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Design, Manufacture Simulator Radar System for Monitoring Marine

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***Abstract* - In this paper, we present the design, manufacture of simulator system for marine-surveillance radar. The objective of this work is to create practicing system which consists of control program and display like a real one. Therefore, it helps users to become familiar with the real system.**

Keywords— Radar, Simulator System, Marine-Surveillance Radar

I. FOREWORD

In modern war; weapons, high-tech weaponry play an important role in winning the wars, in which radar is one of key weapons that having very important tasks in combat [1]. The radar weaponry broadcasts into space to look for infringing airspace goals, seas and islands and territories of the country to promptly inform the defense forces for protecting territorial fatherland. In addition, radar has many other tasks, such as controlling the type of firepower to destroy the target, leading the way for the boats, aircraft of us combats...In the current situation, the design and manufacture of radar systems met too difficulties in technology that Vietnam has to import from abroad. Exploiting proficient use of modern radar weaponry is meaningful. In conditions, real weapons are imported from abroad with a very high price so only vessels are equipped to serve the combat readiness. Therefore, a very urgent issue now is study, design and fabricating simulator radar system monitoring marine to serve training missions. This simulator systems help the training of Navy soldiers, help the soldiers quickly grasp proficient use real weapons; thereby contributing to firmly protect the airspace, waters and island country.

The rest of this paper is organized as follows: In Part II, we briefly present the working principles of the radar system and the principles by the target parameters of the radar. From that, in Part III, we present the design and manufacturing simulator system. Finally, the conclusion is presented in section IV.

II. THE WORKING PRINCIPLE SYSTEM OF RADAR AND MEASUREMENT TARGET PARAMETERS OF RADAR

This section presents the principles of radar, as the basis for our design and fabrication in section III.

A. Classification radar according to the frequency range

TABLE I. CLASSIFICATION OF WORKING FREQUENCY RANGE RADAR

The name of the frequency bands	The range of Frequency
HF	3 MHz - 30 MHz
VHF	30 MHz – 300 MHz
UHF	300 MHz – 1000 MHz
L	1000 MHz – 2000 MHz
S	2000 MHz - 4000 MHz
C	4000 MHz- 8000 MHz
X	8000 MHz – 12000 MHz
Ku	12 GHz – 18GHz
K	18 GHz – 27 GHz
Ka	27 GHz- 40 GHz
V	40 GHz – 75 GHz
W	75 GHz- 110 GHz
mm	110 GHz – 300 GHz

Classification of radar under the working frequency range is presented in Table 1 [1], [2], [3]. The radar working with higher frequencies would have better accuracy in measurement to coordinate the target, but the great loss of path wave lead to reduced observation distance. Vice versa, radar working at low frequency would give increase in observation distance but reduction in measurement accuracy to coordinate target [4], [5].

B. Working principle of radar systems

Working principles of a pulse radar system is presented as in Figure 1. The radar transmitter generates emission ultrasonic pulse passes through the waveguide system to switch the transceiver, this time moving transceiver circuit would close the collection line to prevent ultra-high frequency energy fall into ruin the receiver, simultaneously opening the energy strand give out ultra-high frequency radiation antenna orientation in space as a high-frequency waves. Ultra-high frequency waves and reflections target returns are received by the receiving antenna system switching waveguide transceiver to the receiver. At the receiver, the signal reflected back on target to be selective, transform, amplification leads to the display device. The target display device, through which we can determine the parameters, such as the nature of the target range, azimuth, elevation ...

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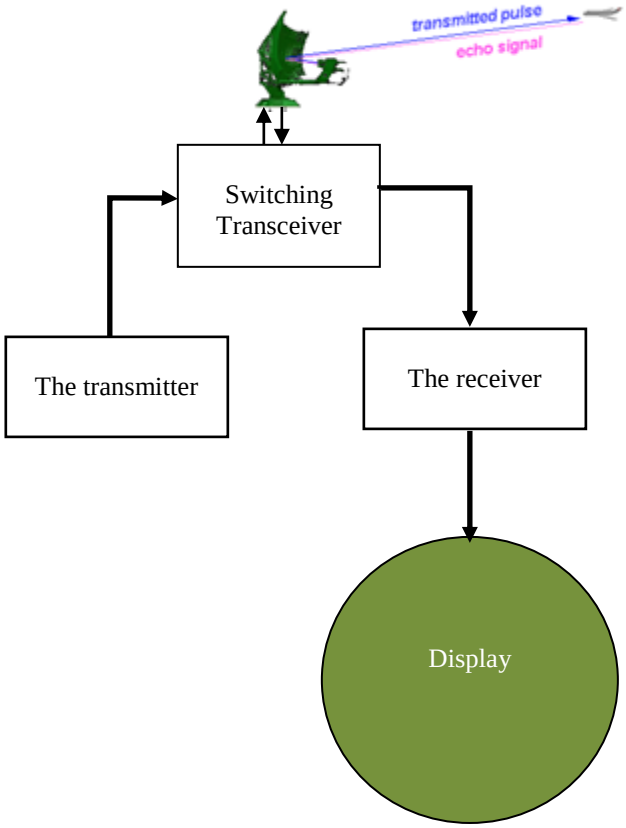

Fig. 1. Working principle of the radar system

C. Principles of the target parameters measuring of radar

1) Measurement of distance of the target's radar

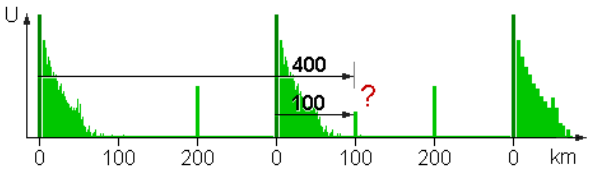

Fig. 2. The distance of two target signals

Principles basic measurement range is as follows: if the call T is the time delay from when the pulses emitted from the antenna to meet target when reflected back by the receiver, the distance of the target is calculated by the formula R (first).

R = (C * T) / 2 (1)

Inside:

R is the distance of the target.

C is the speed of electromagnetic waves (3 * 108 m / s).

T is the time of wave propagation.

Fig.2 a practical example of target range radar, in which the maximum distance that the radar can measure is 300 km, the radar target detection in this figure is at a distance of 100 km.

2) Measurement of azimuth of radar target

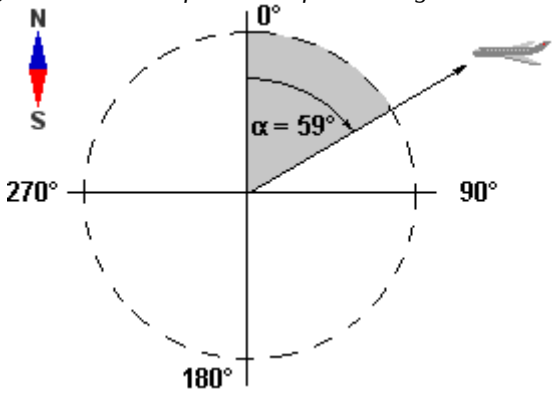

Fig. 3. Principle of measuring the azimuth of radar target

To measure the angle of the goal, when filming and broadcasting antenna space on target detection, it also turns on the radar screen, designed so that they are synchronized and synchronous rotation with each other, meaning that the antenna and ray scan of the same rotation speed, and when the main beam direction, the beam scans North 0 degrees is just right on the target display. Suppose in Fig. 3, beam scanning to meet the target angle α reflex return displayed on the radar screen would measure 59 degrees angle.

3) Principles of target radar elevation measurement

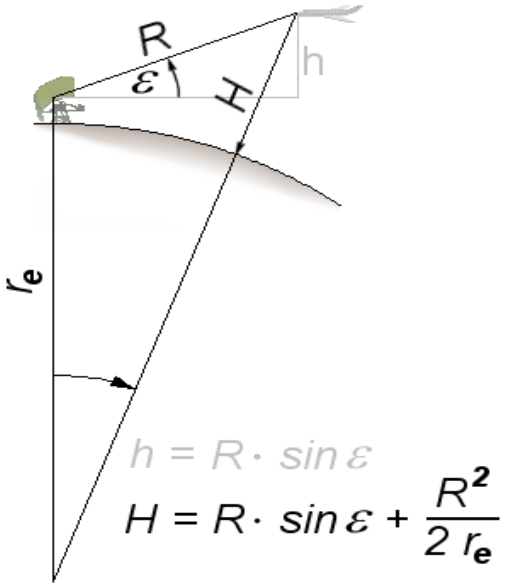

Fig. 4. Principle of the target radar elevation measurement

If the flat ground one can easily calculate the target altitude by the formula (2).

h = R * sin ϵ (2)

In fact our earth has a spherical shown in Fig. 4 so that the actual height of the target calculated by the formula (3).

H = R * sin ϵ + R2 / 2re (3)

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Inside:

h is the height of the target if the ground is considered flat.

H is the actual height of the target.

R is the distance of the target.

re is the radius of the Earth (roughly 6370km) [6].

є is the angle formed by the elevation of the target with the horizontal plane.

III. DESIGN, MANUFACTURE

To design and manufacture of radar simulator system monitoring the sea, we design and manufacture of equipment and control systems, equipment to create false radar target display device and radar targets. The display device is an LCD equivalent magnitude on the radar screen actual device. Two sections below present the design and manufacture of equipment and control systems and equipment to create false radar target.

A. Design system control device

To close with purpose designed training systems for Navy soldiers acquainted with the real system using Russian language, first we design and manufacture the console so that users can interact with the system shown in Fig. 5.

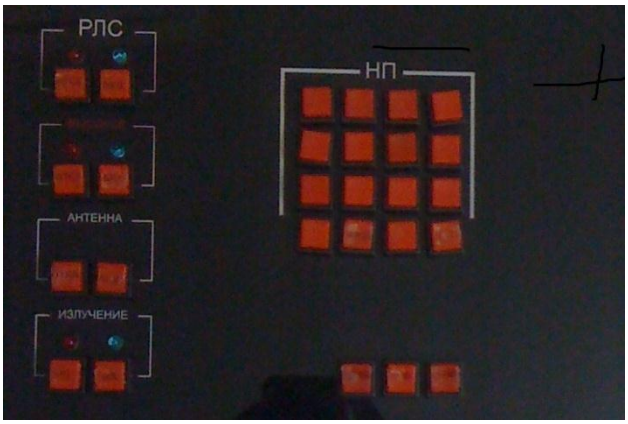

Fig. 5. The console training systems

In it, meaning the button:

РЛС- ВКЛ: is open source machine РЛС

РЛС- ОТКЛ: the machine power off РЛС

ВЫСОКОЕ: the high-pressure opening

ОТКЛ: High pressure is off

АНТЕННА: rotating antenna is controlled

ИЗЛУЧЕНИЕ: the generator output connector

НП: the keyboard data entry

ВВОД: the input choices

СБРОС: the choice is left

The interface consists of a control system and enter parameters to process radar targets. The control includes large buttons to control the spin-off of antenna systems, high-frequency-off broadcast, inquiry our enemy. Part enter the matrix of parameters is key to enter the integers from 0- 9, the basic calculations in addition interface can also distinguish cholera lights. Underneath the panel is the controller with the central block based on PIC microcontroller chip. Press keys on the interface is connected to the control circuit below and be programmed according to the function of each key.

B. Design and equipment to create false radar target

The equipment consists of computer generated fake high-profile graphics card and simulator program target on the radar screen. This computer is connected to a controller that is mentioned in section *A.*

1) The basic algorithm of the system

Basic algorithm of the system is performed according to the algorithm Fig.8, the process is as follows:

Start working, power the system and boot the system.

The system automatically checks for safety, if possible inspection report conducted rotating antenna, if broken back to restart.

Rotating antenna system worked well, proceed broadcast radar, radar when broadcast if the target is located in the wing wave radar will be displayed on the radar screen, if not in the wave channel, the target will not return to play radar waves.

When a target displayed on the radar screen, then proceed to select a target stick, when the target is selected, the system closely following the targets automatically, if the target is not selected display abreast return target .

Ending the basic workflow of the system.

b) Design simulator display radar system

Screen shows radar simulator system used to display radar targets, working status and control systems work.

Screen interface designed like the actual radar screen, to help the training of Marines soldiers close to the actual user interface language is Russian and is shown in Fig. 6.

Display radar simulator system is designed with the following basic components:

In the middle of the screen displays radar simulator system designed display radar targets. In the simulator display system will display programming simulator radar target types, such as boats, flying vehicles, various types of radar interference ..., which also designed programming grid simulator measuring range and azimuth fixed to users quickly determine the coordinates of the radar target.

Right display radar simulator designed to simulate programmable control panel pannel radar and parameter indicator of radar targets and properties functions like radar system in practice.

Above the display simulator designed radar simulator programmed pannel display the working status of the equipment in the radar system.

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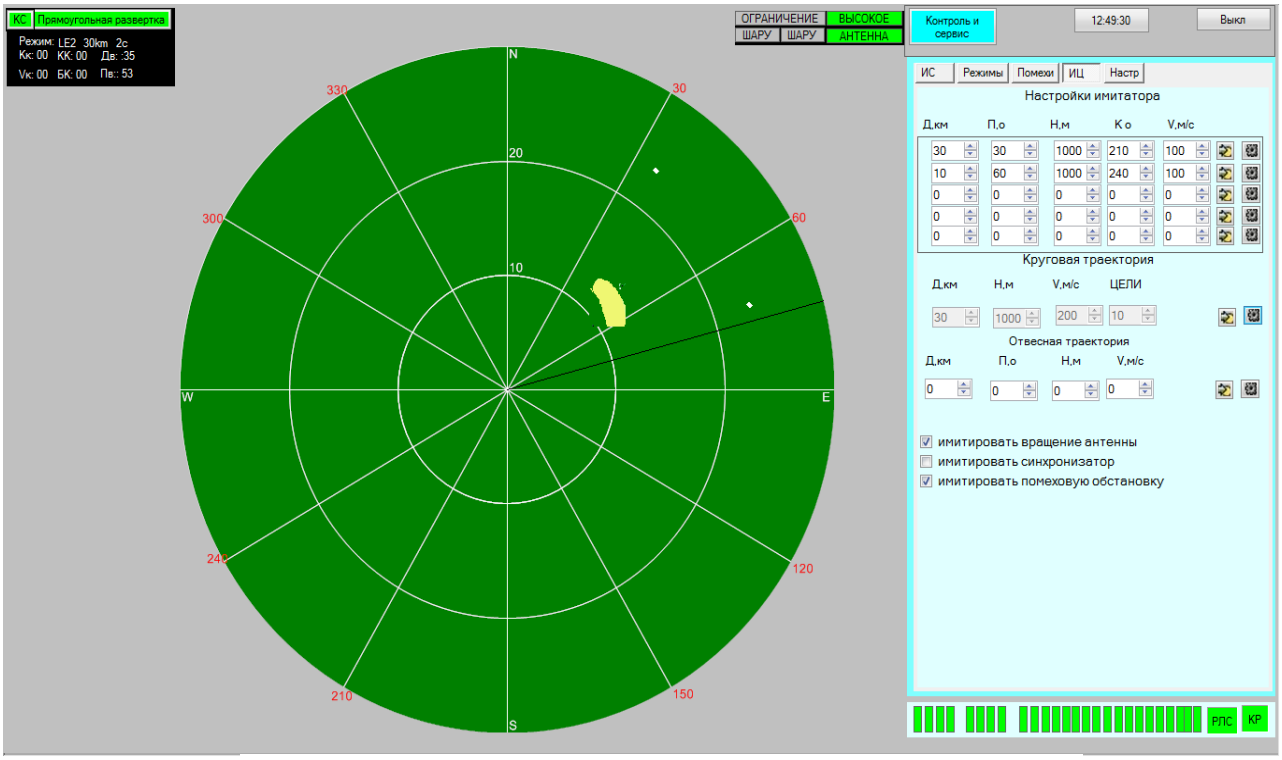

Fig.6. Monitor radar simulator system in working mode

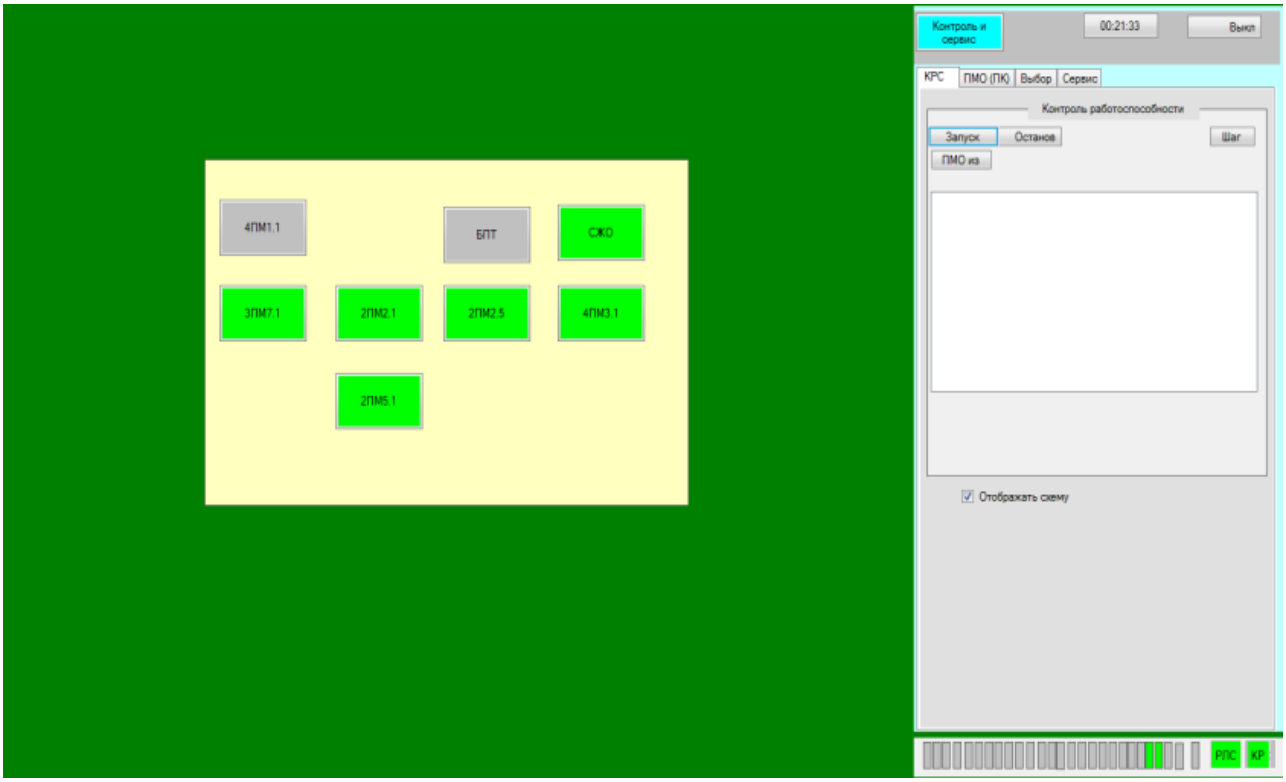

Fig. 7. Monitor radar simulator system in test mode

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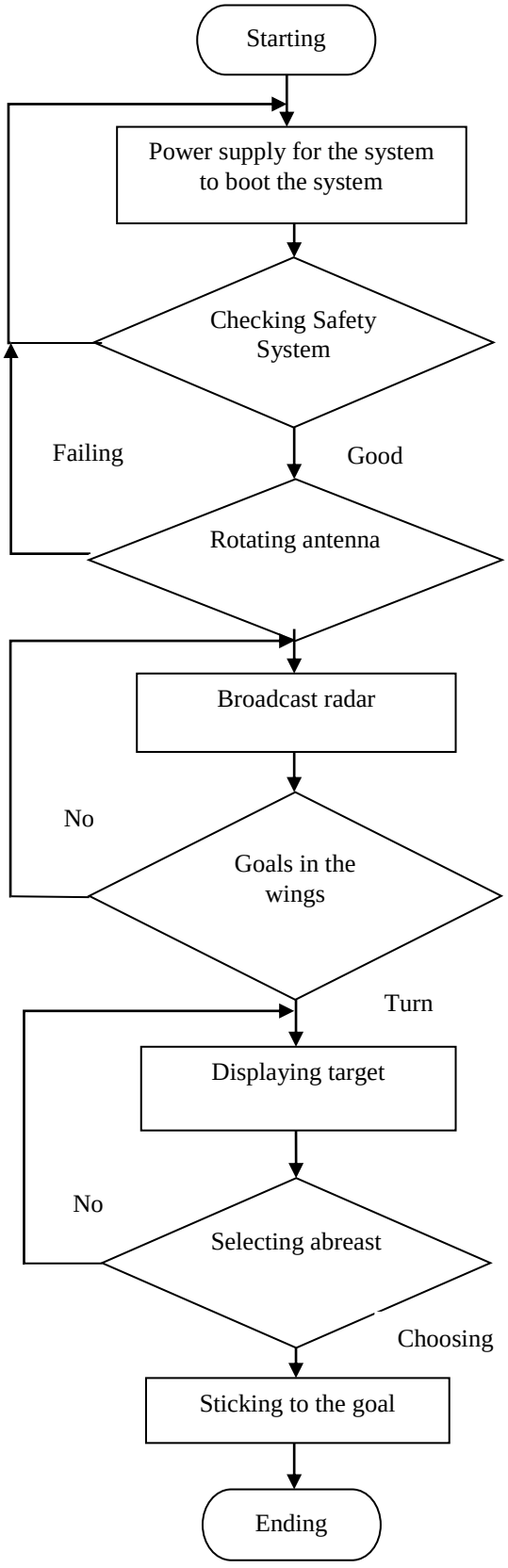

Fig.8 The basic algorithm of the system

c) Design screen radar simulator system in test mode.

Monitor radar simulator system in test mode to simulate the process of checking the truth and radar system is shown in Fig.7. The screen is designed programming consists of 2 parts, interfaces, processes and functions displayed similar real radar systems. The right side panel simulator programming process simulation test equipment in the radar system, programming the left side panel controller emulates the process of checking the equipment in the radar system.

IV. CONCLUSION

In this paper, we present the design and manufacturing simulator system for surveillance radar. The simulator system is done for training, for helping soldiers get familiar with real radar system in the Navy warships. Test results of the system presented in this paper could be promising to design simulator systems for many different types of navy weapons. These systems are effectively meaningful in training for Marines soldiers, and helping them meet the requirements of the task to defend the Fatherland in the new situation.

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