World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:3, No:5, 2009

File Format of Flow Chart Simulation Software - CFlow

Syahanim Mohd Salleh, Zaihosnita Hood, Hairulliza Mohd Judi, Marini Abu Bakar

Abstract**—**CFlow is a flow chart software, it contains facilities to draw and evaluate a flow chart. A flow chart evaluation applies a simulation method to enable presentation of work flow in a flow chart solution. Flow chart simulation of CFlow is executed by manipulating the CFlow data file which is saved in a graphical vector format. These text-based data are organised by using a data classification technic based on a Library classification-scheme. This paper describes the file format for flow chart simulation software of CFlow.

Keywords**—**CFlow, flow chart, file format.

I. Introduction

FLOW chart is a logical display of work flow for any process. In programming activities, flow chart is a useful tool to represent the algorithm design in a general solution level. Flow chart does not necessitate complex syntax and programming language format, therefore programmer could give more concern in the method of problem solving [1]. A completed flow chart should be evaluated and implemented to ensure that the algorithm design fulfil the requirements. A conventional evaluation faces some problems in identifying syntax and logical problems in a flow chart solution. As a result, programming design could not serve as a guideline in programme coding process.

In order to enhance student's understanding towards programming course, a number of tools to aid flow chart development are available such as EdgeDiagrammer [2], SmartDraw [3], SourceCode2FlowChart [4] dan MS Word. Generally, the tools concentrate on the drawing process to create flow chart by providing symbol palet facilities and not on the application of flow chart in problem solving. Hence, the available softwares were not provided with help and monitoring functions to aid users in developing a free error flow chart solution.

The lack of integration between simulation and flowchart tools has limited the use of simulation in many designing projects. Currently, one will check the correctness of the design by either mentally „running it or execute the program code which represent the design. Several works have been done to enhance these tools. One of it is Structured Flow Chart (SFC)[5]. SFC is an algorithm development tool which focuses on the design of flowcharts for structured programs. In SFC, pseudo code is simultaneously generated for each flowchart. The RAPTOR [6] software applies a building block approach, similar to SFC.

Auhtors are with the Faculty of Information Science and Technology Universiti Kebangsaan Malaysia (UKM),43600 Bangi, Selangor, Malaysia

In addition, the flow charts created using RAPTOR can be executed within the RAPTOR environment. The language used by RAPTOR is designed for beginners and does not incorporate complex control structures. Flow Chart and Algorithmic State Machine Editor is a commercially distributed software. It is quite comprehensive tools and stable [7]. However, this tool is very specific to electronic engineering industry.

One of the issues in developing such tools is the file format. Graphical drawing tools use graphics file format to represent its graphical images. Tumay [8] defines that graphic file formats can be categorized into raster (bit-mapped) and vector formats. Raster format typically was utilized for photographic or other highly detailed continuous tone images and build up as a series of pixels that blend together to perform a single image. Common raster graphic image file formats include TIF, BMP and JPG. Almost all sophisticated graphics systems, including SFC, Computer Aided Design (CAD) systems and animation software, use vector graphics. Vector graphics are defined through mathematical expression and are resolution-independent and scalable. Computer text is vector-based, normally just wrapped in a text-base object that includes certain methods for editing the text [9]. Most of the graphical drawing tools such as CAD, used bit-mapped format file but they can be converted to simulation usable form or vector format file. The vector files are smaller in size for drawings of simple layout. The benefit of vector based transfer includes the ability of the images to be converted back to original drawing, once they are converted and edited. However, there is one disadvantage of the converted vector, i.e. the file may result in slower animation (depending on animation software) due to potentially complex calculations for updating images [8].

CFlow is an animated flow chart tool that use vector format file to represent the flow chart image. CFlow utilize a new concept of data representation based on a Library classification-scheme method. A library classification scheme has been accepted as a standard classification framework for information sources in traditional library, and text classification becomes a popular and attractive tool in organizing digital information [10]. This paper will discuss details on the file format of CFlow.

II. CFlow Simulation Software

CFlow is a flow chart software. CFlow development was started since 2002 and is written in Visual Basic. The main idea of CFlow development is to provide a useful software to help students in drafting a programme design during learning programming courses in Faculty of Information Sciences and Technology (FTSM), UKM. There are two main functions in

CFlow i.e drawing and implementing a flow chart. Fig. 1 shows the main interface of CFlow.

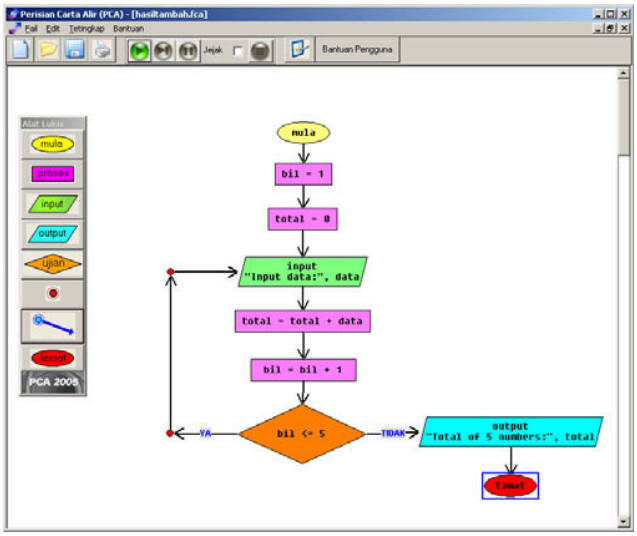
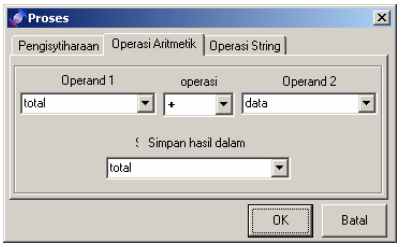
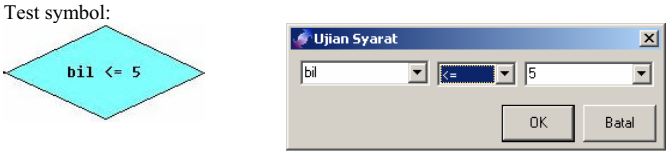
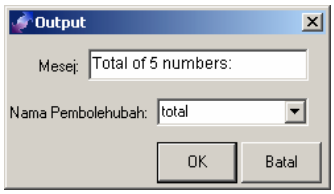


Fig. 1 CFlow main interface

Similar to other available softwares such as EdgeDiagrammer, SmartDraw, SourceCode2FlowChart and MS Word, the flow chart in CFlow was created by using the provided symbol palet facilities. Though there are many symbols to be used in a flow chart, CFlow only uses 8 symbols which are available in CFlow drawing palet such as *mula* (start), *proses*(process), input, output, *ujian*(test), connector, arrow and *tamat* (end) (refer to Fig. 1). To ensure that each selected symbol represents the correct semantic and be able to coordinate the text representation for the utilised symbol, the data input of CFlow is controlled by input windows. Table 1 shows the CFlow data control windows for three main symbols i.e. process, test, and output symbols.

A completed flow chart should be tested to ensure it is free from logical error. This proses is conducted by giving data example and doing evaluation to the generated output. The implementation of flow chart in CFlow applies a simulation technique: it shows a work flow by the movement of active symbols based on the applied solution structure. The simulation approach in CFlow was adapted from programme debugging process, which execute the programme line-by-line. Active symbols are represented by a blue square which will pass each symbol in flow chart diagram from the beginninng until the end of simulation process. Fig. 2 shows the commencement of test symbol during simulation process. The active input and output symbols during simulation activity trigger the display of input screen to read the input from keyboard, and to present the output data respectively. Fig. 3 shows the generated output screen from CFlow. Many of flow chart softwares do not provide the facility to test the flow chart. Literature study shows that RAPTOR is among those softwares that use simulation technic to present the work flow of the flow chart.

TABLE 1
EXAMPLE OF DATA CONTROL WINDOWS IN CFLOW

Symbols	Data control window
Process symbol: `total = total + data`	
Test symbol: `bil <= 5`	
Output symbol: `output "Total of 5 numbers:", total`	

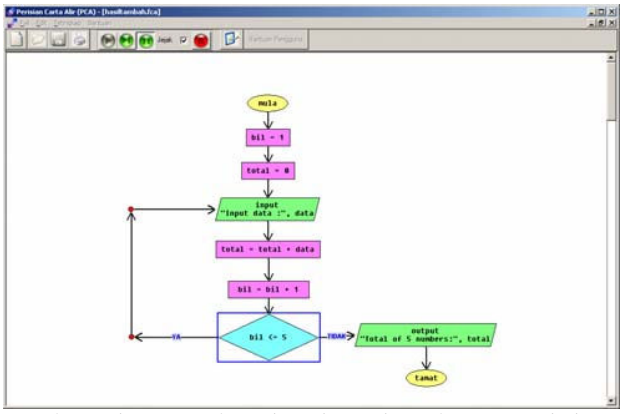


Fig. 2 Blue square in CFlow shows the active test symbol during simulation process

To support the simulation function, CFlow should manipulate each data available in the flow chart diagram. If CFlow applies raster format to save the flow chart diagram, problem will arise in manipulating the data. Thus, each flow chart diagram in CFlow will pass through a transformation process and will be saved in a text based vector format. The method of text organisation in CFlow was adapted from the data classification technique to generate a uniqe calling number for each reference material in library. Fig. 4 presents the method of generating calling number of dissertation in the Library of FTSM, UKM. The calling number of `TSm97.TK.R8` was created by combining 5 different data codes [11].

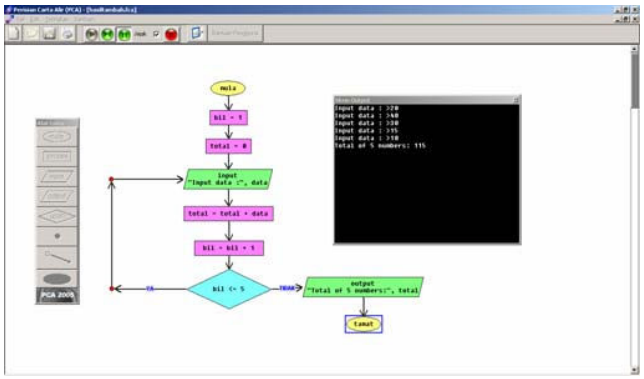


Fig. 3 Generated output from simulation process of CFlow

No. of Code	Code 1	Code 2	Code 3	Code 4	Code 5
Data	Faculty	Education Level	Year published	Department	Dissertation ID
Generated Code	T	Sm	97	TK	R8

Dissertation Calling Number produced by PSP

TSm97.TK.R8

Fig. 4 Data classification method to create calling number for dessertation in library

```
11                <--BILANGAN NOTASI
11                <--BILANGAN ANAK PANAH
---ID#JENIS#KIRI#ATAS#LEBAR#TINGGI#TINDAKAN#TEKS1#TEKS2#TEKS3#---
id1#1#232#78#70#30#MULA#
id2#2#227#135#76#30#DEFINISI#bil#1#
id3#3#176#250#180#40#INPUT#Input data :#data#
id4#2#223#194#92#30#DEFINISI#total#0#
id5#2#175#313#180#30#TAMBAH#total#data#total#
id6#4#175#425#172#80#JIKA_KURANG_SAMA#bil#5#
id7#6#119#462#10#10#PENGHUBUNG#
id8#2#193#369#140#30#TAMBAH#bil#1#bil#
id9#6#118#265#10#10#PENGHUBUNG#
id10#3#138#543#244#40#OUTPUT#Total of 5 numbers:#total#
id11#1#224#617#70#30#TAMAT#

---- ANAK PANAH ---- dari,ke ----
id1,id2
id2,id4
id4,id3
id3,id5
id6,id7 YA
id5,id8
id8,id6
id6,id10 TIDAK
id10,id11
id7,id9
```

Fig. 5 Example of data file from CFlow

Fig. 5 presents the created data file from CFlow based on the flow chart in Figure 1. Data file of CFlow will be saved in a .fca format. The structure and file format of CFlow will be discussed in detail shortly.

III. CFlow Data File Format

Data for a flowchart diagram produced by CFlow will be stored in *.fca* file format. CFlow data in *.fca* format consists of 3 main parts as shown in Figure 6.

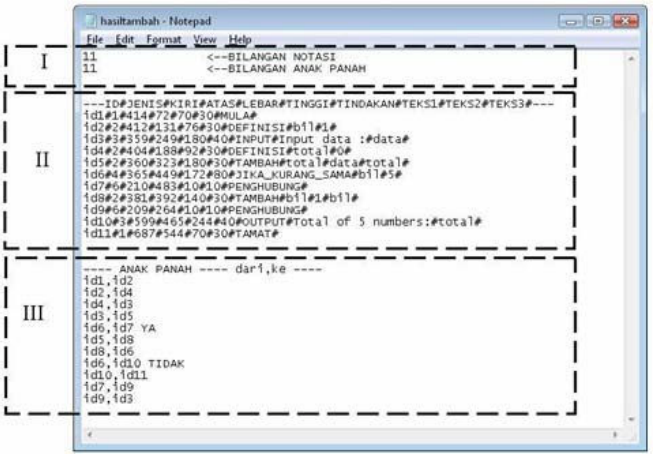


Fig. 6 File format in CFlow

In Figure 6, Part I represents number of symbols and arrow, Part II represents Symbol/Notation information and Part III represents connection between arrows and symbols.

Part I. Part I refers to the overall numbers of symbols and arrows in a CFlow file. The indicated number is important for testing processes for a second evaluate to get the exact number of symbols in Symbol/Notation Information (Part II) and number of connection between arrows and symbols (part III). If the numbers differ, syntax report for flowchart will appear before flowchart is implemented.

Part II. Part II refers to the numbers of sequence of data code that will represent object shape and a few of other important information about the symbol. Every flowchart symbol consists of ten data code that is being used to represent a specific meaning, as listed in Table 2. Every code generated will be split from one another by the symbol "#". One line of sequence data code will represent one flowchart symbol. The objective of using "#" is to make the implementation and detecting error functions to the sequence data code generated by CFlow easier. Table 2 shows ten sequence data code and its descriptions.

TABLE II
TABLE SHOWS THE DATA CODE CLASSIFICATION APPLIED IN CFLOW

Code	Description
Code 1	id symbol
Code 2	id for symbol type: 1 → Elips shape 2 → Rectangle shape 3 → Parallelogram shape 4 → Rhombus shape 5 → Small round shape
Code 3	Left most X position
Code 4	Upper most Y position
Code 5	Weight size
Code 6	Height size
Code 7	Action status based on the symbols type. (Refer Table 3)
Code 8	First text (Depends on the symbol)
Code 9	Second text (Depends on the symbol)
Code 10	Third text (Depends on the symbol)

Part III. Part III refer to the relation for an arrow between a symbol and other symbol. A line represent an arrow relation that connecting two symbol. Every line consist of id for first symbol and id for the second symbol that are connected. Generated relations are as follow:

<sender id_symbol>, <id_symbol receiver>

For example, id1, id2 relation indicator shows the symbol with id1 are connected with symbol with id2. If code symbol 4, refer to signal symbol is being use, meaning that relation generate are as follow:

< sender id_symbol >, < id_symbol receiver >
relationship(YES/ NO)>

CFlow sequence data codes constitute 10 data code. It's being used to encode all flowchart symbols apart from arrow symbol. Nevertheless, data space of 8th code to 10th code in CFlow will be blank if symbol used does not involve that data. Table 3 shows example for 7th code to 10th code produce based on symbol and text inserted.

TABLE III
EXAMPLES OF DATA CODE 7, CODE 8, CODE 9 AND CODE 10 BASED ON SAMPLE DATA SYMBOL

Id Symbol	Sample Data Symbol	Example Used			
		7th Code	8th Code	9th Code	10th Code
1	START	START	None	None	None
	END	END	None	None	None
2	bil = 1	DEFINITION	bil	1	None
	bil = bil + 1	MULTIPLY	bil	bil	1
3	Input data	INPUT	None	data	None
	Output total	OUTPUT	None	total	None
4	bil <= 5	IF	bil	0	None
5		CONNECTOR	None	None	None

CFlow stores a proper and well-structured data arrangement. Fragmentation of its file format into three parts facilitates easy data processing, future compilation and detection of flow chart error which might be accidently generated by user.

IV. Conclusion

CFlow is a flow chart software, intended to be used in programming domain. Besides creating a flow chart, CFlow is also supplied with simulation function to test the validity of flow chart design in solving certain problems. To support the simulation function, CFlow applies text-based vector format for saving its data. This method enables minimisation of memory space usage especially in saving graphical objects that usually consume huge space. This feature is also important for future improvement and enhancement of CFlow.

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