Precision Agriculture based on IoT, Cloud, and Mobile Apps

VIRAL Project Workshop
Mostar, October 2020
Content

- Digital transformation
- Digitalization and smart agriculture
- Key enabling technologies
- Precision agriculture applications
- Project examples
Digital transformation

- Using ICT to improve or create new ways to implement business models and business processes.
  - Currently taking place everywhere around us.
  - Incidentally, even COVID19 situation turned out to be one of the main drivers on how we do business.
Key elements

• Digital transformation
  • Infrastructure
  • Services
  • Entitlement
Digitalization and Smart Agriculture

• Smart agriculture:
  • How do we improve existing business processes and models?
  • Can we create new and innovative business models?
  • How to increase and create new value?
Application domains

- Arable Crops
- Fruit and Vegetables
- Livestock
- Supply Chain
Key technologies

- Internet-of-Things, IoT
- Cloud Computing
- Mobile devices
- Big data and data analytics
- Social media
Internet of Things

Image: Deloitte's IoT Reference Architecture
Cloud Computing

- Scalable Computer Resources
  - CPU and RAM
  - Storage space
  - Network and Internet
- Deployment models
- Service models
  - IaaS
  - PaaS
  - SaaS

image: https://networkencyclopedia.com/cloud-computing/
Mobile devices

• Mobile phones and tablets
• User availability and business models
  • 24/7 anywhere
  • Any time
• Two-way communication:
  • Sensors, user input
  • Processing power
  • Remote data access
  • Visualization
Big data and Data analytics

- Big challenges
- Source of value
- The 3Vs

**THE 3Vs OF BIG DATA**

**VOLUME**
- Amount of data generated
- Online & offline transactions
- In kilobytes or terabytes
- Saved in records, tables, files

**VELOCITY**
- Speed of generating data
- Generated in real-time
- Online and offline data
- In Streams, batch or bits

**VARIETY**
- Structured & unstructured
- Online images & videos
- Human generated - texts
- Machine generated - readings

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image: https://www.wishworks.com
Artificial intelligence and Machine learning


ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

MACHINE LEARNING
Machine learning begins to flourish.

DEEP LEARNING
Deep learning breakthroughs drive AI boom.


• New computing paradigm!
• How do we make a model?

INPUT + PROGRAM = RESULT
Vs.
INPUT + OUTPUT = PROGRAM

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Satellite and drone images

- New possibilities
- Different types of cameras, regular, spectral, thermal
- Image processing, calculating various indices
- Combining with other data
Social media

- New paradigm of social interactions
- Another source of data
- Extremely important, high-risk if mismanaged
Geographic Information System GIS

- Geospatial data
- Temporal data
- Visualization of data from various sources
- Multi-layered approach
Dual nature of ICT

- Great possibilities and benefits
- Potentially great risk if not implemented the right way
Smart agriculture

• Context

(Image: T. Popovic et al. Architecting an IoT-enabled platform for precision agriculture and ecological monitoring: A case study, Computers and Electronics in Agriculture)
From data to making decisions

• Data collection and aggregation
• Converting data into information
• Extracting new knowledge from the information (ES, AI, ML)
• Supporting decision making process
Sources of data

- Various sensors and IoT equipment
- Sensors and cameras on drones, satellites, robots
- Sensors and tags on animals and plants
- Sensors on machinery
- Various types of users of mobile devices and computers
- Other Internet sources via API(sites, portals, social media)
- Etc...
Use cases

• Weather conditions and micro-climate
• **Monitoring parameters** in fields, vineyards, orchard, livestock farms
• Agriculture **machinery** and fleet management
• Assessing **health** and **growth**
• **Detecting disease** or conditions for developing diseases
• **Growth** monitoring, detecting optimal **harvesting time**
• **Pest** control and spraying **optimization**
• **Irrigation** optimization
Benefits

- Savings
- Increased yield
- Healthier product
- Better communication with consumers
Irrigation optimization Example

• Sensor
  • Soil moisture, Teros 10 (30cm/60cm)

• IoT node:
  • Mobile and/or LoRa communications
  • Solar and battery power
  • Embedded computing

• AgroNET platform in Cloud
  • Data Integration
  • Visualization
  • Decision Support: Irrigation Optimization
  • Web and mobile access and notifications
Irrigation Optimization Example

• Data collection and aggregation
• Various types of visualizations for different type of users
• Prediction models: heuristics, AI and ML
• Inclusion of domain experts' know how
• Decision making support: **do or do not turn on the irrigation valve!**
• The use of metrics to assess the benefits
Projects at UDG

- **TagItWine** – H2020 TagItSmart
- **DIPOL** – Digital transformation of agriculture and food supply chain in Montenegro
- **H2020 DEMETER** – Building an Interoperable, Data-Driven, Innovative and Sustainable European Agri-Food Sector
- **VIRAL ErasmusPlus** – Vitalising ICT Relevance in Agricultural Learning
Collaboration

- University of Donja Gorica
- 13. Jul Plantaže
- DunavNET
TagItWine

• Use of active QR codes
• Food track and trace use case
• Counterfeit prevention and detection
DIPOL

- Precision viticulture
- Precision agriculture in orchards
- Food supply chain
DIPOL: Precision Agriculture

- Data collection
  - Weather stations
  - Soil moisture
  - Leaf wetness
  - Pheromone traps with cameras
  - Weather forecast data
- Digital platform (AgroNET) and Use Cases
  - Data collection and visualization (Cloud)
  - Irrigation optimization
  - Disease prediction
  - Insect monitoring and Spraying protection
Global Outreach:
- 69 farming associations
- 47 Countries
- 1.5 Billion People

Multi-Actor Approach
- Using Practical skills
- 8 knowledge to target real life needs, problems & opportunities.

18 Countries
15 member states
60 Partners
318k hectares of land
5.7k Farmers
318k hectares of land
5.7k Farmers
29k Sensors used across 80 sites
9.2k Devices & 131 Large Machinery
20 Pilots
5 Agri Sectors
VIRAL

• Educate educators
• Engage and educate farmers
• Engage business partners
• In-house and field labs
• Workshops / conferences / hackatons
• Partnership development
Conclusions

- Digital transformation and agriculture
- Importance of including ICT in agricultural learning
- Competitive advantage in agriculture
- The time is NOW!
Thank you!

• **VIRAL** project:
  http://viralerasmus.org/

• **DIPOL** project:
  https://dipol.udg.edu.me/site/

• **H2020 DEMETER** project:
  https://h2020-demeter.eu/