Distributed System Architectures, Standardization, and Web-Service Solutions in Precision Agriculture

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Introduction

Background

In precision agriculture,

- planning, execution, monitoring and assessment of farming processes are based on spatially referenced data
- decision-making requires data from many sources, e.g.
  - farm based sensors, equipment and software
  - partners, advisors, authorities
  - external services and databases

Improvements in crop production are achieved by using analyzed data in decision-making (Adapted from Pesonen et al. 2010).
Data requirements in precision farming, e.g.

- good quality and accuracy
- easy integration and transfer between different hardware, software, and information systems
- integrated analysis and transformation of data into useful information
- effective management of GIS data

Farm management information system (FMIS) for precision agriculture
Suitable technologies for the implementation of FMIS for precision agriculture, e.g.

- Communication: SOAP, ISOBUS
- Data transfer XML (e.g., GML, ISOBUS-XML, AgroXML)
- Data storing: Relational and spatial databases (e.g., PostGIS)
- Geosensor networks (e.g., Nittel et al. 2004)
- Location platforms (e.g., Chu & Buyya 2007)
- Standards of Open Geospatial Consortium, e.g.
  - Sensor Web Enablement (SensorML)
  - OpenGIS Location Service (GMS)
  - OGC Web Services (WMS, WFS, WCS, WPS)
Motivation

New methods for FMIS design available

- cf. research results achieved in InfoXT, CropInfra and FutureFarm projects (e.g., Pesonen et al. 2008)

Currently there is a need for FMIS pilots and tests

- We will try to give our contribution to this discussion
Research Focus

To develop and implement the acquisition, storage, transfer, and management of spatial agricultural data

To demonstrate interoperable solutions for the FMIS by applying a location-based service platform and a technology of geosensor networks

To assure the quality of spatial data by utilizing appropriate standards: ISO 11783 and OGC’s standards
Implementation of the system

Locawe Platform

Location-aware system platform developed at CENTRIA Research and Development, Ylivieska, Finland

Client-server solution for outdoor and indoor conditions

Consists of mobile units and servers for services, e.g. tracking and communication

Enables creation of user interfaces, which include location and sensor data, and different media formats
Locawe – field experiments:

Remote monitoring mobile robots (Luimula et al. 2010)

Communication techniques in parallel learning (Sääskilahti et al. 2010)

Techniques for location selection (Luimula et al. 2007)

Automatic rotation and zooming (Partala et al. 2006)

Route visualization techniques (Lehtimäki et al. 2008)

Speed-dependent camera control in 3D mobile maps (Partala et al. 2009)
TECU = Tractor Electronic Control Unit
IECU = Implement Electronic Control Unit
CAN = Tractor Internal CAN bus

Source: AGCO Advanced Technology Solutions
Conclusion

Basic functionality of the system architecture was demonstrated and tested.

Interfaces fulfilled requirements for interoperability and scalability.

The use of chosen standards tackled both interoperability and quality requirements.
Future Work

Evaluation of a full performance in a near-deployment phase

Implementation of new interfaces

- Web Coverage Service: delivery of the spatial data in raster format
- Web Processing Service: functionalities for geospatial processing of data

Study of user acceptance and user experiences
Thank You for Your Attention!

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