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DIGITAL SYSTEM FOR TRACKING AND DISPLAYING TRAJECTORY AND PARAMETERS OF AN OBJECT TRACKED BY AIR DEFENSE SYSTEM 1RL-35M RADAR

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Abstract: *The presented paper is the result of a research project. The goal of the project is to develop a digital system for coordinates acquisition of a moving object pursued by the radar (1RL-35M) and data processing in order to display the object trajectory and parameters needed to air defense system. The experimental model presented below, is a functional laboratory prototype which satisfies the requirements imposed by research topic.*

Keywords: *radar, target coordinates, acquisition*

1. THE DESIGN OF ACQUISITION SYSTEM MODEL OF INFORMATIONS CONCERNING TARGET COORDINATES WHICH IS TRACKED WITH CRT 1RL-35

The experimental model involves the existence of a data acquisition board (NI USB 6210 type) provided by National Instruments with specialized software (LabView) and application made for data acquisition. The voltages obtained from computing device CRT are simulated by three voltage sources. Figure 1 shows the block diagram of the experimental data acquisition system.

Data to be acquired are the current rectangular coordinates (X, Y, H) of the object that results from transformation of spherical coordinates (azimuth, elevation angle and slope distance). These are obtained from 1RL-35 radar as DC voltage.

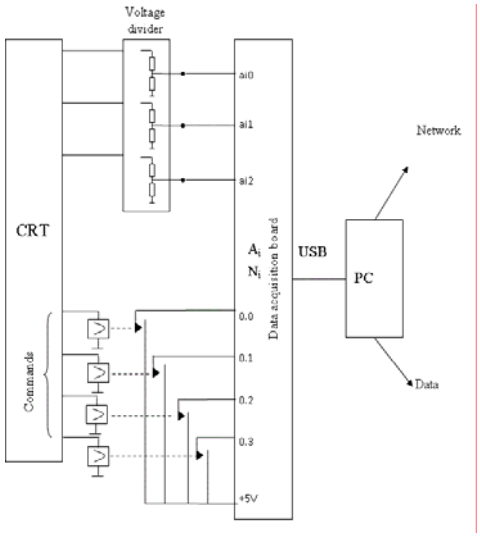

Fig. 1. Block diagram of the data acquisition system

Taking into account the variation of the DC voltage corresponding to object coordinates obtained from the CRT, it is necessary to adjust the voltage level to values of voltage on the 3 input channels of data acquisition board. This is made using 3 voltage dividers.

The graphical interface simulates the on - off switch of the control indicators. This is necessary to signal the relevant events for the object targeting regime as the start and the end automatic tracking. Software control of these signals is performed by relays operated by appropriate command from CRT.

1.1 Continuous takeover of target coordinates data / tracking system operation. This function is provided by the NI USB 6210 that has the ability to acquire 8 digital data and 8 analog values. The analog inputs ai0, ai1, ai2 takes the analog data that indicate the target position on 3 coordinates collected from CRT. To the digital inputs (ports 0.0-0.3) are applied high logic levels corresponding to signaled events - for example, the start and end of automatic tracking through relays contacts.

Acquisition and tracking program of target coordinates is shown in Figure 2.

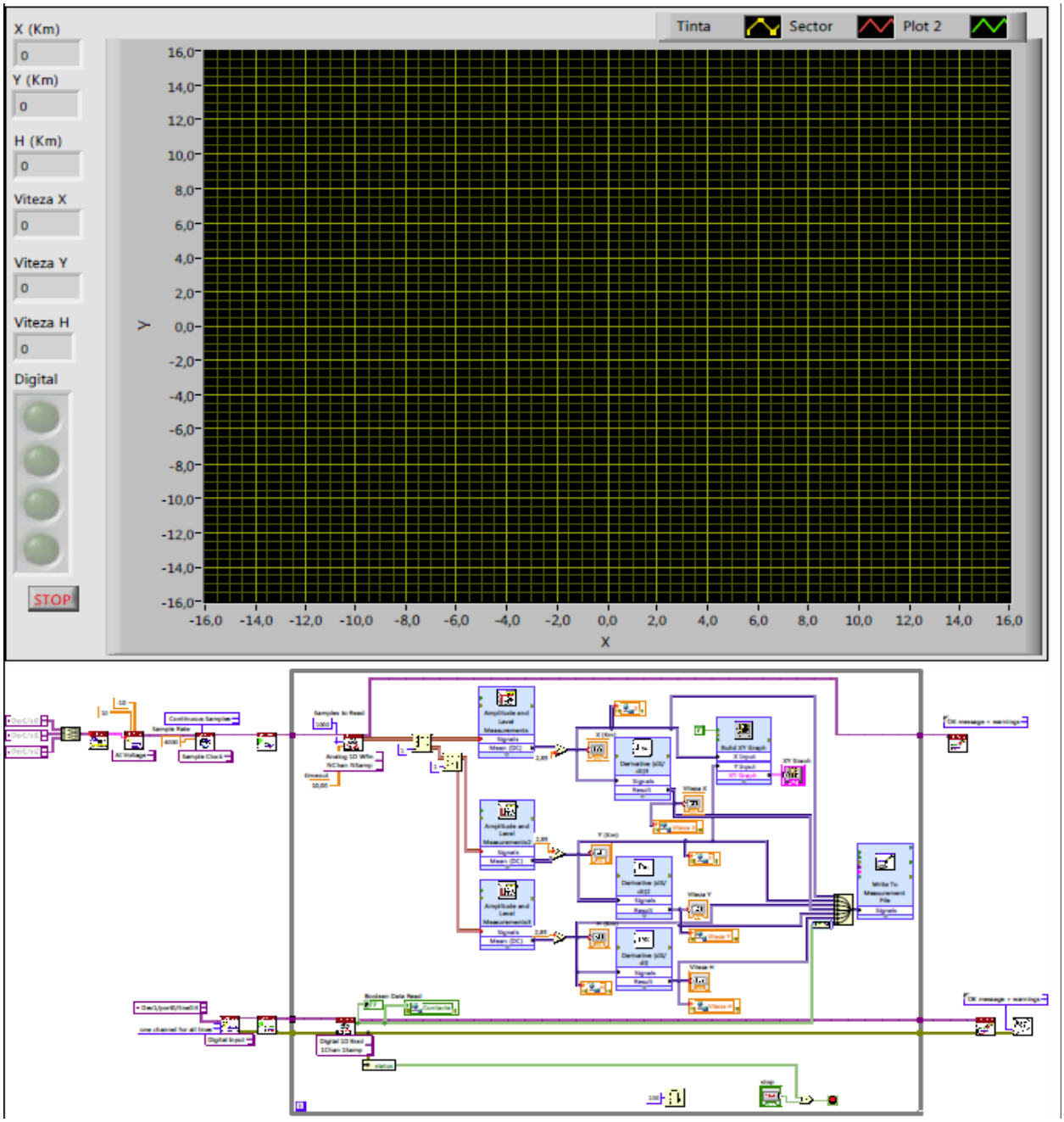

Fig.2. Acquisition and tracking program

The blocks that are represented in Figure 3 perform simultaneously the conversion of the data (analog to digital) and continuous acquisition of the digital data corresponding to

the object coordinates. The sampling rate is required by the acquisition board and it must be enough to record the smaller variations of the object coordinates.

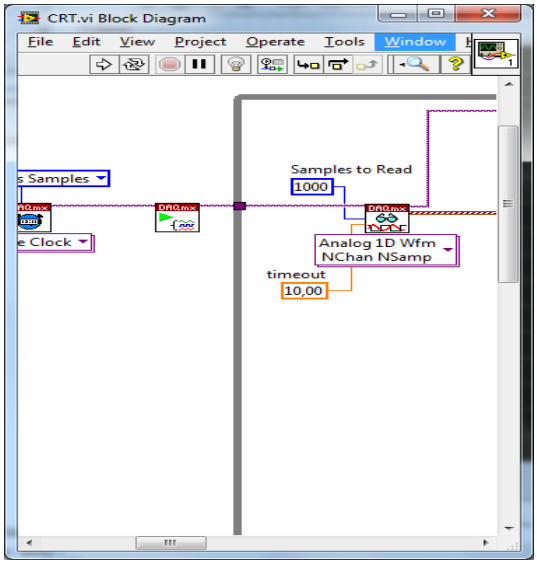

Fig.3. Analog to digital data conversion

1.2. The second function is to display the acquired data (from 1RL-35M) using a graphical interfa ce. Following steps are required:

sampling-holding-quantization

transmission of the digital data in a form of a linear array with three elements

splitting of vector with "Split 1D Array" and filtering of signal to remove noise and unexpected distortions of voltage waveforms corresponding to the target coordinates

transfer to display blocks

The manually setting of radar position coordinates values "X CRT, Y CRT, H CRT", on the front of graphical interface is done by correspondence with the „X CRT, Y CRT, H CRT" blocks from diagram. Values are displayed in km. Also, with an adder in the loop of the program, the absolute values of the object position are automatically obtained on the front panel (the sum between CRT position and object position from CRT – X abs T, Y abs T, H abs T).

To display the combat sector limits (previously entered in the database), the solution -at this moment- is to set the front panel display scale values to the maximum values of the 1RL-35M radar (fig.4).

Displaying the current object position and its trajectory is performed using the XY Graph block.

Examples of trajectories displayed are shown in Figure 5.

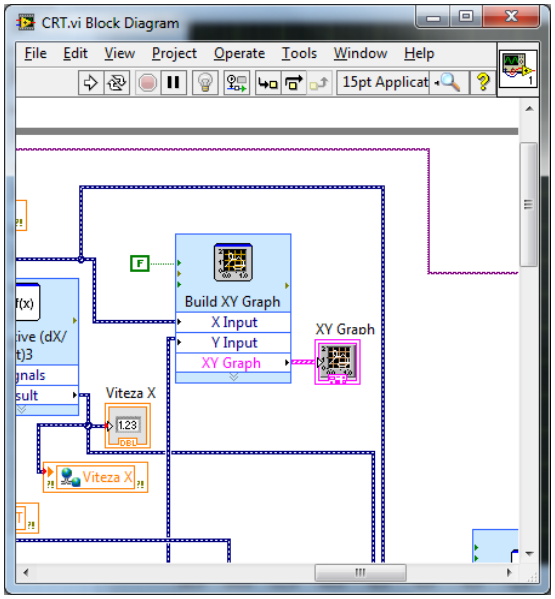

Fig.4. Display creating of object position

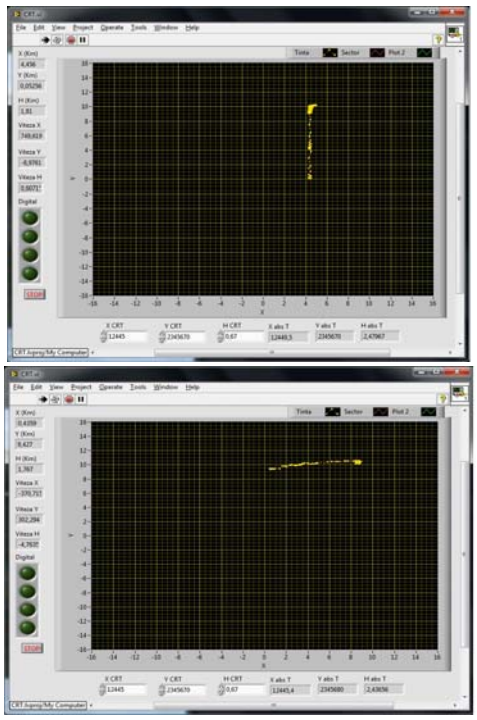

Fig.5. Mode of variation of target positions

1.3. Saving object trajectory data in a database (desired to be accessed in real time remotely through a network protocol).

All the data is collected and entered into the program by means of a multiplexer, obtaining a database during the running of the program,. The database can be found in the form of a file called "Date". A sequence from file in table 1 is presented

In the "Date" file are saved the retrieved and processed data by the program while it is running. Reading the file it can be obtained object trajectory data, given that the data saving to the file is made with appropriate speed sampling rate. Remote real-time transmission implies the existence of a computer network, or a network protocol. In this conditions on control (follow-up) computer should be installed the same software.

Table 1

Dev1/ai0 (DC Voltage)	Dev1/ai1 (DC Voltage)	Dev1/ai2 (DC Voltage)	Dev1/ai0 (Derivative (dX/dt))	Dev1/ai1 (Derivative (dX/dt))	Dev1/ai2 (Derivative (dX/dt))	Untitled	Untitled 1	Untitled 2	Untitled 3
10,084739	-0,000407	-0,000516	0,144654	-0,023013	-0,052601	0,000000	0,000000	1,000000	0,000000
10,084941	-0,000354	-0,000513	0,808748	0,210406	0,013150	0,000000	0,000000	0,000000	0,000000

On this computer will run a second program, illustrated in Figure 6 - which will access the program input data from computer situated in radar through network protocol and specified IP address. As result of running the "Remote" program on the front panel will be displayed the same image as on the display of the computer situated in radar. Figure 7 shows an example with an image of the object trajectory displayed on both panels of computers (radar and control).

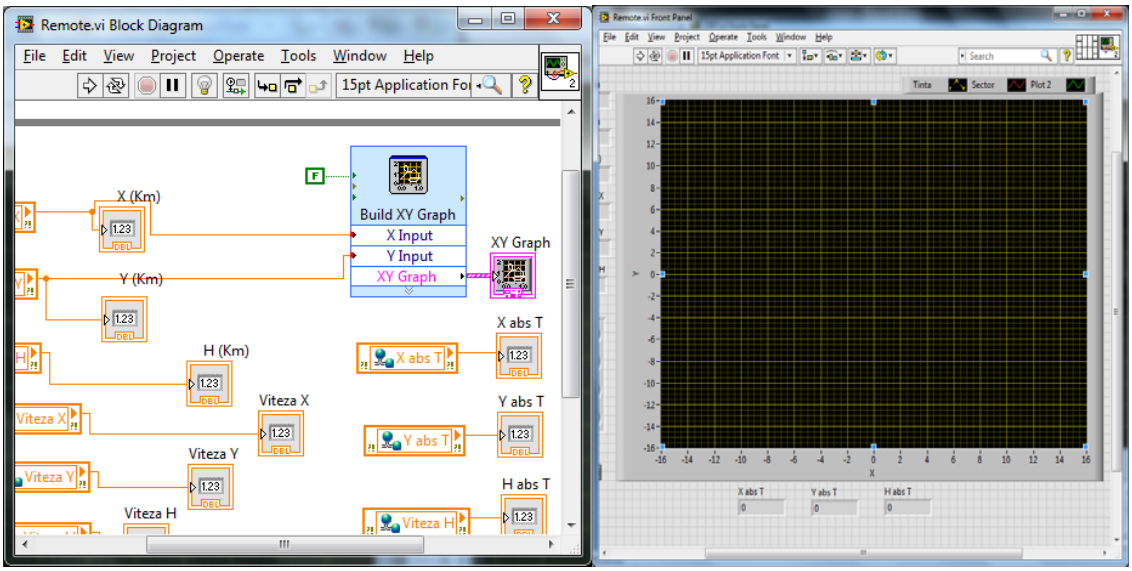

Fig.6. "Remote" program

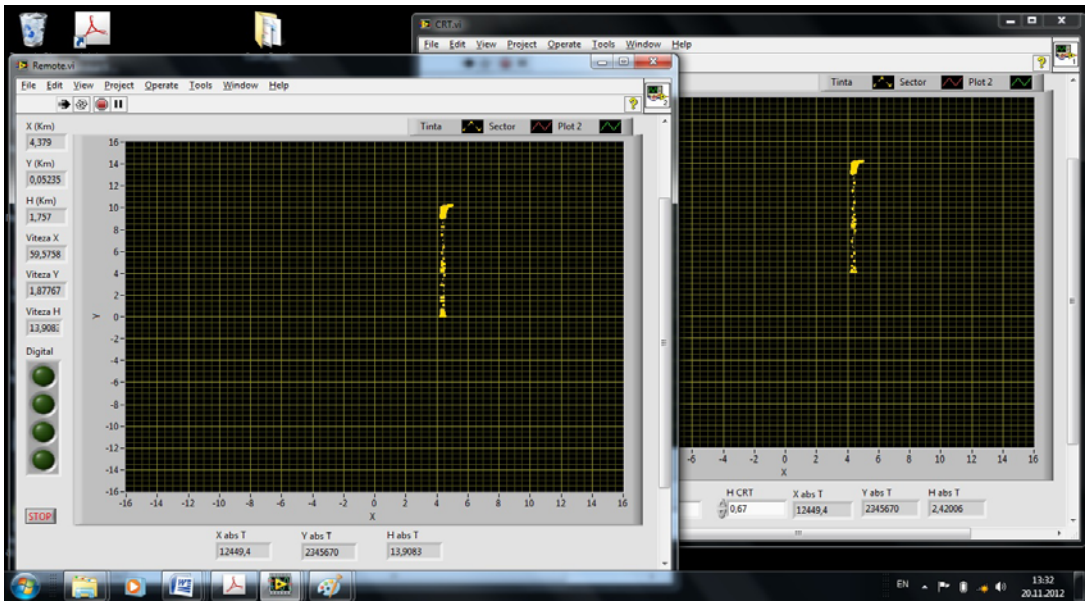

Fig.7. The frontal panels of the computers

2. CONCLUSIONS & ACKNOWLEDGMENT

This paper presents experimental model of a "Digital System for Tracking and Displaying Trajectory and Parameters of an Object Tracked by Air Defense System 1RL-35M Radar ".

The experimental model is fully functional in terms of polygon, in which case the three voltage values corresponding object

coordinates X, Y, H, are acquired from radar computing device. For the experimental model we used three independent voltage sources whose voltage was varied to simulate the variation of the object coordinates.

REFERENCES

1. Research Report of Project “Digital System for Tracking and Transmission of Target Coordinates Tracked with Complex 1RL-35M” sponsored by Ministry of National Defense from Romania.