

# Simulation and Implementation of Radar Video Simulator

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**ABSTRACT:** Radar is a device used on-board ships to detect targets around the ship. These targets are monitored on a Plan Position Indicator. Radar Video Simulator is a device which is used for testing and tuning the radar displays. To monitor the targets Radar Video Simulator requires four kinds of signals. These signals are sync pulse, antenna change pulse, video pulse and heading marker pulse. In this project I have implemented a PCB design to generate four kinds of signals. The PCB is designed using discrete components. The output of the PCB was given to a Radar Interface Board(RIB) and further to Radar Video Display(RVD) Software.

**KEYWORDS:** PCB, RIB, RVD

## I. INTRODUCTION

Radar is a device used on-board ships to detect targets around the ship. These targets are monitored on a Plan Position Indicator.

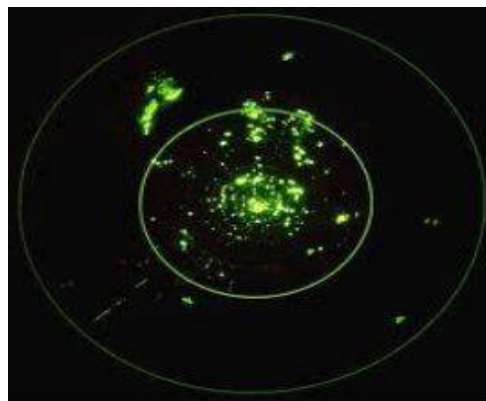


Fig-1 Plan Position Indicator

Plan Position Indicator (PPI) as shown in Fig-1, is circular display in which the radar video is normally presented in the polar co-ordinate system. The center of the circle is considered as the origin and is defined as the position of own ship. Targets around the ship are detected by the radar and presented as video echoes around the ship. Thus each target will be shown as a dot at a particular distance from the center. The radial distance denotes the range of the target and the angular value from the top of the display denotes the bearing of the target from the ship. In order to present the information as described above, there is a requirement for a set of standard signals to be received from the radar. The standard set of signals are connected to the Radar Interface Board which converts the signals from the analog to the digital format. The data in the digital format flows to the Radar Display Software which presents the video on the screen.

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in the PPI format. The Standard set of signals required are Sync Pulse, Antenna Change Pulse, Video Pulse and Heading Marker Pulse. First of all Sync Pulse is coming. The function of Sync Pulse to generate the beam on the PPI. After that Antenna Change Pulse is required to rotate the beam appearing on the PPI. Video Pulse has an important role because targets which is appearing on the PPI is depending on the video Pulse if video Pulse is not coming then Targets will not be appeared. To meet the requirements of testing of Radar Display, this simulator is generating Video, Heading, Sync, and Antenna Change Pulses.

**Antenna Change Pulse:** The angular determination of the target is determined by the directivity of the antenna. By measuring the direction in which the antenna is pointing when the echo is received, the angle from the radar to the object or target can be determined.

**Heading marker:** A mark on a direction compass which indicates the position of the ship's head, such as a lubber's line, or an electronic radial sweep line on a PPI (plan position indicator).

**Video pulses:** Its value is responsible to show the length & breadth of the TARGET on PPI. TARGET Intensity depends on width of video pulses.

**Sync Pulse:** Beam on the PPI is appeared through the Sync Pulse. Sync Pulse is the first input pulse in the Radar Video Simulator System.

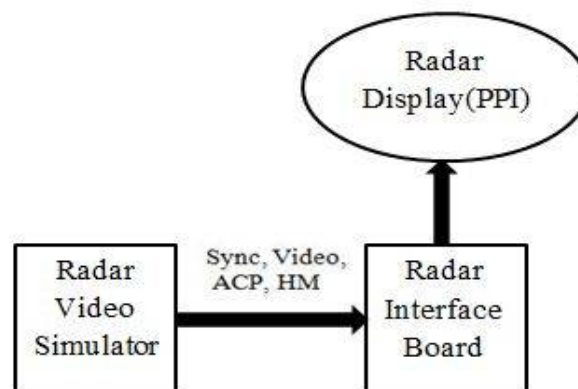


Fig-2 Block Diagram

Block Diagram of my project as shown in Fig-2, I have implemented a PCB design to generate Radar Video Simulator. Radar Video Simulator generates HM, ACP, Video and Sync pulses. The output of PCB was given to the Radar Interface Board, which converts the signals from the analog to the digital format and the output of the RIB which has digital signals fed to Radar Display to monitor the targets.

## II. RELATED WORK

As a first step towards implementing the Radar Video Simulator, an extensive study of the materials related to the radar signals was carried out. The four basic signals that were required to be simulated were identified. A sample interface control document specifying the values of the four signals was generated. The next step was to design the PCB which could generate the required signals.

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Software used for the simulation of Radar Video Simulator is ISIS Professional PROTEUS 7 sp4. This software provides the capability to design a complete electronics board using simulated components. The simulation has all the properties of the actual hardware component and hence it has been possible to see the working of the board even before assembling the complete system using the actual hardware components. The PCB was designed and tested using this tool. The next step has been to implement the PCB by using the actual hardware components. I have implemented a PCB design to generate four kinds of signals. The PCB is designed using discrete components. Main parameter to compute the above four signals is RANGE CELLS, the horizontal line consisting of vertical spikes like measurements which define the address of various other targets. It defines the distance and also defines address in the specified format. The range cell width can be set and the total no. of cells varies with different radars (eg.  $2^{10} = 1024$  for 1000 number of range cells).

Range cell width = 100 m

Total no. of cells = 1000

Total range = 100 m \* 1000 = 100 km

Std. conversion = 1  $\mu$  sec = 150 m

hence, for 100 km the PRT =  $666.6667 \mu$  sec = 0.666 m sec

From the above range cell calculation all the four kinds of signals can be calculated. The Antenna Change pulse is of 1.5 kHz so that in total 4096 number of pulses generated to display whole circle on PPI. Sync pulse is of 1.5 kHz and it is coming before all other pulses. Heading marker is coming after every 4096 pulses to flush all old information present on PPI and it is of 0.33 Hz. The speed of rotation of the heading marker with respect to the antenna is 20 RPM. The video pulse is of 1.5 MHz. The output was given to the Radar Interface Board. These signals are analog and will be converted to digital signals. Then the output of the Radar Interface Board was given to Radar Display to monitor the targets.

### III. EXPERIMENTAL RESULTS

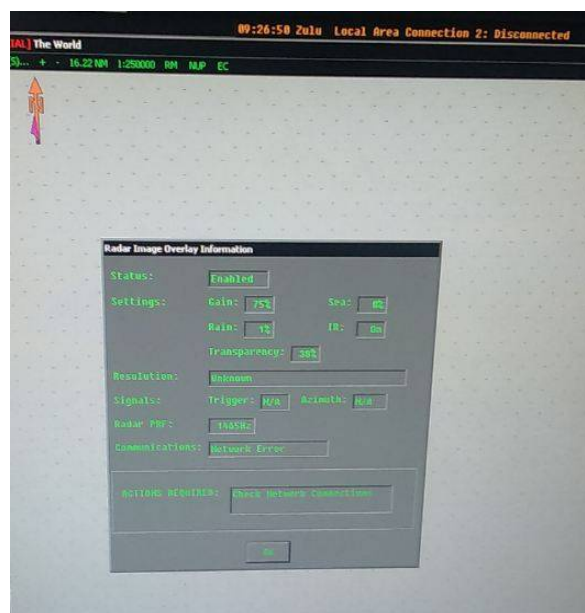


Fig-3 Radar Display before connection

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In the Fig-3, Trigger and Azimuth are not available. Initially the display will be showing not available or lost since no signal is available.

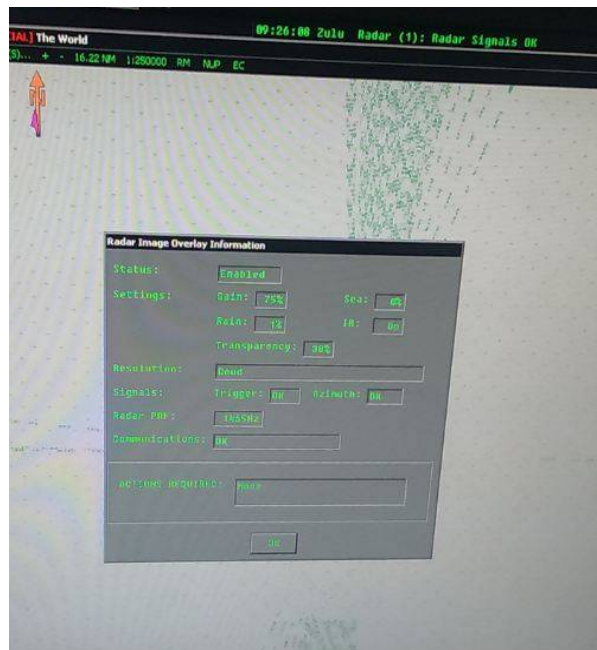


Fig-4 Radar Display after connection

In the Fig-4, From Radar Video Simulator, we send signals to Radar Interface Board and these signals are fed to Radar Display. If the targets are visible and if we are able to monitor, then the testing of display can be done. To monitor targets Radar options has to be setup and there is a video option which has to be setup.

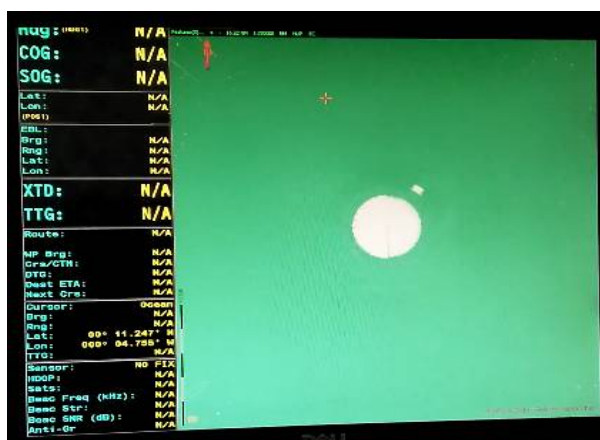


Fig-5 Radar Display after Signals received

In the Fig-5, the center of the circle is considered as the origin and is defined as the position of own ship. Dot presented around the centre of the circle represents target. The target is at range 10 and Azimuth angle 45 degree. The radial

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distance denotes the range of the target and the angular value from the top of the display denotes the bearing of the target from the ship.

## IV. CONCLUSION

I have implemented a Radar Video Simulator for testing and tuning the Radar Displays. It has been possible to generate a simulated target at various range and bearing values using the simulator. By using this information, it has been possible to check the interfaces of the radar with the radar display. It has also been possible to check the accuracy of the Radar Display and carry out tuning of the software so that the range and bearing values shown on the screen are accurate. In the absence of a radar video simulator, the only methodology for carrying out this activity is to connect up the actual radar. Connecting of the actual radar and transmission of the radar has many practical difficulties. Hence this Radar Video Simulator is very useful for technicians' on-board ships to check the serviceability of the radar displays without depending on the actual radar.

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