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EMBEDDED INTELLIGENT ADAPTRONIC AND CYBER-ADAPTRONIC SYSTEMS IN ORGANIC AGRICULTURE CONCEPT FOR IMPROVING QUALITY OF LIFE

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Abstract: Adaptronics science as scientific and multi-interintegrator strategy is used as a vanguard of opening new possibilities for the design, construction and implementation of innovative products and adaptronics systems. Testing soil and arable land can be improved by adapting existing solutions in different areas. An example is the smart device, drone type that can be used in the testing and monitoring of soil and arable land. Precision agriculture is the key area where drones already proving its economic efficiency. If until now, unmanned aerial vehicles were most often used in military and intelligence area, 2015 was an important year in agribusiness supported by the use of such devices: the price is now accessible and the law clarified some aspects of their detention in civilian purposes. An important aspect is the concept of organic agriculture used to improve quality of life.
Keywords: adaptronic and cyberadaptronic systems, organic agriculture, drones, agribusiness

INTRODUCTION

In a research area defined by many of the biggest challenges faced by specialists in computer science and robotics, today, a big challenge is probably related with creating algorithms and programming language for adaptronic and cyber-adaptronics equipment in order to obtain information and analysis using existing infrastructure. An adaptronic and cyber-adaptronic integrates mechanical, electronic and software components implemented on a PC or MCU to produce a flexible and intelligent performing complex signal and data processing. In many cases, adaptronics and cyber-adaptronics systems can be used to improve the performance of a system beyond what can be achieved using manual or ordinary means. Modern society depends on adaptronics and cyber-adaptronics systems for facilities and luxurious living standard that assures them but also for the accuracy of the information provided by them. From devices to smart safety features in cars (such as air bags and ABS) adaptronics and cyber-adaptronics systems are widely used in everyday life.

STATE OF THE ART

Variety of crop plants growing on different types of soil and prefer a particular type of soil. Soils are characterized by structure, pH, water retention power, structure and chemical composition. Testing the soil and arable land analyzes geotechnical and chemical soil properties, allowing establishing strength, density, compaction, contamination, organic composition and content of sandy soil etc.
Analyses of soil properties helps farmers fiind aut quality of the land used for farming and especially what resources remained unused from fertilizers applied.
In dry years, water shortages may cause some problems with fertilizers and may not solubilize, they remain in the soil and on the following crop may be accessed by plants. As a result the farmer may reduce the dose of fertilizers such as phosphorus or potassium, if they know exactly, from analyzes of soil, which is the content of these elements. Nitrogen nor solubilized not spread deep if we have rain. Then, it is good to know that the nitrogen content of the soil may be higher following the drought, which means that fertilization of spring we apply a smaller amount.
There are companies specialized in soil testing and use various devices: precision balance, digester microwave equipment, conductivity equipment, pH meter, ovens, sipper, spectrophotometer, hammer milled, magnetic stirrer, air-determining ions in the soil, machine for homogenized, device for producing ultrapure water, etc.

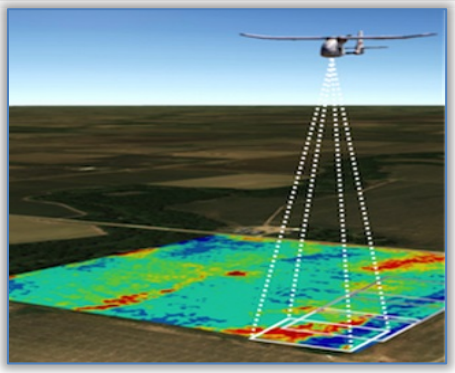

Figure 1: Drone used in agriculture - SLANTRANGE company concept

In Romania: in the last decade, climate change, manifested by periods of drought and flooding, which have become more frequent, occurred on agriculture, resulting in less agricultural production, especially wheat and corn. The data presented in the National Strategic Plan of Romania for the period 2007 - 2013 reveal that due to the high share of cereals (60%) and industrial crops (16.3%) and unfavorable climatic conditions, average grain yields achieved were very low compared to the country average potential (NIS 1998/2003 country level). In the period 1999-2001, the average yield of wheat and rye was 2048 kg/ha, compared with the average country potential of 5500-7000 kg/ha, and the maize production was recorded average of 3,042 kg/ha corn, compared with the average country potential of 8000 kg / ha (NIS 1998/2003 country level) (NIS 1998/2003). Of arable land in Romania prepared for irrigations (2,871 million ha, of which until 2003 were rehabilitated 1.5 million ha (hectares rehabilitated) in 1998-2003 were actually irrigated (at least a watering) between 15,6 and 37,9% of the rehabilitated surface (OECD - 1998/2003 NUTS III), due to lack of irrigation equipment and failure to achieve adequate structures of potentially irrigated crops in optimal conditions.

Due to the fact that Romania is the category of countries poor in water resources, with an average of only 2660 m^3 / place / year (excluding water from the Danube), compared to the average of 4000 m^3 / year / in Europe, and the uneven spatial and temporal distribution requires a well-controlled management and use of this resource, and also the use of all methods (agro-technical, crops structures with genotypes drought-tolerant) for maintaining the stability of crops and agro-ecosystem biodiversity. Moldavian Plain are characteristic of precipitation as rain, which meet in April - May and their uneven distribution during the year.

Multi data from the study found say that every two years droughts can last for 28 days, every ten years can last 42 days, and in five cases out of a hundred, drought can last 48 days. Water scarcity is felt acutely on slopes, where torrential rains favor erosion and reduces the amount of water infiltrated, according to terrain with slope and permeability of 20-75 mm. Actual evapotranspiration is 500 mm, recorded a deficit of 242 mm from June to October. This risk from desertification and drought are amplified due to uneven distribution of water resources and the insufficient flow regularization on watercourses. Process Modeling Training crops in sustainable agriculture systems by controlling all entrances and exits of soil-plant-animal system-the atmosphere at a certain time, depending on system components (rotation cycles, technological inputs, resources technical, etc.), is one of the priority issues for soil and water resource management and for directing agricultural technologies to be subordinated to increasing demand for food and, while facing the proper management of resources and environmental protection.

After Chaussod notion of biological quality agricultural soil has four components namely:

- fertility or directly related agronomic potential biological activity;
- phytosanitary condition of the soil and vegetation;
- environmental impact (externalities) on the functioning of soil;
- resistance or sensitivity to anthropogenic impact soil and environmental and ability to backup the baseline condition.

Sustainable use of soil requires measures to maintain the productivity potential of resources and tracking their progress based on benchmarks and indicators to monitor changes on soil quality. Pieri et al. (1995) believes that these quality indicators are three ways:

- indicators of pressure on soil resources;
- indicators of changes in soil quality status;
- indicators of response to these changes in society.

Some parameters and indicators of soil quality, in economic terms, are already used. These are:

- satisfaction edaphical crops and other human activities;
- behavior of soil as a medium for biomass production;
- suitability of land for different utilities;
- role of soil on urban waste recycling and household waste and residues.

There are companies which are undertaking studies to test soil (eg. SC Minear Laboratories SRL), but most do not offer solutions for improving agricultural yields. The purpose of the project is a study and construction of an experimental model to conduct tests and monitor soil and arable land while providing a set of information that provides solutions to improve organic agricultural yields.

Abroad: numerous studies and surveys over time internationally and nationally have shown that between technological systems of plant cultivation,

state of the environment, economic development and the quality of life there is close interdependence.
The agricultural policies of various countries, especially in the last five decades, huge efforts have been made to modernize agriculture in order to increase the quantity and quality of production, accompanied, however, by a multitude of serious negative effects on the environment.
In European Union countries, the most widespread agricultural system practically generalized, was the conventional one, is characterized primarily by: loosening and processing of excessive soil with the return swath, total removal of plant residues on the surface or even the burning of stubble, fertilizing intense and shorter rotations.
It is widely accepted that conventional energy-intensive agriculture has led to the emergence of negative processes that led to environmental degradation of various resources: soil, water, air, flora, fauna. Of these the soil, which is the bridge between different components of the environment, recorded the most rapid and intense changes due to anthropogenic activities, having a direct and / or indirect effects on other resources in the environment.

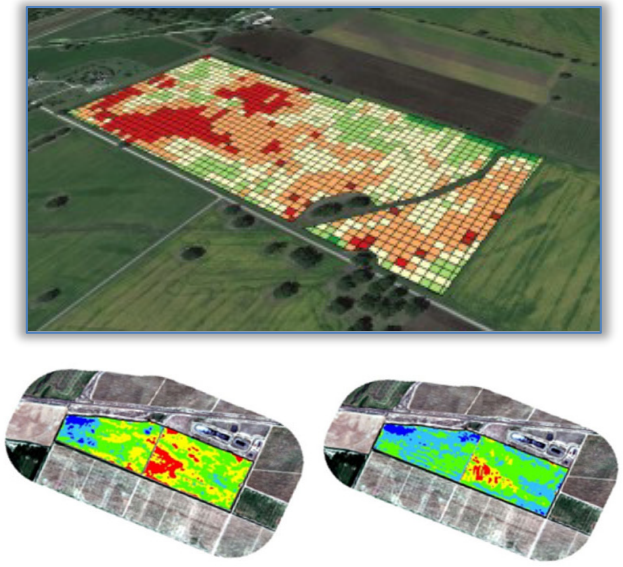

Figure 2: Mapping an agricultural area with a drone

The development and expansion of this new type of system agrotechnological, regarded as ameliorative and conservative was due on the one hand, the progress of the chemical in the diversification of the range of herbicides, and on the other, the emergence of types of agricultural equipment loosening soil modern performance.
The approach at international level regarding the technologies used for monitoring and testing of soil and arable land with the concept of sustainable development, encouraging the use of equipment and non invasive procedures.

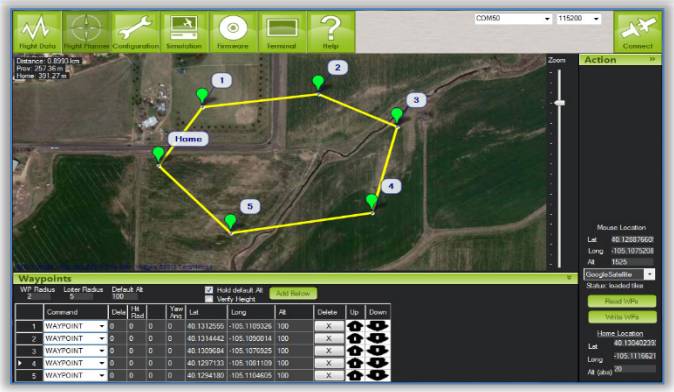

Figure 3: Ardupilot – software for mission planning in agriculture
(according to https://constantgeography.com)

TECHNICAL SOLUTION PROPOSED

In order to support sustainable development and use of new technologies, techniques and intelligent equipment, particularly in Romania, we can use the actual knowledge to conceive a solution that has a good ratio regarding cost - benefit.
The drone will have a body frame / body of light material (fiberglass or aluminum), to reduce the weight and to maximize the time spent in flight. Construction will be done using the 4 arms, which can rotate 360°, each arm having four engines (16 engines for drone).

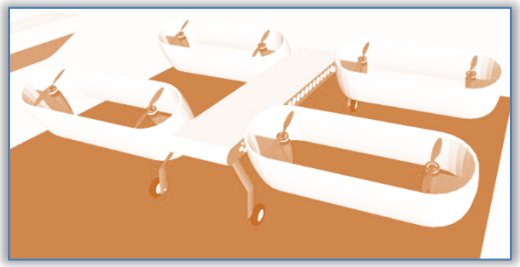

Figure 4: Drone body frame

The engines are important because they raise the entire structure into the air. The models currently on the market, even if they are smaller, are more powerful because it revolves around its own axis. An example of engines capable of providing power for the 4 arms solution, and be able to support the construction of outdoor is WM610 3510H M2, a rotary engine in clockwise (CW) with speed control of electric type.

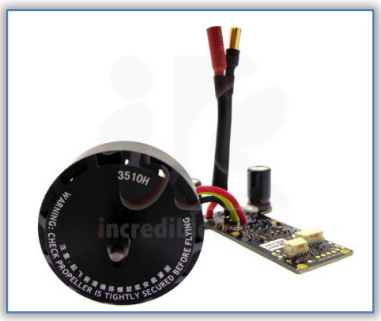

Figure 5:– Motor WM610 3510H M2

To control 16 motors we use wireless controller with integrated video transmission, the frequencies between 2.4GHz and 5.8GHz, control the drone via the controller to be made from a minimum of 1000 meters.

Figure 6: Concept for controller

The battery is an important element in the concept presented. A battery provides flight duration, but can increase the weight of the drone so as to not be profitable. Alongside a classic battery, a solution will be designed to use the mini solar panels, which extend the duration of flight between charging cycles.

Figure 7: Drone battery - classic

The software will be dedicated to this construction, and will provide analyzes for the soil to return for a percentage of future culture analysis on the areas that need to be taken by adding substances or other procedures.

Note

This paper is based on the paper presented at The 1st International Conference "Experimental Mechanics in Engineering" - EMECH 2016, organized by Romanian Academy of Technical Sciences, Transilvania University of Brasov and Romanian Society of Theoretical and Applied Mechanics, in Brasov, ROMANIA, between 8 - 9 June 2016

CONCLUSION

In conclusion, use of new technologies and intelligent equipment monitoring and testing of soil and arable land to improve organic agricultural yields will influence profitability, increasingly more, of land. It is an area of research that will be able to develop and build equipment to ensure sustainable development by using solutions obtained from research.

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