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IDIMT-2023
New Challenges for ICT and Management

31st Interdisciplinary Information Management Talks

With pride we present the proceedings of the 31st annual IDIMT Conference.

The post-covid period brings with it additional challenges for both informatics and information management. The current era is associated with expectations of digitization and a sharp increase in labor productivity, mainly thanks to the former. Of course, this means increased pressure on the security of information technologies and on the knowledge of those workers who design them, as well as the employees who work with them. These topics are explored from different angles in the papers of this conference. We have chosen the following 9 topics for 2023:

- Crisis Management and ICT (Georg Neubauer, Karin Rainer)
- Cyber Security (Michael Sonntag)
- Virtual Collaboration, Teaching & Learning (Anne Jantos)
- Autonomous Vehicles and Smart Environments (Erwin Schoitsch)
- Management of ICT Systems (Petr Doucek)
- Social Media (Antonín Pavlíček)
- Digital Transformation of Supply Chain Management (Radoslav Delina)
- Ethical Aspects of Working with Data (Anton Lisnik)
- Special session: Early Career & Student Showcase (Michael Sonntag)

Based on a double-blind two-step review process we have selected 42 of the submitted papers with a totality of more than 128 co-authors. The program ran in two parallel streams.

The authors come from 10 different countries: Austria, Croatia, Czech Republic, Germany, Greece, Hungary, Palestine, Slovakia, Slovenia and Sweden.

DOI:10.35011/IDIMT-2023

9 783991 511762
ISBN 978-3-99151-176-2
www.trauner.at

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Schriftenreihe Informatik
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Pelegri J. et al. (2002), “Vehicle detection and car speed monitoring system using GMR magnetic sensors,” in IEEE 2002 28th Annual Conference of the Industrial Electronics Society. IECON 02, Sevilla, Spain, 2002, vol. 2, pp. 1693–1695, doi: 10.1109/IECON.2002.1185535.

Peng, F. et al. (2014), “Ultra-long high-sensitivity Φ-OTDR for high spatial resolution intrusion detection of pipelines,” Opt. Express, vol. 22, no. 11, p. 13804, Jun. 2014, doi: 10.1364/OE.22.013804.

Roy (2022), “Automated traffic surveillance using fusion of Doppler radar and video information,” Mathematical and Computer Modelling, vol. 54, no. 1–2, pp. 531–543, Jul. 2011, doi: 10.1016/j.mcm.2011.02.043.

Walter, F. et al. (2020), “Distributed acoustic sensing of microseismic sources and wave propagation in glaciated terrain,” Nat Commun, vol. 11, no. 1, p. 2436, Dec. 2020, doi: 10.1038/s41467-020-15824-6.

Wang, C. (2018), “Reliable Leak Detection in Pipelines Using Integrated DdTS Temperature and DAS Acoustic Fiber-Optic Sensor,” in 2018 International Carnahan Conference on Security Technology (ICCST), Montreal, QC, Oct. 2018, pp. 1–5, doi: 10.1109/CCST.2018.8585687.

Wiesmeyr, C. et al. (2021), “Distributed Acoustic Sensing for Vehicle Speed and Traffic Flow Estimation”, 2021 IEEE 5th International Conference on Intelligent Traffic and Transportation Proceedings (ITSC), p. 2596-2601, doi: 10.1109/ITSC48978.2021.9564517

ERASMUS+ PROJECT 'BENEFIT' – BOOSTING INNOVATION IN DIGITAL FARMING

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DOI: 10.35011/IDIMT-2023-169

Keywords

BENEFIT, Erasmus+, digital farming, precious agriculture, EU–Palestine cooperation, Agriculture 4.0, aquaponics farm

Abstract

The article presents the Erasmus+ project BENEFIT implemented from 2020 to 2023 as an example of cooperation between universities in the European Union and Palestine. The key objective of the project was to support digital farms and the application of smart technologies in precision agriculture. The project was primarily focused on the university sphere, so one of the main outputs was the preparation of study courses related to precision agriculture at Palestinian universities, where European partners oversaw evaluation to ensure the courses met modern education quality requirements. The project also included developing new technologies and transferring ideas and solutions to the commercial sphere. This paper is focused on the part of the project solved at VŠTE in České Budějovice. Among other things, VŠTE analysed successful digital farm solutions in the Czech Republic and supervised some of the prepared training courses. As part of the project solution, a scientific meeting was also held in Prague in September 2022, where the method of aquaponics fish farming combined with the cultivation of useful plants (Aquaponia Hostomice) was presented to the Palestinian participants.

1. Introduction

In 2020, the project BENEFIT (609544-EPP-1-2019-1-PS-EPPKA-CBHE-JP, http://benefit.edu.ps) was launched. The project was run under the Erasmus+ Capacity Building for Higher Education programme by a consortium of Higher Educational Institutions (HEIs) from European Union (EU) countries – Czechia (VŠTE in České Budějovice), Slovakia (Slovak University of Agriculture in Nitra), Greece (University of Patras) and Bulgaria (University of Ruse) connected with five universities in Palestine (Al-Quds Open University, An-Najah National University, University Hebron, Al-Istiqlal University, Palestine Technical University 'Khadoorie') to address the challenges faced by Palestine regarding applying information and communication technologies (ICT) and technological innovations in agriculture. Digital farming, also called precision agriculture (PA), is an innovative concept in the Middle East, especially in Palestine. Precision agriculture is a whole-farm management approach using innovative technologies such as ICT, global navigation satellite system (GNSS) positioning data, remote sensing and proximal data gathering. This is not specifically only about the technologies but about the overall concept putting an accent on understanding how the technologies can make farming more accurate and controlled (Palková et al., 2022). In 'National Agricultural Sector Strategy 2017-2022 – Resilience and Sustainable Development' (2016), several key factors were identified that negatively impacted the development of (sustainable) agriculture: a weak capacity to keep up with technological progress, low competitiveness of local products and abandoning production processes. Automated robotic systems can bring agriculture flexibility in farmer decision making to select the optimal technological arrangements during the field crop production process, which entails economic, environmental and social aspects.

The main goals of the BENEFIT project are:

- Involve Palestinian HEIs in the PA research movement in Europe.

- Encourage Palestinian researchers and academics to have an interest in topics related to the concept, domains, tools and digital technology of PA (e.g. a wide array of items such as GNSS guidance, control systems, sensors, robotics, drones, autonomous vehicles, variable-rate technology, GNSS-based soil sampling, automated hardware, telematics and software).
- Define a qualification profile and the PA curriculum and elaborate assessment standards.
- Involve Palestinian farmers in PA processes, enhancing them with critical-reflective and creative skills.

Parallel with the abovementioned activities, the installation process was realised for equipment related to digital farming laboratories, including equipment deployment and testing. Al-Quds Open University established an innovative management structure to ensure the successful implementation of all activities and the collaboration of all partners to achieve the intended results and impact.

2. Methodology

The project's innovative character serves to the capacity building of Palestinian HEIs and addresses the challenges EU countries face regarding ICT, technological developments and creating a global research framework that will promote innovation and integration of the newest digital technologies into agriculture and rural development. The following actions have been proposed as possible solutions to these problems:

- Work with the private sector to keep abreast of new technologies and encourage their entry into the local market.
- Continuously train human resources in the agricultural sector to keep current with technical agricultural progress.
- Establish a hub for digital agriculture (BENEFIT Incubator).
- Develop a PA e-Repository.
- Design, pilot and evaluate the initial courses focusing on PA.
- Create an international PA research network.

Palestinian university teachers and researchers represent BENEFIT's primary target group. The second (indirect) group includes students, school teachers, innovators, media-related education and business (i.e. chambers of commerce) and policymakers. These groups will create a dynamic shift to launch the concept of digital farming into different sectors, particularly the commercial sector and practical implementation.

Moreover, having partners from EU countries will help Palestinian HEIs develop their quality of services on many levels, including the capacity building of academic and technical staff, setting up the project to European benchmarking standards and allowing for transparency and efficient monitoring and follow-up. Furthermore, as the project involves a consortium of diverse actors with varied methodologies, knowledge and skills, it would be crucial to have EU partners conduct the change and avoid potential obstacles as they have relatively extensive related experience.

In addition, the EU partnership will ensure that the project will be durable through a dissemination strategy. The EU partners will share the project's outcomes and outputs and create/facilitate new networking possibilities with other EU partners.

3. Case studies of digital farming in Czechia

To involve Palestinian HEIs in the PA research movement in Europe, VŠTE analysed existing PA projects in the Czech Republic. In this chapter, several case studies of successful projects are presented. The ideas of these projects can be a source of best practices for universities that participated in the BENEFIT project.

3.1. CleverFarm

An example of a successful PA startup is the Czech company CleverFarm, founded in 2016 (https://www.cleverfarm.ag/). The company offers a whole range of products and services to Czech farmers, with the company's main product being 'smart maps' in the form of a software application (the basic version is free, but additional modules can be purchased). Data from available maps of agricultural land are linked with data from the cadastre, satellite images and meteorological data. The application then supplements this data with information on compliance with agricultural and ecological regulations (fertilisation records, nitrate directive monitoring, Land Parcel Identification System, etc.). Furthermore, the application provides a three-day weather forecast for the monitored location.

Paid add-on modules allow the application to be connected to smart machines (e.g. tractors communicating via ISOBUS ISO 11783 interface) and thus manage, for example, fertilisation. Another module works with online soil sensors and includes an Internet of Things (IoT) Salinity sensor (measures soil moisture, temperature and conductivity), an Absorb soil sensor (measures water potential in the soil) and a Volumetric sensor (measures the volume of water in the soil). Sensors can be connected using SigFox, LoRa, or NB-IoT networks. They offer protection with an IP68 rating and are powered by batteries that have a lifespan of 1.5 to 2 years. The application can also predict selected plant diseases based on measurements (damage caused by corn borers, septoria and phaeosphaeria wheat spots, fusarium head blight or potato gangrene).

Figure 1. Soil sensors from CleverFarm Source: (https://www.cleverfarm.ag/products/sensors/)

Another paid module of the application obtains current information from the cadastre (checking the validity of rental contracts, keeping an overview of paid rent, etc.) and creates documents for tax returns.

The CleverFarm system has been deployed in several agricultural enterprises and has references abroad. For example, it has been employed in Chile to cultivate sour cherries in water-scarce areas, where the optimisation of irrigation management has a significant impact on the economics of cultivation.

3.2. FishRAS

The FishRAS is a recirculation aquaculture system (RAS) project of students from the Czech University of Life Sciences, which consists of breeding fish in a system with a closed water cycle. The fish are kept in tanks with a filter system that cleans and oxygenates the water and returns it to the tanks. The main goal of this project is a significant reduction of water consumption, so this solution is especially attractive for countries facing limited water resources. Other advantages of RAS technologies are eliminating the threat of fish predators and preventing the spread of transmissible diseases.

Figure 2. FishRAS Source: (Ryby-Vlček Facebook, 07-Mar-2019)

3.3. Vertical hydroponics – Feel Greens

A commercial application of vertical hydroponics can be observed in Fosfa a.s.'s Feel Greens farm in Břeclav, South Moravia (https://web.fosfa.cz/en/products/feel-greens/). It took three years to develop this multi-floor farming solution, which is particularly suitable for areas lacking space, such as densely populated regions or urban agglomerations. Compared to classic cultivation, this system only uses a tenth of the water. Hydroponics enables selling plants with a root ball, significantly prolonging their freshness during transport. Due to the closed water circulation and air filtration, no pesticides are needed, and cultivation has no waste. The company has plans to expand production in the near future.

3.4. Varistar

Varistar (https://www.variabilni-aplikace.cz/en/our-services/varistar-portal) offers added value by not selling specific products but a comprehensive service emphasising long-term operation. The company offers an application that integrates data collection from various sources, such as PlanetScope satellite images, soil analysis maps and drainage line maps, which make it possible to create maps of revenue potential and production zones. The system further enhances data utility by enabling Smart Scouting analysis, which helps identify potentially risky areas or zones where plants may fail. Preparing documents for variable soil processing or maps for variable stock fertilisation is also possible. The Varistar system enables connection with spreaders, sprayers and sowing machines of most major manufacturers, including AMAZONE, Bogballe, Fieldstar, Horsch, Kuhn, Kverneland, RDS, Vicon, Väderstad and others. Furthermore, the system supports remote (online) and unattended uploading of created application maps to the terminal of the application device.

3.5. Aquaponics Farm Aquaponia

During the BENEFIT scientific workshop in Prague in September 2022, Palestinian participants visited the aquaponics farm, Aquaponia s.r.o, in Hostomice (near Beroun, 50 km from Prague). The farm focuses on the production of tilapia, trout, sturgeon and African catfish and cultivating herbs such as basil, chives, and baby lettuce. Fish produce natural waste that provides essential nutrients plants require to develop. While the plants absorb nutrients and purify the water, the clean, oxygen-rich water is reintroduced to the fish ponds, reducing water consumption by about 90%. Both the fish and plant production are completely ecological, without any chemical additives. This model could be transferred to Palestine due to considerable water savings and the popularity of tilapia fish in the Jordan Valley.

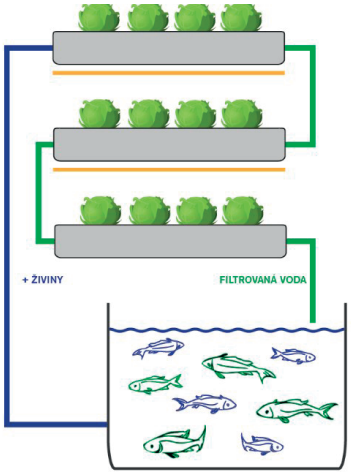

Figure 3. Scheme of aquaponics production Source: (https://aquaponia.cz/jak-to-delame/)

Figure 4. Aquaponics production – fish and plants. Aquaponia Hostomice Source: own

Although the conditions for agriculture in Palestine are different from the Czech Republic (different climate, legislation, etc.), the mentioned case studies of digital farming are focused on transferable technological aspects.

4. New digital farming courses and technologies developed at Palestinian HEIs within the BENEFIT project

Under the supervision of EU project partners, Palestinian universities prepared new courses focused on PA, bought new equipment for PA laboratories and developed new technologies. Some examples of the project BENEFIT outputs are described below.

4.1. AgriLive Monitoring System

A real-time monitoring system based on IoT technology, AgriLive, was developed at Al-Istiqlal University in Jericho to collect data and transmit it to cloud servers.

Figure 5. AgriLive sensor Source: (Al-Istiqlal University, Dr Walid Khalilia)

AgriLive allows multiuser authentication and wireless connection. It is powered by either solar energy or battery and provides a wide range of hydrological sensors, including temperature, pressure, soil moisture, electrical conductivity (salinity), pH and flow meter, with the ability to control actuators like valves or pumps. Current data is presented as a real-time dashboard, while historical data is in the form of graph reports. This data can be exported to Mircosoft Excel for further processing. The system is currently utilised at student-managed date palm and banana farms.

4.2. Precision Agriculture Course at Palestinian Technical University Kadoorie

The course consists of six modules:

- Measuring Soil Moisture and Temperature in Precision Farming
- Precision Technology in Irrigation Scheduling – water flow in pipelines and open channels, programming and management of irrigation water and irrigation scheduling
- Precision Technology in Fertilizers Management – soil nutrients reaction and transformation, soil nutrients evaluation, methods of fertilisers application and fertiliser programming,
- Big Data Management
- Control of Smart Greenhouses – based on analyses by Gaikwad et al. (2016) and Dwinugroho (2021)

- Precision Technology in Poultry Farms and Hydroponic Units – principles of PA in crop and livestock production, data acquisition and management, the application of the sensor in poultry farms and in the cultivation of hydroponic barley
- Precision Technology in Plant Physiology

4.3. Digital Farming and Environmental Safety Course

This course, prepared by Al-Istiqlal University, reviews the principles of photogrammetry and remote sensing related to agriculture, land surveying, geographic information systems and environmental safety. It includes understanding the necessary mathematics and information technology concepts required for image processing and analysis. Photography and digital photography are covered, emphasising designing and creating the data required to obtain survey information following established standards. In May 2022, a BENEFIT project meeting at SZU Nitra (Slovakia) discussed the usage of unmanned aerial vehicles (UAVs) for detecting plant diseases. Čermáková and Danel (2022) published a detailed analysis of UAVs in PA, and project INVARO, which focuses on detecting invasive plants by UAV, was referenced. These findings can also be applied to the teaching of 'digital farming' courses prepared during the BENEFIT project.

5. Conclusion

Digital farming still represents a new field of science. Even if there are five agricultural faculties in Palestine, there are no specialists at the national level. Therefore, providing researchers at national universities with new experience and knowledge in PA is a national priority for Palestine. To accelerate the adoption of digital farming, researchers and technicians must intensively participate in scientific visits, workshops and training courses. The BENEFIT project and its activities can significantly improve the implementation of innovative technologies in agriculture in Palestine and increase the cooperation between the EU and Palestine.

Acknowledgement

This paper was supported from Erasmus+ project 609544-EPP-1-2019-1-PS-EPPKA-CBHE-JP.

References

Čermáková, I. and Danel, R. (2022). Usage of Unmanned Aerial Vehicles for detection of plant anomalies. 30th Interdisciplinary Information Management Talks: Digitalization of Society, Business and Management in a Pandemic, Prague, pp. 367-374.

Gaikwad, A., Ghatge, A. Kumar, H. & Mudliar, K. (2016). Monitoring of smart greenhouse. International Research Journal of Engineering and Technology (IRJET), India, 3(11).

Dwinugroho T. B., Hapsari Y. T. and Kurniawanti T. (2021). Greenhouse automation: smart watering system for plants in greenhouse using programmable logic control. Journal of Physics – conference series 1823(2021).

Palková, Z., Harničárová, M., Valíček, J., Stehel, V., Mihailov, N., Fragkaki, M., Khalilia, W. and Salameh A. (2022). Perspective of education in Agriculture 4.0 in selected countries in European Union and Palestine. 8th International Conference on Energy Efficiency and Agricultural Engineering, Ruse, Bulgaria.

Resilience and Sustainable Development – The State of Palestine Ministry of Agriculture. National Agricultural Sector Strategy 2017-2022 (2016). Online, Available at https://prais.unccd.int/sites/default/files/2018-07/English%20Strategy%202017-2022.pdf