

DESIGN OF OPEN ARCHITECTURE ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS)

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ABSTRACT

This paper is practical design and implementation of an Electronic Chart Display and Information System (ECDIS) is a specific form of computer-based navigation information system that complies with International Maritime Organization (IMO) regulations and can be used in lieu of paper navigation charts in some areas. Not all electronic chart systems can be called an ECDIS, but the term is often incorrectly used to refer to any type of Electronic Chart System (ECS). The true ECDIS system displays information integrates position information from the Global Positioning System (GPS) and other navigational systems, such as Radar, echo sounder, gyrocompass etc. It may also display additional navigation-related information, such as Sailing Directions. This project has a general background about ECDIS, then concerned with the different inputs to this system such as GPS, Radar, Echo Sounder and Gyrocompass. We will demonstrate the program which will simulate the actual work for the ECDIS system with its all interfaces with Rader, GPS, Speed log...etc. We preferred to design the software using the used software c++ Builder 6. This Program is a window based Software.

KEYWORDS: IMO, SOLAS, Ship Control, Signal Processing, Sensors

INTRODUCTION

An Electronic Chart Display and Information System (ECDIS) is a specific form of computer-based navigation information system that complies with International Maritime Organization (IMO) regulations and can be used in lieu of paper navigation charts in some areas. Not all electronic chart systems can be called an ECDIS, and but the term is often incorrectly used to refer to any type of Electronic Chart System (ECS).[1]



Figure 1: ECDIS Display (US Army)



Figure 2: Vector Chart

The true ECDIS system displays information from electronic navigational charts (ENC) and integrates position information from the Global Positioning System (GPS) and other navigational sensors, such as radar, fathometer and automatic identification system (AIS). It may also display additional navigation-related information, such as Sailing Directions. The ENCs themselves are as important as the system that displays them. Confusion sometimes exists between official ENCs which HAVE to be produced by or on behalf of an international government Hydrographic Office, and other commercial electronic charts which, whilst they may be able to be displayed on ECDIS system, do not comply with the IMO regulations for use as the primary navigational charts system.

Only when official ENCs are run in a compliant ECDIS system can it be called an ECDIS. All other chart data used immediately downgrades the system to an ECS, and non-complaint, under the terms of the SOLAS regulations for use of Electronic Charts as a primary means of navigation for merchant shipping. This distinction is ready to ignore the regulations. [2]

ECDIS equipment is specified in the IMO ECDIS performance Standard (IMO Resolution A.817 (19)) as follows: Electronic Chart Display and Information System (ECDIS) means a navigation information system which, with adequate back up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/19 and V/27 of the 1974 SOLAS Convention, by displaying selected information from a system electronic navigation chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring and by displaying additional navigation-related information if required. ECDIS is a ship born navigational device and as such it is the responsibility of IMO. It must support the whole range of navigational functions that make use of the characteristics of the chart data and their specific presentation. Moreover, to be an ECDIS the equipment must be shown to meet all the requirements of the IMO Performance Standards (IMO Resolution A.817 (19)) and offer, beside the graphic presentation of chart data, additional information about the characteristics of the displayed features.

Electronic Chart Display Functions and Types of Charts

When initially loading an ENC, ECDIS displays the standard display. The display uses the system electronic navigational chart (SENC), which is the ENC database together with manual and automated updates. It is this database that ECDIS uses to generate the navigational display. It is equivalent to an up-to-date paper chart. The SENC may also contain additional information from other sources. The level and kinds of information displayed may be modified by the operator subject to the limitations of a display base. The display base is the minimum level of SENC information required at all times in all geographical areas and all circumstances. The display base is not intended to be sufficient for navigation. [3]

Raster Charts

Raster navigational charts are raster charts that conform to IHO specifications and are produced by converting paper charts to digital image by scanner. The image is similar to digital camera pictures, which could be zoomed in for more detailed information as it does in ENCs. IHO Special Publication S-61 provides guidelines for the production of raster data. IMO Resolution MSC 86(70) permits ECDIS equipment to operate in a Raster Chart Display System (RCDS) mode, this is in the absence of ENC. [4]

Regulations and Application

ECDIS (as defined by IHO Special Publications S-52 and S-57) is an approved marine navigational chart and information system, which is accepted as complying with the convention paper chart required by Regulation V/20 of the 1974 IMO SOLAS Convention. The performance requirements for ECDIS are defined in by the International

Electro technical Commission (IEC) in Specification. ECDIS provides continuous position and navigational safety information. The system generates audible and/or visual alarms when the vessel is in proximity to navigational hazards. [5]

Electronic Chart Data

There are two types of electronic chart data; the most common is the vector chart, Vector charts are the chart database for ECDIS, with standardized content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. ENC's are vector charts that also conform to International Hydrographic Organization (IHO) specifications stated in Special Publication S-57. ENC's contain all the chart information necessary for safe navigation, and may contain supplementary information in addition to that contained. In the paper chart (e.g. Sailing Directions). This supplementary information may be considered necessary for safe navigation and can be displayed together as a seamless. ENC's are intelligent, in that systems using them can be programmed to give warning of impending danger in relation to the vessel's position and movement.

Particle Work Description

In this work we will demonstrate the program which will simulate the actual work for the ECDIS system with its all interfaces such as Rader GPS Speed log...etc. We preferred to design the software using the Borland C Builder 6. The demonstration program is made to simulate an idea of an electronic chart display used onboard ships. This Program is a window based Software Builder 6 has strong Imaging tools and has some readymade components that will help us on the program. The complete Source software is available under request.

Description of the Program

The program we programmed is used to displays six Overlapped updated Images which represent sex Views which can create six video layers. Most layers in transparency, picture and size in the real time. We have one Form; all orders to the program are generated from mouse POP-UP Menu or by Keyboard short-cuts. There is the ability to initiate up to 20 tracks for selected targets, these tracks can be updated or even canceled at any time. We can draw a circular zones up to 6 circular zones with selected color and selected line width, the 1st zone can fire alarm for targets go through the zone inside /outside direction. We can draw sector up to 6 sectors with selected color and line width, the 1st sector can fire alarm for crossing targets (inside /outside). We can draw lines up to 8 Lines with selected color and selected line width. We can put marks (up to 6 green circles, 6 Red circles, 6 green squares and up to 6 Red squares) in any place. We can write text Up to 10 text lines in any place in the screen with different size and colors. We can show or hide a bitmap map image.

Program Main Menu

At any place in the display the right clicking of the mouse will show this pop up menu.

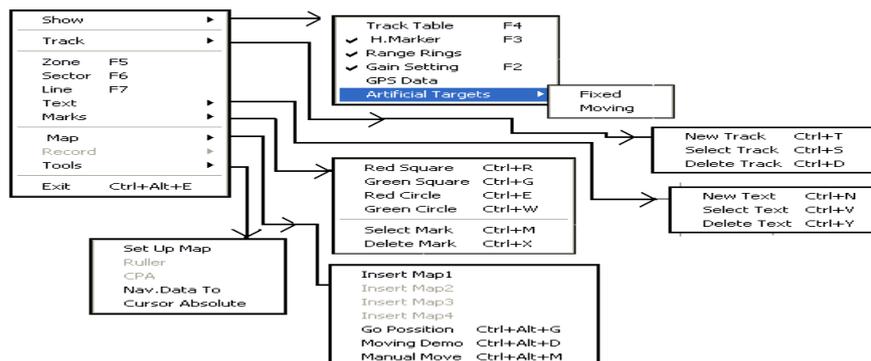


Figure 3: Popup Menu

Range Scales and Initiating a Track

By clicking on the “Upper / Lower arrow” we can change range from 3 Km to 96 Km. by clicking on the “Km” it toggles the measuring system from Km to N miles and vice versa. We can put the mouse at any place over the target and press “Control T” or clicking on the Pop Up menu on “New Track”. The new track starts with this shape “Yellow”.

At any time if we selected to show the track table we will see the (distance, angle, course and speed) for all the initiated tracks. If we selected a certain target we get (during mouse on the target). Now in software version 1 we got 20 fully auto tracks.



Figure 4: Range Scale Window



Figure 5: Target Data

Circular Zones and Sector Zones

When we use the Pop Up menu and select “Zone “We get a control window for zone control (Initiation-canceling-check data). We have 6 Zones activated independently through 6 switches (each switch has a led to indicate its status) after switching any switch we choose the required color from the color Combo Box. On the screen we got a mouse message “Click on Center Point” so we click on the Circle center then the mouse message changes to “Click in outer” so we have to click on the outer point in the circle. A colored circle is drawn. At any time if we put the mouse on the activating switch for this circle we can see the color, center and radius. This is valid for all circles. But circle number1 “Zone1” has advantage of setting alarm zone. We can choose alarm for inside area or for outside area. When a target comes near the guard zone its color and shape is changed. When a target comes inside the guard area its color and shape will changes. All these Circular zones have a geometric response to range scale.

For sector drawing we got the same sequence like circular zones. All these Sectors have a geometric response to range scale.

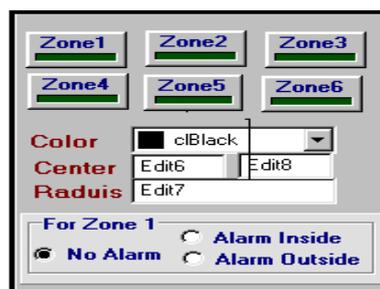


Figure 6: Zone Control Window

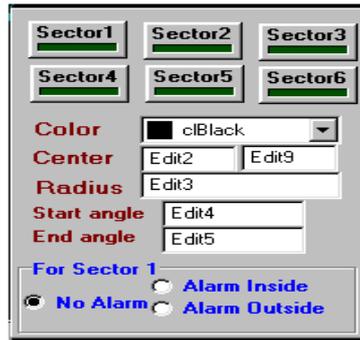


Figure 7: Sector Control Window

Drawing Lines

We have eight lines with selectable colors and full control (draw, cancel, check of start and end points, color, angle and distance). When we choose line from the Pop Up Menu we get this control block. Using it is the same like the circular zones. At any time we can check the Line parameters. All these lines have a geometric response to range scale.

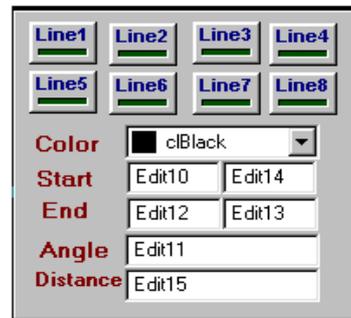


Figure 8: Line Control Window

Marks

The following markers are available.

Table 1: The Available Markers

| Symbol | Quantity | Short Cut Key | Geometric Response |
|--------------|----------|---------------|--------------------|
| Green square | 6 | Ctrl + G | YES |
| Red square | 6 | Ctrl + R | YES |
| Green circle | 6 | Ctrl + U | YES |
| Red circle | 6 | Ctrl + T | YES |

By putting the mouse on any place and press on the short cut key a symbol is painted. At any time we can select a certain symbol and remove it without effecting on the other symbols.

Writing Text

We have 10 colored text messages. We can choose from the Pop Up menu “New Text” We notice that under the clock a text window is created and a color combo box. We can write any text and choose the color and then a mouse message guide you to put the text at any place by clicking the mouse on that place. When we want to cancel the text we must select it first and then cancel it only leaving the other text on the screen.

Show/Hide a Bit Map

For simple maps we can print them in a bitmap image and use it as a back ground for the display. When we work

in a fixed place like ports, we always have a fixed targets, ground, building, navigation Icons, etc... we can draw them on the bitmap and use it. It occupies one of the video planes in the software.

CONCLUSIONS

The system is inexpensive and versatile for ships. This system use for ships which has both digital and analog circuit boards interface for safe navigation. The proposed designed control and give the best use from several types of sensors, each type is dictated to specific task. The system is connected to sensors everywhere in the ship and continuously monitors them; if any sensor reading is updated we get an output on ECDIS display. The monitoring system can record any status and save it in hard disk or printer with time stamp. Adding to that it can be used as base to control variety of all ship status from the bridge. The implementation of this ECDIS system increases the dependency, reliability, reduces the manpower and reduces the cost; also it can be used to add features and fix design bugs after fabrication of a complete ship system. Moreover reprogram ability yields to a much more engineer friendly system.

The demand to reduce manning level led to the development of automatic control ECDIS which enabled operation from the bridge. With vessels capable of safe operation for any period of time in this mode, all the control systems and monitoring facilities are grouped together in ECDIS. The system consumes little power per interface and driver is protected such that it often prevents the user from destroying sensor that was installed or programmed improperly. This system feature improves the setup and reduces the fall down time. The straightforward programming design interface allows the multi use of the design in different cases specially when installing or upgrading sensor or system in the ship. Applying this system a better use of ship sensors and electronic equipment is achieved and can be used to operate and navigate in complex environment according the requirements. [6.7.8]

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