Clinical Decision Support System For Pediatrician Focusing On Cardiovascular Diseases

By

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Dissertation submitted in partial fulfillment of
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CERTIFICATION OF APPROVAL

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Approved by,

____
(Ms. Amy Foong Oi Mean)

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Certification

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

SAIFUDDIN BIN YUSUF

ABSTRACT

Clinical Decision Support System (CDSS) is a system designed to directly aid clinical decision making by compiling and diagnosing information obtained from the data inserted by users. The system will basically analyze the symptoms entered by the users and then compare the symptoms in the database and finally produce the possible diseases based on the symptoms' matched found in the database. This system is practically important to the pediatricians in order to assist them in justifying the diseases suffered by their patients. Because there are a lot of pediatricians' fields in Malaysia, the project's scope had been narrowed down to the pediatricians who specialize in Cardiovascular Diseases. The main objective of this project is to develop a system that able to analyze Cardiovascular Diseases suffered by patients and generate specific solution to help pediatrician in decision making. Besides that, by having this system, it is also can improve the efficiency in analyzing diseases suffered by patients. Compare to the manual system, the pediatricians might face problems in deciding the diseases suffered by their patients. However by having this system it can overcome this kind of problem and assist the pediatrician in making decision by providing solutions. In developing the system, Rapid Application Development (RAD) methodology is used because it is suitable for the short period time of project and the Exsys Corvid will be the main software to build the system.

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NOMENCLATURES

Anomalous: Deviating from a general rule, method, or analogy; abnormal; irregular; as, an anomalous proceeding.

Apex: The blunt extremity of the heart formed by the left ventricle

Artery: Blood vessel carrying blood away from the heart

Asplenia: Congenital absence of the spleen

Atrium: A chamber, used in anatomical nomenclature to designate a chamber affording entrance to another structure or organ. Usually used alone to designate an atrium of the heart.

Cardiac: Pertaining to the heart.

Chamber: A compartment or enclosed space

Clavicle: Also called the collar bone, it articulates with the shoulder on one end and the sternum on the other.

Dilation: The process of enlargment or expansion

Ductus: A duct or walled passageway

Endocardium: The inner most lining of the heart cavities.

Esophagus: Part of the alimentary canal which connect the throat to the stomach.

Hypertension: Persistently high arterial blood pressure.

Hypertrophy: The enlargement or overgrowth of an organ or part due to an increase in size of its constituent cells.

Hypoplasia: The incomplete development or underdevelopment of an organ or tissue

Pulmonary Artery: The short wide vessel arising from the conus arteriosus of the right ventricle and conveying unaerated blood to the lungs.

Pulmonary Trunk: Origin, right ventricle of heart; distribution, it divides into the right pulmonary artery and the left pulmonary artery, which enter the corresponding lungs and branch along with the segmental bronchi.

Septal: A dividing wall or partition, a general term for such a structure. The term is often used alone to refer to the septal area or to the septum pellucidum.

Subclavian: Origin, first costal cartilage; insertion, inferior surface of acromial end of clavicle; action, fixes clavicle or elevates first rib; nerve supply, subclavian from brachial plexus.

Tricuspid Valve: Three cusps (leaflets), divides the right atrium and the right ventricle.

Tracheal: Anatomy a large membranous tube reinforced by ring of cartilage

Valve: A device that controls the flow of a fluid through a pipe.

Ventricle: The paired more muscular chambers of the heart that pump blood into the pulmonary (right ventricle) and systemic (left ventricle) circulation.

Vessel: Water conducting system in the xylem, consisting of a column of cells (vessel elements) whose end walls have been perforated or totally degraded, resulting in an uninterrupted tube.

Viscera: Any of the large interior organs in any one of the three great cavities of the body, especially in the abdomen.

CHAPTER 1.0

INTRODUCTION

Integrating medical knowledge and advances into the clinical setting is often difficult due to the complexity of the involved algorithms and protocols. Clinical decision support systems (CDSS) assist the clinician (pediatrician) in applying new information to patient care through the analysis of patient-specific clinical variables. Many of these systems are used to enhance diagnostic efforts and include computer-based programs that provide extensive differential diagnoses based on clinical information entered by the pediatrician.

1.1 Background of Study

In this subsection, there are three important topics will be highlighted which are the pediatrician, Cardiovascular Diseases and Clinical Decision Support System. These topics are important in determining the goals and purposes of the system.

1.1.1 The Pediatrician

Pediatricians have an almost infinite number of career choices open to them, from doing a fellowship and becoming a specialist, becoming a primary care pediatrician and taking care of children from birth to age 21 years, to working in an administrative office for an insurance or pharmaceutical company. There is a lot of pediatric subspecialty, and one of them is pediatric cardiology – the one who focus on the patients that suffer cardiovascular diseases.

There are the pediatricians who choose not to specialize. As a general pediatrician, they can still choose the type of patients that you would like to take care of. If they have a special interest in allergies and asthma, then they might choose to see more of patients with these disorders.

Pediatrics is a challenging field and provides many options for doctors to choose what they want to do.

1.1.2 Cardiovascular Diseases

Cardiovascular Disease includes dysfunctional conditions of the heart, arteries, and veins that supply oxygen to vital life-sustaining areas of the body like the brain, the heart itself, and other vital organs. If oxygen doesn't arrive the tissue or organ will die. Actually, the *Cardio* term refers to the heart and the *vascular* term refers to the blood vessel system.

Cardiovascular Disease is the technical term for obstruction of blood flow to the heart. In general this results because excess fat or plaque deposits are narrowing the veins that supply oxygenated blood to the heart. Excess buildup of fat or plaque is respectively termed arteriosclerosis and atherosclerosis. Equally significant would be inadequate oxygen flow to the brain, which causes a stroke.

Damage to the heart tissues from CVD or from heart surgery will disrupt the natural electrical impulses of the heart and result in cardiac arrhythmia (an abnormally high or abnormally low heart rate). Individuals often don't realize the aftermath and side effects that invasive surgical procedures leave. Sudden fluctuations in heart rate can cause noticeable palpitations, with an associated faintness, or dizziness, and if severely abnormal could interfere with blood flow and even initiate a heart attack.

Infection of the heart, carditis and endocarditis, is an additional complication that can occur as a result of a weak immune system, liver problems, heart surgery, or from an autoimmune disorder like rheumatic fever. Endocarditis is quite common in persons with compromised immune systems from HIV or AIDS. If not appropriately handled, permanent heart muscle damage can occur from the infection.

1.1.3 Clinical Decision Support System

Clinical decision support systems (CDSS) vary greatly in their complexity, function and application. For this project, the system required the input of patient-specific condition and as a result provides patient-specific recommendations. So the result will provide suggestions for care and treatment based on the diseases suffered by the client. However, CDSS does not make decisions but supports diagnostic decisions of doctors and assist them in making decision.

Some CDSS incorporates fuzzy logic to overcome restrictions of diagnostic programs. Pathophysiologic reasoning has also been used to represent temporal evaluation of single and multiple disease process. More complex systems include computerized diagnostic tools that, although labor intensive and requiring extensive patient-specific data entry, may be useful as an adjunctive measure when a patient presents with a confusing constellation of symptoms and an unclear diagnosis. Other systems, both simple and complex, may be integrated into the point-of-care and provide accessible reminders to clinicians regarding appropriate treatment based on previously entered data. So by having the DSS, it will help the clinicians with suggestions for appropriate care, thus decreasing the likelihood of medical errors. For example, a guideline for the management of community-acquired pneumonia may include a clinical tool that, after the input of patient-specific data, would provide a recommendation regarding the appropriateness of inpatient or outpatient therapy.

However, a lot of people confuse with the concept of CDSS. The survey found that generally Malaysian doctors have attitudes ranging from unfavourable to neutral towards CDSS. Many had misconceptions that CDSS would replace them and pose a threat to them and patients. Doctors intuitively employ complex decision making strategies based on common sense, instead of fixed organisational and medical guidelines. While the doctor would still be able to decide on the course of action to be undertaken, CDSS would present the standard decision approved by the organisation. Among tangible economic benefits of CDSS would be the savings achieved by using less medical resources and time to arrive at a diagnosis, as CDSS produced a tested fixed procedure to arrive at the optimum decision on a range of cases.

1.2 Problem Statement

1.2.1 Problem Identification

Human tend to make a mistake. Sometimes doctors confuse with the diseases suffered by the patients and thus give wrong treatment to the patients. So, the percentage of the doctors use the wrong treatment is high. However, by using the DSS, the likelihood of giving wrong treatment is low because the system has precise data with the example of symptom. Besides, the system can analyze the symptom effectively and intern doctor to make better decision making.

Currently, most of the pediatrician experts are using the manual system to keep all the patients' record. By using manual system, the data will be less organized and hard to be updated. The manual system does not have automatic update that can keep the database updated and easy data tracking.

1.3 Objective and Scope of Study:

1.3.1 The Objectives

The objectives of the project are:

1. To develop a system that could analyze diseases suffered by patients and generate specific solution.
2. To guide and help pediatrician in decision making.
3. To decrease the likelihood of medical or treatment errors by giving correct data hypothesis.

1.3.2 The Scope of Study

The scope of the study will cover the learning on how to develop the system and understand how the system works within the given time frame. The system will be focusing on the 20 types of Cardiovascular Diseases suffered by children. The system also will provide the analysis of the symptom and provide a list of possibility diseases suffered by the children as well as treatment needed by the patients.

1.3.3 The Relevancy of the Project

Malaysia is progressing very rapidly in all aspects of life. It is fast developing and very soon it will be a fully developed country. Currently, the use of technology is the must for most industries including the medical industry. By using the DSS system for pediatrician, it can improve the quality of decision making. The DSS system also can provide correct data hypothesis to guide the pediatrician. By developing the system, it can optimize the use of technology in medical fields and increase the IT literacy among doctors.

1.3.4 Feasibility of the Project within Scope and Time Frame

The project had started by identifying the requirements needed to build the system. Once the requirements and scopes had been identified, the process of understanding the system's flow begins. At the beginning of developing the system, all the information had been analyzed and gathered. With the help of the programming tools, the project will then concentrate more on building the system using Exsys Corvid. All the information needed can be find from books in the library and from the internet. With all the resources provided, it will be a feasible project in the time given.

CHAPTER 2.0
LITERATURE REVIEW

In this section, all the researches and references regarding the topic are identified and analyzed. This section is important in order to emphasize and support the project study. To understand the how the system works, we must understand the basic concept of the Decision Support System.

2.1 Decision Support System

Decision Support Systems (DSS) are interactive computer based systems that assist decision makers to utilise data, models, solvers, and user interfaces to solve semi-structured and unstructured problems. In this project, clinical decision support system (CDSS) is defined to be any software (DSS) designed to directly aid clinical decision making, whereby through the use of specific CDSS, useful characteristics of the patient are made available to clinicians for considerations. CDSS does not make decisions but supports diagnostic decisions of doctors. CDSS is viewed as information technology, defined as mechanisms to implement desired information handling in the organisation. Thus CDSS also supports work procedures and organisational goals. Appendix B shows the DSS framework, attributes, process, abilities, and the DSS schematic view.

According to P. Keenan (1996). *Using a GIS as a DSS Generator*:

> *Decision Support Systems (DSS) are a class of computerized information system that supports decision-making activities. DSS are interactive computer-based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.*

The Whatis.com also agrees with the P.Keenan's opinion by saying that:

> *Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.*

Decision Support System is often to be confused with the Expert System. According to M.K.El-Najdawi (December 1999). *Expert Support System: Integrating AI Technology*:

> *Expert systems are computer programs that embody the knowledge of one or more human experts in a narrow problem domain and can solve problems in that domain matching the expert's level of performance.*

From these definitions, it shows that the DSS is a system that is uses to analyze the data and assist the specialist to make decision. Meanwhile, the ESS is uses to analyze the data and can make a decision by itself. It's mean the ESS can replace human in the making the decision in certain fields.

Because my topic is related to the clinical fields, sometime I tend to use the Clinical Decision Support System (CDSS) rather than Decision Support System (DSS) to emphasis my work. This is because for this project, the CDSS and DSS is the same concept.

However in Malaysia, CDSS has not gained grounds among the doctors, as in some western countries. Many had misconceptions that CDSS would replace them and pose a threat to them and patients. The analysis (done by Lee Philip and Loo Grace) showed they had low awareness and were willing to be exposed to this technology, providing the possibility of a paradigm shift towards adoption in the future as describe in table 1 below:

Theme	No. (%)
Lack of exposure	14 (23)
Insufficient funds	9 (15)
System is not cost effective	7 (11)
Bureaucracy red tape	7 (11)
Low computer accessibility	6 (10)
Low IT literacy among doctors	5 (8)
Lack of system with good research	4 (7)
Few experienced/ respected CDSS developers	4 (7)
No time to learn new technology	2 (3)
Others	4 (5)
Total	62 (100)

Table 2.1: Reasons cited by respondents for slow adoption of CDSS

2.1.1 Component of Decision Support System

There are 4 components of Decision Support System which are:

- ***Data Management:*** Include a database that contains relevant data for the situation and is managed by software called the Database Management System (DBMS). It can be interconnected with the data warehouse, a repository for relevant decision-making data. Usually the data are stored or accessed via a database server.
- ***Model Management:*** It is used to perform the DSS analysis on a model of reality rather than on the real system. A model is a simplified representation or abstraction of reality. The created model will be executed, testing and integrated.
- ***User Interface:*** The user communicates with and commands the DSS through this component. The system provides a familiar, consistent graphical user interface structure for most DSS.
- ***Knowledge Based Management:*** It can support any of the other components or act as an independent component. It provides intelligence to augment the decision making. This component is the optional for DSS.

Please refer to the Appendix A that shows the decision making process involve in Decision Support System (DSS). The Figure 2.1 below shows the schematic view of the Decision Support System.

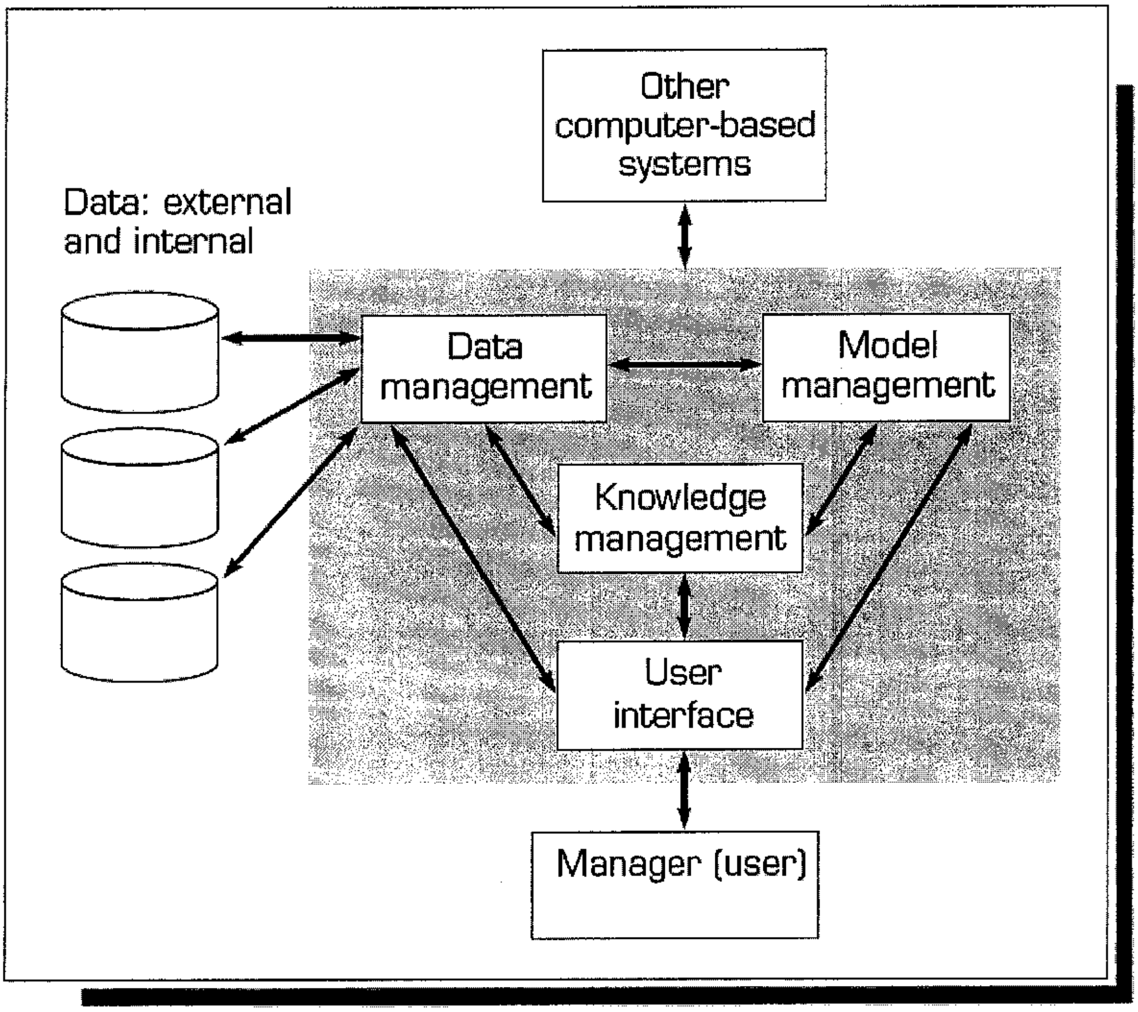

Figure 2.1: The schematic view of Decision Support System

2.1.2 Effects of Clinical Decision Support Systems

As CDSSs mature, they offer increasingly exciting prospects for improving the effectiveness and efficiency of patient care. The potential benefits of using electronic decision support systems in clinical practice fall into 3 broad categories:

- Improved patient safety through reduced medication errors and adverse events and improved medication and test ordering;
- Improved quality of care by increasing clinicians' available time for direct patient care, increased application of clinical pathways and guidelines, facilitating the use of up-to-date clinical evidence, improved clinical documentation and patient satisfaction;
- Improved efficiency in health care delivery by reducing costs through faster order processing, reductions in test duplication, decreased adverse events, and changed patterns of drug prescribing favoring cheaper but equally effective generic brands.

CHAPTER 3.0
METHODOLOGY

3.1 Procedure Identification

3.1.1 Rapid Application Development

In developing the system, I will use the Rapid Application Development (RAD) methodology. RAD is a programming system that enables programmers to quickly build working programs. It is also a methodology for compressing the analysis, design, build, and test phases into a series of short, iterative development cycles. Iteration allows for effectiveness and self-correction. This is because, it allows the programmer to revise the previous development phases. The fundamental principle of iterative development is that, each iteration delivers a functional version of the final system. It is a properly engineered, fully working portion of the final system and is not the same as a prototype. For example, the first iteration might deliver 100% of 10%, the second iteration 100% of 25%, and so on. This methodology also enables us to develop strategically important systems faster while reducing development costs and maintaining quality. This is achieved by using a series of proven application development techniques, within a well-defined methodology. It also uses an approach in which developers work with an evolving prototype. The reason of choosing this method is it helps to develop and produce systems quickly without scarifying the quality of the system.

3.1.2 The Rapid Application Development Process

Basically there are 4 main phases involve in Rapid Application Development (RAD). Before involving in the RAD process, preparing the project planning is very essential. In the project planning, all the related information about the project such as Decision Support System; pediatrician; and Cardiovascular Diseases are carefully gathered. The research was obtained throughout the journal, website and books. After all the phases in the RAD had been completed, the end product is prepared to be presented. Figure 3.1 shows the RAD process that I used while developing the system.

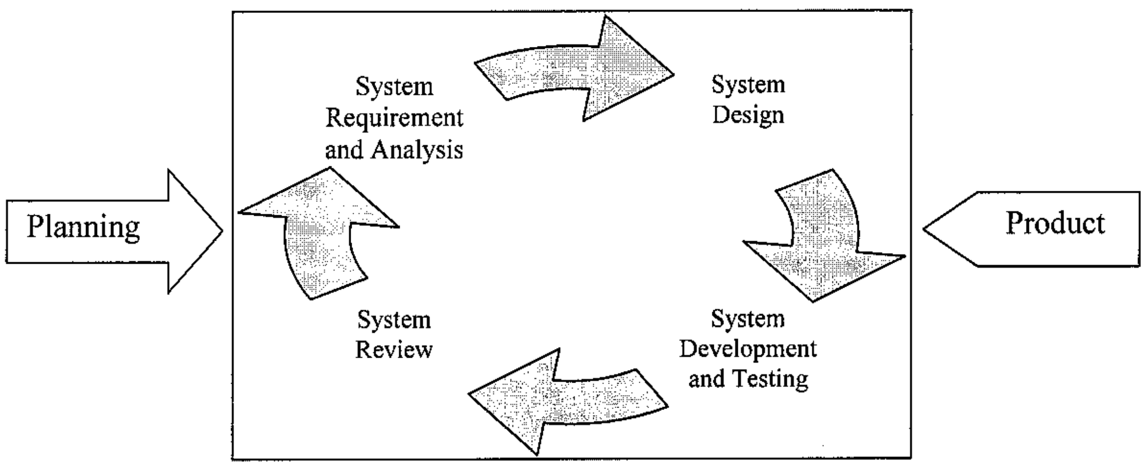

Figure 3.1: RAD Process

System Requirement and Analysis

Also known as the Concept Definition Stage. This stage defines the project functions and data subject areas that the system will support and determines the system's scope. It requires high level or knowledgeable end-users to determine what the functions of the system should be. It should be a structured discussion of the scope problems that need to be solved. It can often be done quickly when the right users and executives are involved. All the information obtained during the planning process is gathered and analyzed. The data need to be analyzed to ensure its preciseness and accurateness. There are so many useful journals, books, websites and articles in the internet that had been used as reference in developing this project.

System Design

Also known as the Functional Design Stage. This stage is used to model the system's data and processes. All of the related system components should be designed as a reference for the system development phase. At this phase, the requirement specification and design model will be clarified. The phases involve in system design process for this project is as below:

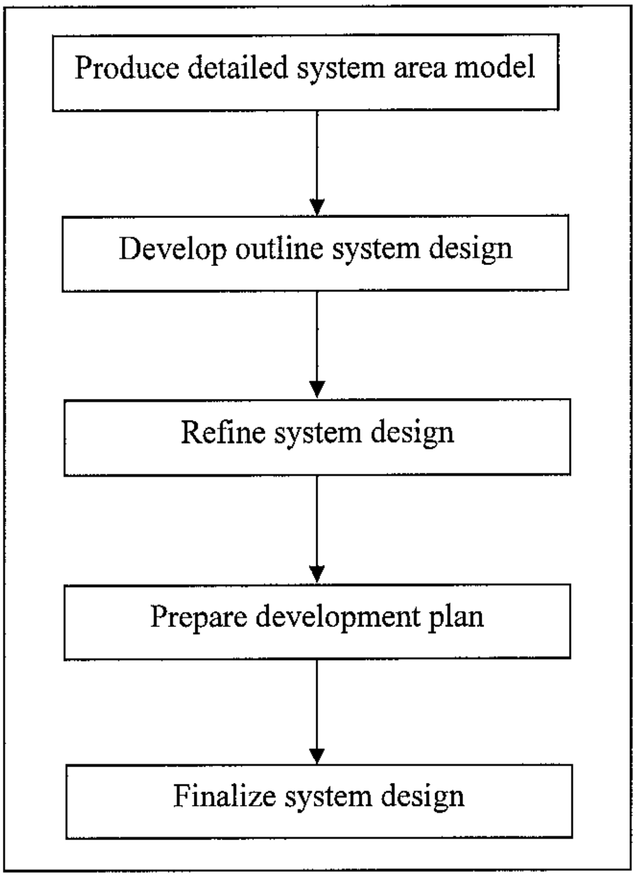

Figure 3.2: Phase in system design

System design is important in order to guide the developer to visualize the flow of the system and the interface. Appendix B shows a functional decomposition diagram of the system. Meanwhile, Figure 3.3 below shows the flow chart process for the main part of this system.

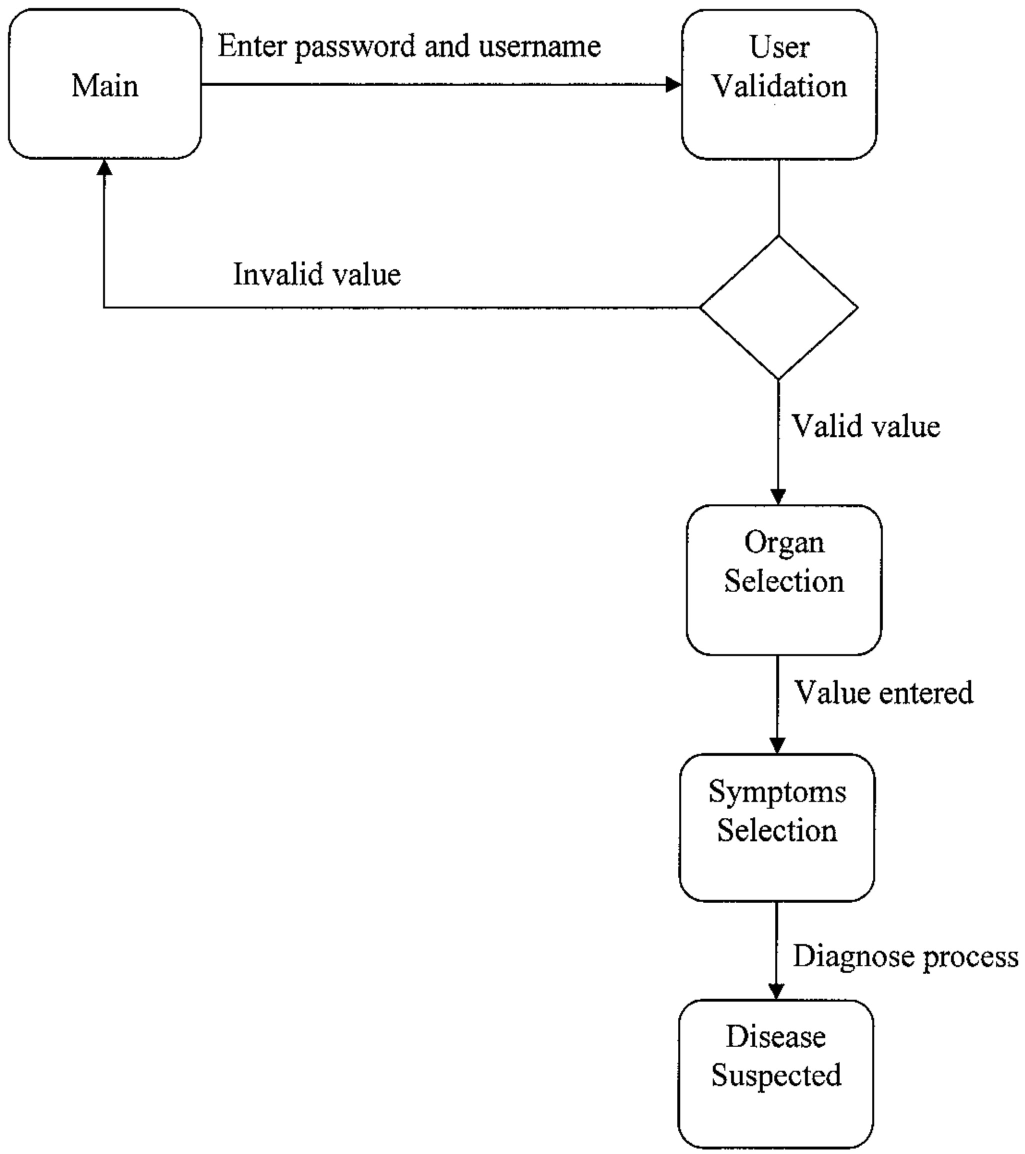

Figure 3.3: Flow chart process for the main part of the system

System Development and Testing

Also known as the Development Stage. This stage completes the construction of the physical application system, builds the conversion system, and develops user aids and implementation work plans. The main part of the system – symptoms diagnose process had been developed using the Exsys Corcid. However, the interface of this system had been developed using the Macromedia Dreamweaver. So, once the symptoms diagnose process had been fully completed, the developer will integrate it with the Macromedia Dreamweaver.

System testing also occurs throughout this phase. The testing process should be done carefully in order to detect any errors occurred. The errors that had been detected will be corrected to ensure the system works as expected. There are two types of system testing that had been used in this phase which are:

- ***Unit testing:*** testing made to ensure that the program fixes the bug without undesirable side effect to the entire program. The testing is focus on small module or part of the system.
- ***System testing:*** testing made to ensure that the entire application, of which the modified program work as expected. The testing is more focus on the system as a whole.

This phase took for about 2 months to be completed. Figure 3.4 below shows the prototype phases involve in developing the system. Based on the figure, before development of the prototype is beginning, all the information collected in the system requirement phases is analyzed. Once the information is being identified, the development of the system will take place. Working prototype is developed based on the information gathered. Testing and evaluation part will be done during the process. Once the prototype is finished, the supervisor will decide either the prototype is complete or needed to be revised or improved. If the prototype needed to be revised, the prototype process will go to the previous phase. Once the prototype is improved, the clean up prototype and documentation will be prepared.

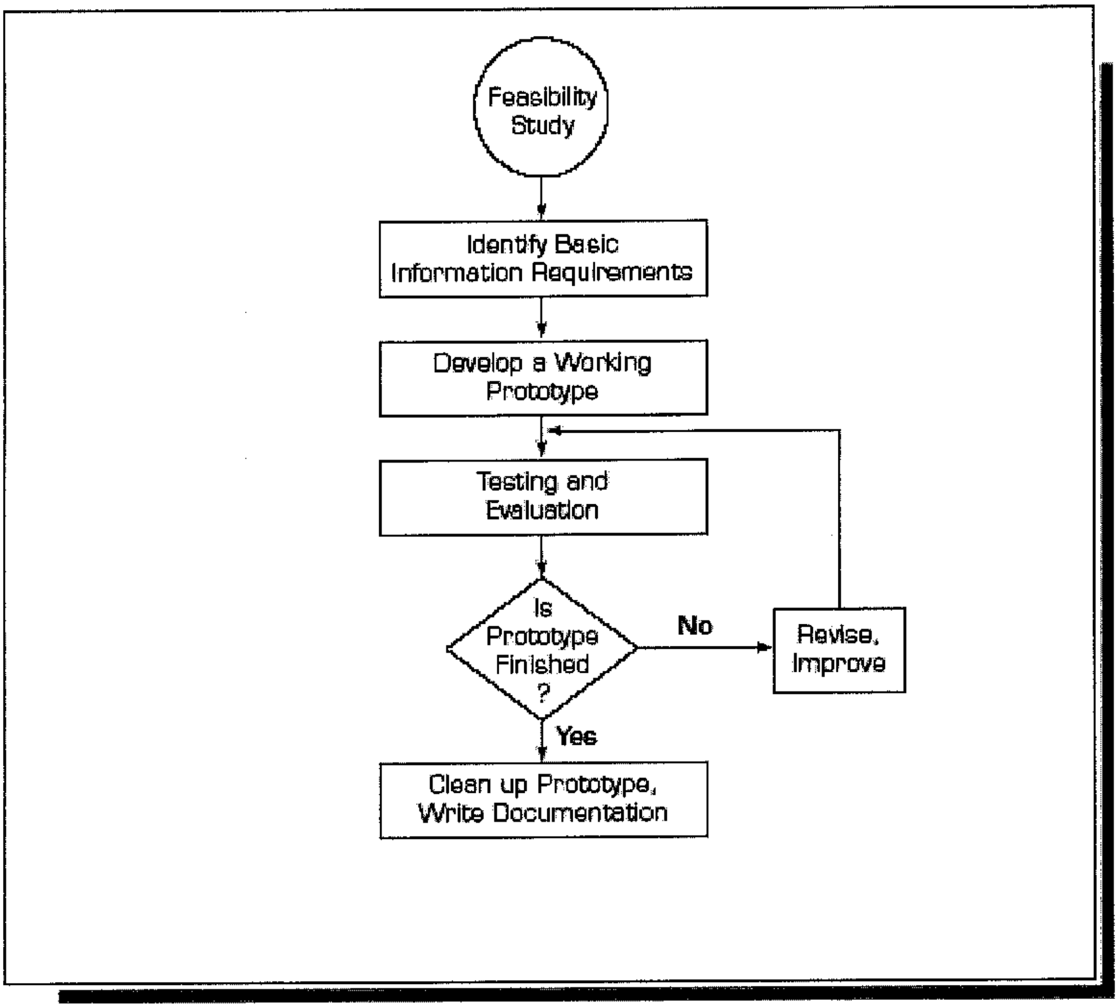

Figure 3.4: Prototype phases

System Review

Once the above phases had been completed, the system now is almost complete. The system review is used to do the final testing for the system. The developed system will be reviewed in order to ensure that the system work as expected before submitted to the users. If the error is detected, the system will be corrected. System review is also used to ensure that the system fulfill the requirement and specification. Appendix C shows the summary of all process involve in developing the system based on the RAD methodology.

3.2 Tools required

The tools that had been used in developing the system are as below:

I. Managerial process:
  - Microsoft Word – used to prepare all the reports and creating the tables and diagrams
  - Microsoft Power Point – the purpose is used to prepare the presentation slide

II. Development process:
  - Exsys Corvid – the main software used to develop the system. The symptoms diagnose process had been developed using this software.
  - Macromedia Dreamweaver MX – this software is used as a platform for the symptoms diagnose. The Exsys Corvid will be integrated using this software. Besides that, Macromedia Dreanweaver is used to manage interface of the system.
  - Adobe Photoshop – used to edit and designing the image and pictures for the system.

III. Database Management System:
  - Microsoft Access – used to store the related data involve such as username and password of the system.

CHAPTER 4.0
RESULT AND DISCUSSION

4.1 Project Finding and Discussion

There will be a few important discussions regarding the Cardiovascular Diseases that will be highlighted in this. All the discussion is based on the finding and research made in the earlier phase of the system development. Besides that, this section also provides the output of the system.

4.1.1 Cardiovascular Diseases

Cardiovascular diseases (CVD) comprise the major disorders of the heart and the arterial circulation supplying the heart, brain, and peripheral tissues. Their common occurrence, and the attendant mortality, loss of independence, impaired quality of life, and social and economic costs are compelling reasons for public health concern.

The heart is a strong, muscular pump slightly larger than our fist. It pumps blood continuously through the circulatory system, the network of elastic tubes that allows blood to flow throughout your body. The circulatory system includes two major organs, the heart and lungs, and blood vessels (arteries, capillaries, and veins). Arteries and capillaries carry oxygen- and nutrient-rich blood from the heart and lungs to all parts of the body. Veins carry oxygen- and nutrient-depleted blood back to the heart and lungs. Heart and blood vessel problems do not happen quickly. Over time, the arteries that bring blood to the heart and brain can become blocked from a buildup of cells, fat, and cholesterol. Reduced blood flow to the heart from blockages in the arteries causes heart attacks. Lack of blood flow to the brain from a blood clot, or bleeding in the brain from a broken blood vessel, causes a stroke. Figure 4.1 below show the human's circulatory system.

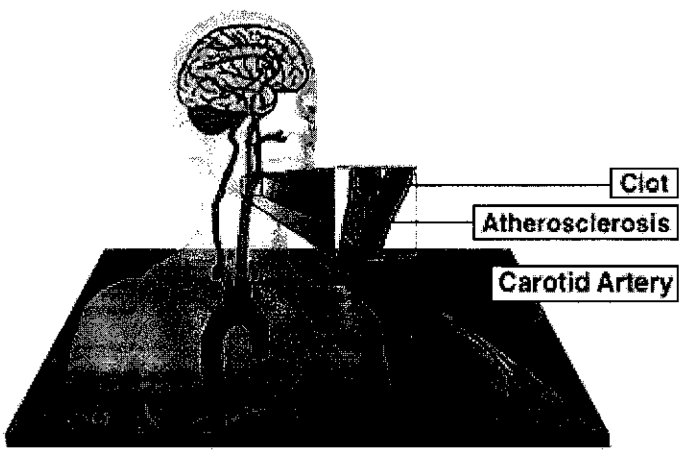

Figure 4.1: Human's circulatory system

4.1.2 Cardiovascular Diseases Risk Factor

There is abundant evidence that the following factors increase cardiovascular risk.

Cigarette smoking

Cigarette smoking is associated with a two to three fold increase in coronary artery disease, stroke and peripheral vascular disease. It is also thought to be the single most preventable cause of heart disease.

Hypertension

Hypertension is a major risk factor for coronary artery disease and is the most important risk factor for stroke. It has been estimated that among those aged 15 years and over, nearly 22 percent of males and 18.2 percent of females have high blood pressure

Cholesterol

The association between cholesterol level and risk of developing cardiovascular disease has been found to be continuous and graded. That is, the risk of cardiovascular disease mortality increases with rising cholesterol levels.

Diabetes

Diabetes is a major risk factor for coronary artery disease, stroke and peripheral vascular disease. It is associated with a two to three fold increased risk in coronary artery disease in men and a four to five fold increase in premenopausal women. There is a five-fold increase in heart failure among diabetics. It is the leading cause of death in type 1 and type 2 diabetics

Obesity

People who are obese (with a body mass index (BMI) of 30 or greater) are two to three times more likely to develop coronary heart disease than those who are not obese. Mortality from cardiovascular disease begins to increase with a BMI above 25.

4.1.3 Prevention of Cardiovascular Diseases

Assessment of risk for the prevention of cardiovascular disease is the role of primary care providers. Interventions are directed at modifying cardiovascular risk factors to reduce the absolute risk of cardiovascular disease. Effective primary prevention interventions include:

- quitting smoking
- reducing high blood pressure
- improving lipid profiles
- more intensive control of diabetes

Cigarette smoking

Effective measures to decrease smoking in the population is to use the nicotine replacement therapy.

Hypertension

Interventions to lower blood pressure include salt reduction, weight loss, exercise and antihypertensive drug therapy. Another is a dietary pattern high in fruits and vegetables, whole grain cereals, low-fat dairy products, fish (especially oily fish), chicken and lean meat. From rigorous meta-analyses of randomized trials of antihypertensive medications (chiefly diuretics or beta-blockers), data have demonstrated a consistent reduction in mean systolic/diastolic blood pressure. The estimated reduction in the risk of having a cardiovascular event over five years is 2–3 percent for each 1 mm Hg drop in systolic blood pressure.

Cholesterol lowering

Interventions to lower blood cholesterol include dietary advice, the use of plant sterols, weight loss, exercise and cholesterol-lowering drug therapy. However, one type of cholesterol-lowering drug (statin) has the most significant effect. A recent meta-analysis of the five major statin trials reported reductions of total cholesterol by 20 percent, low density lipids (LDL) by 28 percent and triglycerides by 13 percent, along with an increase in high density lipids (HDL) by 5 percent. After an average of five years treatment, the risk of coronary heart disease mortality was reduced by 31 percent, cardiovascular deaths by 27 percent and all-cause mortality by 21 percent. It has been demonstrated that the risk reduction is similar for men, women, older people and the middle aged.

Diabetes

Men with diabetes are two to three times more likely to die from coronary heart disease and premenopausal women with diabetes are four to five times more likely to die from coronary heart disease. The prospective diabetes study in the United Kingdom found that the ECG readings of 15 percent of men and 23 percent of women indicated myocardial ischaemia at diagnosis of diabetes (Morrish et al 1991). It is therefore suggested that it is important that all diabetics are assessed and treated for cardiovascular risk.

4.1.4 Type of Cardiovascular Diseases

There are a lot of types of Cardiovascular Diseases suffered by children. However, for this project, the system will identify and analyze 20 types of Cardiovascular Diseases that occur in Malaysia and entire world.

Situs Inversus

Situs describes the position of the cardiac atria and viscera. Situs solitus is the normal position, and situs inversus is the mirror image of situs solitus. Cardiac situs is determined by the atrial location. In situs inversus, the morphologic right atrium is on the left, and the morphologic left atrium is on the right. The normal pulmonary anatomy is reversed so that the left lung has 3 lobes and the right lung has 2 lobes. In addition, the liver and gallbladder are located on the left, while the spleen and stomach are located on the right. The remaining internal structures also are a mirror image of the normal.

Pulmonary Sling

Pulmonary artery sling is created by anomalous origin of the left pulmonary artery from the posterior aspect of the right pulmonary artery. The anomalous left pulmonary artery courses over the right mainstem bronchus and then from right to left, posterior to the trachea or carina and anterior to the esophagus, to reach the hilum of the left lung. This compresses the lower trachea and right mainstem bronchus, producing upper airway symptoms. Compression caused by the sling can produce obstructive emphysema and/or atelectasis of the right as well as the left lung.

Tricuspid Atresia

Tricuspid atresia may be defined as congenital absence or agenesis of the tricuspid valve. It is the third most common cyanotic congenital heart defect; the other two more frequently observed cyanotic congenital cardiac anomalies are transposition of the great arteries and tetralogy of Fallot. Tricuspid atresia is the most common cause of cyanosis with left ventricular hypertrophy.

Ebstein Anomaly

Ebsteins anomaly consists of displacement of the tricuspid valve tissue into the right ventricle accompanied by severe insufficiency of the valve. There is a resultant enlargement of the right atrial cavity with a partially atrialized right ventricle. An ASD is always present. The larger the atrialized right ventricle, the smaller the normally functioning portion of the right heart, resulting in increasing cyanosis because of right-to-left shunting through the ASD. However, the severity of the right-to-left shunt depends more on the severity of the tricuspid regurgitation and pulmonary artery resistance than the contractibility of the right ventricle. Most infants present in the first month of life; some survive to childhood or even adolescence with severe pulmonary hypertension.

Patent Ductus Arteriosus

Patent ductus arteriosus (PDA) is one of the more common congenital heart defects. Depending on the size of the PDA, the gestational age of the neonate, and the pulmonary vascular resistance, a premature neonate may develop life-threatening pulmonary overcirculation in the first few days of life. Conversely, an adult with a small PDA may present with a newly discovered murmur well after adolescence.

Ventricular Septal Defect

A ventricular septal defect (VSD), which is a hole between the 2 lower chambers of the heart, may occur as a primary anomaly with or without additional major associated cardiac defects. It may occur as a single component of a wide variety of intracardiac anomalies, namely, tetralogy of Fallot (TOF), complete atrioventricular (AV) canal defects, transposition of great arteries, and corrected transpositions.

The other diseases that will be analyzed by the system are Aortic Aneurysm; Atrial Septal Defect; Atriuventricular Canal Defect; Infantile; Double Aortic Arch; Hypoplastic Left Heart Syndrom; Pulmonary Atresia; Pulmonary Stenosis; Scimitar Sybdrome; Situs Ambiguous; Tetralogy of Fallot; Infradiaphragmatic; Supradiaphragmatic; and Transposition of Great Vessels. Appendix D will show the summary of Cardiovascular Diseases that suffered by children.

4.1.5 Cardiovascular Diseases Statistic in Malaysia

In Malaysia, about a third of all medically certified deaths are due to cardiovascular disease (CVD). Two-thirds of these CVD deaths are due to heart disease and the rest due to stroke. The number of admissions in government hospitals for cardiovascular disease had increased 14% from 96,000 in 1995 to 110,000 in 2000 with a mortality rate of just above 7% among these admissions.

The CVD had happened in Malaysia since in 1950. It was observed that among six major disease groups reviewed, cardiovascular diseases which occupied third place as a cause of death in 1950 emerged as the number one killer during the 1970s and has remained so since (with exception in 1980). In contrast, infectious diseases which ranked first in 1950 dropped to fourth position in 1980. Between 1960 and 1980, mortality due to cardiovascular diseases was higher in males than in females. This tendency became less apparent during 1985-1989. With reference to race, the incidence of cardiovascular deaths was highest in Indians followed by Chinese and Malays.

Among the specific cardiovascular diseases, coronary heart and cerebrovascular diseases accounted for the main causes of mortality. Mortality due to coronary heart disease has increased by more than three fold over the last 40 years and is still rising. In 1965, mortality due to coronary heart disease was highest in the 55-59 age groups. In recent years (1985 to 1989), it shifted to the older age group (65-69 years old). There was a tendency for higher mortality due to coronary heart disease in males compared to females. Indians had a higher mortality due to coronary heart disease than Chinese and Malays. Below is the summary of CVD statistic according to year, races and gender.

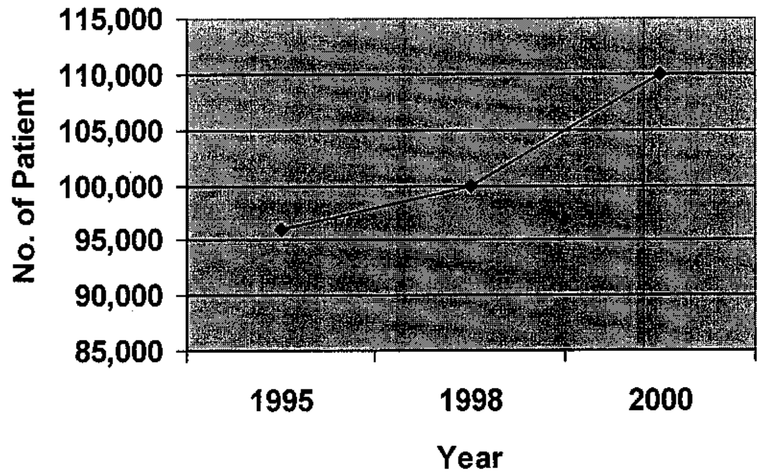

Figure 4.2: Number of patients affected by Cardiovascular Diseases according to year

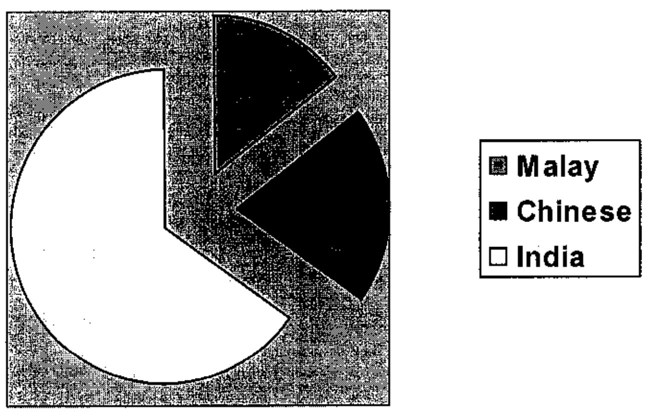

Figure 4.3: Incidence of Cardiovascular Diseases according to races in Malaysia

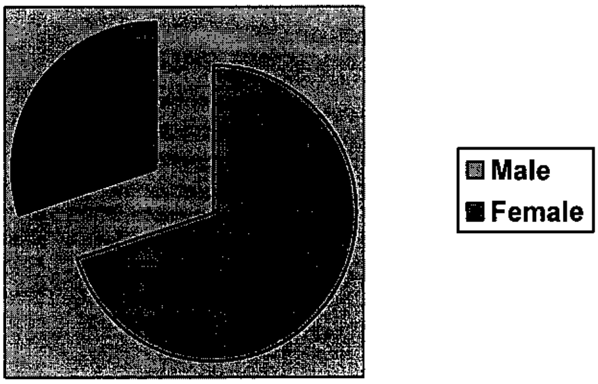

Figure 4.4: Mortality due to Cardiovascular Disease according to gender

4.2 System Output

Basically, the system is used to help pediatrician to decide the diseases suffered by patients throughout the diagnosis process available. The target user for this system is the pediatrician who involve in the cardiology field. The system can be divided into three parts which are:

- ***Introduction*** – the main page of this system. The text describe about the system overview.
- ***Login Page*** – used for user authentication. The reason of having this page is to ensure the security for the system.
- ***Symptoms Diagnose*** – the main part of this system. The diagnose process occur in this part. The system will suggested the disease suffered by patient based on the symptoms entered.

4.2.1 Main Page (Introduction)

The main page of this system briefly describes the system overview. This page is important to explain the function of the system. Figure 4.5 below shows the main page of the system.

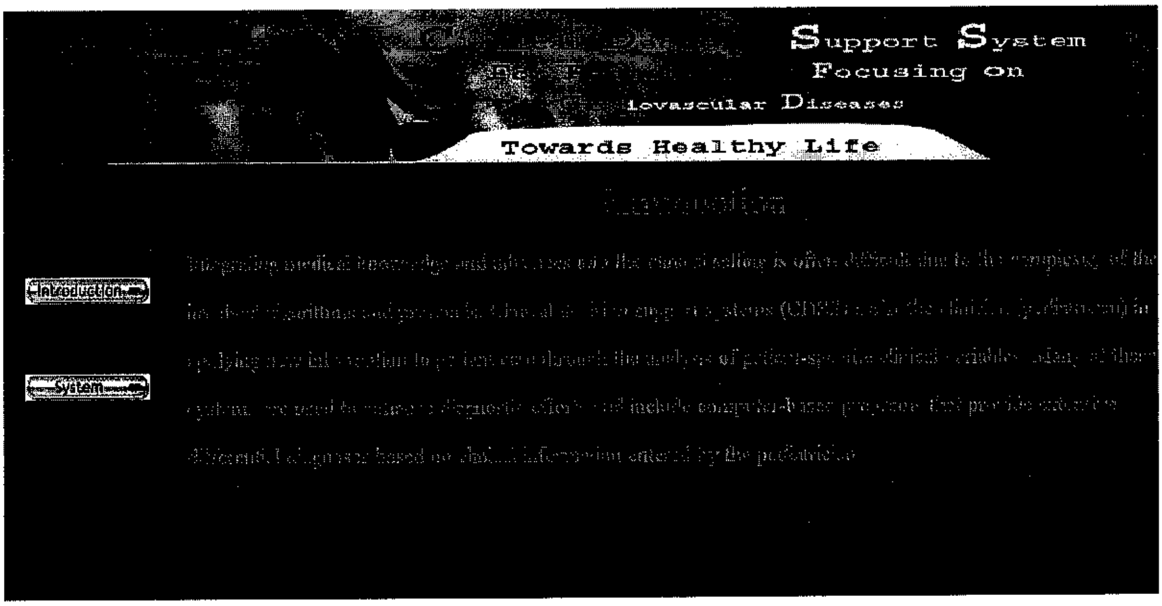

Figure 4.5: The main page

4.2.2 Login Page

In order to ensure the security of the data, this system provides the authentication procedure. The user needs to enter the username as well as the password. This page is important to ensure that only the authorized user is able to use the system. Figure 4.6 shows the login page for this system.

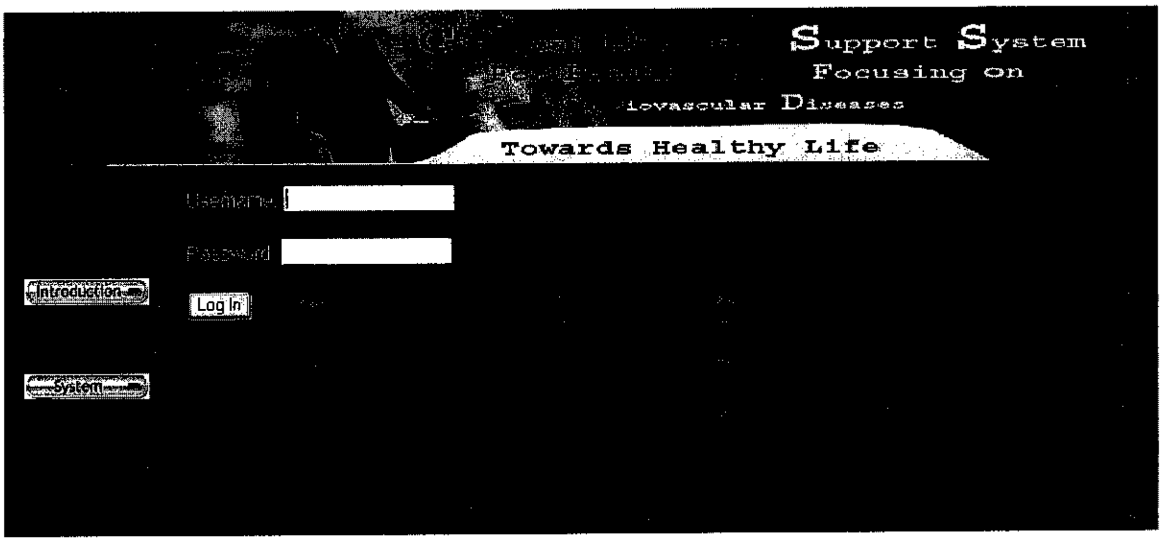

Figure 4.6: The login page

4.2.3 Symptoms Diagnose

This is the main part of the system. All the diagnose process will be done in this page. This page integrates the Exsys Corvid software with the Macromedia Dreamweaver. The symptoms diagnose will be done after the X-Ray screening on the patient. Once the patient's X-Ray image obtained, the pediatrician will use the symptoms diagnose available in the system to decide the diseases suffered by the patient. There will be three processes involve in symptoms diagnose phase which are:

- **Choosing Organ** – the user needs to choose the organ involved. Figure 4.7 shows the interface for this phase.
- **Symptoms Identification** – the user will choose the symptoms suffered by the patients. The symptoms identification will be based on the organ involve. Figure 4.8 shows the system identification interface for the system
- **Disease Suggestion** – once the user identifies the symptoms in the previous process, the system will provide the possible disease suffered by patient. If the symptoms entered by the user is not valid, the system will come out with the most nearest possible disease that may suffered by patient. Besides that, the system will once again provide the related symptoms of the diseases. The reason of having this feature is to help the user identifies the previous stages taken. Figure 4.9 and Figure 4.10 provide the interface of this phase.

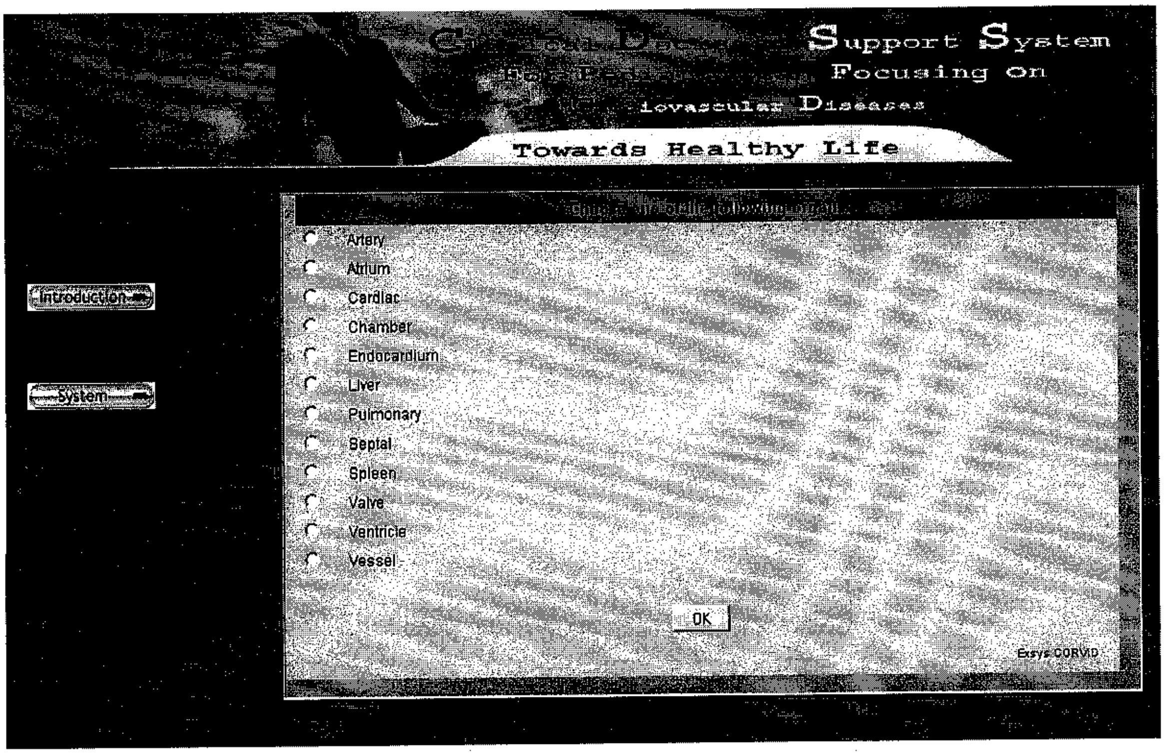

Figure 4.7: Choosing Organ page

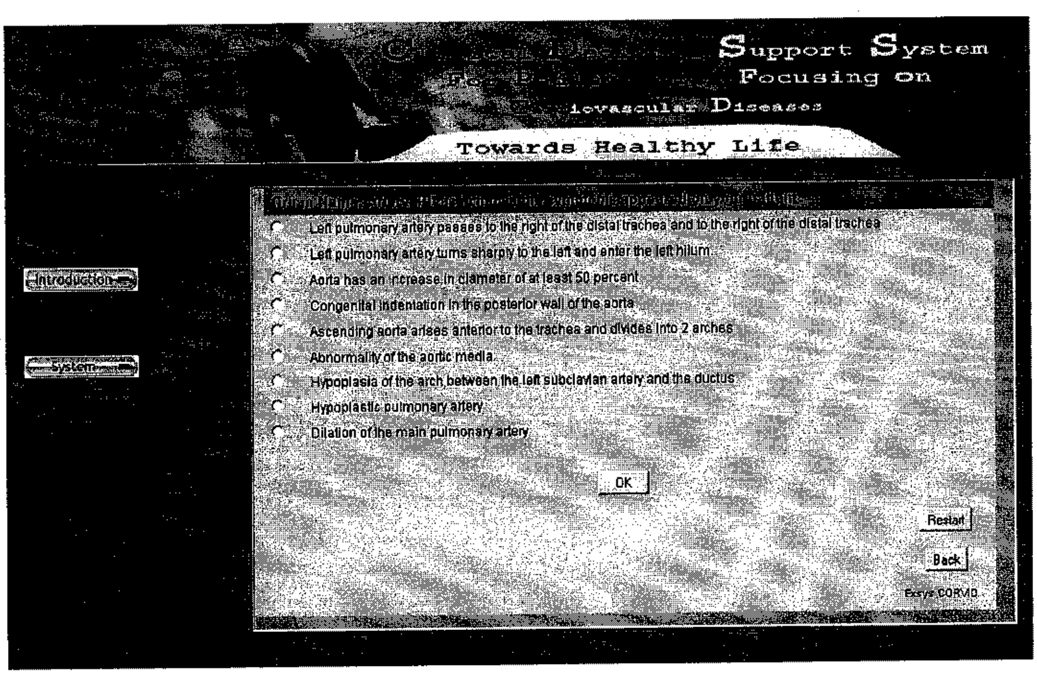

Figure 4.8: The symptoms identification based on the organ

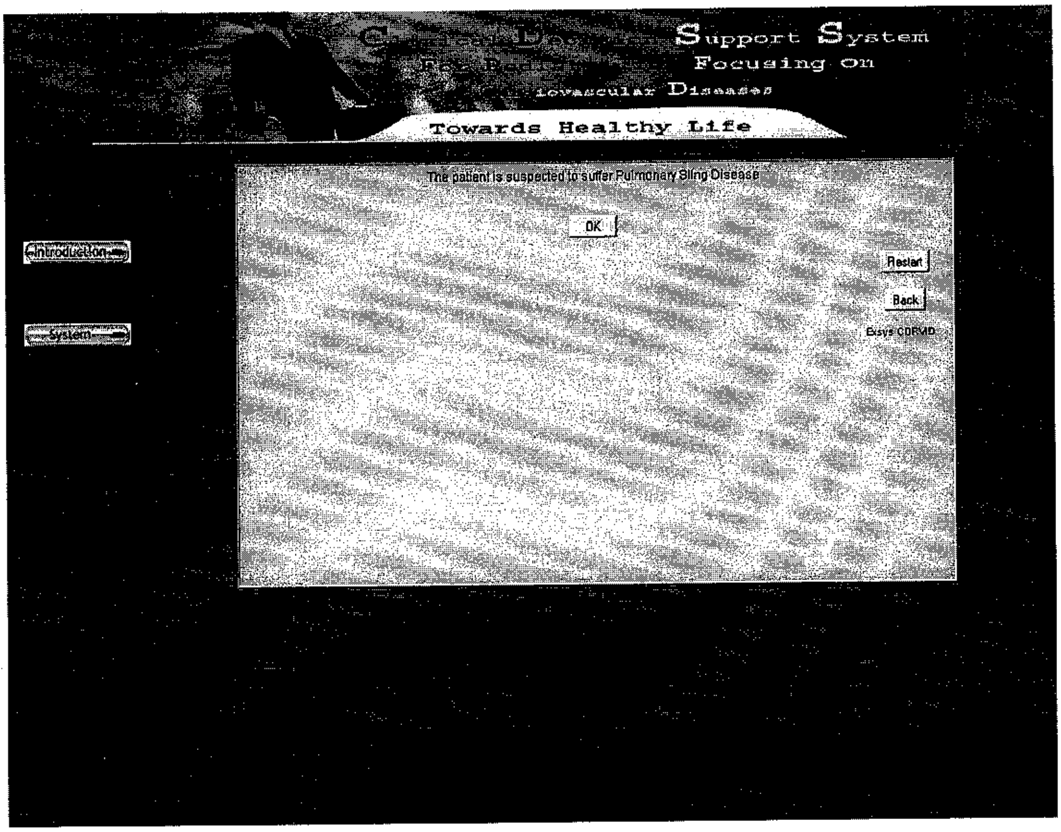

Figure 4.9: The Suggested Disease

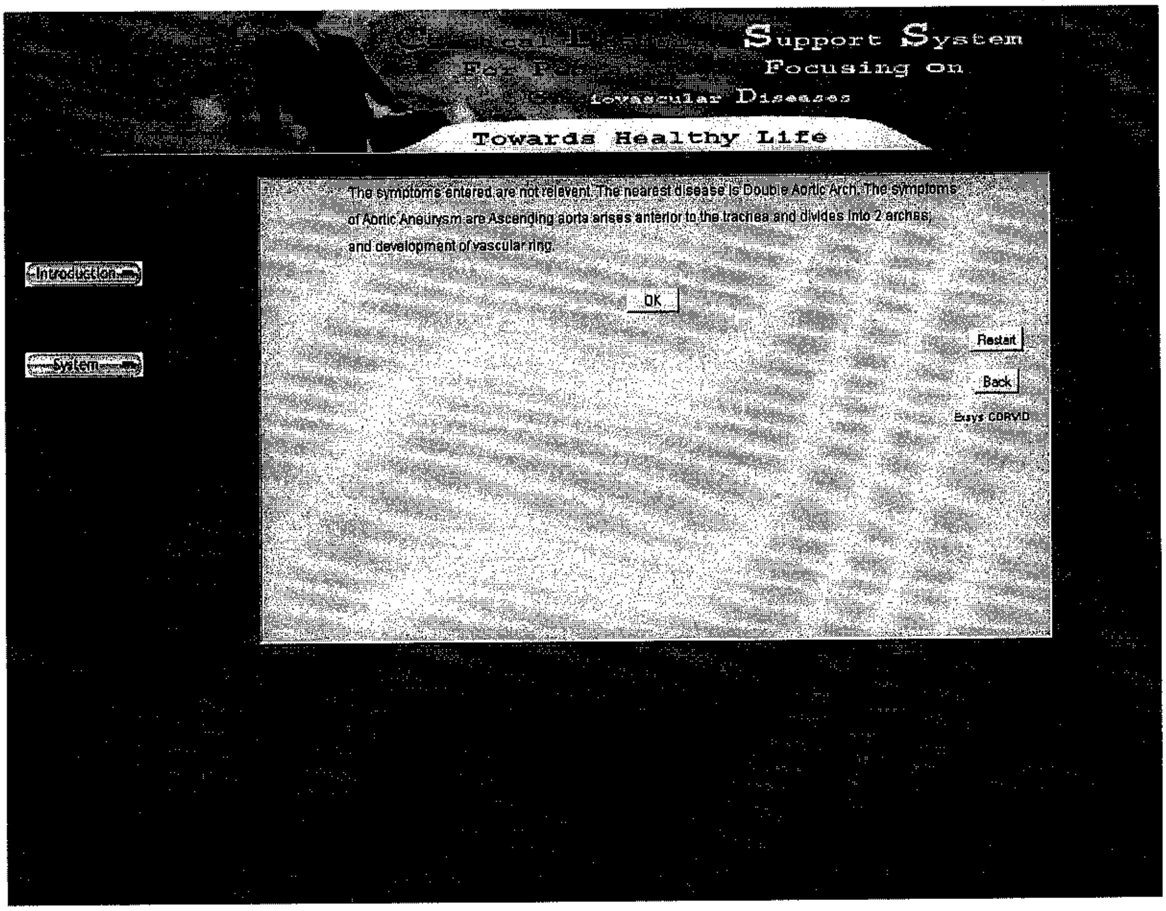

Figure 4.10: The nearest suggested disease for conflict symptoms

Basically, the system has the user-friendly concept. The system is easy to use and the user needs to follow the instruction given. The color and words used is very suitable and match with each others. Besides that, in this system each page had been designed to be the same looks and feels so that the user do not confuse or lose while navigating the system.

CHAPTER 5.0
CONCLUSIONS AND RECOMMENDATION

5.1 Conclusion

By having the Decision Support System (DSS) for pediatrician, it is hope that the system can help the specialist in making precise decision making in order to ensure the patients get the best medical treatment. The proposed system can help inexperienced doctors or their assistant make correct decision based on the data analyzing. Using this system, loss of customer can be avoided and it can increase the quality of care and patient outcomes. Compare with the human being, the use of DSS can decrease the likelihood of decision erroneous thus increase the efficiency in decision making. By conducting further research and study on this project, it can provide very effective system and create brand new solution in this medical field. The uses of technology in making precise decision can be optimized.

5.2 Recommendation

There are a lot of works and development phases needed to be done in developing the system. The system's navigation flows and the user interfaces need to be designed and analyzed carefully in order to come out with the efficient and effective output. The interface of the system should be more user-friendly and attractive. The system should easily lead the users so that they do not confuse will navigating the system.

Because the user is depending on the system to make decision, the correctness of the data should be emphasized. Detail and deep research should be handled in order to ensure that the data obtain is precise and correct. The preciseness of data is very important in this system so that it can give correct solution for the symptoms entered. Besides that, all the data and information obtained need to be gathered, collected and analyzed to ensure the preciseness and integrity of the data.

Currently, the system only can diagnose 20 types of Cardiovascular Diseases because of the knowledge and expertise limitation. If the contents and project scope of this system can be expanded, the output will be more effective and efficient. The doctor can use the system without having any difficulties or limitation. So, further research should be conducted in order to produce creative and effective system.

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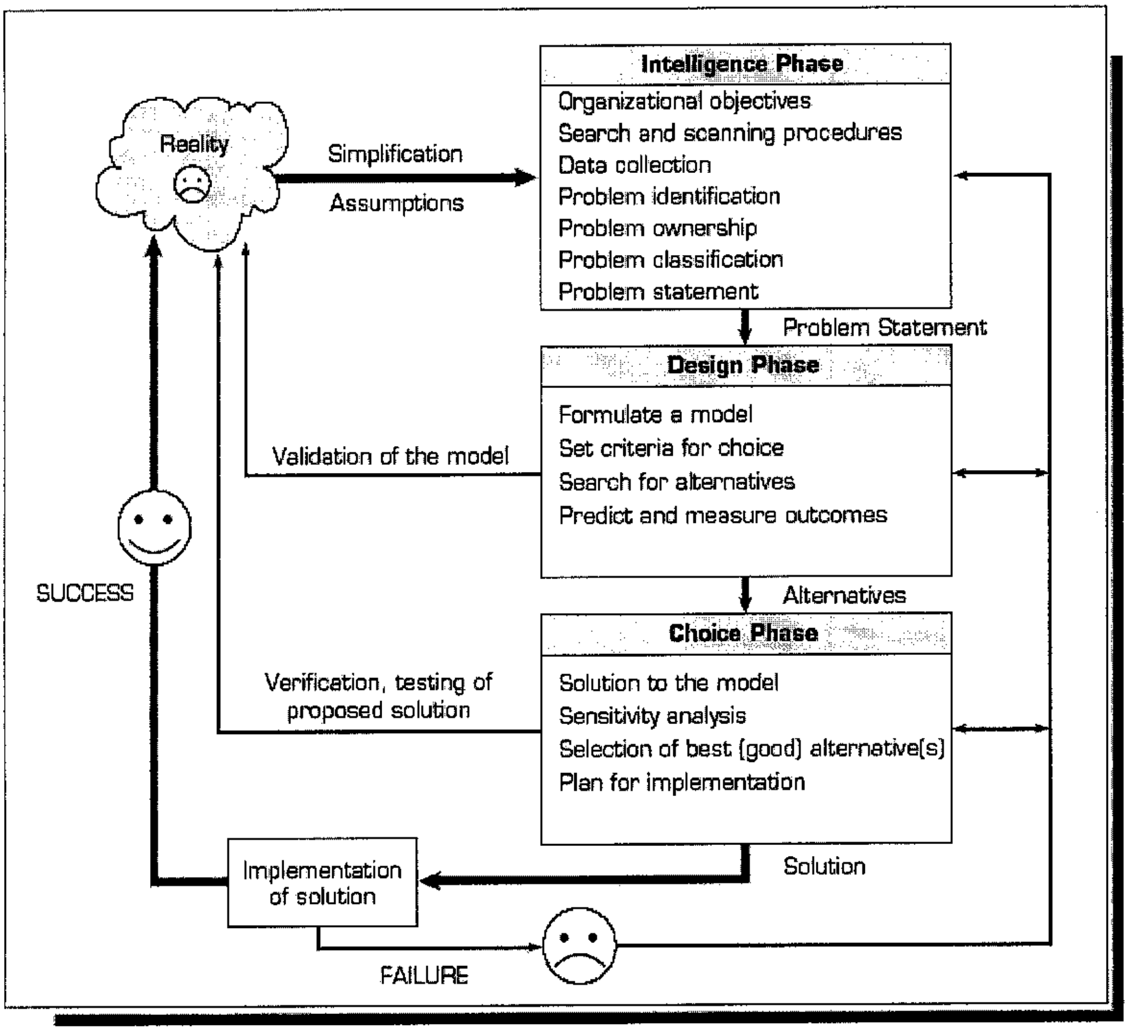
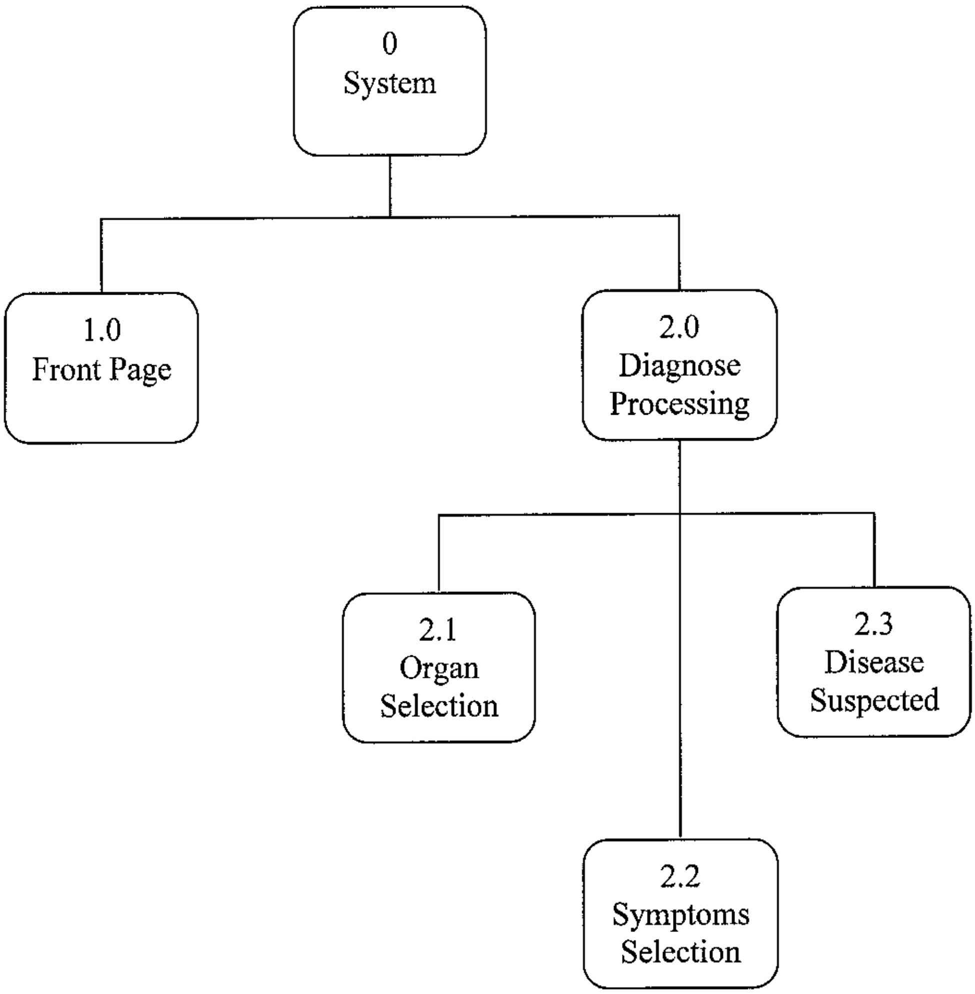
APPENDICES

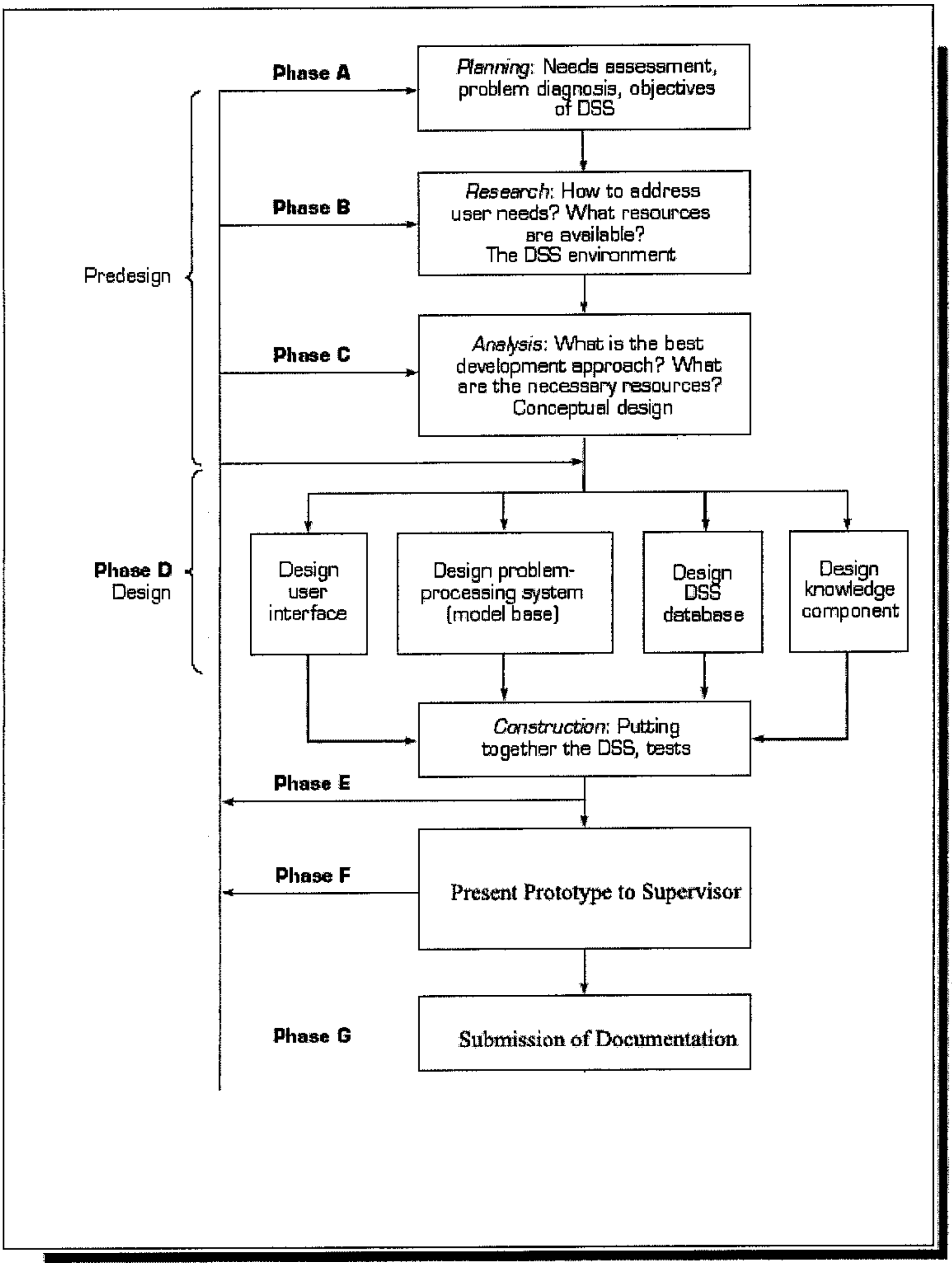
Appendix A: Decision Making Process Involve in DSS



Appendix B: A Functional Decomposition Diagram



APPENDIX C: Summary of Phases Involve in Developing the System



APPENDIX D: Summary of Cardiovascular Diseases among Children

Type	Main Organ Involve	Symptoms
Situs Inversus	- Atrium - Liver - Spleen	i - The morphologic right atrium is on the left, and the morphologic left atrium is on the right ii - The liver and gallbladder are located on the left, while the spleen and stomach are located on the right
Pulmonary Sling	- Artery	i - Left pulmonary artery passes posteriorly to the right of the distal trachea ii - Left pulmonary artery turns sharply to the left to enter the left hilum.
Tricuspid Atresia	Valve	i – Congenital absence or agenesis of the tricuspid valve
Ebstein Anomaly	- Valve - Septal - Ventricle	i – Abnormal attachments of the tricuspid valve leaflets to the annulus of the tricuspid valve ii - Marked variability exists in the degree of displacement of the septal iii - Posterior leaflets into the cavity of the right ventricle
Patent Ductus Arteriosus (PDA)	- Pulmonary - Atrium	i - Pulmonary blood flow excessively ii – Enlargement of left atrial
Ventricular Septal Defect	Chamber	i – Has a hole between the 2 lower chambers of the heart
Aortic Stenosis	- Artery - Ventricle	i – Increase in aorta diameter of at least 50 percent as compared with the expected normal diameter ii – Ventricular hypertrophy and left ventricular dilation
Atrial Septal Defect	- Vessel - Atrium	i – Shunt vascularity with right heart dilation

	- Pulmonary	ii – Failure to thrive and recurrent pulmonary infections iii – Left atrial pressure is greater than right atrial
Atriuventricular Canal Defect	- Endocardium - Ventricle - Cardiac - Pulmonary	i – The endocardial cushions form the lower atrial septum ii – The left ventricular outflow tract is narrowed and elongated iii – Pulmonary shunt vascularity iv – Shunt in the right sided cardiomegaly
Infantile	- Pulmonary - Artery - Ventricle	i – Pulmonary venous hypertension and congestive heart failure ii – Development of right ventricular volume overload and dilation iii – Congenital indentation in the posterior wall of the aorta
Double Aortic Arch	- Vessel - Artery	i – Create vascular ring ii – Abnormality of the aortic media iii - Aorta arises anterior to the trachea and divides into 2 arches iii – Hypoplasia of the arch between the left subclavian artery and the ductus
Hypoplastic Left Heart Syndrome	- Pulmonary	i – Pulmonary venous return is shunted to the right atrium ii – Due to a dilated right heart and pulmonary trunk iii – Develop pulmonary venous hypertension
Pulmonary Atresia	- Artery - Pulmonary - Ventricle	i – Hypoplastic of pulmonary artery ii – Decreased pulmonary vasculature and cardiomegaly iii – Has small right ventricle with a

		thick wall
Pulmonary Stenosis	- Valve - Cardiac - Ventricle - Artery	i – Fusion of the 3 cusps of the valve ii – Dilation of the main pulmonary artery iii – Upturned cardiac apex iv – Increased right ventricle end systolic pressure
Scimitar Syndrome	- Pulmonary	i – Decreased pulmonary arterial perfusion ii – Partial anomalous pulmonary venous
Situs Ambiguous	- Pulmonary - Spleen - Viscera	i – Asymmetric internal structures appear to be symmetric ii – The positions of the viscera and their morphologic characteristics are indeterminant iii – Decreased pulmonary vascularity iv - Asplenia has right sided symmetry
Tetralogy of Fallot	- Pulmonary - Artery - Cardiac	i – Upturned cardiac apex ii – Pulmonary vascularity is decreased and the pulmonary trunk is small iii – Pulmonary artery is not well developed
Infradiaphragmatic	- Pulmonary - Cardiac	i – Pulmonary venous hypertension ii – No cardiac enlargement.
Supradiaphragmatic	- Pulmonary - Vessel	i – Pulmonary veins empty into the right atrium. ii – Significant shunt vascularity
Transposition of the Great Vessels	- Artery	i – The aorta arises from the right ventricle ii – The pulmonary artery arises from the left ventricle iii – A flat or concave in pulmonary artery segment