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Hardware and software of automated system for research in greenhouse production (video monitoring of plant growth inside greenhouse)

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Abstract: *Hardware and software of automated system for research in greenhouse production (video monitoring of plant growth inside greenhouse*). In this article authors solve the problem of video monitoring by example of plants in a greenhouse of a biological object condition. Algorithm, software and results are presented.

Key words: video-monitoring, greenhouse, algorithm, hardware – software complex

INTRODUCTION

Automated accounting system of material and energy resources in agriculture crop is created to monitor and further the maintaining process parameters during seedling plants growth. System testing was carried out at the scientific and experimental farm Vorzel, located in Vorzel town near Kiev. Information management subsystem of the remote monitoring is a part of the automated system.

ANALYSIS OF LAST RESEARCH AND PUBLICATIONS

Today video monitoring systems, particularly in greenhouses, are usually used to ensure safety of the facility to prevent unauthorized intervention, theft, equipment damage. The system for greenhouses, by the Vostok company (Dnepropetrovsk), allows to control and account at greenhouses. General accounting of the greenhouse is complex task. To control the actions of employees, processes and operations, a system of video monitoring is used. Video cameras monitor movements of personnel inside greenhouse, product collection and weighing.Video cameras control territory near greenhouses – as well. The cameras are connected to the DVR, which ensures local and remote monitoring and view the archive.

There are developments of Russian scientists (Moscow State Agro University) regarding video monitoring systems for farming. Video monitoring increases the accuracy of the positioning of workers relative to the object while reducing the cost of equipment and operation of the navigation system [Bashilov 2010]. But they are intended to monitor a large area – fields, gardens using sophisticated constructions telescopic towers, unmanned aerial vehicles and others.

In contrast to the existing systems the target of our system, which is monitoring of biological object condition to automate the scientific research in the laboratory facility or pilot farms. The specialists of National University of Life and Environmental Sciences of Ukraine developed and implemented information

management system for remote video monitoring of the state of biological objects by the example of research piggery, which is also designed to automate research [Kiktev and Veklinec 2012].

MATERIAL, METHODS AND RESULTS

The purpose of this research – observing the growth of plants (including seedlings of tomatoes, eggplant, squash, etc., after planting seeds in greenhouse field (in the laboratory and greenhouse) to the time of transplantation in the open ground. In order to intensify the growth of plants is used process equipment – infrared termo-carpets "heatflow" (developed by the South Korean company NAOS Co., LTD), which heat the ground.

The monitoring is carried out in two ways: at the research laboratory and at greenhouse of the university research farm Vorzel. To automate the research the hardware and software created system which includes: laptop Acer 5520, WEB-camera Gembird CAM 67 U connected by cable via USB-port, software Visual Basic 6.0.

To solve the task authors developed special software (programming language Visual Basic 6.0). The menu structure of the program cover contains the following sections: Shooting, Stop, Lab, Greenhouse.

Menu section Shooting designed to conect with the camera and make photographic shooting of the subject of scientific research at regular intervals (15 minutes). Stop menu section is to quit the program in Windows. Section Laboratory and Greenhouse designed to show the development of the biological object (plant) during some period, at the laboratory or greenhouse.

The program provides recording of images in image files format jpg, file name includes numbering. Each number of previous image file is stored in a text file time.txt, which is located at "C:\\ Proekt_Vorzel\\time.txt". The following structure is used for this:

```
myfile = FreeFile

Open ("c:\Proekt_Vorzel\time.txt")

For Input As #myfile

Line Input #myfile, s

Close #myfile

i = CInt(s).
```

The last operator turns image string type into integer type that is read from the text file is a string. Next step is shooting and recording pictures in a graphic file VIDEO_ N jpg, (N – file number) due to the following operator:

```
SendMessageString hWDC, WM_ CAP_FILE_SAVEDIB, 0, "E: \ Project _ Vorzel \ VIDEO_" & CStr (i) & ". Jpg".

Shooting interval (15 minutes or 90,000 milliseconds) is provided by:
DoEvents

Sleep 900000
.....
Loop
```

Then the variable *i* is assigned a new number (next photo), converted into string type and stored in a text file that contains the current numbers of photos:

i = i + 1

s = CStr (i)

Open (“c: \ Proekt_Vorzel \ time.txt”) For Output As # myfile

Print # myfile, s

Close # myfile

The video is performed by the animation of the photographs with a delay of 200 ms. As a result, it takes few minutes to watch the development of the plant for a week. Image reconstruction is carried out in a separate form, the top line of which shows the date and time of recording. The operator that ensure it:

Form2.Caption = FileDateTime (“E: \ Proekt_Vorzel \ Collection \” & CStr (i) & “. Jpg”)

Form2.Picture1.Picture = LoadPicture (“E: \ Project _ Vorzel \ Collection \” & CStr (i) & “. Jpg”)

Figure 1 shows the algorithm of the program frame shooting of moving objects and reconstruction for video monitoring. Figure 2 shows the dynamics of the plants (pumpkin seedlings) using termo-carpets “heatflow” at the university laboratory and Figure 3 – dynamics of eggplant seedlings also using termo--carpets “heatflow” at the experimental greenhouses.

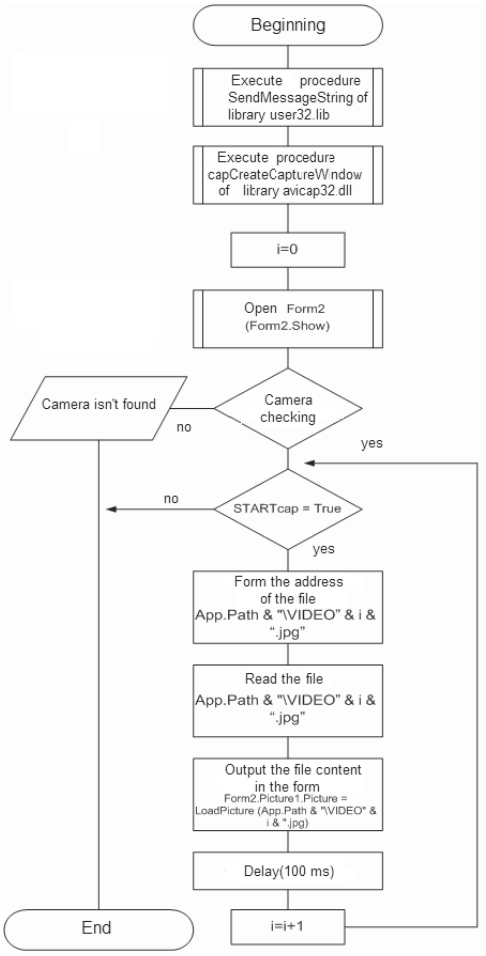

FIGURE 1. Algorithm of the shooting and video making program

CONCLUSIONS

This research present video monitoring system for the biological object, slowly changing (plant in particular). The system makes it possible to observe and compare the development of plants in different growing conditions, assess the intensity of plant growth technology. This system can be used as a part of an automated system of scientific research

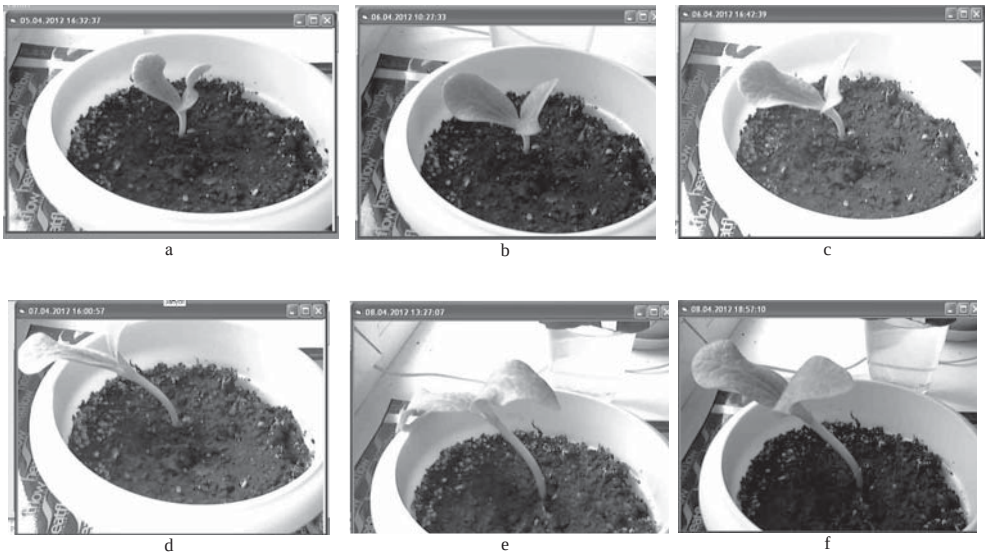

FIGURE 2. Graphical interface information and control subsystem of the remote video monitoring at the laboratory

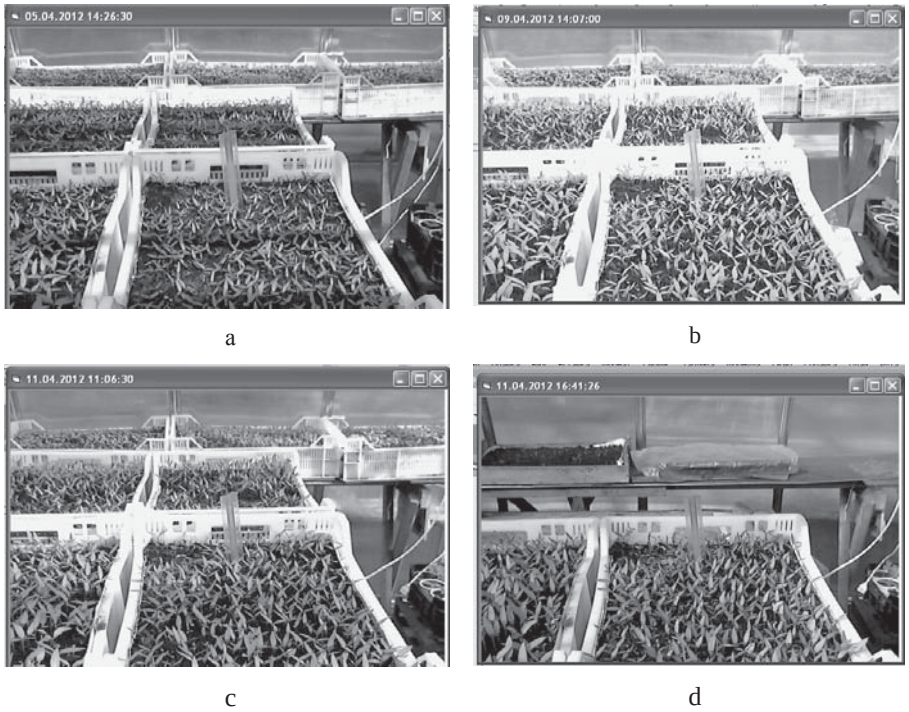

FIGURE 3. Graphical interface information and control subsystem of the remote video monitoring at the greenhouse

in agriculture, as well as the automated system of material and energy resources in horticulture, information and control systems for greenhouse.

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Streszczenie: *Sprzęt i oprogramowanie automatycznego system badawczego w produkcji szklarniowej (wideo-monitorowanie wzrostu roślin wewnątrz szklarni).* W artykule przedstawiono rozwiązania problemu wideo-monitorowania roślin w szklarni w warunkach obiektu biologicznego. Zaprezentowano algorytm, oprogramowanie i wyniki badań.

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