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Digitization of Blowup Images of Contemporary Helicopters: A Case Study

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Abstract

The process of designing aircraft requires information in the form of images and blown-up reproductions of their parts. There are a lot of images of various parts available, but they require to be classified and encoded according to model, system and component. This has been done in a project by the Information Centre, RWR&DC, HAL, Bangalore by designing a user front end in Visual Basic and creating the database of images using MS Access as backend. Each component is given a code indicating the helicopter, system and a unique 3-digit number for the component. The design scientist queries the database based on chosen criteria and retrieve the required blowup image.

1   Introduction

Complexity of aircraft and their constituent parts make the design of a helicopter a daunting but potentially satisfying task. Designers need all the help by which they can get clear successful result. Design is learnt by a combination of theoretical education and design experience in industry. It is a creation process involving the synthesis of knowledge from many disciplines, monitored by qualification checks. There is a bewildering array of data of much interest to aircraft designers.

Blowups published in the technical journal are of vital importance and of paramount use to designers. The rich repository of technical contents of blowups enables designers to make full use of the information in their design and development work. As a primary source of design information it provides an excellent introduction to the fundamentals of civil and military helicopter design. Blowups give a largely descriptive overview of all aspects of the helicopter. The well-illustrated blowup provides an insight into the requirements of each specialist working on helicopter design. Blowups help to assess the merits of different aircraft shapes from civil and military helicopters to V/STOL aircraft.

On analyzing any contemporary helicopter, the designer is always curious to know about what is under the skin, be it Avionics or Flight controls or Weapons system,

The ready-made tool available for the designers, to address their curiosity is the blowups. Taking this cue from the designers, the IC, RWR&DC has compiled a bibliography of blowups published in various technical publications and monographs. While appreciating the usefulness of this publication, the designers suggested that the actual image of the exploded view of the helicopters be also made available for their reference and use. To meet this requirement IC, RWR&DC has taken up a project to digitize all the blow-ups and to develop a suitable codification for the retrieval of image based on keywords. It is also felt that such digitization would also reduce the design / manufacture time scale.

2 Methodology

2.1 COLLECTION OF BLOWUP IMAGES

The primary sources of information for collection of blowups are the technical periodicals & monographs. These primary sources have been scanned starting from 1964 to date. After a detailed technical documentation the selected blowups have been photocopied, arranged in order and kept ready for the digitization process.

2.1.1 Scanning:

The hard copy blowups are scanned using a Vidar scanner and converted into Image format documents. The blowups are usually of A3 or A3 plus size. The settings of the scanning software are adjusted to match the size of the hard copy. The scanning resolution is increased to improve the quality of the image.

2.2 REFORMATTING

The scanned images are cleaned in order to remove unnecessary specks in the image. This is done by the despeckling tool in the scanning software. Proper skewing is done by selecting a suitable angle to aligning the improper skew of the image. This is done by the deskewing tool in the scanning software. Unwanted stains and areas are removed to eliminate storage space occupied by them.

2.3 IMAGE ORGANIZATION

The main objective of this project is to provide a detailed view of a particular part or component of a helicopter. Considering a helicopter BELL-407, to view its nose structure the front portion of the image is zoomed using Adobe Acrobat Exchange and is highlighted for distinction. This part of the image is then cut and stored as a separate image using Adobe Photoshop.

In order to uniquely identify a helicopter, codes are assigned for it as shown in the Table 1.

HELICOPTER CODE	HELICOPTER NAME
001	AS-355
002	CANADAIR
003	EC-120
004	EC-TIGER
005	EH-INDUSTRIES
006	EXPLORER
007	KAWASAKI-BK117
008	NH-90TTH
009	SIKORSKY RAH-66
010	SIKORSKY S-92
011	BEL-407

Table 1: Codification of Helicopter

The information pertaining to blowups is broadly grouped into four main systems as follows

i)   Avionics and Electrical system like navigational lights, VHF antenna, Lighting, etc.

ii)   Flight control like pedals, yaw control, rotor blades, etc.

iii)   Power plant like main gear box, hydraulic pumps, etc.

iv)   Structure and general like fuselages, nose bulbs, doors etc.

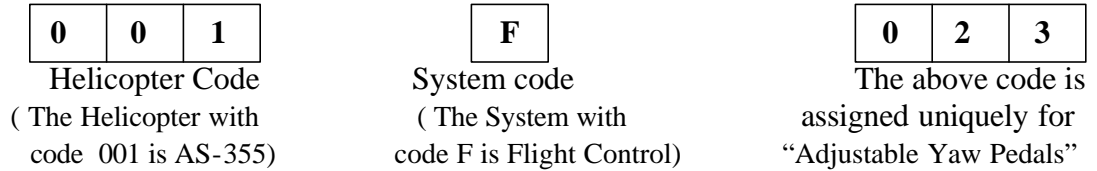Codes are assigned for each of the above system as shown in the Table 2.

System	System Code
AVIONICS ELECTRICAL	A
FLIGHT CONTROL	F
POWER PLANT	P
STRUCTURE	S

Table 2: Codification of Systems in a helicopter

The component system is the integral part of the image helicopter image system and hence codes are assigned for each of the components associated with the respective system. The component code comprises of 7 digits; the first three digits identify the helicopter to which the component belongs; the fourth digit identifies the system under which the component is

grouped and finally a unique three digit number describing the component. This codification has improved the performance of the retrieval system as the component can be easily queried with the code.

For Example the component "Adjustable Yaw Pedals" in the helicopter AS-355 is coded as follows.

0	0	1

Helicopter Code
(The Helicopter with
code 001 is AS-355)

F

System code
(The System with
code F is Flight Control)

0	2	3

The above code is
assigned uniquely for
"Adjustable Yaw Pedals"

Few examples of codified helicopter system components are shown in table-3 for reference.

Helicopter Code	System Code	Component Code	Code	Description
001	A	007	001A007	THERMALLY HEATED AND DEMISTED WIND SCREEN
001	A	014	001A014	INSTRUMENT PANEL
001	A	015	001A015	AVIONICS
001	A	017	001A017	CIRCUIT BREAKER PANEL
001	A	104	001A104	CABIN VIBRATION RESONATOR

Table 3: Codification of system components

3   Information retrieval system

After scanning, codification and indexing, the helicopter images are organized and stored in separate directories in a PC. The directory layout is as shown in the Fig. 1. The root directory is the "blowups". The "blowups" directory contains the subdirectory "pics" which stores the full size images of the helicopters. Under the "pics" directory is subdirectory "system". Under the system directory there are different directories for each helicopter. In each of these directories, images of the components of respective helicopters are stored.

Fig 1. Directory Layout

blowups	**Root Directory**
pics	**Contains Full sized images of the helicopter blowups**
system	
001	**Contains Components Images of helicopter AS-355**
002	**Contains Components Images of UAV Canadair**
003	**Contains Components Images of helicopter EC-120**
004	**Contains Components Images of helicopter EC-Tiger**
005	**Contains Components Images of helicopter EH-Industries**
006	
007	
008	
009	
010	
011	

Initially it was felt that the information retrieval capabilities of Acrobat Exchange could be sufficient for the storage and retrieval of images in PDF format (Portable Document Format). Acrobat Exchange has many utilities like zooming, bookmarks, linking, etc. Bookmarks are

created for each helicopter component. Using the zooming facility, a detailed view of the component can be displayed. But the main disadvantage of Acrobat Exchange is that the user has to manually search the bookmark for the component he is looking for. For example if a user wants to view the "adjustable yaw pedal" of helicopter AS-355 then he has to go through all the bookmarks in order to view it. Alternatively the keyword describing the component can be input and retrieve the user's requirement. Keeping the above requirement in view a custom made application is also developed in Visual Basic retaining the features of PDF documents developed in Acrobat Exchange.

The custom made information retrieval software is designed for retrieving the indexed image. A simple front end is created using Visual Basic. The application has controls on the user form like ComboBox, TextBox, ListBox, etc. The ComboBox is a dropdown menu of items from which the user can select his required item. The ListBox is similar to ComboBox but the items are displayed in a list. The front end is the client area visible to the user. The user interacts with the front end by providing inputs and retrieving the required results. The back end is not visible to the client. The back end stores all the required data used in an application. MS-Access 97 is used as back end in our application because of its easy availability. A database of available images of the helicopter blowups is created in the backend. The front end communicates with the back end for the queries submitted by the user. The user can select a particular helicopter and view its respective components. The application also provides a zooming facility to view the intricate components. When the user selects a component of a helicopter, then the application accesses the database to find a match for that particular component of the helicopter and retrieves its path and displays it to the user, as shown in the flow diagram.
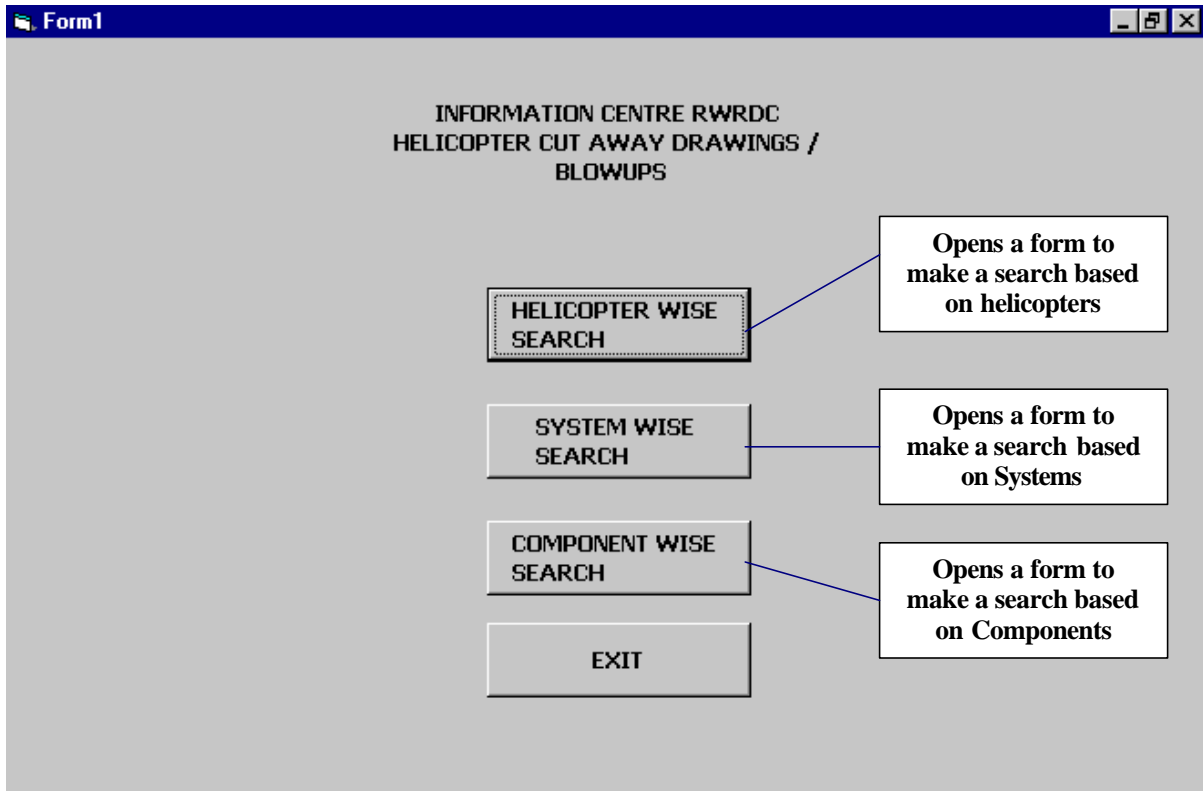
Fig. 2: Flow Diagram
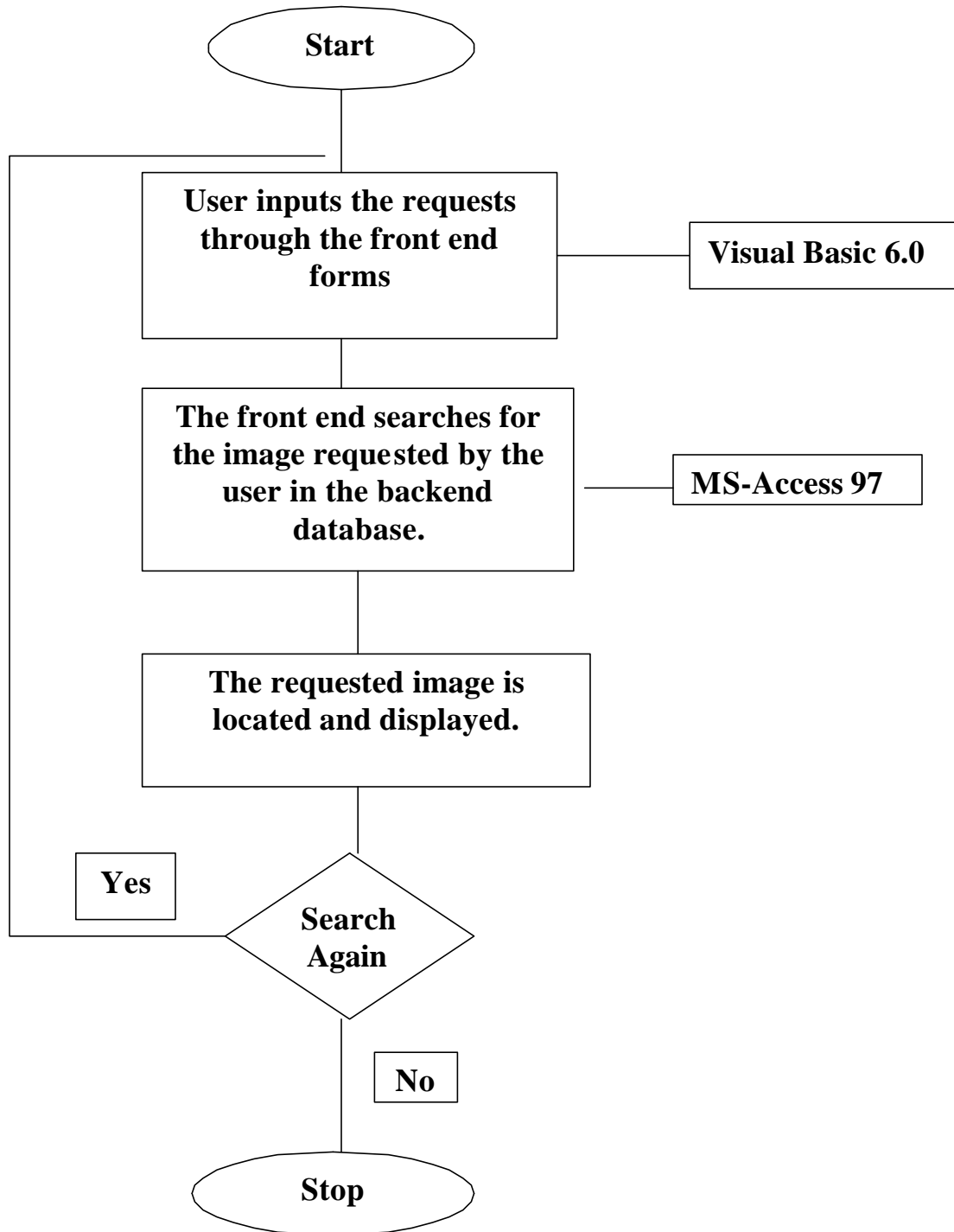
4   Main Menu

The Fig3. represents the Main Menu form which appears to the user as soon as the user clicks the application. The user can choose the search criteria from the menu.

Fig3. Main Login form

5   Search form

The Fig. 4, 5, 6 represents the respective search forms for viewing the helicopter blowups and their components based on chosen criteria from the main menu.
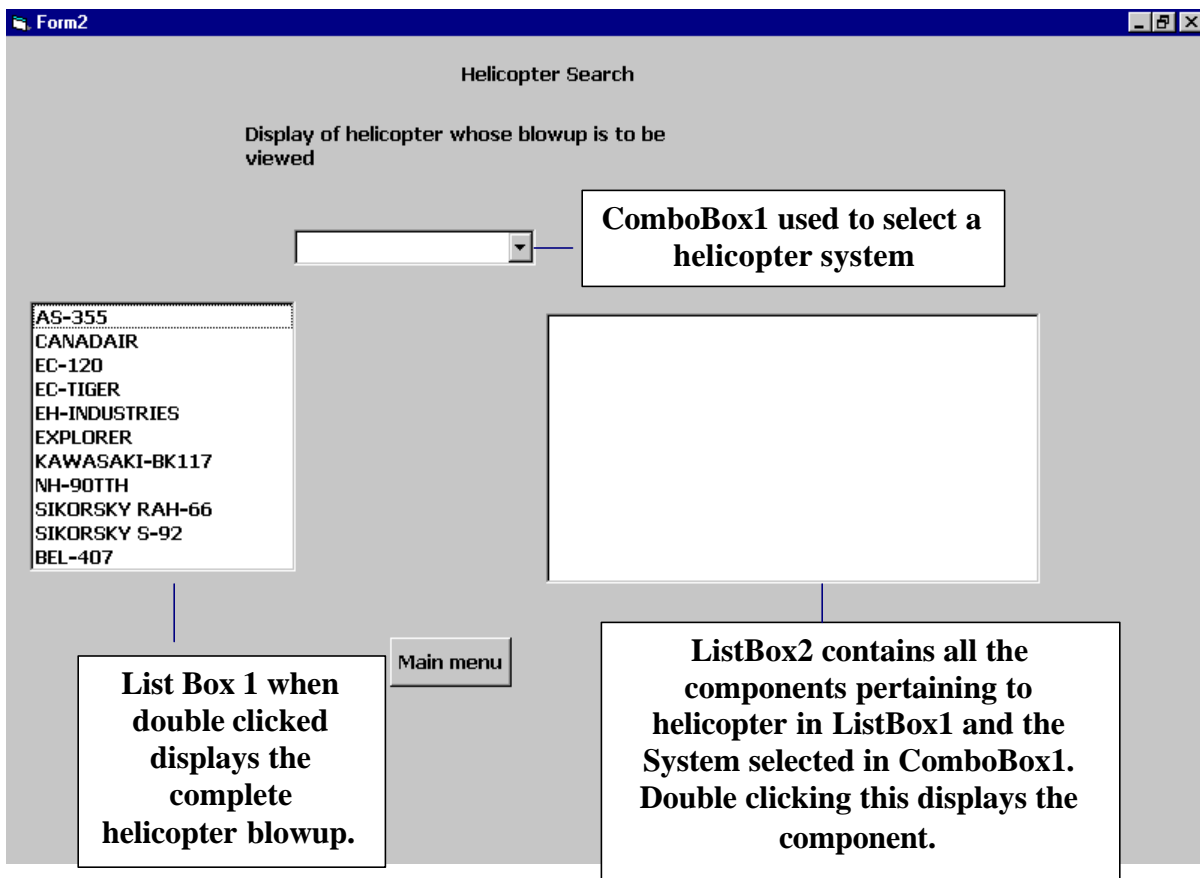
Fig 4. Helicopter search form.

Fig 5. System Search Form

Fig 6. Component search form

6   Sample search

Fig. 7. represents the display form of turboshaft engine for Canadair

To decrease the Zoom

Fig 7. Display of Single Turboshaft Engine for Canadair

To increase the Zoom

Red highlighter for pointing out the location of the component
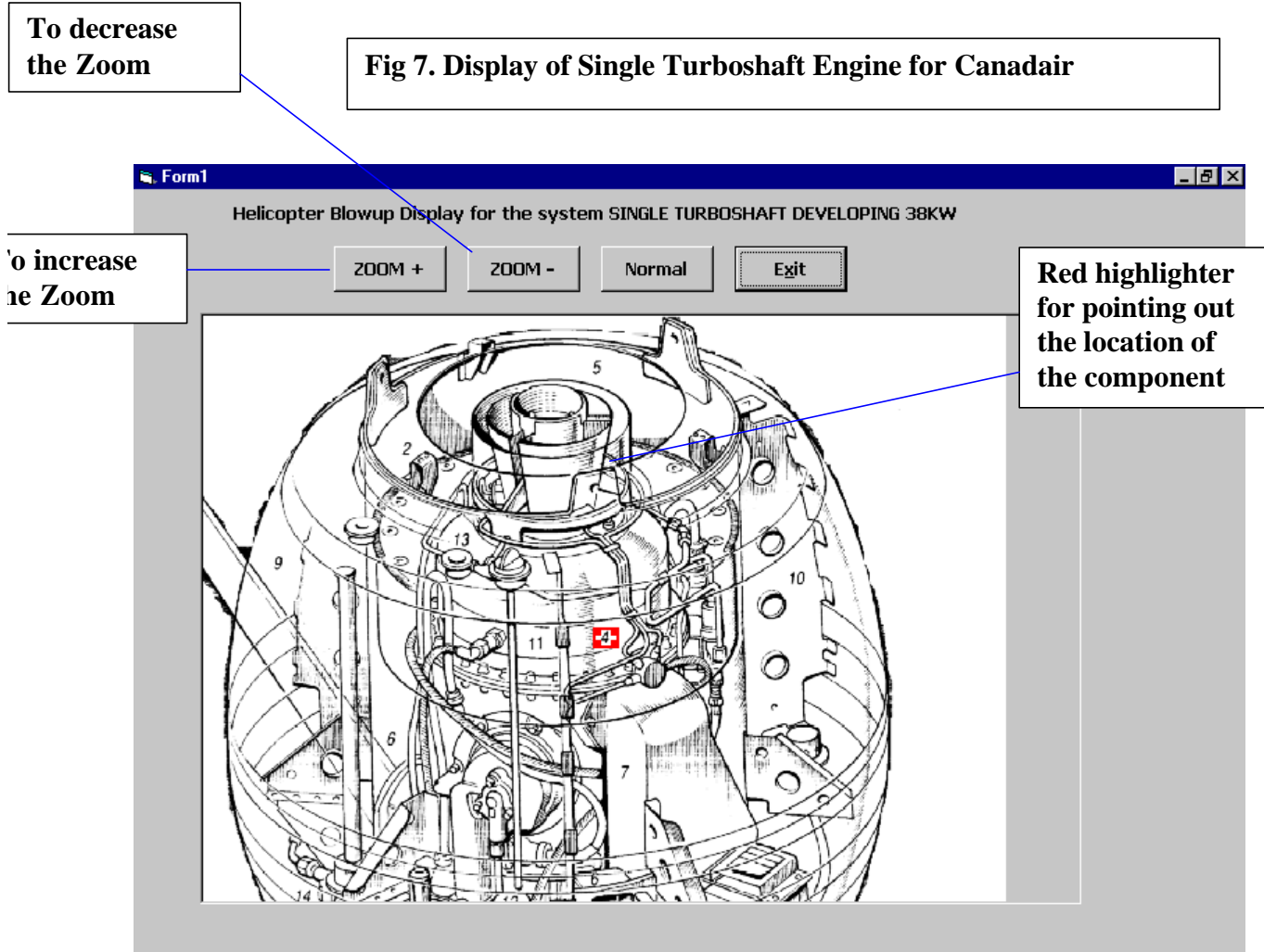
7   CD-Publishing

The indexed images are written on a CD-ROM and arranged in the same manner as explained in the Fig. 1. The Visual Basic program is compiled into an executable setup program so that the user can just double click the setup program to install the application from the CD-ROM. The CD-ROM is written using in-house CD-ROM publishing facility. The information is also made available to various departments through the Local Area Network via shared folder.

8   Conclusion

IC, RWR&DC have been assigned with the task of building up of the electronics archives for RWR&DC. The idea of digitization of helicopter blow-ups and CD-Publishing was carried out and implemented completely in-house using in-house facilities. This project has saved an enormous cost of sourcing out of such a task and helped to acquire more knowledge on digitization and to sharpen our technical skills to take up similar projects in the future. The expertise, thus gained, could also be extended to digitize the information of our own indigenously developed helicopters and helicopter flight manuals.

9 References

1. **Kuppuswamy (S).** CD-Rom Publishing: A case study, paper presented at National Convention on Library & Information Networking (NACLIN-2000).

2. **Kuppuswamy (S).** Electronic Documentation and CD-ROM publishing of lecture notes of Rotary Wing Technical College, RWR&DC, HAL Bangalore. Paper presented at National Conferences on recent advances in Information technology 17th-19th Sep 2001, IIT Chennai.