
<th>No</th>
<th>Title of Invention</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Method of Diagnosing Faults in Machinery using Vibration Characteristics.</td>
<td>2015. 11</td>
</tr>
<tr>
<td>2</td>
<td>Faults Prediction Method for Plant.</td>
<td>2015. 03</td>
</tr>
<tr>
<td>3</td>
<td>Fault detection and fault diagnosis method of planetary gear unit.</td>
<td>2015. 02</td>
</tr>
<tr>
<td>4</td>
<td>Method of predicting residual life of rolling bearings</td>
<td>2015. 02</td>
</tr>
<tr>
<td>5</td>
<td>A method for evaluating the condition of a machinery using the amount of vibration of a rotating machine</td>
<td>2014. 12</td>
</tr>
<tr>
<td>6</td>
<td>Method of predicting tool life through analysis of vibration characteristics</td>
<td>2018. 06</td>
</tr>
<tr>
<td>7</td>
<td>Real-time vibration analysis and automatic vibration method of rotating machine</td>
<td>2018. 06</td>
</tr>
<tr>
<td>8</td>
<td>Method of Diagnosis of Defects in Facilities using Vibration Spectrum Analysis</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Portable measuring device of equipment using vibration characteristics</td>
<td>-</td>
</tr>
</tbody>
</table>