PRECISION AGRICULTURE

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Overview

- Precision Agriculture (PA)
- PA Current Trends.
- Variable-Rate Technology (VRT).
- Site-Specific Crop Management (SSCM).
- Our Own Developed Sensors.
- Ismailia - A case Study.

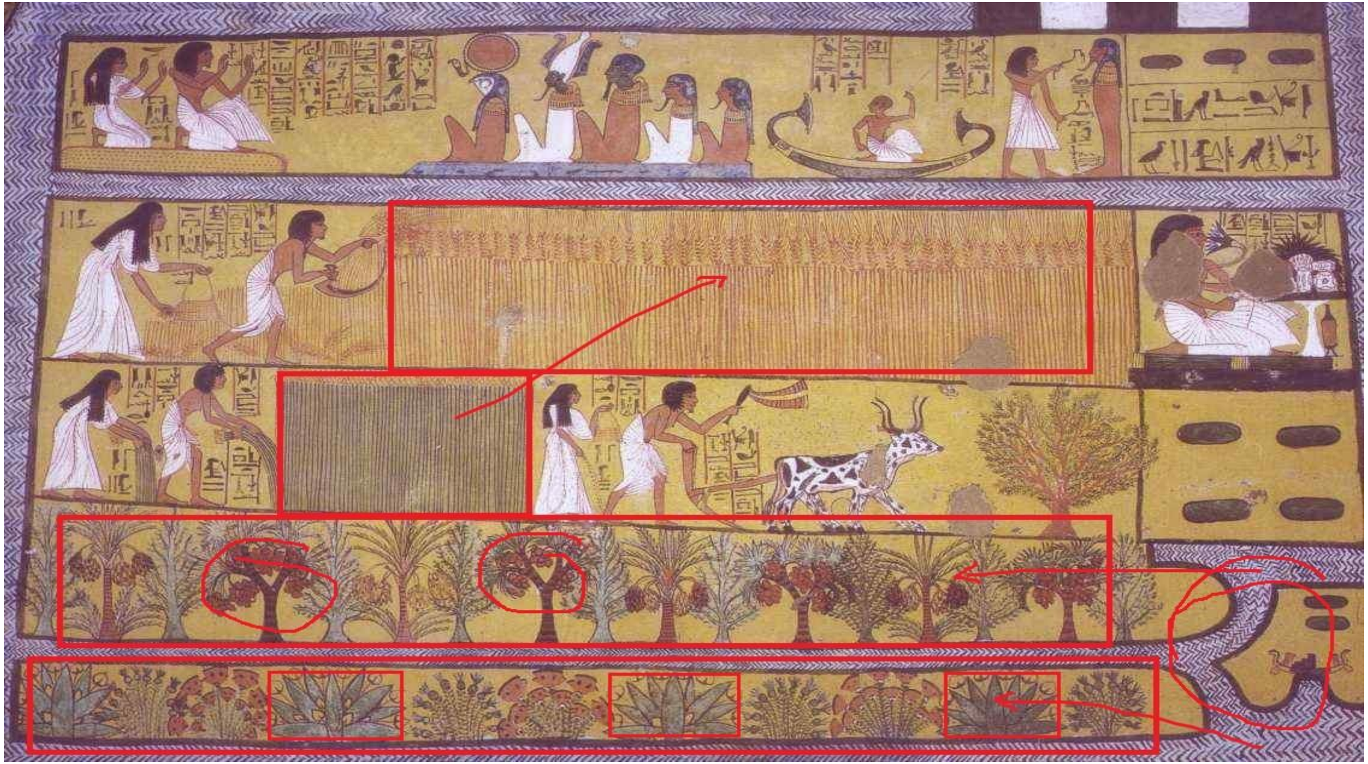
Precision Agriculture (PA)

- An integrated information- and production-based farming system that is designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment.
- Precision Agriculture is NOT a Technology, it is a Management Philosophy to respond to Spatial Variability.

PA History

The term precision agriculture appears to have been used first in 1990 as the title of a workshop held in Great Falls, Montana, sponsored by Montana State University. Before this, in the 80s, the terms ‘site-specific crop management’ or ‘site-specific agriculture’.

History



Precision agriculture issues

Precision agriculture aims to optimize field-level management with regard to:

- Crops:
  Matching farming practices more closely to crop needs
  (e.g. fertilizer inputs).
- Environmental protection:
  Reducing environmental risks and footprint of farming
  (e.g. limiting leaching of nitrogen);
- Economics:
  Boosting competitiveness through more efficient practices
  (e.g. Improved management of fertilizer usage and other inputs).

Precision agriculture issues

Precision agriculture also provides farmers with a wealth of information to:

- Build up a record of their farm.
- Improve decision-making.
- Foster greater traceability.
- Enhance marketing of farm products.
- Improve lease arrangements and relationship with landlords.
- Enhance the inherent quality of farm products. (e.g. protein level in bread-flour wheat)

PA Stages and tools

Precision agriculture is a four-stage process using techniques to observe spatial variability:

1- Geo-location of data:

Geo-locating a field enables the farmer to overlay information gathered from analysis of soils and residual nitrogen, and information on previous crops and soil resistivity.

Geo-location is done in two ways:

1- The field is outlined using an in-vehicle GPS receiver as the farmer drives a tractor around the field.

2- The field is outlined on a base map derived from aerial or satellite imagery. The base images must have the right level of resolution and geometric quality to ensure that geo-location is sufficiently accurate.

PA Stages and tools (Cont.)

2- Characterizing variability:

- Field variability can result from:
- Climatic conditions (hail, drought, rain, etc.).
- Soils (texture, depth, nitrogen levels).
- Cropping practices.
- Weeds and Disease.

This information may come from weather stations and other sensors (soil electrical resistivity, detection with the naked eye, satellite imagery, etc.).

PA Stages and tools (Cont.)

3- Decision-making: 2 ways for dealing with variability

Using soil maps, farmers can pursue two strategies to adjust field inputs:

1- Predictive approach:

Based on analysis of static indicators (soil, resistivity, field history, etc.)

2- Control approach:

Information from static indicators is regularly updated during the crop cycle by:

- Sampling: weighing biomass, measuring leaf content, etc.
- Remote sensing: measuring parameters like temperature (air/soil), humidity (air/soil/leaf), wind or stem diameter is possible thanks to ***Wireless Sensor Networks***
- Aerial or satellite remote sensing: multispectral imagery is acquired and processed to derive maps of crop biophysical parameters.

Decisions may be based on decision-support models (crop simulation models and recommendation models), finally it is up to the farmer to decide in terms of business value and impacts on the environment.

PA Stages and tools (Cont.)

4- Implementing practices to address variability

Application of crop management decisions requires agricultural equipment that supports variable-rate technology (VRT).

Precision agriculture uses technology on agricultural equipment (e.g. tractors, sprayers, harvesters, etc.):

- GPS and DGPS.
- (GIS) geographic information systems.

i.e., software that makes sense of all the available data, variable-rate farming equipment (seeder, spreader).

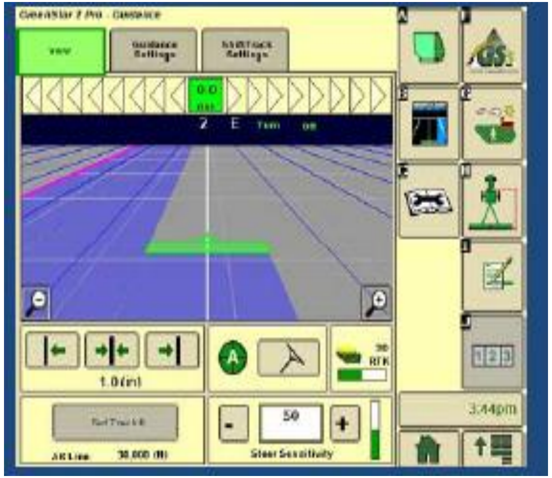
Current PA Trends

- Demand for high-level GPS accuracy (few inches)
  - – Real Time Kinematics (RTK) Correction.
  - – Strip tillage, fertilizing, and planting.
- Input Management
  - – Precise fertilizer and pesticide application.
  - – Variable-rate seeding.
- Solutions for information management
  - – Decision-making.
  - – Utilizing yield data, zone creation.

Guidance

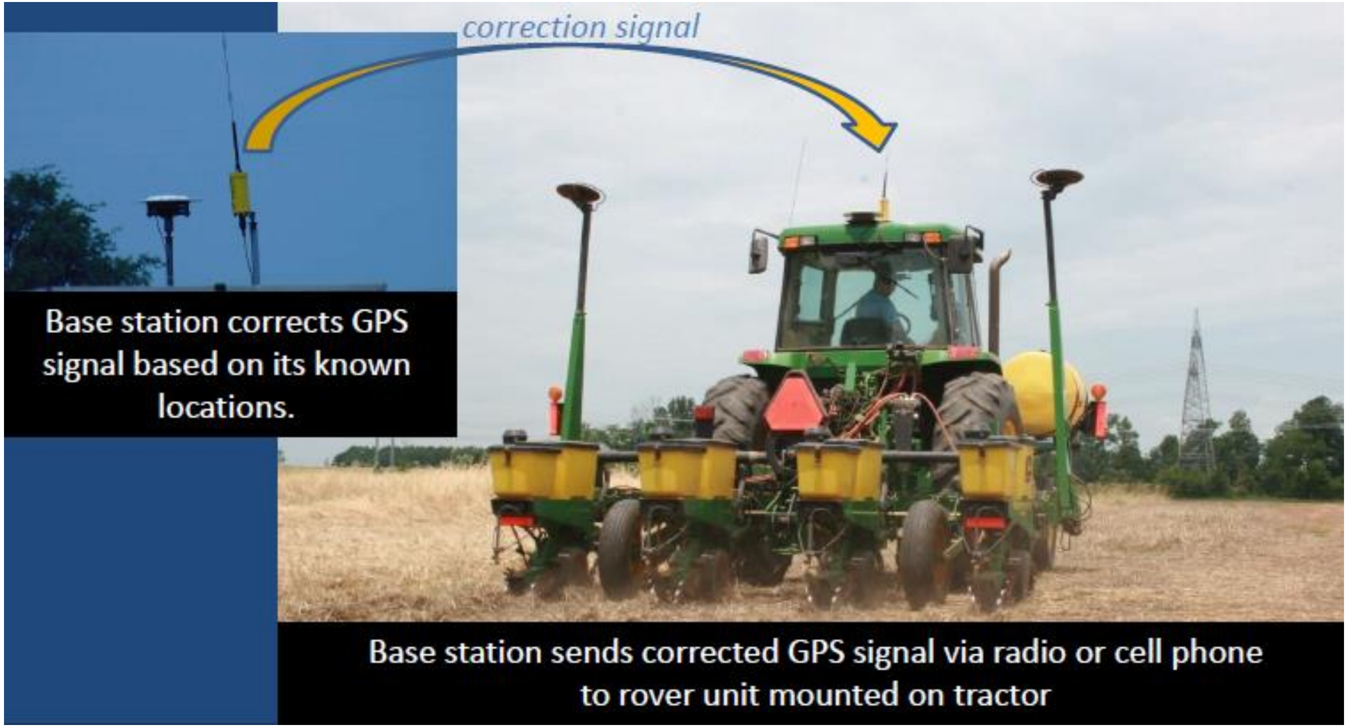
<u>Two Types of Systems:</u>

1. Lightbar or Parallel Tracking
   – Operator still drives machine.
   – Lightbar provides feedback on proper positioning reference.
2. Autoguidance or AutoSteer
   – Machine drives itself.
   – Operator only turns machine around, then lines up on next pass before engaging.



UAV and Field Drones

Real Time Kinematics Technology (RTK)



Nozzle Control

Variable-Rate Technology (VRT)

- Any technology that enables the variable-rate application of agricultural inputs.

OR

- Technology which permits precise application control of inputs.

Uses of VRT

Inputs

- Nutrients / Fertilizer
  - Micronutrients
- Pesticides
  - Herbicides
  - Insecticides
  - Fungicides
- Seeding
- Irrigation

VR Control Systems

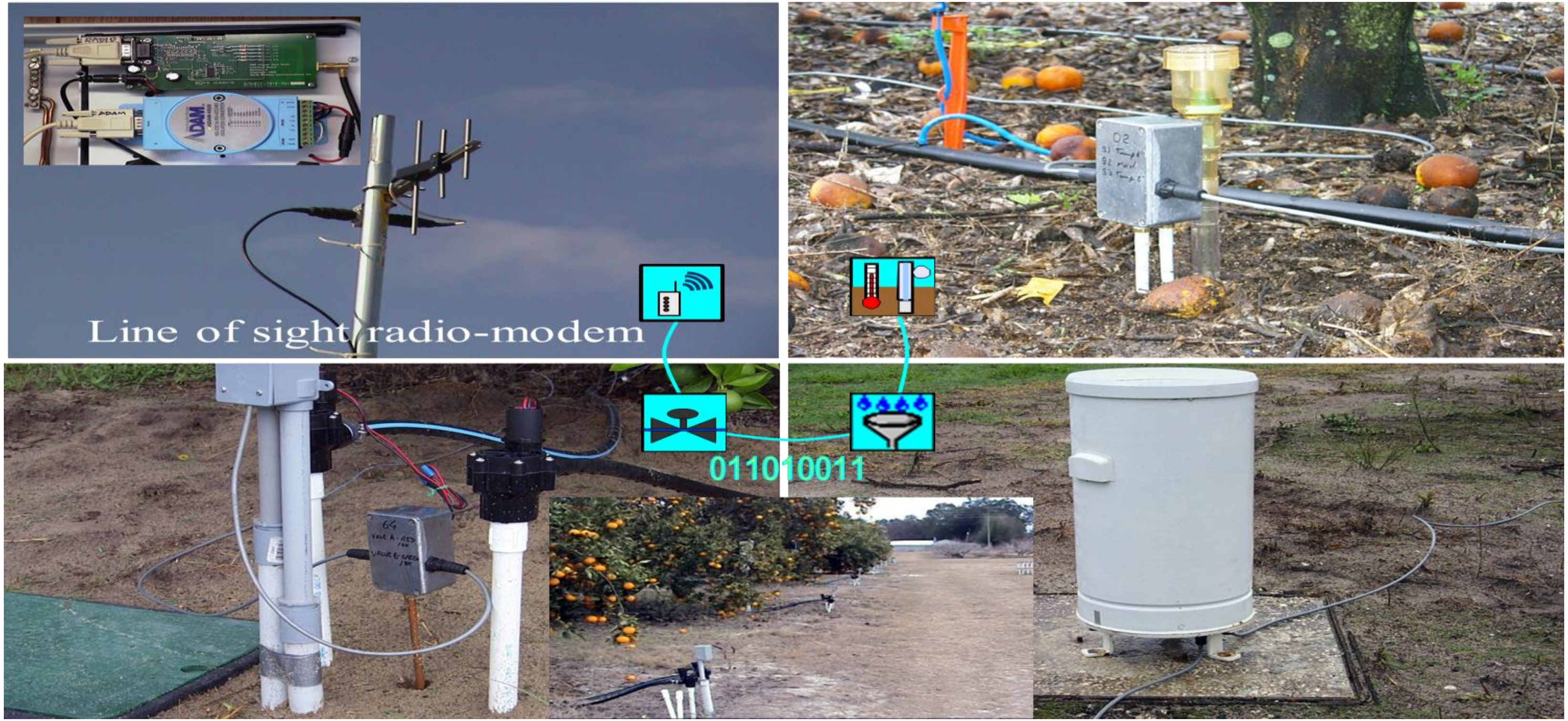
Computer, Controller and Software

DGPS Receiver

Hydraulic Valve and Motor

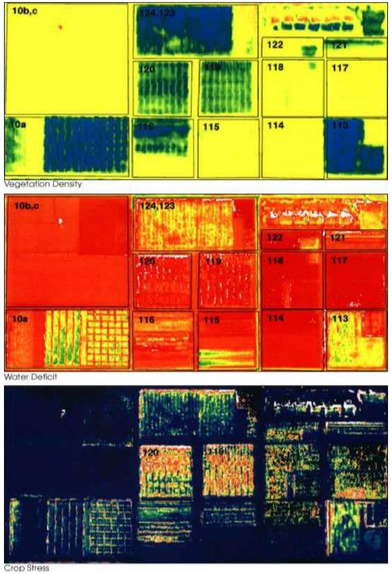
Metering Device

Wireless Sensors



Site-Specific Crop Management (SSCM)

A form of PA whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they vary in the field.
(Yield Mapping)



SSCM & Yield Mapping

Satellite image Red outline is field boundary.

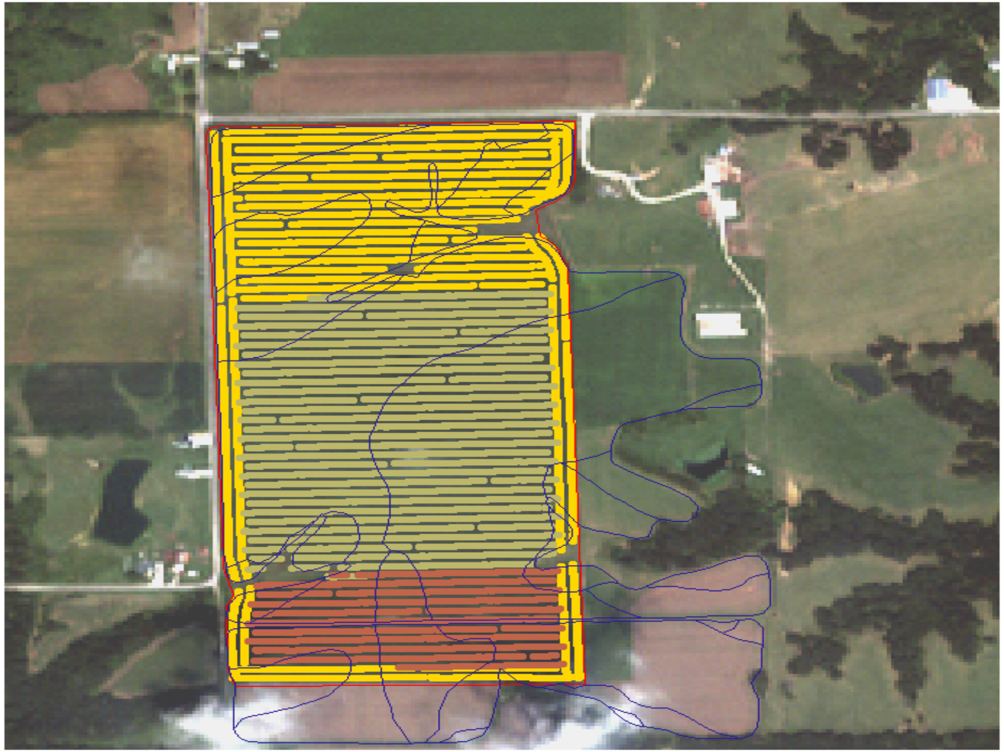
SSCM & Yield Mapping (Cont.)

Planned comparison
Design 3 varieties.

Single-block non-replicated.

Note: soil types are outlined in blue.

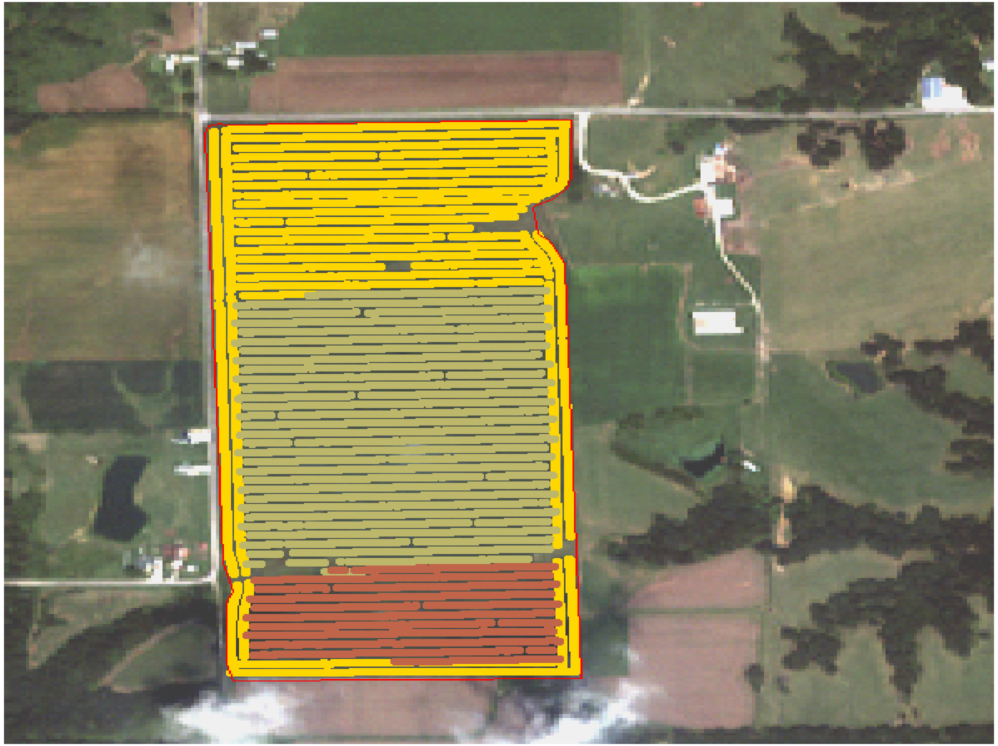
Each variety is represented on each major soil type/zone.



SSCM & Yield Mapping (Cont.)

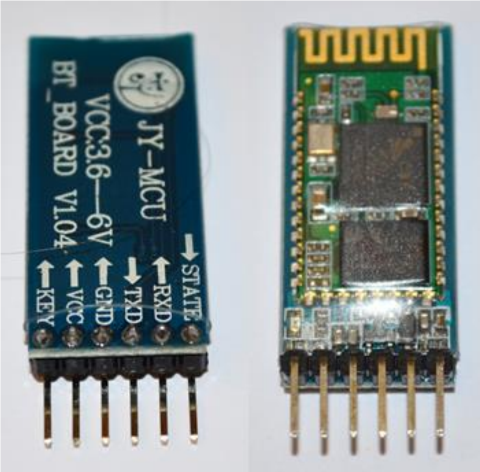
Once designs are decided upon in off-season, implementation is simple at planting time.

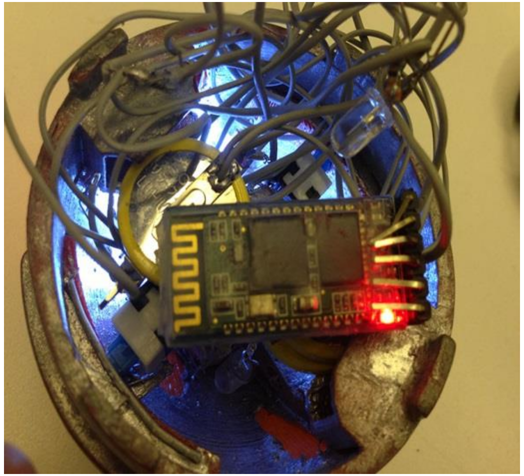
Treatments can be changed at normal planter refilling times.

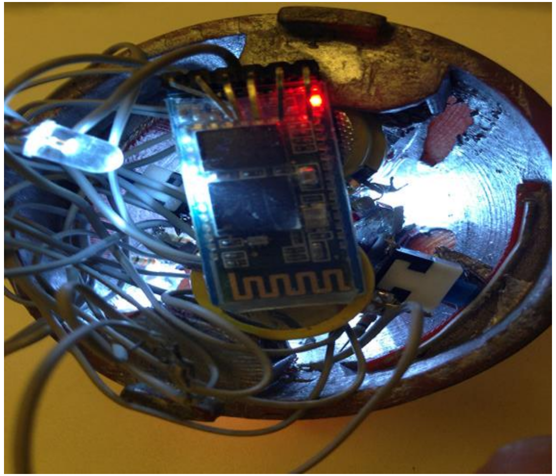


Our Own Developed Sensors

Bluetooth Access Point

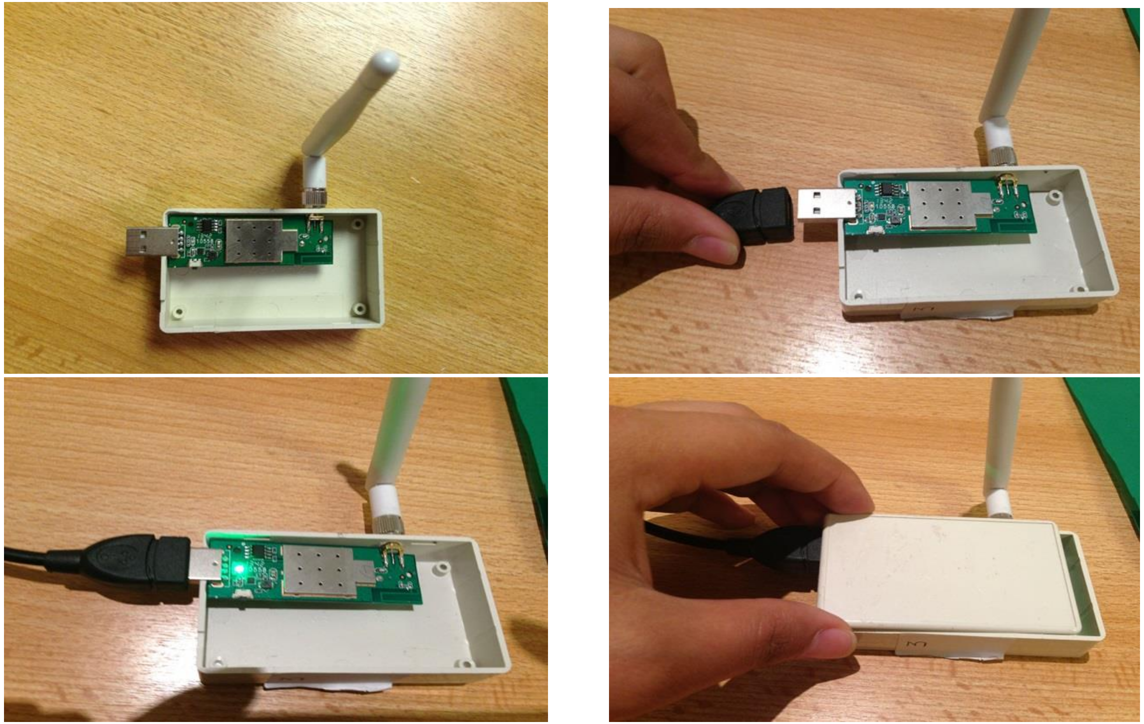




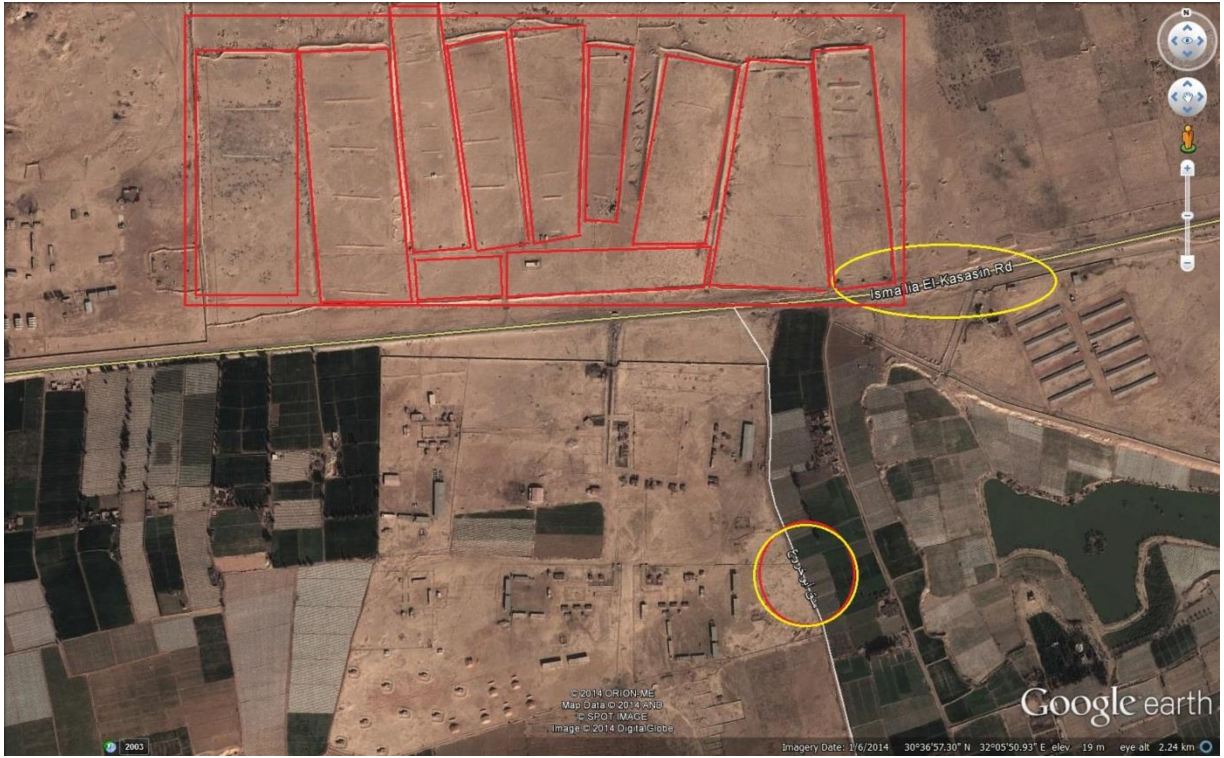


Our Own Developed Sensors (Cont.)

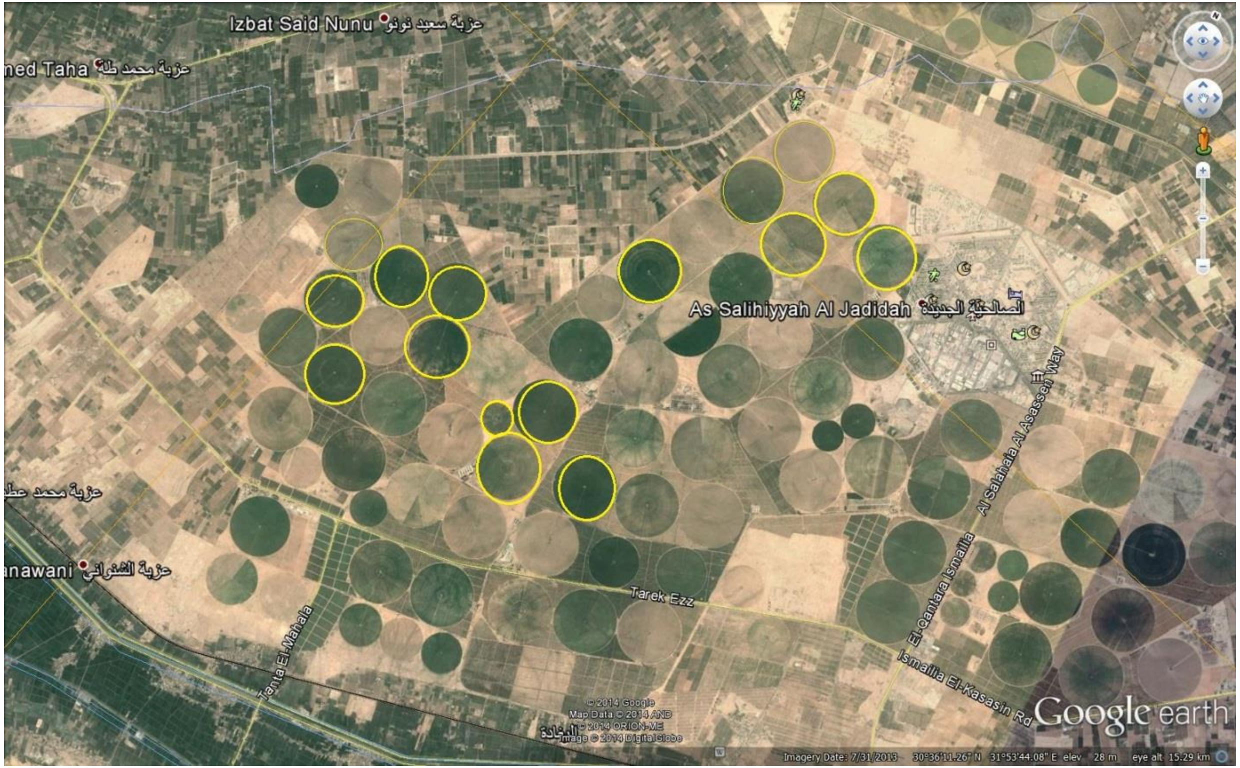
Field Localization Wi-Fi Access Point – Centroid.



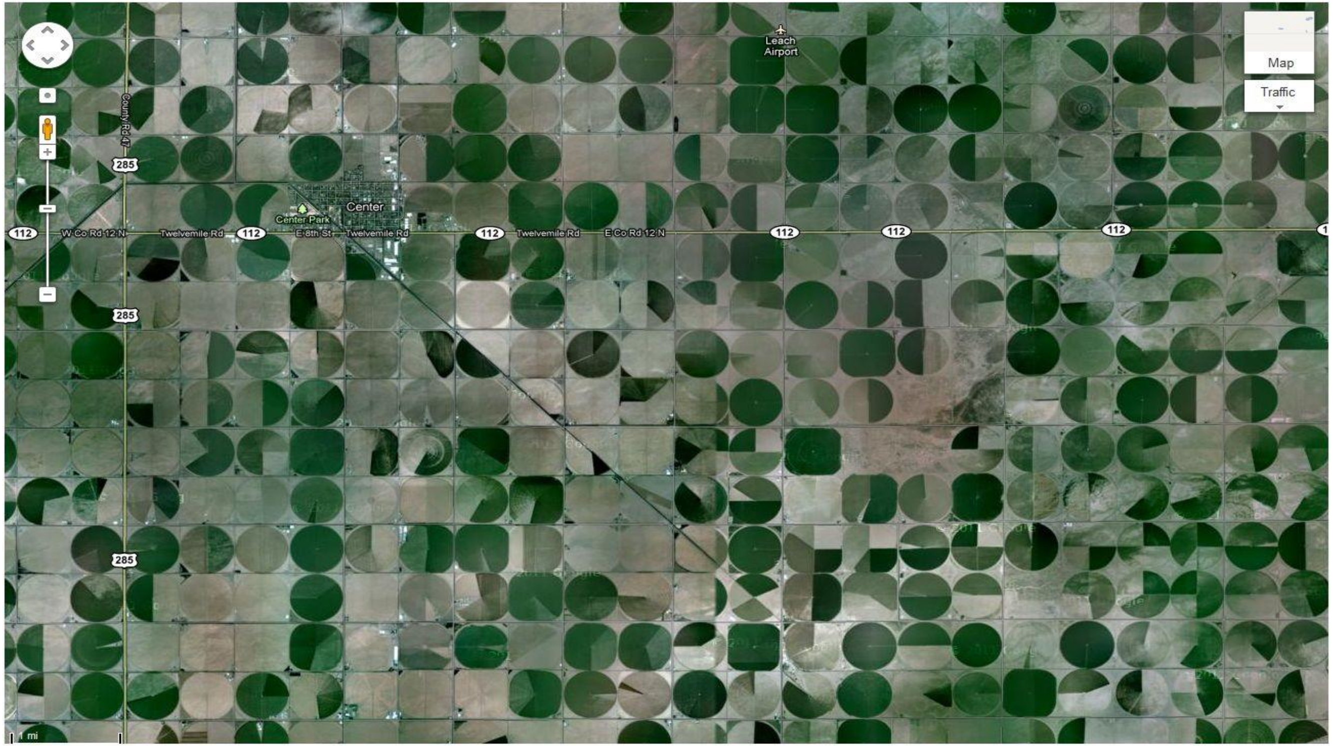
Ismailia - A case Study



Ismailia - A case Study (Cont.)



PA - US


Leach Airport
Map
Traffic
County Rd 47
285
Center
Center Park
112
W Co Rd 12 N
Twelvemile Rd
E 8th St
E Co Rd 12 N
1 mi

Future Directions

- Use of Augmented Reality.
- Reality Mining Services.
- Use of internet of Things.
- Use of Robotics and Cyber Organisms.

Thanks !