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등록 하기 matlabexpo.co.kr
Internet of Things (IoT)를 위한 애널리틱 개발 및 적용

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What is IoT?

Devices → Analytics → Insight
Do hamsters run a marathon every day?
Challenge
Measure and evaluate the energy efficiency of residential homes and factories based on data from onsite sensors.

Solution
Cadmus used ThingSpeak to collect up to the minute temperature, humidity, and power usage data and use MATLAB to analyze and visualize the data.

Results
- Market opportunity seized
- Development effort cut by two-thirds
- Sensor networks quickly deployed
IoT Analytics

- Devices
- Analytics
  - Access and Explore Data
  - Preprocess Data
  - Develop Predictive Models
- Insight

- Business Data
- Sensor Data
- Data Reduction/Transformation
- Feature Extraction
- Model Creation
- Model Validation
Algorithms are Key to IoT Systems and MATLAB Can Help

- Real data is messy and needs to be cleaned up.
- Features need to be detected and classified.
- Missing data points need to be handled.
- Predictions need to be made.
IoT Analytics Framework

- Communication
- Connectivity

Analytic IoT Platform
- Online analytics
- Visualization and reporting

Smart Connected Devices
- Local embedded algorithms
- Data reduction

Algorithm Development
- Historical analytics
- Sensor analytics

Deploy analytics to cloud
Deploy algorithm to device
IoT Analytics Challenges

- How do I collect enough data to build my algorithm?
- How do I develop my algorithms?
- How do I deploy my algorithms on a smart device?
- How do I deploy my algorithms to the cloud?
IoT Analytics Challenges

How do I collect enough data to build my algorithm?

Communications Network

Deploy analytics to server/cloud

Data Aggregation & Analytics

Deploy algorithms to nodes/devices

Smart Connected Devices

Algorithm Development

Sensor Analytics

How do I develop my algorithms?

MATLAB
What Is ThingSpeak?

Web Site For People

Web Service for Devices

```json
{
  - channel: {
      id: 38429,
      name: "Car Counter",
      description: "Counting number of cars passing a reference line in 15 sec interval",
      latitude: "42.28",
      longitude: "-71.35",
      fields: "Number of Westbound Cars",
      field2: "Number of Eastbound Cars",
      created_at: "2015-05-19T20:14:03Z",
      updated_at: "2016-05-10T10:36:35Z",
      last_entry_id: 1477231
    },
  - feeds: [
      - {
          created_at: "2016-05-19T10:36:20Z",
          entry_id: 1477230,
          fields: "18.000000",
          field2: "0.000000"
        },
      - {
          created_at: "2016-05-19T10:36:35Z",
          entry_id: 1477231,
          fields: "18.000000",
          field2: "14.000000"
        }
    ]
}
```
ThingSpeak

- New MathWorks web service hosted on AWS
- Lets you collect, analyze and act on data from “things”
- Over 130,000 users worldwide
- It has MATLAB for IoT Analytics
- It’s free to get started

https://thingspeak.com

Collect  Analyze  Act
Custom Visualizations with ThingSpeak – Weather Station Example

WeatherStation

Channel ID: 12337
Author: MathWorks
Access: Public

MathWorks Weather Station, West Garage, Natick, MA 01760, USA

MATLAB Analysis | MATLAB Visualization

Field 1 Chart

Field 2 Chart

Channel Location

Channel Status Updates
Predictive Analytics Example with ThingSpeak

Predicted and Measured Ockway Bay Tide Chart

Channel ID: 137305
Author: mawrey
Access: Public

Tide measurement and forecasting with the effect of wind predicted using neural networks.

- tide
- wind surge
- neural network

Historical Wind and Tide Data

Neural Wind Forecast

Predicted and Measured Ockway Bay Tide Chart

- Actual
- Astronomical Forecast
- Wind Driven Tide Forecast

Data Export
More Information

MATLAB Analysis
MATLAB Visualization
IoT Analytics Challenges

How do I collect enough data to build my algorithm?

Communications Network

Data Aggregation & Analytics

Deploy analytics to server/cloud

Deploy algorithms to nodes/devices

Smart Connected Devices

How do I deploy my algorithms on a smart device?

Algorithm Development

Sensor Analytics

How do I develop my algorithms?
Sensor Analytics and Development of Smart Connected Devices

- Connect and Acquire
- Signal Processing
- Machine Learning
- Embedded Implementation
Example: Human Activity Analysis and Classification

<table>
<thead>
<tr>
<th>Feature</th>
<th>Classification Method</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVM</td>
<td>Linear SVM</td>
<td>86.4%</td>
</tr>
<tr>
<td>SVM</td>
<td>BoxConstraint = 3</td>
<td>87.1%</td>
</tr>
<tr>
<td>KNN</td>
<td>Fine KNN</td>
<td>94.9%</td>
</tr>
<tr>
<td>KNN</td>
<td>NumNeighbors = 2</td>
<td>90.7%</td>
</tr>
<tr>
<td>KNN</td>
<td>NumNeighbors = 1</td>
<td>94.1%</td>
</tr>
<tr>
<td>KNN</td>
<td>NumNeighbors = 2</td>
<td>93.7%</td>
</tr>
<tr>
<td>Ensemble</td>
<td>NumLearners = 100</td>
<td>95.9%</td>
</tr>
</tbody>
</table>

**Scatter Plot of humanAct**
Objectives
 Measure, explore, discover traffic patterns
 Provide live local traffic information service

Solution
 RaspberryPi + webcam
 Automated deployment of vision algorithms on embedded sensor

Example: Partitioning Algorithms Between Device and Cloud
When should I go to work?
Designing Smart Connected Devices

- Gather data from sensors using I2C/SPI and other interfaces
- Use pre-built libraries for signal processing, computer vision, machine learning and more
- Automatically generate C / C++ and HDL code
- Embedded targeting packages for a wide variety of hardware
IoT Analytics Challenges

How do I collect enough data to build my algorithm?

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Data Aggregation & Analytics

How do I deploy my algorithms to the cloud?

Deploy analytics to server/cloud

Smart Connected Devices

Deploy algorithms to nodes/devices

Algorithm Development Sensor Analytics

How do I deploy my algorithms on a smart device?

How do I develop my algorithms?

How do I collect enough data to build my algorithm?
ThingSpeak for Small Scale Deployment

- Ingest
- Store
- Compute
- External Data & Business Systems
- Deploy analytics To cloud
- Smart Connected Devices
- Algorithm Development Sensor Analytics
Integrating MATLAB with Third Party IoT Cloud Platforms

- **Ingest** IoT Platform
- **Store**
- **Compute**
- **Deploy analytics To cloud**

**Algorithm Development**

**Sensor Analytics**

**Gateway**

**Smart Connected Devices**
Integrating MATLAB in Large Scale Production Systems

Data

- Databases
  - neo4j
  - MongoDB
  - SQL Server

- Cloud Storage
  - Azure Blob
  - Azure SQL

- IoT
  - Kafka
  - MQTT
  - ThingSpeak

Analytics

MATLAB Production Server

Business System

- Visualization
  - Qlik
  - Tableau
  - Spotfire

- Web
  - Microsoft IIS
  - Apache Tomcat
  - WebSphere

- Custom App

Public Cloud

- Microsoft Azure
- Amazon Web Services
- Rackspace
- OpenStack

Private Cloud

Platform
MathWorks Addresses IoT Analytics Challenges

- Quickly collect and analyze IoT data with ThingSpeak and MATLAB
- Develop analytics algorithms using MATLAB and toolboxes
- Deploy on smart devices using code generation and embedded target support
- Deploy on cloud using ThingSpeak and MATLAB Production Server
What You Can Do to Learn More

- Log-in to ThingSpeak with your MathWorks account and explore
- View a webinar on Machine Learning with MATLAB
- Read a Technical Article on Forecasting Tides with MATLAB
- Read a tutorial on how to send data to ThingSpeak over MQTT
Using the Corporate Template

- Avoid manually formatting whenever possible. Instead, use built-in styles, templates, layouts, and colors.

- When creating new presentations, select the slide layout that best suits your needs from the built-in theme, then add content.

- When creating custom shapes, text boxes, and other elements, start from scratch rather than reformatting template shapes.

- When applying the new template to existing presentations, review your presentation carefully and manually adjust any formatting issues that have occurred. For additional help, contact Creative Services.

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