Development of rule-based expert system for conceptualisation of poster design

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Abstract. This study discusses development of rule-based expert system (R-ES) as a decision support for poster design conceptualisation. Users of the proposed expert system are novice poster designers while the experts are senior and professional poster designers. Development of R-ES is started by defining type of poster to be designed. Based on professional poster designer’s experiences, 5 types of poster have been proposed, which are advertising, information, movie, event and political poster. A knowledge-based system consists of IF-THEN rules have been developed by the experts to determine poster design concept that are colour combination, poster size, font type and size, expert note, and poster sample. Result of this study is an online expert system for conceptualisation of poster design that could be widely used by novice poster designers without constrained by space and time.

1. Introduction
According to Bureau of Labour Statistic, demand of graphic designer will grow up to 4% in 10 years ahead. Other than that, there is growing about 24-26% in computer field or digital area [1]. Graphic design is a practical activity consists of visual material, typography, pictures and other elements to communicate or create experiences to the audiences [2]. Graphic designer needs to understand how to communicate a message through graphic design. There are some common issues that novice graphic designers usually do, such as “design for themselves”, “overestimating the client's ability to translate words into visual language”, “making a similar design as existed design” and “less knowledge in technical design”. On the contrary, professional poster designer would digs more information about client needs, conduct deep researches in design scope and takes other designer’s experiences for consideration [3]. Thus, novice designers need professional designer’s experiences in visualising the message through graphic design.

PW is a small to medium company that runs their business in digital printing and produces graphic design product such as poster, banner, pamphlet and others. Graphic design is the crucial process in this company; unfortunately they have faced issues. Some of products require more time to be finished, because the prototype does not meet the client’s expectation, then a lot of design revisions should be carried out. Designing is not only about splendid design but also how to make it works [4]. All of the graphic designers who work in this company are senior high school graduated. They can operate the software to design by self-taught but do not know more about visual communication knowledge. The company owner cannot hire professional graphic designer because of the high salary demand.
Motivation of this study is to extract professional poster designers’ knowledge and experiences to be a systematic knowledge that could be used as reference when making poster design. In term of the knowledge based system development, professional poster designers would be the experts who have special knowledge or expertise that most humans do not have [5]. In this study, based on the professional poster designers’ opinion, there are 5 types of poster that would be covered. The proposed system would be an expert system (ES) and user of the ES is novice poster designers. Extracted knowledge from the professional poster designers would be represented using a rule based system that consists of IF-THEN rules; therefore the proposed ES is called as rule-based ES (R-ES). In term of decision making, an ES would make decision based on subjective expert opinion. Therefore, sometime ES provides less accurate solution. However, an ES is able to provide accurate solution when expert's knowledge could be acquired well. In previous studies, expert systems played a role in detecting optometrists in livestock, where the results of detection by expert systems has high accuracy as well as diagnosis that made by an expert [6, 7].

One of the advantages of ES compared to human experts is ES could work 24 hours per day and 7 days per week. Besides, ES also able to conduct computation in very short time. In the investigated company, demand of new poster design is very high. Poster designers in that company mostly are novice poster designer; therefore, ES for poster design conceptualisation would plays an important role.

2. Literature survey

2.1. Graphic design
Graphic design could be described as a work of art that has functions, aspects of beauty, and a regular structure for several different types of text and illustrations or images. The purpose of graphic design is to find the right presentation to convey the message according to the recipient, the media and the economic situation [8]. One of the important factors in a poster is the graphic design. There are several previous studies that showed the importance of graphic design in delivering messages to the audiences or users. Soyłucicek [9] conducted a study on educational games with the application of graphic design to attract children's attention through visual appearance of the game. That study proofs the important role of graphic design in delivering information. Another study conducted by Shahdad & Filmore [2] in the field of graphic design using TRIZ method that has been combined with a well-known optimisation technique that is Genetic Algorithm (GA). Altis & Ekren [10] and Suharjito et al. [6] conducted similar study that used expert systems to solve problems, a particular problem and proved that the proposed ES was a good method for engineers to solve problems [11]. Based on reviews above, it is known that there have been several graphic design studies with different methods, yet there were no previous studies in the field of graphic design by applying an ES as decision support. Therefore, this study aims to develop decision support systems for poster design using R-ES.

2.2. Expert system (ES)
Expert System is a computer intelligence program that uses knowledge and procedures to draw conclusions from existing facts to solve difficult problems using significant expertise. Two parts of expert system are the development system and the consultation environment. The development system or development environment is the part where the expert system is built. The consultation environment describes how the instructions or recommendations are given to the user. The development process begins with knowledge engineering that builds the system by gaining knowledge from experts. This knowledge is programmed on the knowledge base as facts about the subject area (domain), usually under conditions of ‘IF-THEN’ rules [5]. Architecture of the proposed R-ES in this study is depicted in Figure 1.
2.3. Role of graphic design in poster design
Posters are two-dimensional products, a one-page formatted used to inform or to influence or to promote something. The main purpose of making posters is to communicate or deliver messages [12]. Poster must have some basic compositions as follows: 'grab attention', 'set it apart', 'communicate key message', and 'single surface, one unit' [13]. The compositions would be delivered through a graphic; therefore, graphic design becomes critical thing in poster design.

3. Methods

3.1. Data collection
In this study, primary data is collected through in-depth interview with the professional graphic designers. Objective of the interview is to get basic knowledge on poster design, especially on graphic design. Even though the developed R-ES has interface for the professional graphic designers to add, edit or delete the facts and the knowledge-based system, however, the R-ES requires initial facts and knowledge that could be used to design the database for the R-ES. Secondary data is collected from internet. The secondary data that have been collected such as poster design, type of poster design and color imagination in graphic design.

3.2. Knowledge acquisition
The knowledge base that required for poster design is information about the types of posters, fields or types of industries that are intended for making posters, sub-fields or sub-categories that are intended for poster making, the atmosphere or mood displayed on posters and areas where posters will be shown or exhibited.

3.3. Knowledge-based system construction
There are three steps in constructing the rule that are symbolisation, decision tree and rule construction. Decision tree was created by analysing existing expert knowledge in the application domain. There several elements used to design a poster, which are colour, image, typography and poster size. From these elements, categorisation is developed to design decision trees. Categorisation is built from variables that arise from the problem domain. Before making decision tree, it is required to transform the variables into symbols. In this study, variables for poster design are question, poster type, category, sub variable, mood, area, and gender object variable. Table 1 shows the X symbols and their meaning. Table 2 shows F symbols that represent display area of poster and Table 3 shows the Y symbols that represent poster design output. Figure 2 shows simplified decision tree of the proposed R-ES.
Table 1. X symbols and their meaning

| No | Code | Question Variables                                      |
|----|------|--------------------------------------------------------|
| 1  | X1   | What type of poster do you want to design?              |
| 2  | X2   | What kind of industry or category do you want to design the poster? |
| 3  | X3   | What kind of sub category do you want to design the poster? |
| 4  | X4   | What kind of mood that you desire to express in your poster? |
| 5  | X5   | Who is you want to show the poster?                     |
| 6  | X6   | Where do you want to show your poster?                  |

Table 2. F symbols and their meaning

| No | Code | Area       |
|----|------|------------|
| 1  | F1   | Indoor     |
| 2  | F2   | Outdoor    |
| 3  | F3   | Social media |

Table 3. Y symbols and their meaning

| No | Reasoning Rule                                                                 |
|----|--------------------------------------------------------------------------------|
| 1  | If Advertising Poster and Child product and love and playful and Indoor then Y1 |
| 2  | If Advertising Poster and Child product and love and playful and Outdoor then Y2 |
| 3  | If Advertising Poster and Child product and love and playful and Social Media then Y3 |
| 4  | If Advertising Poster and Child product and joy and calm and Indoor then Y4 |
| 5  | If Advertising Poster and Child product and joy and calm and Outdoor then Y5 |
| 6  | If Advertising Poster and Child product and joy and calm and Social Media then Y6 |
| 7  | If Advertising Poster and Child product and happiness and Indoor then Y7 |
| 8  | If Advertising Poster and Child product and happiness and Outdoor then Y8 |

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336 If Political Poster and trust and Social Media then Y336

Figure 2. Simplified decision tree of the proposed R-ES

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3.4. Entity Relationship Diagram (ERD)
Relationship between objects in the proposed R-ES is shown in Figure 3.

4. Result and discussion
Result of this study is a R-ES. First, users or experts must login to the system so that the R-ES could prepare related modules and menus. Figure 4 shows the login page for users and experts. For user’s side, after logged in, the user would be able to add parameters and answer the added parameters in order to get concept of the poster to be designed. Figure 5 shows the menu to add the parameters while Figure 6 shows interface to answer every parameters by the user. After user finished answering all of the parameters then the R-ES would generate the concept of the poster to be designed and a design example. Figure 7 shows the interface to display the concept of poster design that covers colours, font type, poster size, general note, and poster sample. By reading the generated concept and seeing the poster example, the user would be able to generate ideas to design a new poster. Figure 8 shows example of poster design by novice poster designer after being assisted by the proposed R-ES. Type of the poster is indoor poster for advertising of children’s product with joy theme with soft colour.

![Figure 3. ERD of the proposed R-ES](image-url)
Figure 4. Login page for users and experts

Figure 5. Menu for user to add parameters of poster design

Figure 6. Interface to answer all of parameters of poster design

Figure 7. Interface to display concept for poster design

Figure 8. Example of poster design by novice poster designer assisted by proposed R-ES
5. Conclusion
Based on the explanation above, it could be concluded that the developed knowledge-based system that consists of IF-THEN rules could be used to represent professional poster designer knowledge. The developed knowledge-based system could be extended to be a R-ES and could be used to assist novice poster designer in designing a poster. The generated concept of poster design is also not very rigid. It means that the generated concept of poster design is just used to trigger creativity of the poster designer. Therefore, another benefit of the proposed R-ES is it could be used to train novice poster designers to be professional poster designers.

6. References
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