



INITIAL DESIGN MODEL OF HYBRID INTELLIGENT DECISION AID

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ABSTRACT

This paper describes an ongoing study related to design model development which specific to youth in assisting them making study and career decisions. Studies show that there is lack of decision aid provided specifically for youth that combines personal personality along with the type of multiple intelligences in the decision-making process. For that reason, this study focuses on the intelligent aspects in the development of intelligent decision aid application. The aid apparently integrates Personality Traits (PT) and Multiple Intelligence data (hybrid) in development of a computerized personal decision aid for youth named as Youth Personal Decision Aid (YouthPDA). Therefore, this study aims at development of precise design model of intelligent YouthPDA as guidance before a helpful decision aid will be utilized. Accordingly, this paper proposes an initial Design Model of Hybrid Intelligent Decision Aid. There are two main phases involved in the design model development; requirement analysis and model development.

Keywords: design model, hybrid decision aid, multiple intelligence, personal decision aid, personality traits.

INTRODUCTION

Personal decision aids (PDA) found to be very helpful in making everyday decisions. There are various areas which can be assisted by the existing decision aids in the market. Most of the literatures show a list of options or alternatives provided by the decision aids are based on the list provided by the user only. However, the list does not necessarily correspond to a person's individual personality. Therefore, the type of personality and intelligence level of a person must be assessed prior to giving them a list of suitable alternatives for decision-making process.

Meanwhile, the development process for the decision aid uses several methods, ranging from simple to most complicated calculation. However, the process appears to be lacking at the preparation of alternatives or suggestions at the recommendation stage. Most of literatures show intelligence and the knowledge management aspects are not present in mostly decision aid whereas knowledge management mostly used in organization decision support system (Bolloju, Khalifa, & Turban, 2002; Oduzoa, 2010; Patrizia Ribino, 2011; Sim et al., 2001). This process is needed to help the youth in terms of identifying their personality traits and intelligence level. It may not be used in all areas, but it is needed to be applied for important areas such as education and career, as requested by the youth (Norfiza et al., 2013) with necessary standards included. This is because the education system has set a number of criteria that must be followed before one may pursue to further their education.

Youth generally defined as a group of age 15 to 24 year old. In the society, youth plays an important role because not only they are valuable asset to their family but also to development of the country. Hence, their personal decisions particularly relating to education and career should be taken into stern consideration. Study by Norfiza et al. (2013) found that youth tends to make decision with guidance from their parents or from professional advisors. In most cases, youth will face uncertainty and low self-

confidence in making their own decision due to parental expectations (Khasmohammadi (2010).

Youth tends to make decision on their own following the manual process (e.g., asking close friends, parents' involvement and the influence of advertising) without knowing their own personality traits. Abbas, Hoffmann, Howard, and Spetzler (2007) indicated that the decision process will be affected if it involves incomplete information and assumptions. Furthermore, one will have the possibility to make an inaccurate decision if there are deficiencies in the decision-making system (Payne & Bettman, 2002).

The development of an ideal personal decision aid is very much needed for a person to manage personal matters by providing constructive suggestions (Zhang, Miao, & Luo, 2011). Thus, clear guidelines before building a decision aid is very essential to avoid erroneously that will give a long-term impact especially to the youth. So, the development of the decision aid structures needs to be refined.

Therefore, this study chose to hybrid both theories of Personality Traits (PT) and Multiple Intelligence (MI) to provide appropriate recommendations for the youth to consider in making decisions. Prior to the decision aid development, one comprehensive guideline should be provided to help the designer to ensure that the aid will have all the necessary components. The proposed design model is a model containing the relevant decision-making techniques, criteria and theoretical foundation for youth PDA.

This paper emphasizes on the development of youth PDA design model. Several areas have been identified to apply this PDA. However, for the development of a prototype, two key areas that needed by the youth is study/learning and career decision aids. As explained earlier, the main focus is on the development of the design model which is the technique of creating intellectual elements that combines two main theories.



Hence, YouthPDA is aimed to help youth make decision in a particular field (e.g., study and career) by presenting options as a result of their personal background that has been processed. This is explained in Ule (2009) that decision-making is a process of making a choice by individuals, groups and institutions among many possible courses of action, evaluation, thinking and feeling in a given situation. It is also in line with the opinion of Hayes and Akhavi (2008) which is the important part in a decision aid is the technique that is understandable to solve a problem. This shows that the technique also provides a role in the development of the decision aid as well as a pleasant interface. Accordingly, YouthPDA design model incorporates smart feature called hybrid intelligent system that combine the theories of Personality Traits and Multiple Intelligence before the decision-making process takes place.

Thus, the main focus of this paper is to identify the required elements of relevant decision-making techniques, criteria and theoretical foundation in the development of a design model for hybrid intelligent YouthPDA. In addition, a comparative study between the decision aids is also essential to help in finding and determining the decision aid's trends and current needs in developing the design model.

METHODOLOGY

As illustrated in Figure-1 and 2, there are two main activities involved in Phase 1 which are comparative analysis and questionnaire analysis. While, Phase 2 concentrates more on the development of the design model, this phase also involves comparative analysis in order to gather more information on the decision techniques, decision criteria and related theories as well as user interface design principles. The outcomes of Phase 1 and 2 are the main focus of this paper, while Phase 3's is intended to be discussed in a different study. Next sections will discuss more on these two phases.

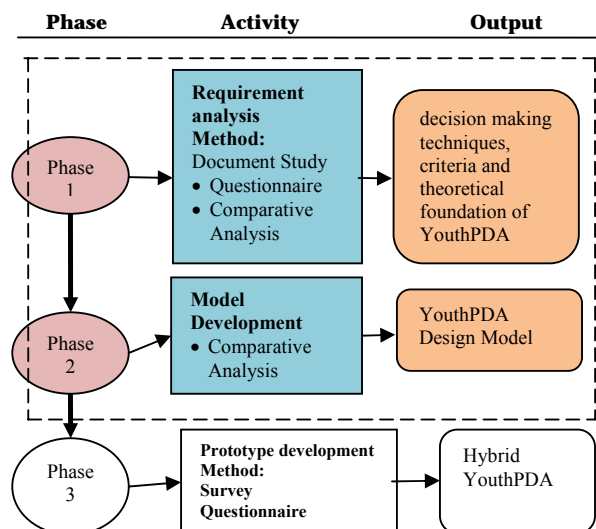


Figure-1. Main activities in design model development.

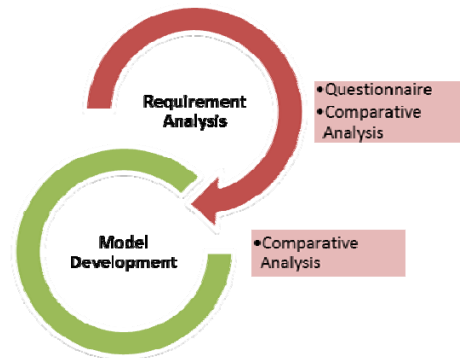


Figure-2. Processes in design model development.

Phase 1: Requirement analysis

The development of the YouthPDA design model extends the idea of Siti Mahfuzah (2011) where the theories of PT and MI will be added and hybrid in the decision-making process. In contrast, the decision-making style or process differs from the previous study which the former aid emphasizes more on method with formula calculation. As for this study, the hybrid YouthPDA design model is developed by integrating two main theories which are PT and MI into the solution design.

A. Questionnaire analysis (Preliminary study)

A preliminary study was carried out by making a survey using an online questionnaire that were given to a group of youth to determine their styles of decision-making, awareness, as well as their required areas of decision-making. Figure-3 shows the screenshot of conducted online questionnaire.

Figure-3. The screenshot of online questionnaire.

From the preliminary survey, the study found that majority of the youth is inexperienced with decision aid. The outcome from the survey also revealed that, two most wanted areas of decision-making by youth are study and career.



B. Comparative analysis

As mentioned earlier, Phase 1 also involves a comparative study of decision aids. Thirteen samples of decision aid have been compared and reviewed in terms of the decision techniques used, decision criteria, and its theoretical foundation.

Table-1. Comparative analysis of the decision aids.

Decision aid	Description	MCDM/focus
1. Personalized Decision Aid for Mobile Phone Selection (D.-N. Chen, Hu, Kuo, & Liang, 2010)	Mobile phone selection Method • Ranking analysis • Equal weight based system	Analytical Hierarchy Process (AHP) Personality (No) Intelligence (No)
2. MCDM in Lightweight Concrete for Floating Houses (Nekooie, Mohamad, & Mahdinezhad, 2011)	determines the most resistant lightweight concrete mixtures Method • Fuzzy linguistic variables	Multi-criteria Optimization and Compromise Solution Method (VIKOR) Personality (No) Intelligence (No)
3. MCDM System using AHP Method (Al-Azab & Ayu, 2010)	Assist decision makers sort out decision on certain problems. Method • Ranking user preferences	AHP Personality (No) Intelligence (No)
4. An Enhanced Hybrid Fuzzy MCDM for Vendor Selection (Vahdani, Alem-Tabriz, & Zandieh, 2009)	Selecting vendor in supply chain Method • Weightage decision matrix • Ranking preference order	Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) Personality (No) Intelligence (No)
5. MCDM to Evaluate Mobile Phone Alternatives (Isiklar & Buyukozkan, 2007)	Evaluate mobile phone selection Method • Identify relative weights • Rank mobile phone alternatives	• AHP • TOPSIS Personality (No) Intelligence (No)
6. SMART Decision Support System	Evaluate many areas Method • User ranking their	Simple Multi Attribute Rating

(University College Dublin)	preference attributes • System weightage attribute's ranking	Technique (SMART) Personality (No) Intelligence (No)
7. Hunch Website (Mukherjee, 2009)	Online personal decision-making tool Method • Suggest alternative for the user	Ranking Personality (No) Intelligence (No)
8. Let Simon Decide	Online personal decision-making web Method Combines user qualitative input with a weighted, mathematical formula	Weighted decision analysis Personality (No) Intelligence (No)
9. Choose It!	business, financial, and personal life decisions	Decision Matrix Personality (No) Intelligence (No)
10. Decision Oven	personal and business decisions	Decision Matrix Personality (No) Intelligence (No)
11. DEXi	Incorporates qualitative multi-attribute models for the evaluation and analysis of options	Qualitative multi-attribute model Personality (No) Intelligence (No)
12. Logical Decision v6.1	let decision maker organize the information they have collected about the choices from spreadsheet and database	• simple rank • tradeoffs • AHP Personality (No) Intelligence (No)
13. Super Intuition	considers alternative list, decision table, facts, value rankings and ratings	Decision table Personality (No) Intelligence (No)

Table-1 summarizes the findings of thirteen decision aid samples with their features. The chosen samples of decision aid represent different modes of application; online application, software and spreadsheet.



Some of the samples focusing on one area of decision-making, however there are also samples that able to provide assistance in many areas of personal decision-making. The sample aids are representative of available decision aids, and the analysis shows that none of the decision aids integrate the theories of PT and MI in their decision-making process.

Table-2. Comparative analysis of types of design model.

Title	Design model	description
Measuring Helpfulness of Personal Decision Aid Design Model (Siti Mahfuzah & Norshuhada, 2010)	Conceptual	<ul style="list-style-type: none"> •Illustrates elements of PDA (decision-making process) •Shows the interaction, behavior and technique used for the proposed system
Designing Architectures from Problem Descriptions by Interactive Model Transformation (Alebrahim, C, Heisel, Choppy, & Hatebur, 2012)	Architectural	<ul style="list-style-type: none"> •Models context diagram for Patient Care System •Describes relationships among major structural elements, derived from the class-based elements and flow oriented elements (data flow diagrams, control flow diagrams, processing narratives)
Ontology Models for Interaction Design: Case Study of Online Support (Butler, Hunt, Muehleisen, Zhang, & Huffer, 2010)	Working/procedural	<ul style="list-style-type: none"> •Shows procedures for modeling the user's problem space in Ontology Management Tools (OMT). •Shows user interface technology and integrated design effort with the user interface, information architecture, and implementation factors.
Designing Parameterized Signal Processing IPs for High Level Synthesis in a Model Based Design Environment (Butt & Lavagno, 2012)	Model-based	<ul style="list-style-type: none"> •Describe the design of a parameterized bit-true Intellectual Property (IP) that using C code •An approach for establishing a common framework for communication throughout the design process and support

		development cycle
Real-Time Design Models to RTOS-Specific Models Refinement Verification (Mzid, Mraidha, Babau, & Abid, 2012)	Real-time	<ul style="list-style-type: none"> •Depicts real-time response triggered by event •Integration between design and implementation phases •As instance of the verification-oriented meta-model

Table-2 depicts the comparative analysis on different types of design model. This process is necessary for understanding the whole idea and concept of the design models. In this study, the proposed design model for YouthPDA has adopted the development of conceptual design model. This is because of a conceptual design model acts as an advanced description of how a system is prepared and functions. The model requires and defines the main design descriptions and similarities engaged in the design. It also consists of the system that exposes concepts to users which comprising the task-domain data objects for users to create and manipulate, their attributes, relationships between these concepts and the operations that can be performed on them. In addition, Johnson and Henderson (2002) have listed six basic requirements along the development of conceptual design model which are; Lexicon, Task scenarios, User-interface, Implementation, Documentation, and Design process.

Having completed the comparative analysis in Phase 1, a number of significant aspects of Human-Computer Interactions (HCI) components start to emerge. It is believed that sound considerations of the HCI components are also important in the development of the decision aid (Zhang et al., 2011). Therefore, this study is considering the inclusion of HCI components that will be used as additional components for decisional guidance in the YouthPDA design model.

HCI components

There are four HCI components derived from the comparative analysis in Table 1 that will be the added in the YouthPDA design model. The components are user interface, graphic design principles, interaction styles and design elements. As far as the development of the YouthPDA design model is concerned, each components have implications over the proposed decision aid content and each of the components is determined by certain principles (Te'eni, Carey, & Zhang, 2006) and have their own justifications.

A. User interface

i) User familiarity

The interface should be based on user-oriented terms and concepts rather than computer concepts. For example, provide youth with interface items that relate to their real world.

**ii) Consistency**

The aid should display an appropriate level of consistency. Commands and menus should have the same format, command punctuation should be similar, screen layout, and makes more predictable on the process

iii) Minimal surprise

If a command operates in a known way, the youth should be able to predict the operation of comparable commands

iv) User guidance

Some user guidance such as help systems, on-line manuals, etc. should be supplied

v) User diversity

Interaction facilities for different types of user should be supported. For example, some users have seeing difficulties and so larger text should be available

B. Graphic design principles**i) Metaphor**

Tying presentation and visual elements to some familiar relevant items

ii) Clarity

Every element in an interface should have a reason for being there. White space will allow eye to rest between elements of activity. It is used to promote simplicity, and strengthens impact of message

iii) Consistency

In layout, color, images, icons, typography, text, should be constant within screen or across screens, and stay within metaphor everywhere

iv) Alignment

Allows the users' eye to parse display more easily. It is "Read-flow" principle where the grids horizontal and vertical lines help to locate window components. Only one alignment either left, center, or right is recommended to be chosen and to use it everywhere in the application.

v) Proximity

Items close together appear to have a relationship such as between one label and its text box. Therefore, distance implies no relationship

vi) Contrast

Able to pull and guide the eyes around the interface. Supports skimming and can be used to distinguish active control, to set off most important item. The advantage is to add focus or to energize an interface.

C. Interaction Styles**i) Menu**

Set of options displayed on the screen, shortens learning, permits use of dialog management tools and allow easy support of error handling

ii) Windows, icons, menus, pointers (WIMP)

Default style for majority of interactive computer systems, especially PCs and desktop machines

iii) Form fills

Primarily for data entry or data retrieval, may simplify data entry and requires good design and modest training

iv) Pull-down

A sub-menu that appears as a superimposed drop-down menu on the screen. Always available to the user by making selections on a top menu bar

v) Point & Click

Used in multimedia, web browsers, hypertext, icons, text links or location on map. Requires minimal typing

D. Design elements**i) Text**

Characters and symbols such as titles, descriptions, instructions and captions.

ii) Colors

A good contrast color between foreground and background is advisable, a way to call attention to extreme data values, differentiate among items and speedily convey information

iii) Images

Use meaningful graphics, representation of outcome and explanations with pictures

iv) Icons

Represent object or action in a familiar and recognizable manner

v) Hypermedia

Documents that could contain several types of media which allow information to be linked with association.

vi) Hypertext

Way of handling text and graphic information by allowing users to jump from a given topic whenever they wish, to related ideas.

Phase 2: Development of YouthPDA design model

This study emphasizes on context aware approach which is based on users' environment and follows to adaptive context task as illustrated in Figure-4.

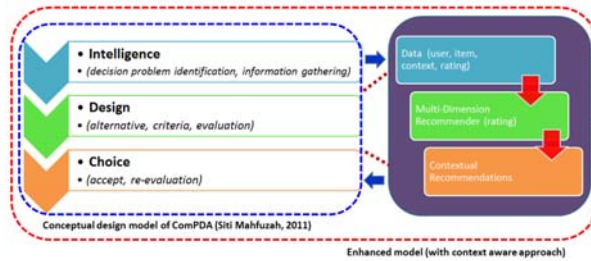


Figure-4. YouthPDA model with context aware approach (Norfiza et al., 2014).

Three main components are derived from the context aware approach, namely intelligence, design, and choice. As mentioned earlier, the proposed design model in this study has adopted the development of conceptual design model. This sub-section highlights the main structures of the design model which are the decision technique, decision criteria as well as the theoretical foundation.

i) Intelligence

User profiling is introduced in the intelligence process by capturing data from multiple intelligence and personality trait questions. This is the part where youth problems were identified.

ii) Design

The YouthPDA application needs user input which are; youth's academic achievement and their characteristic value in both personality traits and intelligent for profiling purposes. Threshold setting should be setting up prior to the user profile that has been normalized, followed by storing in user profile database.

After that, the results from user will be calculated right after the extraction of context aware information. The output (recommendations) will be retrieved and directly will be displayed to the user. Therefore, the results will go through the threshold re-evaluation process if they are unable to satisfy the user and will undergo the user profiling once again. This process generally will change the result such as insincerely reading and answering the PT and MI tests or the aging factor that might change the interest or habit of the user that might affects their personality.

The results that have been generated will be updated in the database and the recommendations will be displayed to the user. In this case, the pointed out areas for YouthPDA which are study and career will notify the youth's personality type as well as their multiple intelligence level. User profiling including youth's personality and intelligence level will be setting up based on the test given followed by recommendation results that provided for youth to choose the best selection out of multiple alternatives given.

iii) Choice

The last process involving the options of either

accepting or rejecting the recommendation while updating the knowledge repository with new case. The knowledge repository is also referred to in situation where recommendation is rejected or deadlock takes place.

Process of identifying contents through literature studies, comparative analyses and survey have found that there are some important components are missing in the solution process of decision-making aid. Those components are necessary to gratify the youth's needs by assist them in making better decision.

This initial concept of design model is designed to be ease of understanding. Yet, the design model has to stress on the intelligence part which is the problem solving. The underlining section which satisfies the Phase 2 of this study needs special features for the youth by including techniques, criterion, as well as decision theories in development process.

A. Techniques

i) Multi-criteria decision-making (MCDM)

MCDM is a study of decision-making for problems which has multiple objectives, is one of a general class of Operations Research models (Pourjavad & Shirouyehzad, 2011) and one of the best techniques to solve problems considering various criteria for decision-making. It is a set of methodologies which is used to compare, rank and select multiple alternatives having multiple attributes. MCDM is a famous decision-making process using technique and procedures of multiple conflicting criteria (Habiba & Asghar, 2009). In general, MCDM creates predetermined options in different criteria in the problem solving.

ii) Case-based Reasoning

There are many prominent artificial intelligence techniques across literatures, but Rule-based System (RBS) or Rule-based Reasoning (RBR) is one of mostly used technique to analyze data structure of knowledge-based approach, and thus provide the necessary solutions (S. Chen, Jakeman, & Norton, 2008).

Two types of RBS are Forward Chaining and Backward Chaining. YouthPDA uses Forward Chaining method in the development stage which applies inference that creates step-by-step logic rules for achieving appropriate solutions based on facts. In this AI approach, RBR utilizes the "if-then" rule statement (Buchanan & Short life, 1984) and the solutions are based on gathering knowledge of literature that has been form as bunch of rules.

This technique is used since the classification made (known as the knowledge base) from set of rules as suggested from previous studies about relation between MI and PT in career and study. In other word, this type of reasoning method could classify the solutions by using those facts (MI and PT) to be integrated as new solutions. Forward Channing contains rule statements that create patterns for each of given solutions.

These patterns are used for inference engine to match the users input towards database as provided



solutions. In particular, the “if” statement here means “when condition is true”, the “then” means “perform action A” and the “else” means “if the condition is not true take another actions”. Inference engine are programs that can process those rules based on facts of a certain condition.

B. Criteria

i) Education level

Study area which is the main finding in previous preliminary investigation involves the programs selection in Higher Education Institute (IPT). This process of selection requires Sijil Peperiksaan Malaysia (SPM) results from the education system in secondary school.

ii) Intelligence level

Each and every person has a quite high level of intelligence in one or more areas from the nine's type of multiple intelligence that has been clarified by Gardner (1983; 1993; 2011)'s theory. These intelligence levels are different from one person to another and it is unable to be detected with the naked eye, even if they are siblings, lived with, or obtain the same SPM results.

The nine's type are; Linguistic (finding right words to express what its' mean), Logical-Mathematical (quantifying things, making hypotheses and providing them), Musical Rhythmic (discerning sounds, their pitch, tone, rhythm, and timbre), Bodily-Kinesthetic (coordinating your mind with your body), Spatial (visualizing the world in 3D), Naturalist (understanding living things and reading nature), Intrapersonal (understanding yourself, what you feel, and what you want), Interpersonal (sensing people's feelings and motives) and Existential Intelligence (tackling the questions of why we live and why we die).

iii) Personality style

Personality of each individual is unique that will discern their behaviors and thoughts from one to another. One of the approaches that will immerse into multiple aspects of individuals is Personality Traits. The reaction of individuals behavior might affected by trait that is a recognized characteristic (Cherry, 2013). There are a few types of personality indicator that able to measure each individual including Myer Briggs Type Indicator (MBTI) and Big Five personality traits. In particular, MBTI is used as assessment of personality theories.

In the meantime, Robbins and Langton (2007) have categorized individuals in 16 differences personality traits group. Formerly, MBTI started with 8 indicators namely Extroverted (E), Sensing (S), Thinking (T), Judging (J), Introverted (I), Intuitive (N), Feeling (F) and Perceiving (P). The merging personality into 16 types then produce four categories of person including i) NF: valuing (manifesting universal values and valuing people), ii) SF: relating (including and building trustworthiness), iii) NT: visioning (pulling people with ideas to an optimistic future), and iv) ST: directing (action from a strategic

perspective). These characteristic are easily differentiating a person with the profession that the youth will be attached with.

C. Decision theories

Besides the Personality Traits and Multiple Intelligence Theory, five other decision theories that act as the guide in constructing the initial design model for Hybrid Intelligent YouthPDA are Behavioral Decision, Cognitive Psychological, Utility, Preference, and Dominance. The theories were connected with the structure of hybrid decision aid.

D. Technology

The completed YouthPDA construction will be packaged in the form of execute file that is able to be run on desktop or over the Internet which is able to be downloaded by youth. This decision aid is specifically designed for youth and may possibly be used in schools and IPT.

Based on the deliberated techniques, criterion, and decision theories, additional components (user interface, graphic design principles, interaction styles and design elements), the design flow is setting-up. This design section has been discussed in previous sub-section which applies the context aware approach. The details of proposed initial Hybrid Intelligent YouthPDA Design Model are displayed in Figure-5.

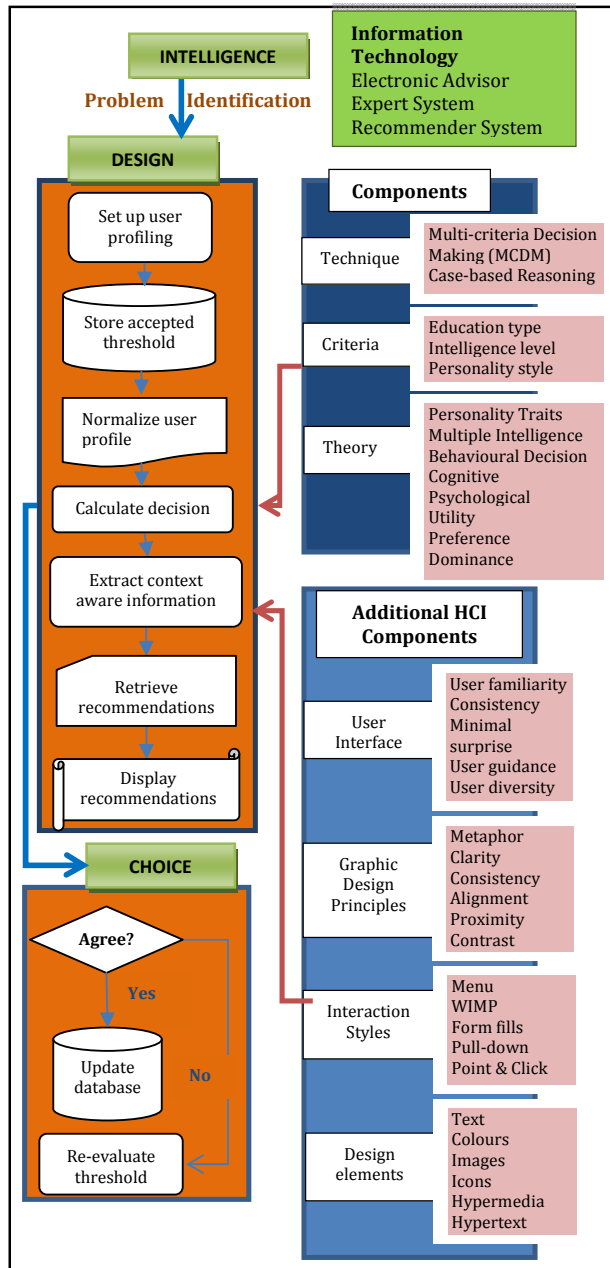


Figure-5. Proposed initial design model of YouthPDA.

CONCLUSIONS AND FUTURE WORKS

The main objective of this paper is to discuss the development process of the YouthPDA design model for study and career decision-making. Most of the developed decision aids do not have an intelligence element in the selection process, where the user themselves will give the list of options for the decision-making process.

YouthPDA is a system that was deliberately designed to help young people in making decisions relating to study and career based on integration of both PT and MI data. This profile serves as a context aware, work on rule-based reasoning in the decision support

process. It is known that each individual is unique. Therefore, the intelligence level and personality of each individual must be considered before they make important decisions for their future. The decision aid can be used to help young people make decisions based on their interests, background and ability rather being influenced by the people around them.

Generally, this study reports an ongoing research regarding the development of Design Model of Hybrid Intelligent YouthPDA. Comparative analysis and survey analysis have been carried out in identifying the techniques, criterion and theory as the main components; user interface, graphic design principles, interaction styles and design elements as additional components of the proposed design model.

Future works of this study is to validate the proposed design model through expert review and prototyping method in order to measure the helpfulness of the decision aid. Also, this study also considering in expanding the decision-making area associated with young people.

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