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# Design of wireless sensor network for monitoring of soil quality parameters

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**Abstract**

Design of wireless sensor network for monitoring of soil quality parameters (temperature, humidity, conductivity and acidity) is proposed in the study. The structure, panels and block - diagrams of graphical user interface in the software LabView are developed. Web-based mobile system for wireless measurement of temperature, humidity, conductivity and acidity based on Arduino modules is proposed. The devices are configured and appropriate software for the operation of wireless sensor modules is written.


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*Keywords:* wireless sensor network, soil quality parameters, LabView

## 1. Introduction

Precision farming is a new technology that allows manufacturers to adequate manage the land depending on spatially differentiated information. It is an innovative, technological and information based intelligent approach to identifying, analyzing and managing the variables to obtain profitable production with optimum production and conservation. Precision farming has great potential in developing economic and environmental benefits, which translates into reducing the use of water, fertilizers, chemicals, labor and equipment.

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Increasing electricity prices, together with high technological requirements and the need for lowering production costs require the development and optimization of Information Technologies -advising systems for measuring and monitoring the parameters of the land.

The benefits arising from the application of wireless sensor technologies (Baggio, 2005; Losilla et al., 2007; Zhang et al., 2004) in precision agriculture come from precision in the amount of irrigation (H.E.L. de Lima et al., 2010), fertilizer use only in necessary areas and controlling the quantities of fertilizer. Other advantages of wireless sensor networks are (Buratti et al., 2009):

• possible to monitor parameters for long periods of time;

• directly and accurately monitor the status and parameters of the cultivated lands and the opportunity to intervene in emergency situations;

• remotely decision-making;

• analysis and storage of information;

• the ability to create graphical user interface for system monitoring;

• permit accurate assessment of new methods and techniques for processing the earth's surface.

For the establishment and operation of a wireless sensor network required placement of sensors at key locations so as to cover the whole area.

Studies on the positioning of sensors in building a wireless sensor network marked significant progress in the last decade. In scientific studies have examined the positioning of sensors in terms of data transmission, and various regular distributions of sensors in the form of a square, triangle and hexagon network.

In precision farming requires full coverage of the surveyed area. On the other hand, the number of sensors should be as low as possible, since more than one sensor would imply a high final value for construction of the network. It is possible and a higher impact on the environment. It is require minimal energy consumption of the network. This means minimal cost for maintenance of the network. Sometimes batteries that operate the network are expensive and sometimes expensive their replacement, especially when it comes to hard to reach areas and others.

Reducing the number of sensors results in an increase of the energy network. On the other hand, in order to reduce the energy of the network it is necessary to add sensors. Therefore, the aim is to determine the balance between the number of sensors and energy consumption in view of the basic parameters based on the number of messages transmission time information, the total number of packets sent and the amount of loss of information.

## 2. Materials and Methods

### *2.1. Wireless sensor network topology.*

The Wireless sensor netowrk topology is based on ZigBee protocol for network communication. ZigBee standard supports various network topologies: point to point (point - to - point), point-to-multipoint (point- to -multipoint), stellate (star), tree (tree) and cellular (mesh). The latter has the ability to dynamically change the route between the devices on the network based on the availability of intermediate routing devices - units. There are three types of network ZigBee nodes: coordinator - obligatory at least one of each ZigBee network and initializes the formation of the network and performs a function as its coordinator (managing node); it can work as a router after setting the network; router - associated with ZigBee coordinator or another ZigBee router; involved in the transmission of information between nodes in the network. Regardless of their purpose devices in ZigBee network usually have: synchronous and asynchronous communication interfaces, analog - digital converters, digital inputs and outputs general. Through its diverse peripherals ZigBee modules are various applications for controlling production processes, periodically measuring the parameters of physical and electrical parameters and others. [25].

The coordinator creates a ZigBee network and its route map, administers various nodes in the network, monitor network parameters and provides basic maintenance. It connects via multifunctional development platform through an asynchronous serial interface (UART). Coordinator module provides access through radio channel development platform to individual routers and measuring sensors in the ZigBee network. Through it enters the measurement information from all the measurement sensors connected to a ZigBee network nodes.