RESEARCH ON THE KEY TECHNOLOGY OF ECDIS BASED ON THE S-52 STANDARD

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Abstract:

Electronic charts are a new navigation aid that can provide significant benefits to maritime navigation safety, and commerce. More than simply a computer graphics display, electronic chart systems combine both geographic and textual data into a readily useful operational tool. Electronic charts are a real-time navigation system that integrates a variety of information that is displayed and interpreted by the mariner.

IHO Special Publication 52(IHO-S-52) is the IHO Specification for Chart Content and Display of ECDIS. It includes appendices describing the means/process for updating, color and symbol specifications. Electronic charts automate the process of integrating real-time positions with the chart display and allow the navigator to continuously assess the position and safety of the vessel. This paper discussed the key problems, which will provide the theoretical foundation and practical experience. On the bases of analyzing the S-52 standard, this paper discussed the key technology in the Electronic chart display system, including such follows: Propose a new automatic assignment symbols which consist of points, lines and areas. According to the S-57 standard and S-52 standard, it is decided by the objects attribute when a symbol was shown.

In order to meet the mariner's evolving requirements, it should be designed with enough flexibility. It contains conditional symbology procedures for cases where symbolizing depends on circumstance, such as the mariner can select a safety depth or safety contour. For a safety depth, all soundings less than or equal to the safety depth are emphasized. For a safety contour, ECDIS highlights this contour over other depth contours. Establishing a color table so that the color will be changing.

Key Words: S-52 Standard, Visualization, ECDIS

1. Introduction

Charts are used in worldwide, due to the particularity of charts mapping regions and oceangoing requirements, connect with International Charts Display Standard is the necessary condition.There are two necessary conditions to realize ENC International Standardization, one is according to S-57(IHO Transfer Standard for Digital Hydrographic Data) to produce data, and the other is representing the real world with

S-52. S -57 is a Data Transfers Standard, its data model without any regulations of information graphic display only provide methods to describe real world. The presentation of information is considered to be independent of its storage. S-52 is the Specifications for chart content and Display for ECDIS, including "Presentation Library" and "Colour & Symbol Specifications".

The S-57 states, which describes the concept of presentation of S-57 chart data representing the real world: " The presentation of that information may vary to suit a particular use, e.g., it may be presented either graphically, using symbols, or in textual form "According to this principle, S-52 indicates that "ECDIS display mode which used in maritime must consider of IMO/IHO ECDIS performance requirements (IMO PS) adequately", it requires that the presentation of charts on an ECDIS screen changes depending on parameters and selections defined by the mariner, such as safety contour, time of the day, traditional or new symbology, etc. Thus the presentation model must cover not only colour and symbol definitions but also instructions how to handle a dynamically changing presentation as well.

This paper gives some examples on dynamic display, conditional symbolization, colors scheme, symbol system conversion, online visualization, etc..

2. S-52 Standard Brief Introduction

Implement content of Presentation Library (PL) to realize S-52 display style.Symbolization injunction and symbol system are the graphics describe language of ENC, and the look-up tables as ligament to contact symbol injunction and S-57 object, Display Generator(DG) basic operation procedures indicate how to associate with PL's all contents by SENC S-57 object and realize S-57 object character conjoint with actual display on an ECDIS screen finally. Therefore, DG's flow will become the direction to design structure and symbol arithmetic of whole look-up table, eventually achieve to objects symbolization.

3. Design and realization of the Display Generator

The presentation model for ECDIS is built from two major parts. One is "Presentation Library for ECDIS". Including a library of colours, line styles, fill styles, point symbols and a set of symbology instructions and look-up tables for the translation of object descriptions into symbology instructions. The other is Display Generator (DG), a description of a programmable structure, which serves as a functional model for the graphic of an ECDIS system and which explains how to use the elements of the PL and how to ensure the correct display of data structured according to S-57.

IHO provides two kinds of PL: letter description and digital carrier to ensure ENC Standardization, for DG ask producers to unattached develop them refer to S-52 and its appendix. So ENC display should base on PL and realized by unattached develop DG (Fig. 1).
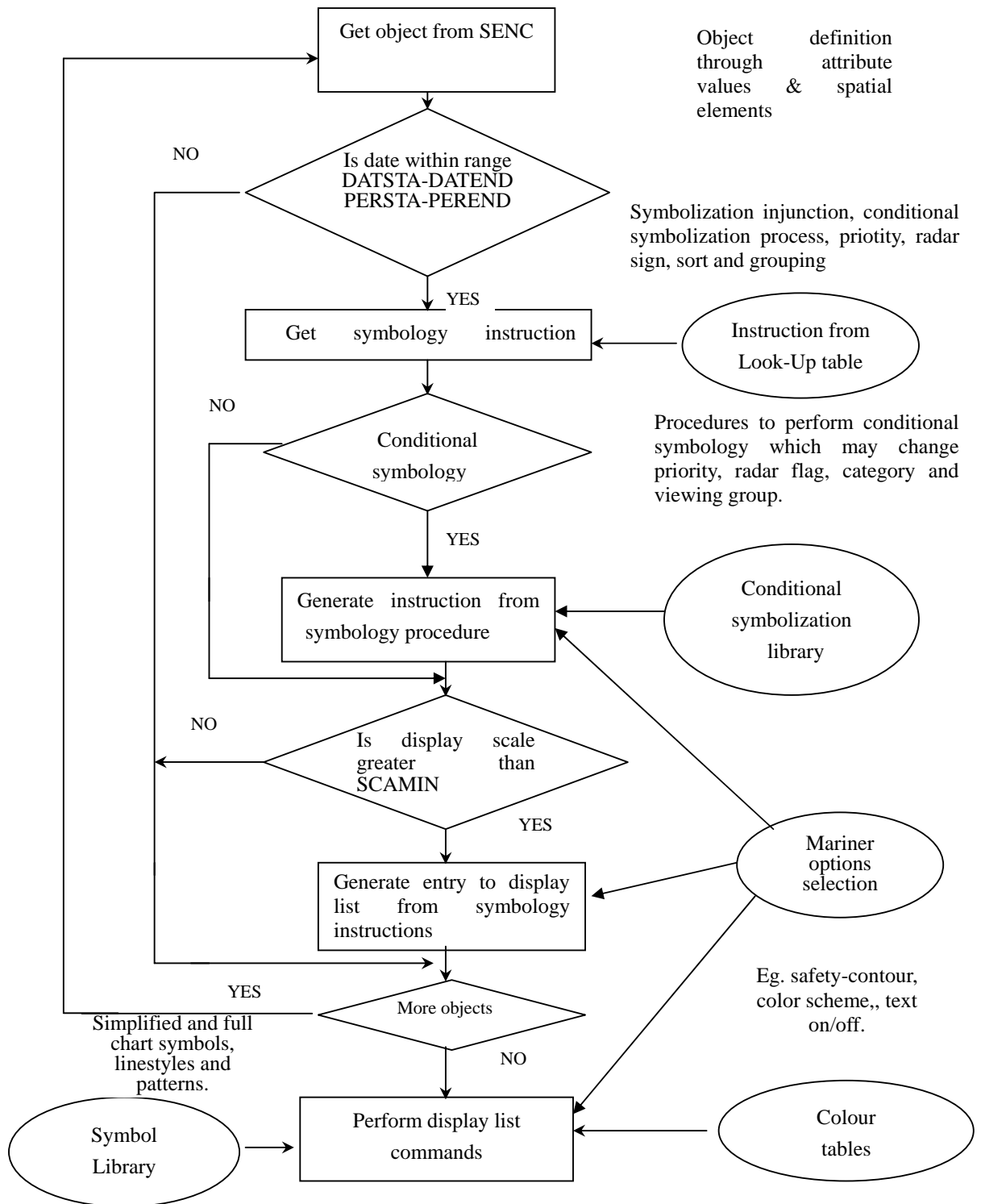
```
                    ┌─────────────────────────┐
                    │   Get object from SENC  │          Object      definition
                    └─────────────────────────┘          through     attribute
                                 │                        values   &   spatial
                                 ▼                        elements
            NO          ◇ Is date within range ◇
      ◄─────────────────   DATSTA-DATEND
                            PERSTA-PEREND               Symbolization injunction, conditional
                                 │                      symbolization process, priotity, radar
                                 │ YES                  sign, sort and grouping
                    ┌─────────────────────────┐
                    │ Get   symbology   instruction │◄────  ⬭ Instruction from
                    └─────────────────────────┘              Look-Up table ⬭
                                 │
            NO                   ▼                      Procedures to perform conditional
      ◄──────────────◇    Conditional    ◇             symbology  which  may  change
                            symbology                  priority, radar flag, category and
                                 │                     viewing group.
                                 │ YES
                    ┌─────────────────────────┐
                    │ Generate instruction from │◄───   ⬭ Conditional
                    │ symbology procedure      │         symbolization
                    └─────────────────────────┘          library ⬭
                                 │
            NO                   ▼
      ◄──────────────◇ Is display scale ◇
                         greater     than
                         SCAMIN
                                 │ YES
                    ┌─────────────────────────┐
                    │ Generate entry to display │◄───
                    │ list  from  symbology    │      ⬭ Mariner
                    │ instructions             │        options
                    └─────────────────────────┘         selection ⬭
                                 │
      YES                        ▼
  ◄────────────────◇  More objects  ◇          Eg. safety-contour,
  Simplified and full            │             color scheme,, text
  chart symbols,                 │ NO          on/off.
  linestyles and      ┌─────────────────────────┐
  patterns.           │  Perform display list    │◄───  ⬭ Colour
            ⬭ Symbol  │  commands                │        tables ⬭
              Library ⬭└─────────────────────────┘
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Fig. 1   Display Generator

## 4. Key technology realization

4.1 Dynamic symbology based on attribute values & spatial elements

According to S-52, most objects use symbolization injunction such as points, lines, areas, etc. to visualization, but some others are complex between its attribute value and symbolization injunction, or depend on conditional parameters which enactment by mariners' selection.To handle complex presentation situations conditional symbology is required.it's an effective solution to make chart symbols simplify.Conditional symbolization need input different parameters through a series of determinant conditions and procedures to realization.

- Input parameters

The great masses of conditional symbols are dynamic and confirmed by target attribute value and mariners' selection. For example, the symbolization procedures of DEPARE
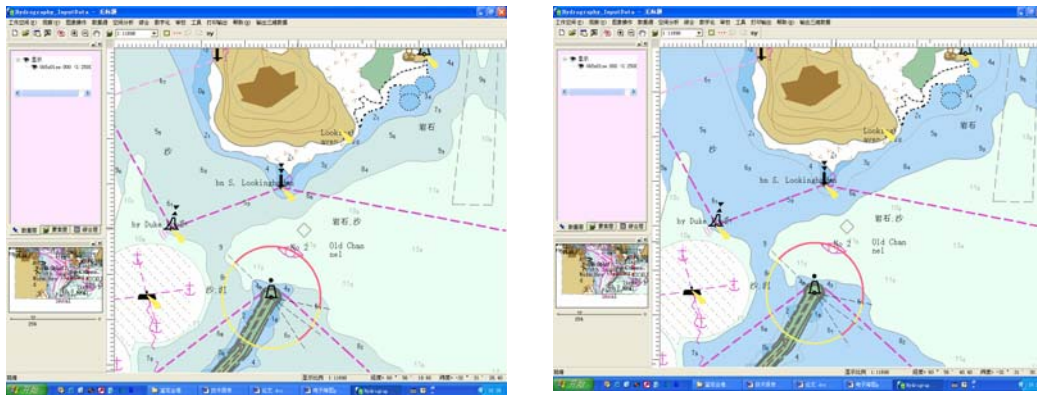


(a) 5 meters safety-contour          (b) 10 meters safety-contour

Fig.2   Conditional Symbolization

is decided by conditional symbolization procedures DEPARE 02, DEPARE 02 will compare the numerical value between three contour parameters (shallow-contour, safety- contour and deep contour) and this target's attribute (DRVAL1 and DRVAL2) to decide symbology instructions. An object of the class "depth area" is colored and covered with fill patterns, according to the mariners selextions of shallow contour, safety contour and deep contours.  If the symbolization injunction was matched with safety-contour depth value which input by mariners, the contour or an object of DEPARE will be highlighted and displayed in all conditions (IMO PS 3.6).The procedures will decide a contour whether matching with the selected safety- contour, in case of the selected safety- contour isn't in ENC data, the procedures will default it as the next deeper contour. The contour which is selected as safety- contour will be highlighted and bring into DISPLAYBASE (Fig.2).

● Relation with spatial position

Some conditional symbols not only depend on their target attribute value and input parameters, but also impact of spatial position. For example, a contour as a safety-contour should considering its depth value and the depth of adjacent areas, so symbolization procedures must detect the attribute of adjacent targets.

● Combination among targets

In S-57 data mode some targets need combination, such as aids to navigation targets. These targets' symbolization procedures were restricted by correlative targets character. The topmarks, symbolization should combine with their basal platforms, like buoys. In the procedures search basal platforms through lookup other objects at same position, according to the basal platforms which are fixed or floating and then choose erect or gradient symbols on objects. Basal platforms and topmark symbols will display at same position and they are uniform to the traditional symbols (Fig. 3).



Fig. 3 A topmark in different basal platform display different effect

## 4.2 Color Palette

PL provides 6 color tables adapt to different light conditions (such as day-bright, dust, night, etc.), each color was named by 5 character codes which reflect their purpose, also called "color identifiers", each kind of color identify refers to the definition of CIE. In ECDIS system, the figures, navigation lines and symbols must distinguish to background color obviously, all symbols need tinctorial dynamic representation.The designs of colors and symbols must ensure the important ENCs and navigate essentials visualization in day-bright and night (Fig. 4).
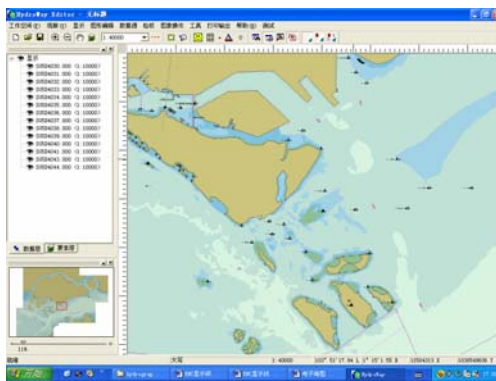


Day-bright
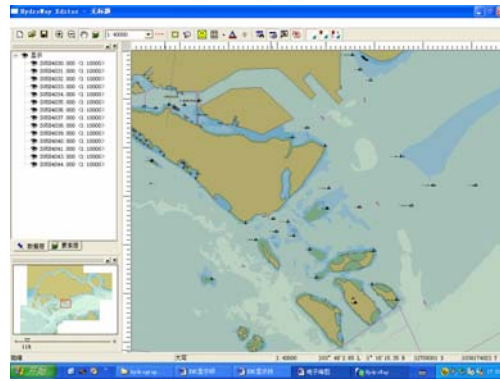


Day-whiteback
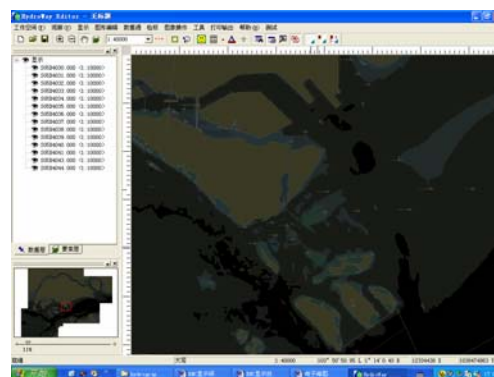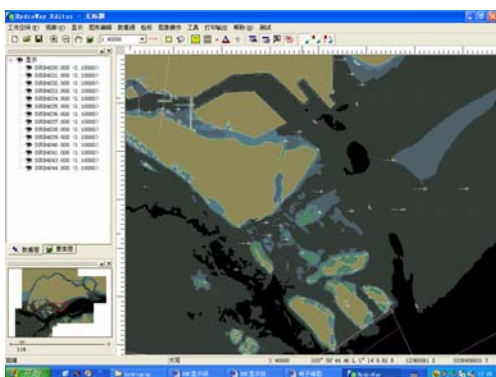
4.3 Display Modes

ENC information display as options have three modes:

● Basic Display

Display prerequisite information, including coastline, safety-contour, isolated danger, buoy, beacon   traffic separation zone, etc..
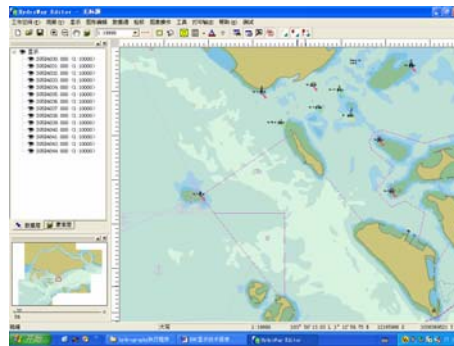
● Standard Display

At first time the ENC display content, expect basic display also including aid to navigation equipment, fairway, channel limit, restricted navigation zones   restricted area, etc..
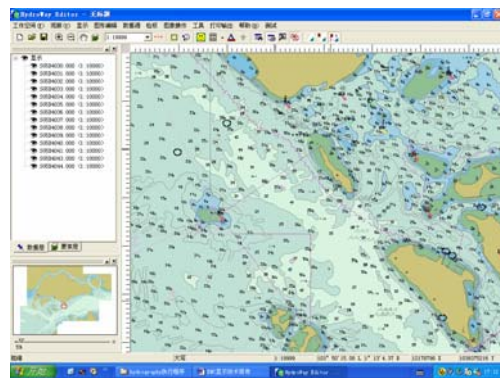
● All Essentials Display

All essentials, including soundings, underwater cables, etc.. So, display information amount are all essential display> standard display>basic display (Fig. 5).
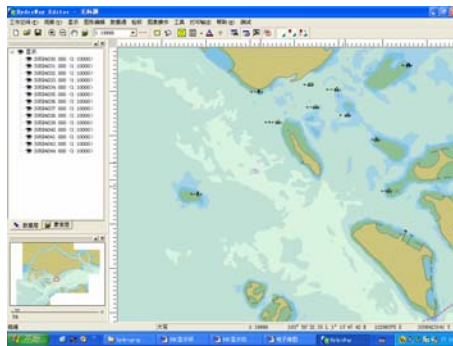


Basic display mode



Standard display mode



All essential display mode

Fig. 5 Display Modes

## 4.4 Control Different Symbol Systems

According to S-52, essential attribute decided its visualization representation, one essential has different attribute values and the symbol representations are different. Information should terseness and exactitude, in navigation could choose symbols representation mode. In the light of International Standard, display system design two sets of symbols: simple symbol and traditional symbol (Fig. 6). Mariners could choose by themselves.
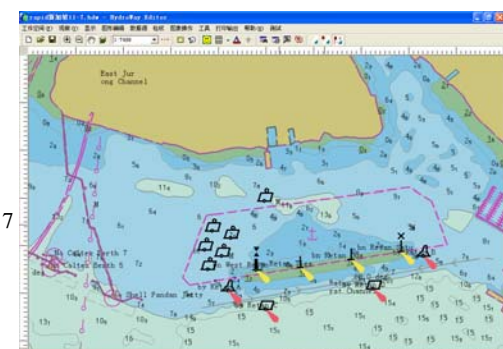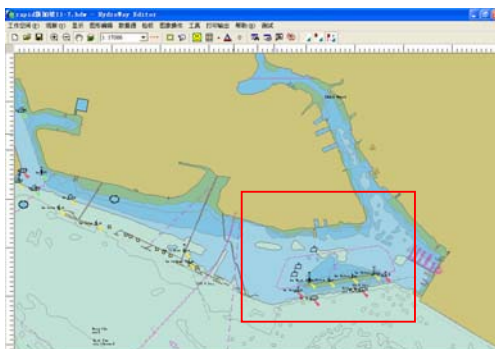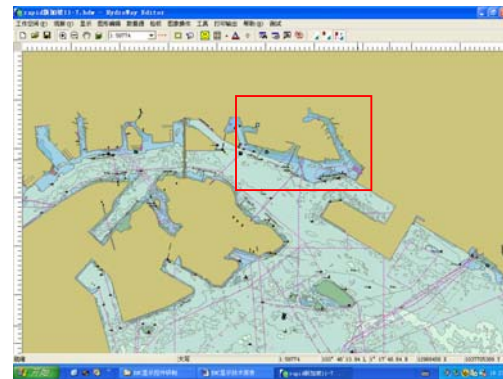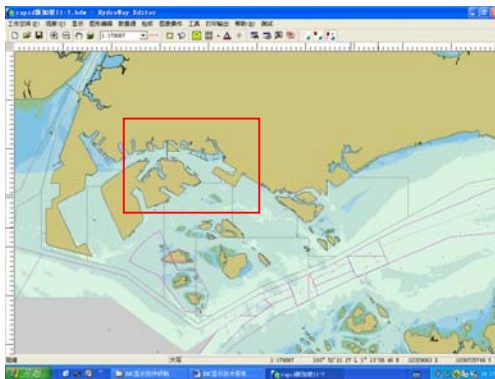


Simple symbol                                          Traditional symbol

Fig. 6 Different Symbol Systems

## 4.5 Multi-scale ENC

For display objects distinctly, how to realize unlimited zoom in, zoom out, cruise and mergence on multi-scale ENC in ECDIS is an important problem. Setup the SCIMAX and SCIMIN of object attribute to realize multi-scale representation. The red frame is the enlarge region in Fig. 7.



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## 5. Conclusion

In this paper, Visual C++ 6.0 as exploiture tool realize to international standard ENC display platform in proprietary intellectual property rights, complied with Digital Chart Display Standard issued by IHO S-52&S-57 and IMO A.817&A.694. Use control technologies connect with navigation, tracking, data collection, etc. hardware equipments could develop professional information system for different industries.

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