Gheorghe Manolea, Florin Ravigan, Alexandru Novac

The Command by GSM for positioning Systems of Anti-hail Ramps

The points of anti-hail missiles are the technical stations distributed being often isolated from the viewpoint of power systems and communication channels. The solution that can be used to achieve communication with these stations is based on mobile network infrastructure which could be used to transport data packets useful.

1. System description

That paper presents a part of the results of the researches from a project named "Joint Risk Monitoring during Emergencies in the Danube Area Border". This project is a border collaboration between Romanian and Bulgarian partners and it's objectives was to design an efficient system that will monitor risk situations.

Figure 1. The elements placed on a ramp

The team from University of Craiova has been focused on developing of integrated system for monitoring and control equipment located in a local unit launch anti-hail rockets.

This system includes all information flow: from clouds GIS layer point selector and the launch angles for the calculation of the launch ramps that point, initiating communication, orientation data transmission, extraction and validation, transferring to the system motion control, mechanical achievement orientation and storing all data exchanges to further analysis.

The structure of the entire system from a launch point is shown in the figure below.
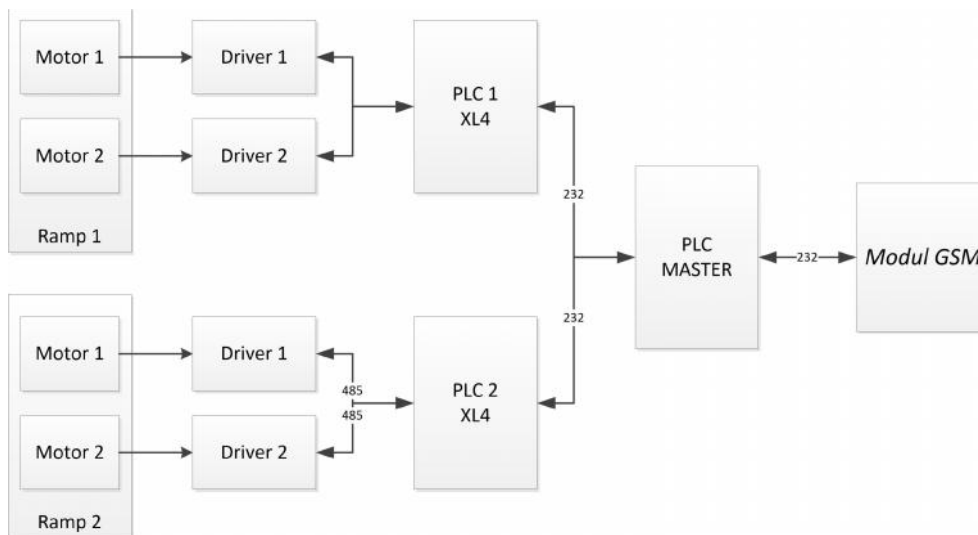

Figure 2. The structure of the orientation system

The rockets used to fight hail are launched using ramps with two axes. Launch point has two launch pads each engine operated using the brushless. These engines are coupled with two gearboxes in the two axes of rotation for elevation and azimuth.

Every motor is powered by an intelligent servo-driver which received the information about axe position via a RS-485 bus from a Horner XL4 PLC with touchscreen. These PLCs are communicating with a master PLC realized with am Atmega128 microcontroller. This microcontroller has the job to access the GSM module for communication with the Centre Commandant.

The orientation coordinates can be introduced automatically from Centre Commandant or locally using a graphical interface developed for tactile screen of the XL4 PLC.

The authorized user has the possibility to type in manual mode the coordinates using the following interface by pressing the "Pozitie" button.

317

Figure 3. The graphical interface running on XL4 PLC

This graphical interface running on tactile display of XL4 PLC also gives the option to set the origin of displacement, the speed, the acceleration and deceleration.

2. Communication system

On the decision center to launch dispatch after analyzing more data received from the National Agency of Meteorology and Hydrology. For data transmission between monitoring station and launch points can be used various communication solutions own or use the Internet to enjoy a very wide spread in a very diversified infrastructure: copper wires, fiber optics, radio waves, microwaves. We chose to use a GSM modem that allows opening a communication tunnel GPRS (General Packet Radio Services) in isolated areas, tunnel data to be handled.

Data reception in the point hail missile is achieved using a GSM module. It allows connection to a mobile phone provider and the use of options for transmitting digital information data.

When using this solution is recommended to take into account the following considerations:

- the opening of the connection during up to 10 seconds;
- asynchronous transfer speeds of up to 57600bps;
- control application must provide all connection configuration parameters;

318

- Data security can be achieved by providing a protocol to control application.

Module Telit GT863-PY is chosen. The figure below shows the side views its.

Figure 4. The structure of the orientation system

The figure above presents the two sides of Telit GT863-PY module: a) RS-232 connector, auxiliary connector, status LEDs indicating the module; b) antenna connector, power connector, SIM card slot (subscriber identity module). This module has the following features:
- Operates in four frequency bands: 850, 900, 1800 i 1900MHz;
- Allows control via AT commands standards 07.05 and 07.07;
- TCP / IP via AT commands;
- Serial communication speed of 300-115200bps;
- normal SIM slot card.

Starting this device is made by connecting the power supply line. Similarly, the stop device is carried out by disconnecting the power source.
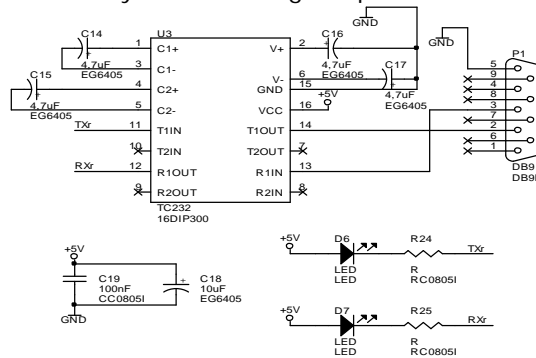

Figure 5. The RS232-TTL interface

Through the serial port, GSM module can be connected to any device that can communicate RS-232 standard. If you can use a simple microcontroller interface circuit TTL-232 performed with TC232.

319

Figure 5. Testing the GSM module programming

Master PLC software package from the point of release is the introduction of an initiation sequence to achieve, maintain and release data connection to the server from the command and control center system to fight hail.

Algorithm to initiate, maintain and release connection includes the following steps:
-the configuration of Internet provider is made with AT command:
AT+CGDCONT=1,\"IP\",\"net\",\"0.0.0.0\",0,0
-sending login data(user and password):
AT#USERID=\"\"
AT#PASSW=\"\"
-settings of quality of service parameters
AT+CGQMIN= 1,1,0,0,5,4
-the initialization of GPRS connection
AT#GPRS=1
-connection is established to the desired host
AT#SKTD=0,5000,\"109.101.3.10\",0,0
The check of connection is done when is received the string "CONNECT":

```
et1: if (UART1_Data_Ready()) {
    uart_rd = UART1_Read();
     if (uart_rd!="CONNECT") {
     delay_ms(2000);
     goto et1        }   }
```

The connection with the host can be closed anytime sending the string composed by three "+" character.
The GPRS connection can be done with the AT command:
AT#GPRS=0

Every AT command are followed by characters with the codes 13 and 10(enter and new line). It is recommended to use a 200ms delay between commands to let the GSM module to process received commands.

The structure of every data package for a launching point is presente bellow.

8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
1	A16	A15	A14	A13	A12	A11	A10	0	E16	E15	E14	E13	E12	E11	E10
0	A26	A25	A24	A23	A22	A21	A20	0	E26	E25	E24	E23	E22	E21	E20
0	0	0	0	A28	A27	A18	A17	0	C6	C5	C4	C3	C2	C1	C0

The signification of notations are:

A_{1x} and E_{1x} are the bits of word containing the azimuth and elevation coordinates for ramp number 1. Similar, A_{2x} and E_{2x} for ramp number 2. C_x bits represents the CRC code. In this way it is assured the integrity of transmission, avoiding the errors from the values of coordinates.

Bellow is the sequence of Ladder program running on XL4 PLC witch detect first byte of data package and it receives all six bytes and verify the cyclic redundancy code.
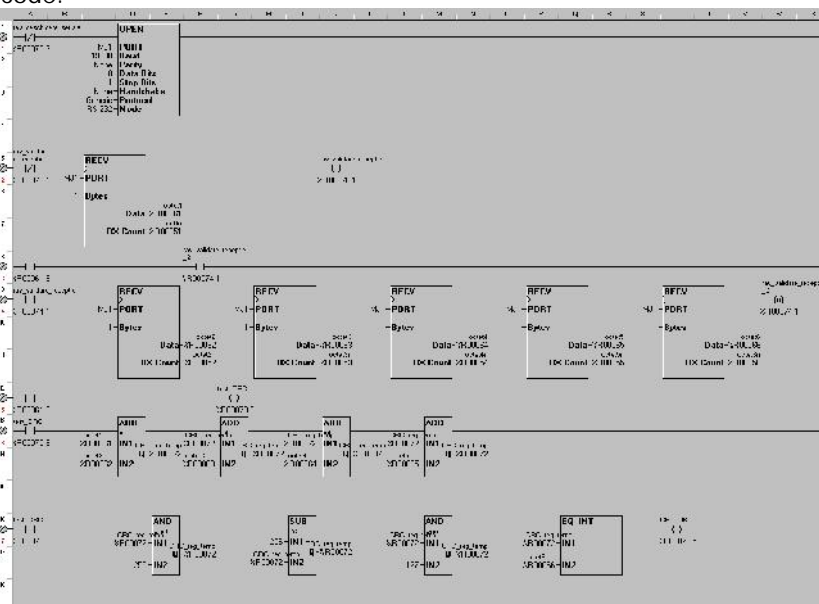

Figure 6. A sequence of Horner PLC program

All data changed between the components of the system are stored in a log database running on server.

3. Conclusion

The system is integrally functional and it represents a very good solution thinking at costs and efficiency to the problem of hail. The designed project can be multiplied to cover a large area and it is optimized to be operational in a very short time.

This system can be helpful for farmers preventing the devastating effects of hail. All this can only be achieved on a system quickly and accurately.

References

[1]   ***** Telit GT-863-PY User manual.
[2]   ***** AT Commands.
[3]   ***** Horner XL4 User manual
[4]   ***** Joint Risk Monitoring during Emergencies in the Danube Area Border, MIS-ETC Code: 166, Application number 2S-2.2-1
[5] ***** Raport intern R.I. 3-A3/1.3 (47)- Realizarea interfeței software dintre GIS i componentele informatice ale sistemului antigrindin , University of Craiova, CITT, 2012.

Addresses:

- Prof. Dr. Eng. Gheorghe Manolea, University of Craiova, B-dul Decebal, nr.107, ghmanolea@gmail.com
- S.I. Dr. Eng. Florin Ravigan, University of Craiova, B-dul Decebal, nr.107, ravigan.florin@gmail.com
- Dr. Eng. Alexandru Novac, PROMAT Craiova, Str. Fra ii Gole ti, Bl. K28, alexandru_novac@yahoo.com