RFID-based Logistics Information Service with Semantic Web

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Research Goal

● Main Goal
  - Effective management logistics information and retrieval
  - Globally connected logistics information service using Semantic Web
    • Support data integration
    • Support Interoperability

● Goal of current step
  - Managing different types of data in a system
  - Information retrieving in the system
RFID-based Logistics Environment

- Logistics Environment
  - Physical flow of products
  - Information (about products, shipment, business transaction, etc)
RFID-based Logistics Environment

★ Case: Baggage transit (airplane)
  - Attaching barcode to the baggage
  - And then?

Send baggage (Code: KE3xxxx) → Transfer (1 baggage transit) → Not Arrived (Where’s my baggage?/Lost?)

Request Information?
RFID-based Logistics Environment

- **Management Logistics**
  - Managing physical flow
    - Manage and control movement of products
    - Movement of products
      - From manufacturer to manufacturer distribution center
      - From manufacturer distribution center to retail distribution center
      - etc
    - Logistics companies are looking for lowest-cost or fastest path/method
  - Managing logistics information
    - Information of products, and movements of products
      - Ex: “Is the product valid for sale?”
      - Ex: “Where the product is now?”
      - Ex: “When the products arrive at the destination?”
RFID-based Logistics Environment

- RFID technology
  - RFID (Radio Frequency Identification)
    - Means of automatically identifying objects
    - Alternative technologies
      - Barcodes
      - Magnetic strips
  - Being applied to many areas
    - Ex: SCM (Supply Chain Management)
RFID-based Logistics Environment

● EPC Network (typical research on using RFID technology)
  - Auto ID center
    • Connecting information and physical flows
    • Automatic, reliable transfer and update of information based on physical operations
  - EPCglobal
    • Standards Development
    • Implementation Support (Commercialization)
  - EPC (Electronic Product Code)
    • Unique ID
      - Header : Company : Object Class : Serial Number
    • Under processing of standardization
RFID-based Logistics Environment

“Managing Logistics Information”
Elements of RFID-based Logistics System

- **RFID & RFID reader**
- **RFID Middleware**
  - Application Level Event: Filtering Event
- **Information Service**
  - Manage EPC-related data & product data
- **Discovery Service of Information Service**
  - Handle Which information services have observation data of a product
- **Naming Service**
  - Provide location of Products’ Information
RFID-based Logistics Information Service

- Logistics Information

![Diagram showing Observation Data, Attribute Data, Containment Data, and Transaction Data]
RFID-based Logistics Information Service

- Logistics Information
  - Observation data
    - RFID sensed data by RFID reader
    - Time-stamped data
    - \{ EPC, Sensed-Location, Sensed-Time \} + \{ additional info \}
  - Attribute data
    - Information of product (instance level)
      - Information of each product
    - Information of product type (class level)
      - Information of a product model
● Logistics Information (Cont.)
  - Containment data
    • Information of Packaging
      - Ex: 10 cellular phones are packed in a box
    • Relation of container and contents
      - Container loads products without data conflict
  - Transaction data
    • Business transaction
      - order, shipment, delivery, etc
      - Information Relation of business transaction and products
RFID-based Logistics Information Service

- Logistics Information Service
  - Manage and retrieve logistics information
Semantic Web in Information Service

- Define Ontology for Information Service
  - Ex: EPC, time, attribute, value,,

- Representation of logistics information
  - Using Semantic Web
    - For effective data sharing information with various applications
      - Data Integration
      - Consistency of data

```
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:epc="http://durumi.cs.pusan.ac.kr/ontology/epc#"
  xmlns:dc="http://purl.org/dc/elements/1.1/">
  <epc:RFID_SensedData>
    <epc:ReadDateTime>2005-06-10 11:34:50</epc:ReadDateTime>
    <epc:ReaderID>rd345612</epc:ReaderID>
    <epc:ReaderLocation>Jang-jeon, Busan</epc:ReaderLocation>
    <epc:ReaderType>Normal</epc:ReaderType>
  </epc:RFID_SensedData>
</rdf:RDF>
```
Type Conversion
- Time
  - Local time $\leftrightarrow$ Standard time (G.M.T.)
- Temperature
  - Fahrenheit $\leftrightarrow$ Celsius
- Unit
  - Length, Weight, Volume, etc
- Etc

Time(G.M.T) $\rightarrow$ Time(Korea) $= G.M.T + 9$ hours

Time(G.M.T) $\rightarrow$ Time(Finland) $= G.M.T + 3$ hours
Data Constraint Check
- Type Checking
- Validity of product in certain condition

<table>
<thead>
<tr>
<th>EPC Code</th>
<th>Product</th>
<th>Valid Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.203D2A.916E8B.8719BAE03A</td>
<td>Electronics</td>
<td>12 ~ 30</td>
</tr>
<tr>
<td>01.203D2A.916E8B.8719BAE03B</td>
<td>Disc</td>
<td>10 ~ 25</td>
</tr>
<tr>
<td>01.203D2A.916E8B.8719BAE03C</td>
<td>Clothes</td>
<td>5 ~ 20</td>
</tr>
<tr>
<td>01.203D2A.916E8B.8719BAE03D</td>
<td>Snack</td>
<td>0 ~ 15</td>
</tr>
</tbody>
</table>
Data Constraint Check (Cont’)

- Containment Data
  - For instance
    - Container CA
      » Contains product P1 and product P2
    - Product P1
      » Food-stuff with moisture
    - Product P2
      » Electronics
      » Cannot be loaded with something moisture

=> P1 and P2 cannot be in the same container
Semantic Web in Information Service

- Containment Data Constraint Check

Diagram:

- Container: urn:epc:id:sgtin:15025.87.485
  - Containment Data
    - ContainerID: urn:epc:id:sgtin:12825.87.485
    - ProductID: urn:epc:id:sgtin:15025.31.110
    - ContainmentRelation: packing
    - Date: 2005-06-09 08:10:50

- Product: urn:epc:id:sgtin:15025.31.110
  - ProductID: urn:epc:id:sgtin:15025.31.110
  - ProductName: SPH-V6900
  - OriginatedCountry: ko
  - ClassIdentifier: unspsc:43191501
  - CommodityName: Mobile Phone
  - BasisPrice: 60,000

- Product: urn:epc:id:sgtin:15025.31.111
  - ProductID: urn:epc:id:sgtin:15025.31.111
  - ProductName: SPH-V6900
  - OriginatedCountry: ko
  - ClassIdentifier: unspsc:43191501
  - CommodityName: Mobile Phone
  - BasisPrice: 60,000

Constraint Conflict
Summary

● Applying Semantic Web to logistics information service
  - For interoperability with applications
  - For data integration
  - Consistency

● Developing Ontology for logistics information service
  - Representing logistics information using that ontology
    • Ease to expand
    • Data type checking and conversion
  - Constraint Checking
    • Containment data, attribute data
Future work

- Development Information Service System
  - Implementation of information service
  - Globally connected information service

- Inference of logistics information
  - Set relationship between logistics information
  - Developing inference engine
Thank you!

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