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INTELLIGENT SYSTEM FOR THE ACTIVE CONTROL OF WORKS FOR APPLYING PHYTOSANITARY TREATMENTS

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***Abstract**: multidisciplinary researches for developing the technical equipment destined for the optimal application of phytosanitary products have led to an advanced conception for the design, operation and instrumentation based on the concept of precision agriculture. The technical equipment has the purpose of identifying the base crop plants, as well as the area situated between the crop rows, through the means of image recognition algorithms, subsequently calculating the degree of weeds in the area situated between crop rows. After identifying the weed degree, a distribution of phytosanitary treatments is performed, proportional to the degree of weeds in crops.*

***Keywords**: precision agriculture, phytosanitary substances*

1. Introduction

By applying a phytosanitary product is aimed to solve certain problems related to plant health. An incorrect application of phytosanitary products can lead to:
- Product waste, which will eventually lead to increased costs for the farmer;
- Operator contamination;
- Environment contamination.

For a correct application of phytosanitary substances (dosed and distributed with precision), the equipment for applying pesticides needs to operate in a reliable manner and to be used adequately, in the purpose for which it was designed.
Concerns related to the incorrect application of phytosanitary products were intensified, analysing:
- the effect of nozzle type, nozzle size, spray pressure and spray boom height on drift, according ISO 22866:2005, concluding that Venturi nozzles had the highest drift reduction potential, followed by the low-drift nozzles and the standard flat-fan nozzles;
- the influence of operational parameters as droplet size range and air flow rate on airborne spray drift both for field crop sprayers;
- effect of width of spray-free buffer zones, nozzle type and air assistance on spray drift.

2. Material and method

The intelligent system for the active control of works for applying phytosanitary products – SITF- represents a complex equipment destined to be fitted on classic machines for applying phytosanitary treatments in field crops.
The system will be achieved in the form of a kit that can be adapted on almost every model of equipment destined for applying phytosanitary treatments in field crops, the only dependence of the kit toward the tractor being the electric power source.
The graphically simulated experimental model of the intelligent system for the active control of works for applying phytosanitary products fitted on classic spraying machine is presented in (fig. 1).

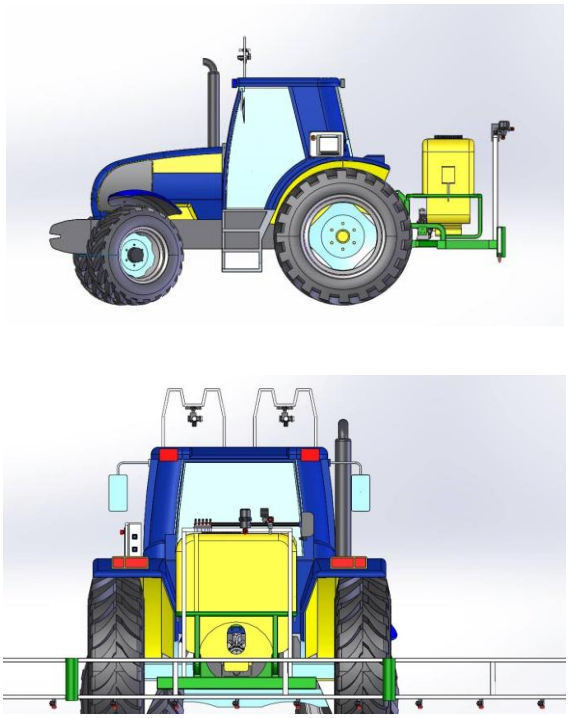

Fig. 1. Graphically simulated experimental model of the intelligent system for the active control of works for applying phytosanitary products - SITF

3. Results

The operation of the experimental model implies interconnecting and synchronizing hardware components with software components installed on the three main elements within the intelligent system for real time active control of works for applying phytosanitary treatments:
- intelligent cameras for image recognition, with software that will be developed in Vision Buider AI;
- PLC (programmable logical controller), with software developed in GXWorks2;
- operating terminal, software developed in GotDesigner.

Overall operating manner:
In the view of optimal operation of the intelligent system, the software requirements that the soft will comply are as follows:

- The intelligent cameras capture images of the crop situated in front of the spraying machine, synchronized with its movement speed. The cameras will analyse the images and will transmit to the PLC the crop's degree of infestation with weeds, on interest zones, identical in width with the width of the segments of the spraying boom.
- The PLC will calculate the norm of phytosanitary substance depending on the degree of weeds and will command, through a specific command algorithm, the valves with motors that feed each boom segment. The command algorithm will be based on the principle of the negative reaction received from the pressure sensors on each boom segment and will take into account the direction of rotation of the electric motor that drives the valves. Therefore, different quantities will be applied on each boom segment correlated with the percentage of weeds in the areas covered by them.
- The graphical user interface will allow selecting the reference norm of phytosanitary substances for the treated crop, to visualise working parameters (Pressure, flow rate, speed, etc.)

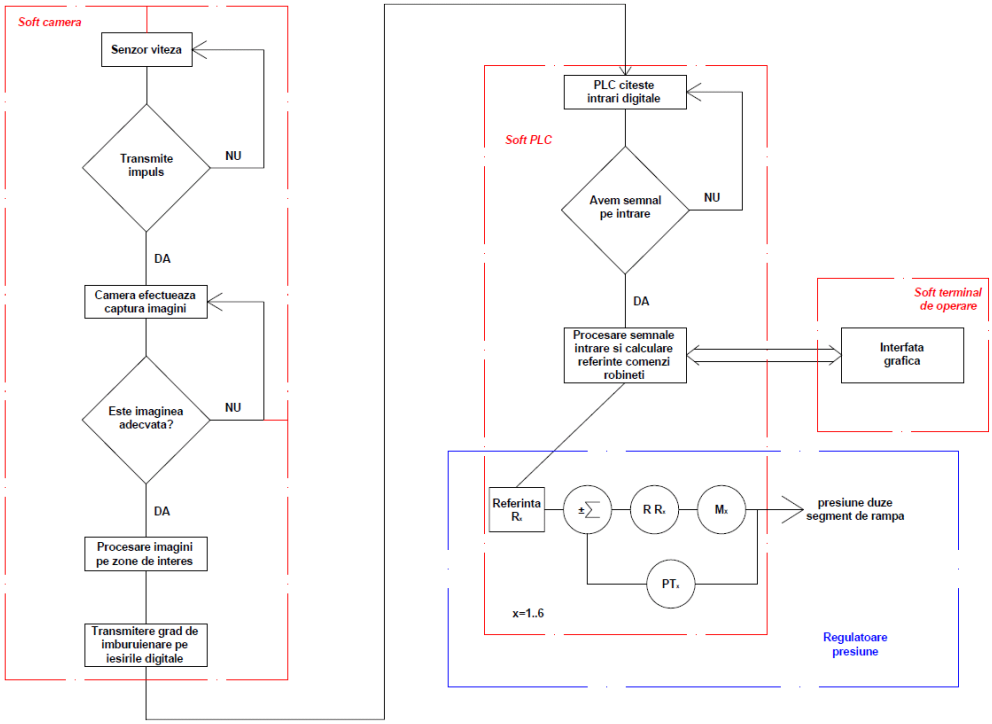

Fig. 2. Software logical scheme

The automation scheme for the intelligent system for real time active control of works for applying phytosanitary treatments in field crops depending on their degree of weed infestation comprises:

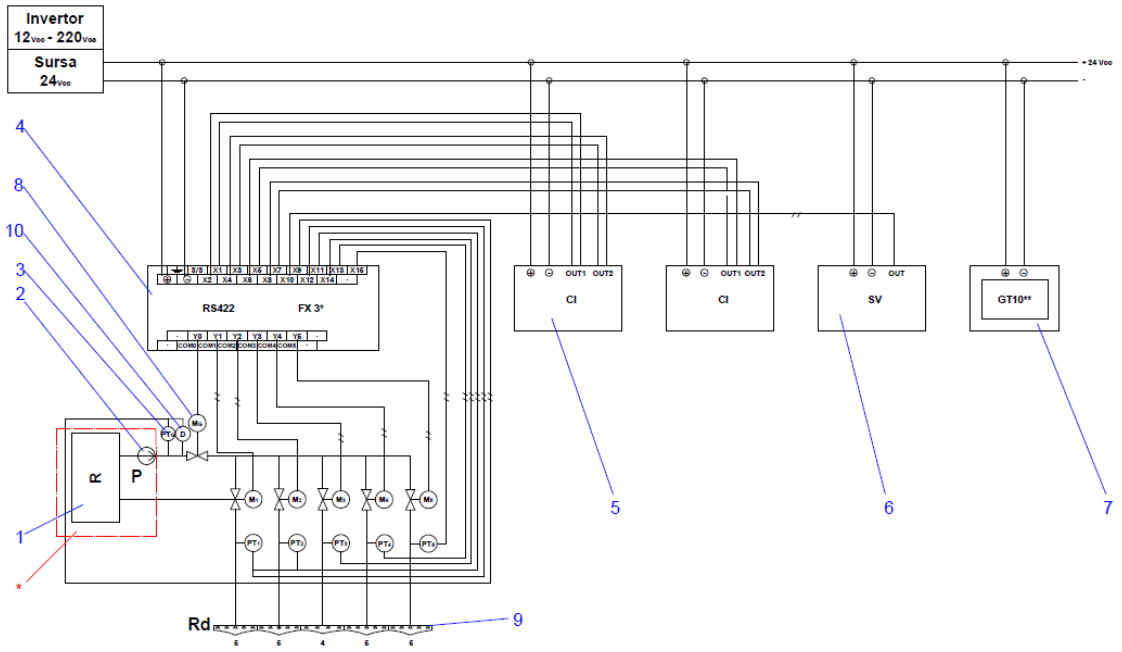

Fig. 3. Electric and automation scheme for the intelligent control system
(1.R –spraying machine tank, 2.P – spraying machine pump, 3.PTx pressure transducer, 4.FX 3* – PLC, 5.NI17**– intelligent camera, 6.SV – speed sensor, 7.GT10** - operation terminal, 8.Mx electric motor, 9Rd – 5 segment boom of the spraying machine, 10 D– flowmeter)
*components situated in the red frame are not part of the kit

The intelligent command and control system is powered by an inverter with a 24 VCC source connected to the tractor's battery.

4. Conclusions

The implementation of this system for controlling the distribution of phytosanitary treatments in field crops leads to cost reduction by optimizing the quantity of treatments applied.
Along with optimizing the quantity of phytosanitary treatments applied, a beneficial effect is registered in terms of environment protection, materialized by reducing soil and air pollution.

Acknowledgment

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