

IN-CAR ENTERTAINMENT AND MAINTENANCE SYSTEM (ICEMAN)

Focusing on Media Integration and Interface

By

Ikhwan Efendi Nazaruddin

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
Information Technology

JUNE 2004

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information Technology Programme
Universiti Teknologi PETRONAS
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Approved by,



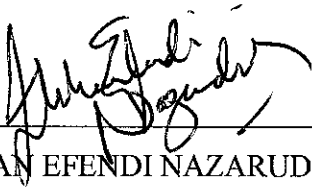
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TRONOH, PERAK

June 2004

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.



IKHWAN EFENDI NAZARUDDIN

ABSTRACT

The Final Year Project project is In-Car Entertainment Maintenance System (ICEMAN) focusing on the interface of ICEMAN and the integration of media. The existing Car Computer (Carputer) is only used for entertainment purposes such as playing DivX and MP3s. With the ICEMAN, further functions will be expanded such as the maintenance system of the car and voice recognition software integrated within the ICEMAN. The objective of this project is to produce a user-friendly interface, integrating the media into the ICEMAN and building the ICEMAN itself. The first part of this project would be the development of the software for the ICEMAN. This covers on the user-friendliness and the integration of media. The media application will achieve user-friendliness in terms of easy understanding and easy usage by avoiding clutteriness. Implementation of it can be seen such as by using big graphical icons and drop-down menu. The second part of the research will cover the hardware installation of the ICEMAN into the car. This research will cover on the best setup that can be applied to the ICEMAN according to the time and cost constraints available. The setting up of the ICEMAN will be explained. The methodology used to develop the MediaBox Application is the V-Model. A Carputer by the name of ICEMAN will be produced as the end-product of this project.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION ON CAR COMPUTER (CARPUTER)

A Carputer is an abbreviation of Car Computer. With the new advancement of technology, the need for a computer by your side seems to be a necessity. With the invention of Personal Digital Assistants (PDAs), Laptops and Tablets, just to name a few, computers have been integral in a person's daily life. With the innovation of the Car Computer (Carputer), integration of a computer with the car seems ideal as many hours are spent in the car, as a mean of transportation.

The concept of the Carputer was first innovated in the United States and Europe due to the fact that, In-Car MP3 Players were expensive. As an alternative, discarded PCs were converted and placed into the cars and play a role as a "mini MP3 jukebox". The Carputer is an easy way to store songs and other entertainment Medias as it can store large capacity of entertainment Medias according to the size of the hard disk that is being used for the Carputer.

The Carputer was once a dream for car enthusiasts that dreamt of a computer built-in the car. Now, with many car enthusiasts that are also computer literate, many dream concepts can be achieved, and one of them is the Carputer. The Carputer can achieve what a normal PC able to execute. These functions include Word Processing, Internet, and playing games, just to name a few.

The challenge of building a Carputer is the hardware and software itself. In terms of hardware, the main challenge is to power up the computer in the car. Not only that, but another challenge is to use a LCD TFT Monitor instead of a normal VGA Monitor. The challenge here is to convert the output to the monitor from a VGA output to the RCA or S-Video output.

Other challenges in the hardware are the input peripherals such as the mouse and keyboard. Many criteria have to take into account on choosing the right input devices such as the ergonomics of the devices while driving and the space for storing these devices. Placement of the devices can also be a challenge as space in the car is limited.

In terms of software, the challenge consists mainly on having an easy to use software and interface. Current operating system bundled softwares or any software that would be suitable, are not appropriate for the Carputer, as the graphical interface is too small in a TFT LCD Monitor. It will be difficult for users, especially while driving, to actually control the software functions if the icons are displayed too small. With that, custom made software is needed to enable it to be more user-friendly than the current software available.

1.1.1 Advantages of Carputer

In-Car Entertainment will always leave something to be desired. Currently in Malaysia, popular radio stations such as Hitz.FM and ERA.FM keeps on repeating the same song over and over again almost every other day. The music on the radio stations too may not be what a user wants to listen to. Single-disc CD player is the next option which has limited and fixed number of songs, approximately ranging from 18 to 20 songs. Once a user is bored with the current CD, a user will tend to change his or her CD. To add to it, a user has to constantly sort through his or her CD collection to listen to what he or she wants. Besides, not many users will actually listen throughout the whole CD the whole time.

With that, car audio enthusiasts invented the CD changer to solve the problem. This proves to be a better solution, adding up to 10 or so CDs to flip through. This sums up to roughly of 150-200 songs, where not each of the available songs are to the user's liking. Another option is the MP3 Player where a user may burn themselves a CD containing all the MP3 songs they would like to listen to. While this may be the best option yet, but it may prove that it is still limited onto the space of the disk itself.

Other means of car audio entertainment is available, where an example of a “mini MP3 jukebox” stores the MP3s in a special storage. The problem regarding this invention is that it is too costly for a tool that can only play music.

With a Carputer, a user can have access to all of his or her favorite tracks at the touch of a button. Not only that, but transferring the MP3s can also be cost saving as there would not be the need of burning tons of CDs. Instead, it can be easily transferred via USB Hard drive or a USB Thumb Drive. Storing a huge number of MP3s is a possibility in a Carputer, without the need of changing CDs. The action of changing CDs is now changed into the action of clicking the mouse to choose a song. This proves to be much simpler and friendlier.

Also not to forget, the Carputer will enable the passenger to watch movies or video clips while the driver is driving. This will actually be a great help to the driver especially on long journeys. This is due to the fact that the driver will need some accompaniment to make sure that he or she will not be sleepy. With the passenger awake to accompany the driver, the journey would not be as dreadful as the driver usually go through. If the driver is in the middle of a traffic jam, the driver will be able to watch the videos. Instead of venting anger frustratingly at other drivers, he or she will be enjoying luxuriously in the middle of a traffic jam, enjoying his or her collection of music videos or movies.

A Carputer also can act as a mobile office, as word processing softwares such as Star Office or Microsoft Office, will enable the user to do their work in the car. If the Carputer is connected to the Internet using a Wi-Fi card, the Carputer will be able to surf the net at the nearest Hotspots location. With installing the Carputer in the car, the once unimaginable things can be realize into reality. In fact, there are many more functions that can be applied in the Carputer.

1.1.2 The difference between a Carputer and a PC

A Carputer needs to be powered from the car's 12 Volt battery supply, which means that an inverter or a 12v DC-DC is needed. The Carputer's monitor is not the standard VGA monitor, where it uses a TFT LCD monitor. The input peripherals are still the mouse and keyboard, but choosing the right one will be vital for the Carputer. This is because the input peripherals have to be suitable for user to use while driving the car. The software to run the Carputers has to be a custom made software as the user interface has to be bigger than the normal Windows platform application. This is to ensure better visibility for the drivers.

1. 2 BACKGROUND STUDY

With understanding the basic concept of Carputer, the ICEMAN is an extended version of the Carputer. With the ICEMAN, many functions that were overlooked in a Carputer is given a re-emphasizing.

1.2.1 Introduction of ICEMAN

ICEMAN is the abbreviation from In-Car Entertainment and Maintenance System. The ICEMAN is a concept taken from the Carputer which is widely developed in Europe and the United States. Carputer is widely used for an entertainment system, but the Carputer is enhanced by implementing voice recognition and a maintenance system. The ICEMAN serves as a multifunction system, which provides entertainment in terms of music and movies, a Car Maintenance System and a Voice Recognition system which will improve usability of the system. With this, the need of a major part of the ICEMAN is needed, which will hold the links between all the 3 elements of the project (Entertainment, Maintenance and Voice Recognition). The system will provide the interaction and customization of media players similar to Winamp and Windows Media Player, with the bonus of having voice interaction and integration of data regarding the Maintenance System.

The ICEMAN will adopt the Carputer concept and further enhance the system in terms its functionality and usability. Software for the ICEMAN is developed on Visual Basic and it consists of three parts; MediaBox, CarMan and E-Speak.

1.2.2 MediaBox as an Entertainment Application

MediaBox is a software developed using Visual Basic 6.0. This software consists of two sub-components, MediaBox MP3 Player and MediaBox Movie Player. Both of this software has the same look and feel which makes the software easier to be used.

MediaBox MP3 Player only runs MP3s. It is different than other MP3 Players as it uses a bigger set of icons to represent its control functions such as Play, Stop and Rewind. The MediaBox MP3 Player is unique and different than other MP3 Players available.

MediaBox Movie Player runs Video CDs and other video files. Video files that are supported by the MediaBox Movie Player are in the format *.divx, *.avi, *.mpg, *.mpeg, *.dat, *.wmv and *.asf. The layout is similar to the MediaBox MP3 Player so that user will be able to use the MediaBox softwares easily.

1.2.3 CarMan as a Car Maintenance Application

CarMan is a Car Maintenance software developed using Visual Basic 6.0 and Microsoft Access. This software is also divided into two sub-components, the car maintenance database and a reminder system to remind the user to service their car parts.

The car maintenance software consists maintaining the car's battery, brake pad, air filter and timing belt. It will store vital data of these components in the Microsoft

Access database. Not only that, but the maintenance software will also include a reminder function that will remind the user to service the vehicle components once it is due to be serviced.

Not only that, but the car maintenance software will also schedule and remind the user to service the car. The scheduler is an estimation by months generated by the timer function in Visual Basic.

1.2.4 E-Speak as an Embedded Voice Recognition System

E-Speak is a voice recognition system embedded in the ICEMAN's software. The system is developed using Visual Basic 6.0. It is divided into 2 sub-components; the first is voice activated function and the second is voice message.

The voice activated function will execute actions based on the action stored on the source code of the I-Speak software. The software will enable user to control the separate softwares developed in Visual Basic with the user's voice. For example, if a user wants to shut down the system, he or she can say "Shut Down" and the ICEMAN will shut down automatically.

For the voice message system, each action will be followed by a voice confirmation. This is to ensure that the ICEMAN receives the instruction that was requested by the user. For example, when the ICEMAN is shutting down, the system will give out a voice message stating a shut down sequence is initiated.

1.3 PROBLEM STATEMENT

The problem statement is the one of the most important phase in this research project. This is due to the fact that, identifying the problem correctly is the key in ensuring that the product developed is in accordance to the requirements.

1.3.1 Problem identification

There is a need to have computer to keep track of car maintenance data. The data can only be more accurate if it is integrated within the car. Once it is integrated with the car, the computer will be able to remind the user of the need to service or check parts of the car that needs repair.

The current car entertainment system seems to be dull and needs a spark in creativity. With the invention of head units that can play MP3s and Video CDs, a user can watch and listen to their favorite MP3s or Movies in the car. Unfortunately, high-end head units cost more than a thousand ringgit and this proves not to be worth it if it's function is limited.

The best solution to it is to install a computer in the car. However, the hardware setup would be a hassle, as the computer components needs to be rewired and placed strategically in the car. Not only that, but powering up the computer components using a DC current instead of the household AC current. Another thing to be considered is how to get the car audio speakers to receive input from the ICEMAN. A suitable TFT LCD Monitor needs to be properly chosen as the monitor can have glares that cannot be seen at certain angles. This will prove a weakness to the ICEMAN if the monitor can only be seen at a certain angle.

The input peripherals such as the mouse and keyboard have to be the right type so that the user can use it easily while driving. The mouse and keyboard have to be easily used as the driver needs minimal time to maneuver throughout the user interface.

The current Carputer's functionality is limited and is more concentrated on Entertainment. Not only that, but the integration of the media is not as smooth as

expected. This can be seen where the integration of the media in the Carputer is not as user-friendly for drivers or users to maneuver throughout the system. The software is not as user-friendly as thought to be and is not easily understood. The visibility of the interface is not well layout for a small TFT LCD monitor.

To have a “hands-free” ICEMAN, there is a need to use voice to instruct actions in the car. To do this voice recognition system is needed. This system will also have a voice message system once the action is done to reconfirm with the user that it has executed the requested action.

1.4 OBJECTIVES AND SCOPE OF STUDY

Objectives and scope of study determines the emphasis after which the requirement and problem identification has been carried onto the research project. Objectives will provide the author on ensuring that the author will ensure on producing the intended product at the end of this project. The scope of study instead will determine which functionality the author will concentrate on.

1.4.1 Objectives

The main objective of this project is to build a Carputer that is developed using unwanted or junks computer parts. This is to prove that the ICEMAN is not expensive to be developed and is feasible to put a Carputer in Malaysian cars. Not only have that, but the ICEMAN’s software developed had the functionality of running the media such as DivX and MP3s. Also, this research project is to learn and acquire the knowledge, experience and expertise to develop a Carputer in the form of ICEMAN as well as to study the fundamentals of developing a Carputer. Not only that, but to be familiar with connectivity of the computer components with the car so that the ICEMAN will run smoothly. A user-friendly interface is also needed to ensure that users can use the ICEMAN efficiently. The application developed will be based on

researched on the current desktop and Carputer applications. With that, application that seems to be the best for the ICEMAN will be developed while minimizing on similar flaws of media applications. The application that needs to be developed is a movie player and an MP3 player. This is to integrate media into ICEMAN.

The media application will achieve user-friendliness in terms of easy understanding and easy usage. This can be done by implementing big graphical icons that depicts the functionality of each icon while avoiding clutterness. Other than that it will have a drop-down menu so that it will be able to jump from one application to another while maintaining the interface on its nice “look and feel”.

Next, is to have a software that can integrate voice recognition and a car-maintenance system. This is so as current Carputer software’s do not have this feature. Not only that but the software created has to be easily understood, which means that it needs minimal time to digest and interact with and clearly visible.

To add more to it, one of the objectives is to understand the product development, be it in terms of hardware or software. This is needed so that the product produce will have commercial value and can be sold to many users that want a difference.

1.4.2 Scope of Study

The scope of study of this project will be basically divided into three parts. The first part will focus on how the interface should be user-friendly. The interface should be easily understood and used, as to maximize the user’s or driver’s concentration on the road.

The second part of the study will look into functions that should be integrated into the software. The integration of the media and other functions such as the maintenance system and voice recognition will be focused on. This is to further expand the functionality and capability of the ICEMAN.

The third part will be the study of hardware connectivity in the car. This will cover from powering up the ICEMAN using the car's 12V Battery to displaying the software through a 6" TFT monitor. Other concerns regarding the hardware are connecting the ICEMAN to the Pre-Amp, input and output devices.

CHAPTER 2

LITERATURE REVIEW AND THEORY

The development of the interface for the ICEMAN should be assisting the user or driver and be easily understood and used (Wade, 1984). The interface should be able to tell the user or driver the functionality of each icon. The key to determining the degree of friendliness of an application rests at the level of the user interface.

The interface should also be simple enough, not only for computer literate people but also the computer illiterates (Wade, 1984). With a simple interface, the ICEMAN will have more commercial value. This will also prove that the ICEMAN has high usability compared to other Computer software. The interface and messages must be concise, unambiguous and readily understandable (Wade, 1984). The simpler the interface of the ICEMAN, the better it is. With a simple interface for the ICEMAN, it is easier for any user or driver to use it, be it that they are computer literate or not.

The screen display should be kept neat and uncluttered (Wade, 1984). It is harder to read a page of text on a screen than a printed page with the same information. Avoid the unfortunate but commonplace compulsion to fill the entire screen. Spread the information over two or more screens rather than trying to cram everything onto one. Thus, it is important to not have many icons being displayed on the screen as it will reduce the driver's focus on the road. Moreover, the interface should not be cluttered as the display will be displayed on a 6" TFT monitor. This means that if many icons are displayed, it will be very small for the user to look at and will further disrupt their concentration on the road.

With evolution of computers to be integrated in-car, telematics applications were created. In developing in-car products, safety and efficiency is important and crucial for the drivers (Ekholm, 2002). Telematics is a wireless communications system designed for the collection and dissemination of data. Applications include vehicle-based electronic systems, mobile telephony, vehicle tracking and positioning, on-line navigation and information services and emergency assistance. Static applications include stock control (automatic ordering), and monitoring of utilities meters. With that, the development of ICEMAN should be safe enough to ensure that the

development of the ICEMAN is not merely just a research project development but also friendly enough for the drivers to attend to.

In-Car User Interface should be straight forward and simple to understand. (Ekholm,2002). This is important to ensure that the driver is not distracted and focused too much on the ICEMAN instead on the road. If this happens, the ICEMAN is not assisting the user but instead will harm the user and may cause fatal effects.

Many companies are moving into integrating computers built-in the car to create a new trend in computing. Most of the applications to be developed will be most likely not related to driving (A° kesson and Nilsson, 2002). This means that developing the ICEMAN to have applications such as MP3 Player and a Movie Player would be inclining to the needs of the industries currently. Available In-Car application is questionable as some of them tend to distract drivers on their concentration. (A° kesson and Nilsson, 2002). To ensure that concentration remains at a high rate, as stated before, the ICEMAN applications developed should be easily digested.

With that, the In-Car application must meet the Human-Computer Interface (HCI) and Human-Machine Interface(HMI) to design the applications. With the two, the objective of the application would be to ensure that driving is safe and enjoyable(A° kesson and Nilsson, 2002). This is necessary as when a user is enjoying driving the car, the user's percentage on meeting an accident is least likely. This is so as the user will be less stressful and enjoying the driving with extreme pleasure.

With implementing In-Car applications, proves that drivers still able to drive properly with the implementation of it (A° kesson and Nilsson, 2002). This means that, there is no reason that there would be high risk on developing this project as other research has been done to ensure that developing In-Car applications is feasible and safe.

On the contrary, development of the car radio used to have major concerns as it may cause distractions during driving. It is proven that secondary tasks that cause accidents at a higher rate. Example of the task is using the handphone while driving(Wheatley,2000). This shows that by having the ICEMAN in the car, it would not be a distraction for the drivers. Applications such as MediaBox will not distract

the user as it does not need the user's full attention and concentration as compared to the handphone. This proves that the implementation of the ICEMAN and MediaBox would notharm the safety of the user.

With the current technologies, cost could be a major factor in developing the best design. Not only that, it is different to actually manoeuvre in a car than at home at the desktop(Wheatley,2000). As technologies comes by, more friendly and reliable application can be developed for the ICEMAN but it may prove costly right now. Thus, waiting for the influx of technologies and developing it then would be the best option still.

The user interface is intended to help the user in solving the needs of the user. By using a formal methodology, a better output is produced (Green, 1981). This means that, to develop the MediaBox, the Waterfall Model has to be properly followed to ensure that the user interface will be near to perfection. With that, the ICEMAN will actually be beneficial to meet the needs of the user. Else, it would be dangerous to the user's concentration if the interface is not understood well.

It is seen that, the higher priority command should be more visible than the lesser priority (Mackinlay, 1988). This means that, for example, the play button in MediaBox should be bigger than the lesser priority function such as the volume control. In logical, this is done because the play action is used more frequent than the volume control. A more visible play button is indeed better in this case.

As stated before, with the advancement of technology a car does not only serve the purpose as a means of transportation (Korhonen,2000). This means that most of our time is spent in the car and by implementing the ICEMAN it provides alternative means of entertainment. This can also be a form of relaxation if a user is stuck in a traffic jam, enjoying the MediaBox while others are frustrated with the current condition.

It proves that having an In-Car application do not effect the performance of the driver during the testing done (Lai and Cheng, 2001). This means that the implementation of ICEMAN is further supported where in-car applications is proven not to be a

distraction to drivers. Not only that, but it also does not change the driver's pattern of driving during the execution of the In-Car application.

On optimizing the interface, it is needed that the interface is fast enough and convenience for the user. Not only that but it is easy to learn and use (Draper and Norman, 2003). This means that the ICEMAN application should be easy to use and straight forward. Not only it is easy to use, but learning on how to use it is also important as to ensure that the application provides convenience to the users.

The advancement of technologies sees that mobile technologies have become an integral part of life (Castleman, 2001). This means that implementing and developing the ICEMAN is considered to be part of innovation of technologies and seems to be the way into the future by having a smart car.

Improvements on the interface is necessary but not necessarily preferable. The need to change is needed only when it is necessary (Telles,1990). With that, improving the current Carputer software is important as with the new advancement of ideas and technologies, a better output is produced that aims to improve the user-friendliness of the product.

It does not necessarily mean that the interface developed is the best interface that can be achieved and suitable for all users (Grudin, 1990). This means that, if a user who is very used to using Winamp for example, uses the MediaBox, it does not necessarily mean that the user will be completely satisfied with the application developed. Basically, an interface developed could not meet and satisfy the needs of each and every user.

The interface developed by the author does not mean that it meets the user-friendliness intended. This is because, the author may understand it in a different way that a user who will uses it (Gertner,1990). This means that, to avoid things like this to happen, other views from other users are needed. This is to ensure that the user will understand the software developed easily.

For the best application, the In-Car Application interface must accommodate quick glance for the user to understand the whole application (Alpern and Minado, 2003). This means that, the application developed should be easily digested and easily understood only with a glance. This ensures faster learning of the application and faster manoeuvring of the application itself.

In telematics, safety is very important. The importance of safety is at the same level of the primary objectives of the application itself. It shows that when a user glances at the application when in need to do something with the application, the time taken is longer (Trbovich, 2003). A user will only glance on the monitor of the ICEMAN more, if it needs to use the application. This means that while the application is running, the user will use less time to glance at it. Meaning, the understanding of the interface is really important as users with the intention of controlling certain actions will use more time. This means that graphical icons are better than text to depict the functionality of each button.

CHAPTER 3

METHODOLOGY / PROJECT WORK

3.0 PROCEDURE METHODOLOGY

The procedure methodology is divided into three main parts; the procedure identification, ICEMAN's Hardware Setup, the Software Model : V-Model and lastly the Hypothetico-Deductive Methodology.

3.1 Procedure Identification

Research is defined as 'the process of findings solutions to a problem after a thorough study and analysis of the situational factors' (Sekaran, U., 2000). Although research does not necessary have to solve a problem, it also means of equipping oneself with additional knowledge. In this project, research plays a vital role in understanding the development process and tools to build the application.

There are several steps identified in this research, to understand what the problem area or issue is, to know where the problem area or issues exists, to identify as clearly and specifically as possible the problems or issues that need to be studied and resolved, to gather information, analyze the data and determine the factors that are associated with the problem or issue, to solve the problem or issue by taking the necessary corrective measures, to check whether the solution for the problem is feasible with constraints such as time and money and lastly, to develop the end product with the recommended solutions that meets the constraints.

3.2 ICEMAN's Hardware Setup

To start things of, the first that needs to be developed is the hardware for the ICEMAN itself. The hardware setup for the ICEMAN took a lot of research and designing as there were no references to refer to as this is the first time that it is

implemented in a Malaysian-made car. To setup the hardware, I have developed my own hardware setup model to ensure that the hardware installation for the ICEMAN will be smooth and without any hiccups.

The main concept of this model is adapted from the waterfall development model. But due to the fact that this model is intended specifically for the ICEMAN's hardware, a few adjustments were needed. Below is the ICEMAN Hardware Setup Model:

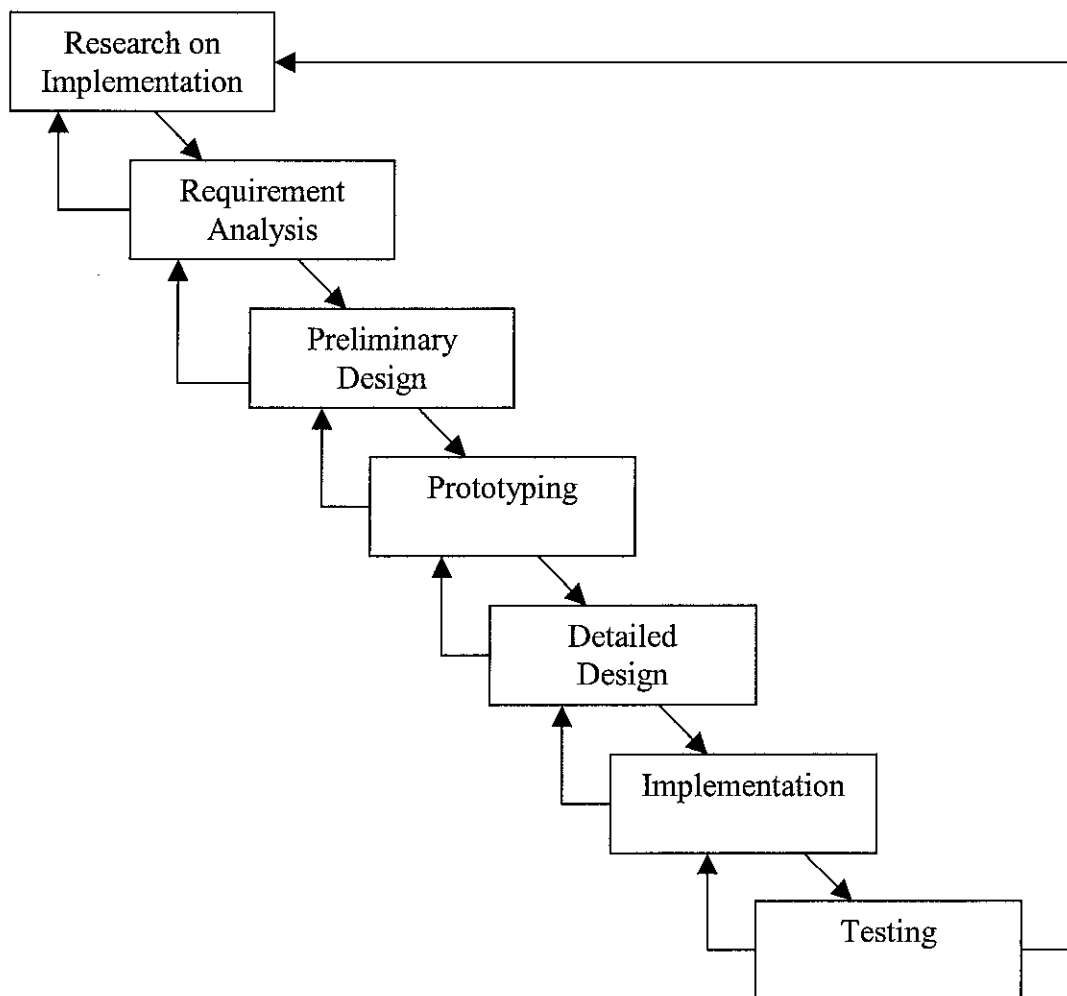


Figure 1: The ICEMAN Hardware Setup Model

At each stage, there are specific objectives to be accomplished; where each activity must be deemed successful for work to proceed to the next phase.

The major activities in the ICEMAN Hardware Setup Model are as follows:

3.2.1 Research on Implementation

Research on the ICEMAN is done throughout the hardware and software development. The research on hardware is mainly revolves on these questions:

- How do you power up the ICEMAN?
- What monitors are the best for the ICEMAN?
- What type of keyboard and mouse is feasible for the ICEMAN?
- How do you connect the outputs to the TFT LCD Monitor and the Car Audio Speakers?
- What type of microphone is good for voice recognition system?
- Where is the best place to put the ICEMAN in?

Throughout the first few weeks after the project-kickoff, research was done mainly to understand on how to implement ICEMAN in the car. A web-based forum, www.mp3car.com, was a great help for newbies to start on developing the ICEMAN. In this forum, Carputer owners around the world share one common goal: to develop and help other Carputerians. From these forums, many things are described including the setup of Carputer to the next development that a Carputerian is up to. All the answers that were questioned before the start of this research were answered in the MP3Car.com forum. With the research in the forum, it looks feasible enough to be developed in Malaysia, while considering all factors such as the heat and the bumpy roads. Current Malaysia market on an entry-level MP3 player costs approximately RM650 and an entry-level Video CD player costs RM800. With the ICEMAN, an estimation cost of RM1000 will enable users to have both high quality MP3 and Video CD players. Not only that, the ICEMAN also can be further expand in the near future to implement other features such as Internet access and GPS system.

3.2.2 Requirement Analysis

Once the research of implementing the hardware is done, the next step is analyze what are the requirements that are needed for this project. This requirement covers on how and what are needed to endure that the ICEMAN will function and run smoothly. With that, the lists of ICEMAN hardware components are as the following:

- Car
- 12V Battery
- DC-AC Inverter
- Hotwires, Fuse and other extension wires
- Pre-Amp
- 6" TFT Monitor
- RCA Cables
- Car Audio System
- Processor and Motherboard
- Sound Card
- Graphic Card with TV/Out
- Motherboard and Processor
- Hard Disk
- CD-ROM Drive
- Microphone

From observation and research on creating the ICEMAN in MP3Car.com, we have found out that many hardwares are needed. Some of the hardwares used are from old or unwanted computer components. For example, a discarded Pentium III processor is used to run the ICEMAN. The hardware for the ICEMAN will not necessarily be state-of-the-art computer components, but merely "junks" for some of us. Additional to that, 90% of the computer components are from a discarded computer.

The computer components were salvaged from a nearby rubbish disposal area. 90% of the computer can be used, which included:

- Pentium III MMX 450 MHz processor
- ASUS Motherboard
- 64SDRAM
- 40X CD ROM
- Sound Blaster Live! Value Sound Card
- 32MB ASUS RIVA TNT2 with TV-Out Graphic Card

On top of that, a 6GB Hard Disk was donated and used for this project.

With the computer components settled, the output and input peripherals were needed. A 6" TFT LCD Monitor is used to display the output from the ICEMAN. This monitor is connected through an RCA cable from the monitor RCA input to the RCA input of the TV-Out. This monitor is protected by a 100MA fuse and powered directly to the car's 12V Battery. To power up the ICEMAN, a 300W DC-AC inverter is used. The inverter's positive terminal is connected directly to the car's 12V Battery terminal, while the inverter's negative terminal is grounded to the chassis of the car. The car's audio speakers are connected through the Pre-Amp to the sound card via a 2 to 1 RCA cable.

3.2.3 Preliminary Design

At this phase, the design part is to make sure that all component works and to simulate it for the prototype of it. This is to ensure that during the implementation phase, nothing is left out. The prototyping will be done indoors, where the power supply will supply by the household 240V AC. The 12V power for the 6" TFT Monitor will be powered by the ICEMAN's power supply unit, using the -12V and +12V power output it has. For input peripherals, the standard keyboard and mouse will be used and computer speakers will emulate the car audio speakers. Another option is to power up directly from the car's 12V DC Battery. The computer components needs 4 inputs of power in the form of +12V,-12V, +5V and -5V. Unfortunately, to eliminate the use of inverter and use the car's battery directly, it is far costly as it costs twice more than an inverter. Due to the cost constraints, we were not able to do this.

3.2.4 Prototyping

The prototyping phase starts as soon as the preliminary design is done. The prototyping is done indoors and to simulate what will happen in the car itself. Using

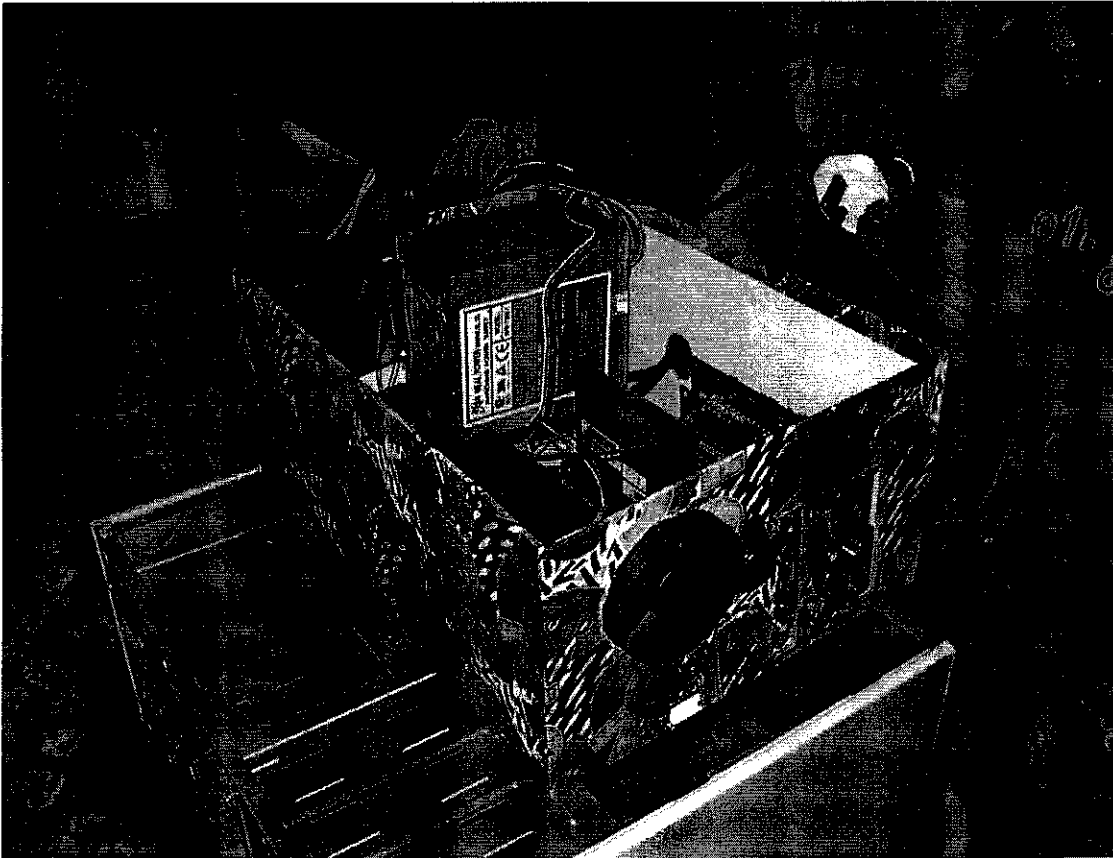


Figure 2: Computer components are placed in a box

the design that was constructed in the preliminary design, the prototype is constructed. The computer components are placed in a gift box due to the fact that it is easy to customize the box to make it suitable for the ICEMAN. A car battery was also used to check the monitor's power supply and simulate the monitor itself.

The computer components are modified according to the best and most suitable way of installing the hardware setup. The first is to disassemble the computer components so that justification of the components to the box can be done. Once the components are identified, the placements of the components are planned out in detail. This is to ensure where the right place to cut and modify the box.

The first component that is secured in the box is the motherboard. The motherboard is secured with the plastic secure screws that can be found in the any computer casings. The secure screws was forced into the box, to ensure that it will be secure enough and will not make the motherboard move in the box. After the motherboard is placed in the box, the cards were then slotted into the appropriate slots. The setback to this is hat, due to the box limited space, the card edges has to be bent so that the card can be inserted to the slot. Not only that, but a slit at the where the car is inserted needs to be done, as if this is not done, it will hinder from the card to be slotted into the appropriate slots. Once the slit and the bending of the edge of the card is done, the box has to be cut where the ports are located for input and output interfacing.

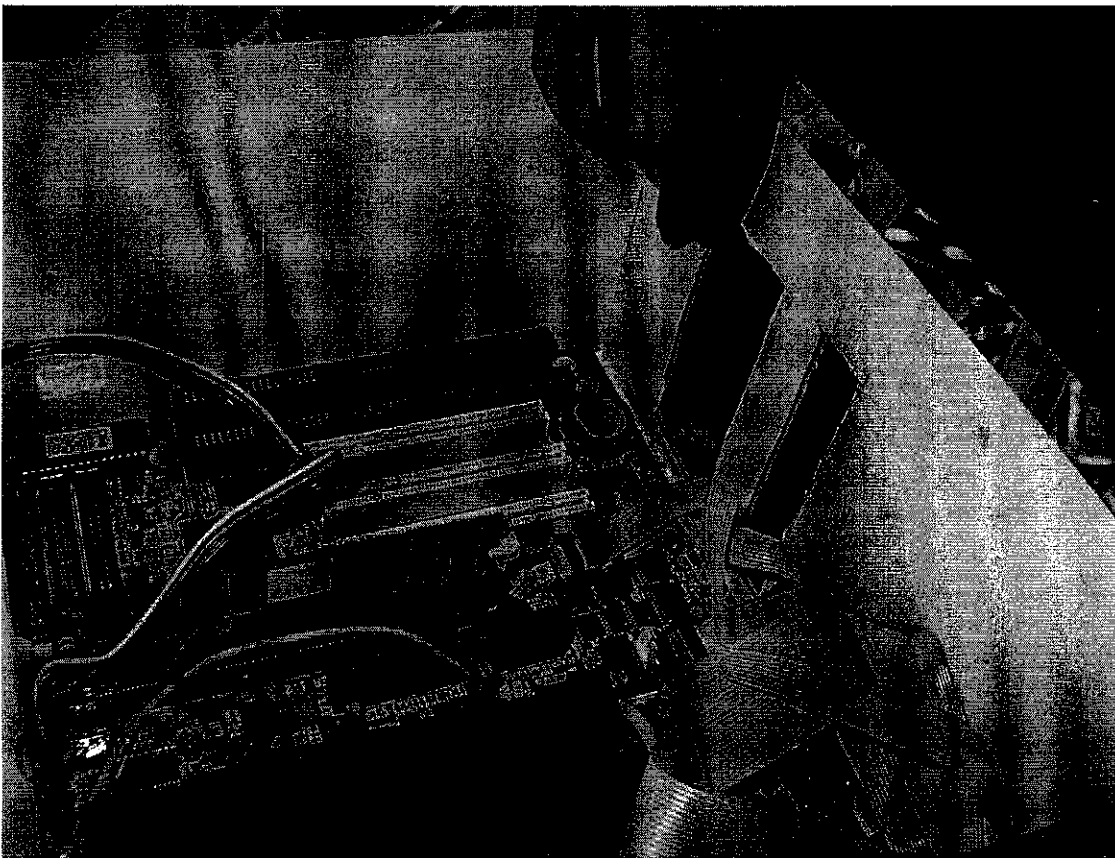


Figure 3: The box is cut to enable input output interfacing

Once that is done, the power supply and the hard disk is secured into the box. Another opening in the box is done due to the fact that there is a need to wire out one of the Molex connectors and the IDE cable. The wired out Molex connector and IDE cable is used for the CD –ROM, which will be placed around the front seats area.

Further on, the next modification is to actually place two cooling fans at each end sides of the box. One of the fans will be blowing cold air into the box, and the other will suck the hot air out. This is done to reduce the heat of the motherboard and the other computer components, especially when placed in the trunk of the car with the hot weather in Malaysia.

After the modification of the computer components and box is done, the system is tested out to check whether it runs as expected. Testing the connections will be done rigorously because once it is placed in the trunk of the car; it will be a hassle when suddenly a malfunction in the ICEMAN hardware occurred.

If all the functionality of the computer components passed, the ICEMAN is ready to be installed in the car.

3.2.5 Detailed Design

For the time being the design for the placement of the hardware is in the trunk of the car. The computer components are placed in a big gift box that can be made into a custom made computer casing. All computer components except for the CD-ROM is placed inside the box. To make the components fits snugly into the box, the box has to be cut and modified to enable the components are able to be placed correctly. From Figure 3, it can be seen that the box has to be modified to enable the components such as the Cooling Fan can be placed strategically in the box. Next, the inverter is located behind the Sub-Woofer speakers while the input peripherals are also located in the trunk of the car.

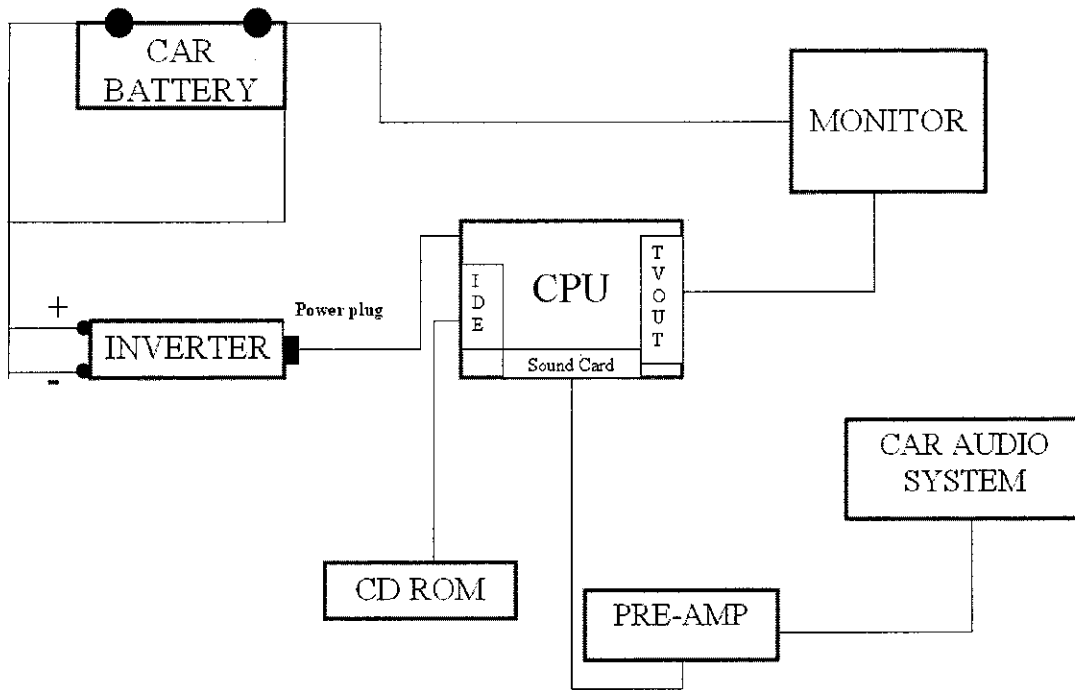


Figure 4: The Layout of the ICEMAN Architecture

The ICEMAN will be powered by the car's 12V Battery through the inverter. This inverter will invert the current from 12V DC to 240V AC. The 12V Battery will power up the 6" TFT monitor and the graphic card with TV-out will feed the monitor for its display. For output of the sound, the sound card will be connected to the Pre-amp, which is connected to the Car Audio System.

The CD-ROM will then be connected directly to the IDE slot of the Motherboard. It will be placed between the front seat, and on top of the arm rest. For the input peripherals, the mouse and the keyboard was chosen correctly to ensure that it meets the requirements. The mouse is a trigger like mouse where it uses RF waves. This is beneficial to the ICEMAN, so that the mouse can be controlled at any angle within 12 Feet from the receiver. For the keyboard however, it was decided that a small keyboard will be used so that it will be stored easily in the glove compartment. The keyboard wires are extended and can only be used with a P/S 2 port. Due to the fact that the motherboard does not support P/S 2 keyboard port, a converter is used via USB. It works well and there seem no problem to using the keyboard and the mouse in the car.

3.2.6 Implementation

Once the design is completed, installing the hardware would be the next step. The hardware was installed without any problem and runs smoothly. The RCA cables, Hot Wires and other wires are covered underneath the car's carpeting and the rear seat. The input and output RCA cables are fed using Shielded RCA cables.

This is so as to ensure that the input and output devices are not interrupted by noise from the power cables. The TFT LCD monitor is placed at the passenger side of the dashboard due to the fact that there is no space to be put elsewhere.

As stated before, most of the computer components are re-used from scrap computers and this proves a plus point to the project as it proves that the ICEMAN hardwares are not costly and old computer components can be used for the ICEMAN setup. Modification and wiring was done on my own and some with the help and consultation from professional wiremen.

Below depicts on how the hardware setup is done:

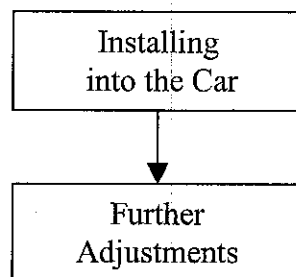


Figure 5: Hardware Development Phases in ICEMAN

- Installing into the car

The power cable from the 12V DC battery to the inverter was done by a professional wireman. A Hot Wire power cable is used, as this wire provides stable power and has less resistance than any other power cables. The fuse is used to protect the computer components from sudden spikes in the voltage. If there is a spike or surge in the voltage, the fuse will fuse itself to cut off the power from the 12V DC battery to the components.

The inverter is used to provide power to the computer as it will invert the 12V DC to 240 AC. An inverter is used instead of a DC-DC power supply because, the inverter is cheaper and making a DC-DC power supply will be time consuming. Once the inverter is installed the ICEMAN can be powered up using a switch that is located at the front.

As for the monitor, the power for the monitor is directly connected to the 12V DC battery as it needs a 12V DC voltage. The input of the video is connected through a 24K gold-plated shielded RCA cable to the TV-out of the graphic card. As for the sound, the sound card is connected to the pre-amp with a 2 to 1 24K gold plated shielded RCA cable.

Basic wiring principle in a car is that not to place the power cables and the input output RCA cables next to each other. Preferably, one side of the car will be used for the power cables and the other will be used for the RCA cables. This is a good practice as power cables will emit electromagnetic fields and can distort the signals that is transmitting in the RCA cables. Noise will affect both audio and video signals. The best solution is to use shielded cables as it will shield the signals from any noise that may interfere with the signals.

The shielded cables, even though is more expensive from normal RCA cables, it provides better quality signals. This is due to the fact that the shielded cables will not

be interfered with any interference from other sources such as the power cable. If the RCA cables are interfered with the external interference, noise will occur.

Once the system is running, there are a few things that were not thought of. First, the mouse and keyboard is placed in the trunk where the user is not able to control the ICEMAN while driving or on the move. Second, the placement of the CD-ROM is not appropriate in the trunk as users may want to change the CDs while driving.

- Further adjustments

As for the Input Devices, the keyboard will be placed in front, and most likely at the front passenger seat. A more suitable keyboard would be a small keyboard that will fit nicely in the glove compartment. To do that, some wiring modification and extension need to be done. The keyboard wires are sliced and extended using insulated copper wires. These wires are run through the left side of the car.

As for the mouse, a trackball is the best solution for easy handling while driving. I have found a Radio-Frequency mouse that can be controlled at any angle within 12 feet. The shape of the mouse is very ergonomic as it is like a gun and follows the contour of the hand. Not only that, it is easy to be used, as the trackball is in the center and can be controlled with the thumb and the left click is at the first finger. The RF receiver is placed in the back seat's arm rest holder. There, the RF receiver is hidden from the passengers.

As for the CD-ROM, the best place to place the CD-ROM is at the arm rest of the driver. With that, extension of the power cable of the 5V Molex extension from the Power supply is needed. Not only that, but a very long IDE cable is needed for the CD-ROM feed information to the ICEMAN. The problem with IDE cables is that, the longer the IDE cable, more of its data or signal will be lost. So, the IDE cable should not be too long as this will make the IDE cable not being able to transmit data to the ICEMAN from the CD-ROM.

As for the Noise that comes from the car's speakers, there are many options to handle it. Not all may reduce the noise, but all of the option will be used until the noise subsides. The first is to use a ground loop, so that it will ground excessive power charge to the ground loop. Next, there is an option to ground the inverter directly to the negative terminal of the battery. Also, it is also believed that the wires has to be separated, where one side of the car handles the power cables and the other are the input or output cables. Another option is to ground the sound card to the chassis of the car or the same point where the inverter is grounded.

Other than those options, use Shielded RCA cables wherever possible to eliminate the noise. Finally, the last option is to mute unnecessary or unused functions in the sound card.

For the video signal, the Shielded RCA cables are the best option for it to reduce the noise signals.

3.2.7 Testing

Once the ICEMAN is implemented in the car, testing is done. All functions of ICEMAN hardware is tested out in the car to check whether the connections are properly connected. Many testing have been done and all system and unit testing was run smoothly without any flaw. The ICEMAN hardwares from the inverter to the mouse and keyboard works well in the car.

3.3 THE SOFTWARE MODEL: V-MODEL

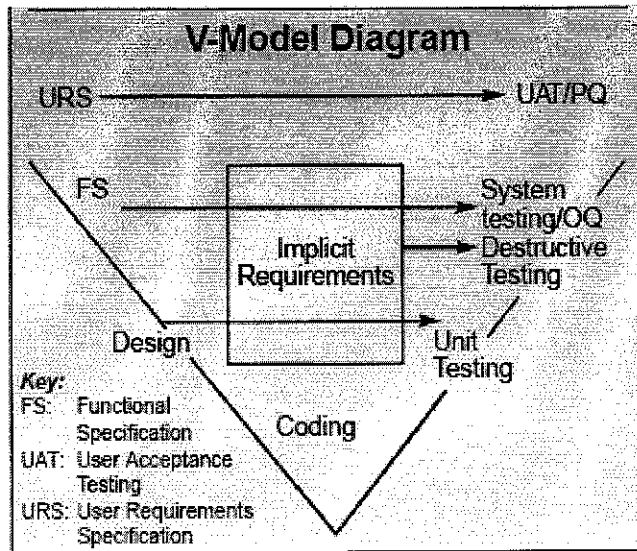


Figure 6: The V- Model Diagram for Software Development

The V-Model is chosen due to the fact that testing and development of the system can be done parallel. According to CMM standards, the V-Model is the most reliable and stable. During testing, if there is a code error, the testing phase can roll back to the development phase. Not only that, but if there is a necessity of enhancing the software during the testing phase, the developers can go back to the functionality specification or design to tackle the matter. This way, bugs and errors will be very minimal as unit and system testing can be done parallel to the specification and design phases.

The V-Model also covers the maintenance and modification of the ICEMAN. With the V-Model, quality can be assured as minor errors and bugs will be look into more detail in this software lifecycle. This software lifecycle is applicable for small and large development projects in various environments. This means that by applying the lifecycle to the development of ICEMAN's interface, software with high quality will be produced.

In this model, there are 7 key steps altogether. They are User Requirements Specifications, Functional Specifications, Design, Coding, Unit Testing, System Testing/Destructive Testing and finally, User Acceptance Testing. This models is

applied only onto the development of the MediaBox Applications which includes, MediaBox MP3 Player and MediaBox Movie Player. Other features that is integrated into the MediaBox such as the E-Speak Voice Recognition is not covered in this model.

With that, the steps below will depict what are the progresses currently in each phase:

3.3.1 User Requirements Specifications

To enable the software to be easily created Visual Basic 6.0 is used. This software currently supports many modules that will make it easier to create a very user-friendly interface. Other software used for designing the interface is Adobe Photoshop CS. This software is used to design buttons, backgrounds and logos.

3.3.2 Functional Specifications

Once the user requirements on the software is met the functional specifications of the software is determined. On this project, it is determined that the project covers two aspects; media integration in an application for entertainment and interface user-friendliness.

For the Media Integration, the functional specification of the application would cover 2 aspects, audio and visual entertainment. For audio entertainment, this will only cover media on MP3s and creating an application for it. Thus, the visual entertainment covers media such as MPEG and AVI that are popular file extensions for various visual entertainments. An application is also to be created for the handling multiple visual entertainment.

As for the user-friendly interface, the interface it shall be easy for users to switch from one application to another and the buttons are easily seen.

3.3.3 Design

The software design of the interfaces should be user-friendly. The main functionality of the system is represented with big icons. The main menu should also be easily understood and navigated. It is also necessary for the software to include a function where a user can exit or jump to other applications from anywhere in the current screen. The color scheme or theme for the software should also blend in together with the look and interior of the car. The icons or buttons should be easily navigated as users may use the mouse while driving to select certain applications. The use of touch screen here can be implemented, instead of using the RF mouse. Indeed, it will be much more user-friendly but unfortunately to the cost constraints, it was not possible to include it in the prototype. A touch screen costs approximately RM1300. Another option for the buttons too would be physical buttons that acts like “Hot Keys”, but unfortunately, due to time constraints we could not achieve that as more research needs to be implemented.

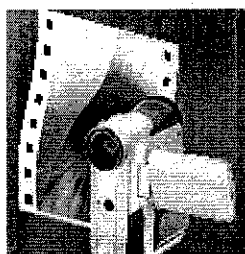


Figure 7: An example of the ICEMAN software icon

3.3.4 Coding

The coding is done using Visual Basic 6.0. Many components were used to extend the feature of the ICEMAN software. The components that were used were chosen as to get an interface that is easily navigated throughout the software. To ensure that the software is easy to be maneuvered from one page to another, a drop-down menu was used. This drop-down task bar is created with a component called DeskUtils.ocx. A form created using this component can be hidden like a Windows-styled hide bar. Here, the drop-down task bar is placed with all the shortcuts to the functions of the ICEMAN.

The downloaded open source codes were referred to and manipulated to ensure that it meets the software requirement for ICEMAN. With the help of the open source code, it was able to do an MP3 Player and Movie Player from scratch. The open source code was a reference as to understand how the flow of the software should be like. Other than that, the splash screen timer was learned to make an interesting splash screen startup.

The software development kicks-off by developing of the functional areas features of the software itself and only then moving on towards the end product. The flow of the development is as below:

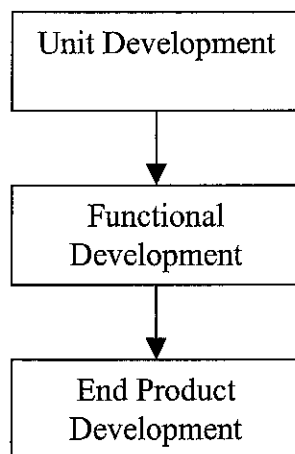


Figure 8: Software Development Phases in ICEMAN

- Unit Development

The unit development aspect covers only one media player at a time. The first media that was develop was the MediaBox MP3 Player. This player was adapted from the open source application that was downloaded and used the base code to manipulate it to meet to the requirement and the acceptability to be placed in the car. The forms involved in developing were five forms, mainly, frmMain, frmList, Form1 and mp3Info. These 4 forms are the gist of the MediaBox MP3 Player.

The landing page of this MP3 player is the frmMain. This frmMain is designed as to be easily understood and nice to look at. With having a very nice look and feel, users will be able to maneuver around the software. The media commands such as Play and Stop is clearly visible at a glance. The playlist is situated in the center of the screen for easy song choosing.

Other functions include the “Grab File” button. With this button, user will be able to see or hide the playlist and other buttons associated with it. Once the button is pressed, the software hides or shows the playlist. Other buttons include save playlist, load playlist, open file, open directory, remove selected file and remove all.

Another feature that can be found in the main page is the “Shuffle” button, where a user will be able to listen to songs randomly. This will avoid the user to be bored with the arrangement of the playlist. On top of the playlist, is shown the time and label for the song. The label is in marquee style, moving from right to left.

A unique feature that is unavailable in other software in the market or in the freeware world is a playlist that shows and hides itself within the period of the song time. For example, for the first 10 seconds of the song, it will show the playlist will hide itself. Next, if it is in the last 10 seconds of the playlist, it will show itself. This is done to make it easier for users to choose the songs that they want to listen to by clicking the playlist itself. Another reason why the playlist is set to hide and show within the time frame is to avoid the MediaBox MP3 Player to look cluttered while playing the selected MP3.

All of the main icons are depicted graphically, as it is faster to understand graphics. It was tested before with text instead of graphical icons, the effect is that it is difficult to read the text with such small display used.

The frmMain uses a slider control to as a slider for the track duration of the MP3 file. Two scroll bars are also used in the frmMain as a volume control and a speaker alignment, where it aligns the speaker to be bias to the left, center or right.

OCX files that were used in the frmMain were the common dialog OCX. This will enable the software to create a pop-up file list selection. This is used to select MP3s that are available in the ICEMAN and be placed on the playlist. Refer Appendix B for more details on frmMain.

As for frmList, here it stores all the MP3s in the playlist and points back to the list in the frmMain. The only form that is visible is frmMain, where others are not visible including frmList. The function of the frmList is to keep track of the playlist that is playing on the frmMain. Not only that, but the frmList is used to save and load the playlist in notepad with the extension file *.lis. The default name for the playlist is mylist.lis . The frmList is also responsible for adding and removing any MP3s in the list in the frmMain.

For each entry in the list in frmMain, the list will write the contents of its list in 2 text files, Load1 and Load2. Here, Load1 is used as a reference to what the playlist is currently loaded with. Not only that, but whenever a user exits MediaBox MP3 Player and re-enters again, the previous list will be loaded. Load2 is used as a backup playlist for Load1.

Next, is the mp3Info and this form is also not visible to the users. The function of this form is to read the MP3 formats and the data that contains in each file. This includes the bit rate of the data, the file name of the MP3 and track duration. It also determines what format it is. Basically, mp3Info is used to check on the data of the MP3s.

Form1 is used to select all MP3s in a directory. This feature is similar to the common dialog box, but it selects a number of files. Common dialog cannot be used here as common dialog box can only select one file at a time. With this feature, a user will be able to select multiple files at a time to be added to the playlist. This form is also not visible to the users.

After completing the MediaBox MP3 Player, the MediaBox Movie Player is created. It uses the base codes of the MediaBox MP3 Player, and uses similar naming conventions. Also, the MediaBox Movie Player uses four main forms, frmMainMovie, frmListMovie, Form1Movie and MovieInfo.

The frmMainMovie is an enhanced feature from frmMain from the MediaBox MP3 Player. One of the additional feature is that, it displays the video image, instead of the time and label in the MediaBox MP3 Player. Another feature is the Full Screen feature, where a user can change to full screen mode with a click of a button. This frmMainMovie also has a playlist, where the playlist will also hides and show within the time frame. The difference here is that, when the video image is shown with the playlist, the video image is 1/16 of the screen. But when the playlist disappears, the video image is enlarged to 1/8 of the screen. This is to ensure visibility is high in both situation. Refer to Appendix B for more details.

As for the frmListMovie, is exactly a replicate of the MediaBox MP3 Player. Its function is to stores the playlist in the list box and the *.lis file that is created with the notepad. The playlist in the frmMainMovie is grabbed from the contents of Load3 and Load4 files. MovieInfo has also the exact function as the MP3Info, except that MovieInfo reads the contents of the video files, instead of MP3 files. Also, the Form1Movie is an exact replicate of the Form1 form from the MediaBox MP3 Player.

- Functional Development

The functional development is to create other functions such as the exit menu and switching from the MediaBox Movie Player and MediaBox MP3 Player. All of the forms that was created in the Unit Development Phase, is integrated into one project. In this phase, 3 forms were created, frmDropDown, frmDropDownMovie and Exit Menu.

The frmDropDown and frmDropDownMovie uses the same OCX files. The DeskUtils.OCX is downloaded from www.freevbcode.com . With this OCX, a

hidden-drop-down task bar is created on the top most of the screen. This task bar will only be visible when a mouse over is done on the frmDropDownMovie or frmDropDown.

In the frmDropDown and the frmDropDownMovie, there are 5 icons that are displayed on it. In the frmDropDown, a user can switch from the MediaBox MP3 Player to the CarMan, MediaBox Movie Player, External Applications, Exit and Main Menu. As for frmDropDownMovie, a user can switch from the MediaBox Movie Player to the CarMan, MediaBox MP3 Player, External Applications, Exit and Main Menu.

The other form, which is Exit Menu is executed only when the user click on the Exit icons. In the Exit Menu, the user has 4 more options, to shut down the ICEMAN, to restart the ICEMAN, to cancel the exit function and lastly to exit the ICEMAN software. The shut down and restart function is created with the basic shut down and restart command that is embedded in the Windows kernel. Below is an example of the embedded command for shutting down the ICEMAN.

Shell "Shutdown.exe -r", vbMaximizeFocus

Refer to Appendix B for more details.

- End-Product Development

In this last phase of software development, the integration of all the software are done. This includes the CarMan and other external applications. In the external applications, user can execute Microsoft Word and Yahoo! Games Dynamite. Other than integrating all the software together, the Main Menu and the Splash Screen is created. The splash screen is researched on the www.freevbcode.com website for a great splash screen in Visual Basic.

The splash screen is created using translucent effect and a timer to get it dissolves within 5 seconds. The image is given a 255 value, and once the timer starts counting,

the image will decrease its value until it becomes totally dark. Once that happens, the splash screen dissolves and the main menu appears.

For the main menu interface of the ICEMAN, the user should be able to visualize the interface clearly. Not only that, but the interface should be easily understood and user friendly enough to minimize the time focusing on the ICEMAN rather than on the road. The proposed interface is as below:

The main menu is designed using Adobe Photoshop CS. The background for the main menu differs from the other software to make sure that it does not give a dull look. Blue and steel silver is used because blue depicts the ICEMAN concept and silver are the backgrounds for all the other softwares. In the main menu, there are only five options, MediaBox MP3 Player, MediaBox Movie Player, CarMan, external applications and exit menu. Each of this option will direct the user to the specific software or functions.

The integration of the ICEMAN software is done by combining all the forms into one project. This is to ensure that it will not call external files, which could increase latency time.

All of the icons are created with Adobe Photoshop CS to ensure that all icons are at the same size and same concept. The image for the icons must be appropriately chosen so that it will be easier to understand. Many images were downloaded from freeware sites that can be used for the ICEMAN icons. Not only that, but each software or function is depicted by an icon, as to standardize the image. This is to ensure that the user will understand more easy on the interface and function of each icon represented.

3.3.5 Unit Testing

Once the coding is completed, a unit testing is done. There are more bugs that occur than expected and this requires more bug fixings. Each of the functionality was checked and tested so that there would be minimal bugs in the software. The MP3 Player and the Movie Player was tested rigorously separately to ensure that basic functionality of the player is bug-free.

3.3.6 System Testing/Destructive Testing

Once the unit testing is done, a system testing is needed. This is to make sure that the integration of all the functions are done correctly and without any flaw. It was found that some bug fixing are required and more unit testing should be done. After the bug fixes, a system testing is done again to ensure that the software would run the way it is intended.

3.3.7 User Acceptance Testing

A user acceptance testing is done in the car. The functions of the software run smoothly in the car using the 6" TFT LCD Monitor. The testing s done rigorously to ensure that it meets the software requirement and design that was first discussed in the early stages.

3.4 HYPOTHETICO-DEDUCTIVE METHODOLOGY

In addition to that, Hypothetico-Deductive methodology is also conducted in which includes processes as follows:

3.4.1 Observation

By looking at the current In-Car Entertainment setup in Malaysia, a new way of In-Car Entertainment is needed. This is to ensure value for money setups that are done with satisfaction. Not only that, but current Computer softwares functions are limited and not properly designed.

3.4.2 Preliminary information gathering

The data gathering method for this project is collected through the collection of books and references from the library, research on internet and forum websites and conducting a Q&A session with experts in the field of this subject. Besides that, in order to develop the product, a detail research need to be done such as the uses or the capability of the ICEMAN, what are the pros and cons of having an ICEMAN, the architecture of the ICEMAN and how the ICEMAN will be developed, be it in terms of hardware or software.

3.4.3 Hypothesizing

After all relevant information has been gathered, a concrete and well understand hypothesis is being produce in identifying the targeted goals to achieve. A lot of questions can be asked at this stage. For example, how will the connections of the ICEMAN be? What formats does the MediaBox components supports? All these questions need to be asked so that the system is able meet the requirements.

3.4.4 Further scientific data collection

During this stage, further clarification and information is being determine and refine in assuring that no information is being over looked or left out. For example: determine the suitable hardware and application to be used, ways on how to integrate the functions of the software, and how the connectivity of the hardware in the car.

3.4.5 Data analysis

At this stage, all the data collected is then analyzed for the second time and any changes or additional information to be added in is done during this phase. This include the analysis on the hardware and software, would Visual Basic supports certain functionality.

3.4.6 Deduction

After the analysis was made and analyzed, then it can be concluded that it is advisable to have an ICEMAN included in the car to ensure better In-Car Entertainment. Not only that, but it can be concluded that developing a new software would be more feasible to meet the functionality of the ICEMAN.

3.4.7 Implementation

Finally, the implementation and execution of the research project after all requirements have been clearly determined.

3.5 TOOL AND EQUIPMENT REQUIRED

Tools needed in this project are divided into 2 categories; hardware and software as the following:

3.5.1 Software

Operating System: Windows XP

Application: Visual Basic 6.0

Graphic Authoring Tool : Adobe Photoshop CS

3.5.2 Hardware

12V Battery

DC-AC Inverter

Hotwires, Fuse and other extension wires

Pre-Amp

6" TFT Monitor

RCA Cables

Car Audio System

Processor and Motherboard

Sound Card

Graphic Card with TV/Out

Motherboard and Processor

Hard Disk

CD-ROM Drive

Microphone

128MB SDRAM

CHAPTER 4

RESULTS AND DISCUSSION

This project aims to find out how ICEMAN can further enhance the concept of Carputer. Also, it is to check whether the ICEMAN produced is feasible and beneficial. It is very important to learn the overall review on the ICEMAN specifications, requirements, pros and cons and also to create a positive perception towards the creation of this product.

4.1 SOFTWARE RESULTS

At the completion of this project, it is expected that a very easy interface and system will be developed for the ICEMAN. The current available Carputer interface is cluttered with icons. Not only that, but the interface is also difficult to understand, as it has no explanation and the icons for the functions are very small. Thus, to use this software, more time will be needed to actually getting use to the layout and understanding the software.

The software is mainly developed in Visual Basic 6.0. For the graphic designing works, it is authored in Adobe Photoshop CS. Visual Basic 6.0 is chose as it is easier to create Windows interface rather than using other programming tools such as MFC in Visual C++. Not only that, using Visual Basic 6.0 is friendlier for application development and faster in creating interfaces. In fact, with the appropriate OCX, Visual Basic 6.0 is flexible and a very powerful tool. For example, with the OCX many extensions can be integrated with Visual Basic such as Macromedia files integration and database applications.

The base code for the MediaBox is extracted from multiple references available to the author. Since the base code itself consists of tons of bugs, most of the time were lost during fixing the base code. In fact, the codes cannot be ported into the base code of

ICEMAN software as the functionality of the codes are different from the intended usage on the ICEMAN.

The ICEMAN software has a very nice interface using steel color as its main theme. The landing page or the main menu shows a different color theme from the rest to show that it is the main page and not an application. All applications uses solid still background fully and only the main page has the background of blue and steel. It is important to have a very nice “look and feel” interface to ensure that the user will not be bored and tired looking at the interface.

Mainly, the software is separated into 4 functions, MediaBox MP3 Player, MediaBox Movie Player, CarMan and External Applications. All of these are depicted in every application and page via drop-down menu bar. By putting in the drop-down menu bar, it ensures that the software is more user-friendly as user can choose and jump directly to any embedded application within the ICEMAN itself.

To ensure that the visibility of the software remains high, the placement of the icons is not scattered. This is in fact a way to reduce clutterness and increase understanding of the user interface. The icons depicted for each of the action or functions in the ICEMAN are stringently chosen to determine which graphical design depicts the best for the function or action. For example, the CarMan icon uses a picture of a car while the MediaBox Movie Player uses a picture of a video recorder and a film strip.

The MediaBox uses big icons. This is important to deliver which are frequently used buttons and which are the more important functions for the user. Not only that, but the more visible the button is to the user, the easier the user will be able to click on it. This is important to ensure that the time taken to click the buttons is minimal as possible. The exit menu uses Windows XP icons to ensure that users will understand easily as Windows XP users will be very familiar to the set of icons.

In the MediaBox applications, the placement of each icon is similar in both in the Movie Player and MP3 Player. This is done to make sure that user will not be confused in having two separate sets of icons, for the similar set of actions. In each of the MediaBox application, the playlist is featured. This playlist is unique from other software's playlist where the playlist will be made visible to the user for the first 10 seconds of the media and the last 10 seconds of the media. The 10 second option is created to make the user able to switch files to the user liking. The point the playlist is made invisible after that is to make sure that the application is not cluttered. The MediaBox applications have an all-in-one function that is unavailable in other softwares. The all-in-one here means that in one form all the necessary icon is depicted and not depicted in separate forms.

Basically, the ICEMAN software has a better user interface than the most of the current Carputer applications.

4.2 SOFTWARE DISCUSSION

With the implementation of the ICEMAN software into the car, many things were observed. It was seen that the functionality of the icons depicts very well in the 6" monitor. The more important the icon or function is, the bigger the icon is. This is to ensure that lack of visibility on the road is hindered. Not only that, but the interface will take less time for maneuvering and ensures that it will still promote high concentration on the road.

The placement of icons consistently ensures easy navigation throughout the software. Not only that, but the easy to use drop down menu bar, means user can hop from one application to another.

There were also some limitations found in the software. These limitations could not be debugged due to time constraint. The file name for the MP3 cannot be too long as

this will make the label for the application to display improperly. To solve this, the label has to be set longer and can take more than a fixed set of characters. Another setback is that the full screen function in the MediaBox Movie Player is limited. The function during full screen is fixed and cannot be manipulated to make it friendlier. This can be solved by using certain OCX and embed it in the Windows Media Player OCX.

Other than that problem, the MediaBox MP3 Player will only read properly if the media are stored in the same folder of the ICEMAN software. Unfortunately, this bug cannot be determined as in certain beta computers tested it worked normally. The problem may arise in the coding path where the application path of the media stored is not fixed.

4.3 HARDWARE RESULTS

The hardware is divided into computer components, In-Car Entertainment components and additional components. The computer components is placed in the trunk of the car due to the limited space in the cabin of the car. Not only that, but the computer components needs to be modified to ensure that the it fits nicely in the box. The box needs to be modified to ensure that it can contain the computer components.

The monitor used is a 6" TFT LCD Monitor. This was used to avoid any glare on the screen. Not only that, but it is to ensure that the monitor can be viewed at odd angles. This is important to make the ICEMAN software visible to the user. The monitor is then powered directly to the car's 12V battery and the input and output is feeded with RCA cables. The RCA cable must be shielded to avoid noise distorting the signals.

The inverter is used to power up the computer as it converts the DC current to AC current. This inverter creates power for the computer and stabilizes the voltage of the

computer. Meanwhile, the input peripherals used is an RF mouse which provides a very good way to control the mouse pointer and the 88-keys keyboard is small enough to be placed snugly into the glove compartment of the car.

If the length of the wire is not long enough, two options were used; extending the wires by cutting and connecting an extended wire or by using an extension for the wires.

4.4 HARDWARE DISCUSSION

Noise is the main culprit in setting up the hardware for the ICEMAN. To solve this problem, shielded wires are used to ensure that it will not be interfered with unnecessary waves that may distort the signals. Other than that is to use the ground loop. The function of a ground loop is to reduce the power exerted by the electromagnetic waves and ensuring a clean power will be produced. Once a clean power is produced, there would not be any spikes and any distortion of signals.

The inverter is actually a bad method to power up the computer components. This is so because it provides a big interference and noise to the signals in the RCA cables. The inverter was chosen because it is cheaper than any other option of creating a custom power supply. Another method to power up the computer components is to use a DC-DC power supply unit used in heavy industries. This is better because there is no conversion in power involved. It is believed that during the power conversion in an inverter, from DC to AC, the noise occurs. DC-DC power supply is not chosen as it cost twice more expensive than the normal inverters.

As for the input peripherals, both the keyboard and mouse should use RF and be wireless. This is important to ensure flexibility in controlling functions in the

ICEMAN itself. Not only that, but it will also make sure that it is less cluttered in the car with the wires dangling everywhere. Wires are sensitive and if it stepped on an input device which is not an an RF or wireless input devices , the wires may break and cause malfunctionality of the devices.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The aim of this research project is about learning the fundamental of Computer and the ICEMAN architecture and its development tools in building both the hardware and software. The hardware is integrated with the car audio system and wiring connectivity of the car system itself. Installing the ICEMAN in the car will have the same priority as setting up the software. The software of the ICEMAN is user-friendly enough and simple. This is to ensure that less time will be used to concentrate on the ICEMAN and more concentration will be used on driving the car.

To ensure that the project will be a smooth running project, it is ensured that research on both hardware and software are needed. In terms of hardware, choosing the right tool will be vital as this will determine the right output for the ICEMAN. For the software, mastering Visual Basic and researching on the OCX files for the media integration would be vital to ensure the end result of the product.

The ICEMAN was able to integrate media such as DivX and MP3s into 2 separate applications that are the MediaBox Movie Player and MediaBox MP3 Player. A user-friendly interface is also needed to ensure that users can use the ICEMAN efficiently. It can be concluded that the MediaBox Applications contains more benefits of other media applications than their flaws.

The user-friendliness is achieved by having easy to use and understand interface. Big icons, choice of colors, the 10 seconds playlist provides the strong points for the MediaBox applications on its user-friendliness. The drop-down menu provides user to hop to another application within the ICEMAN while maintaining the “look and feel”. The ICEMAN software was successfully integrated with other applications such as the CarMan and the E-speak.

On the hardware side of the ICEMAN, wiring concepts is vital as this proves to ensure the placement of each hardware. Not only that, but the concepts will be vital on how to make sure that the output or input signal is at their optimum level. It is also proven that, the ICEMAN prototype can be developed using unwanted computer components.

ICEMAN is an enhanced version of the traditional Carputer. With the ICEMAN, it is hoped to bring more options on the Carputer software and to create a more user-friendly Carputer. Not only that, but the ICEMAN is easy enough to be used by both the computer literate and computer illiterate.

Throughout this research project, a lot of knowledge transfer has been done through researching materials on the internet, Carputer experts, and other related sources. This adds knowledge on how feasible commercializing the ICEMAN. At the end of this project, knowledge on the hardware components and the connectivity between the car and the ICEMAN is easily understood. Not only that, but it is also believed that knowledge on authoring and programming tools such as Visual Basic 6.0 and Adobe Photoshop CS has increased tremendously.

5.2 RECOMMENDATION

To further enhance this product, the ICEMAN can be enhanced with the following:

5.2.1 GPS

With the GPS feature, a user will be able to map out his or her journey. Not only that, but the user will be able to find and access the shortest route possible and most important of all to locate where is his or her location currently.

5.2.2 Internet Access

The Internet connection can be done with using a GSM modem or GSM handphone. With that, the ICEMAN will be able to dial into any Internet Service Provider and log onto the Internet.

5.2.3 Networking

This feature includes Wi-Fi where a user can park his or her car in a Hot Spots area. With that, the user can access the internet with ease from the ICEMAN. Not only that, but with Networking, file transfer and sharing can be done when two cars with ICEMAN is next to each other and they are logged into the same network.

5.2.4 SMS to Service Center

This feature can be done using the GSM modem or GSM handphone. An SMS will be sent to the Service Center if the user wants to book a place in the Service Center for car servicing via SMS. This can be done using the AT+ commands.

5.2.5 Reverse Sensor Camera

A reverse sensor is feasible by putting a web cam at the rear bumper of the car. The image needs to be inverted so that it will look as though we are turning behind instead of looking at the screen.

5.2.6 Digital Mileage

Digital Mileage can be achieved with including an OBD-II reader. This reader will read data from the ECU chip of the car and convert Analog signals to Digital signals into the car. With that, the car's mileage and maintenance system will be more accurate.

5.2.7 Pattern Recognition

This is another option for the car's mileage. A web cam is placed facing the odometer and captures the change on the odometer. Once the odometer reaches a certain

mileage, the web cam will recognizes the next change or pattern and informs the ICEMAN on the next service.

5.2.8 Updated News

Constant update of news via Network, SMS and Internet that will be displayed on the monitor

5.2.9 Touch screen

The touch screen will be used as an input peripheral instead of the mouse and keyboard.

5.2.10 Hands-free Phone Assistant

The ICEMAN will be able to connect the calls and used the car audio speakers as handphone speakers. Not only that, but the ICEMAN can interface with the phone and will be able to list the phone book on the ICEMAN itself. Not only that, but it eill be able to display who is calling and the image of the person.

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- MP3Car.Com Forum
<<http://www.mp3car.com>>
 - The ACM Portal
< <http://portal.acm.org/portal.cfm>>

APPENDICES

Appendix A

Below are sample photos of Carputers:

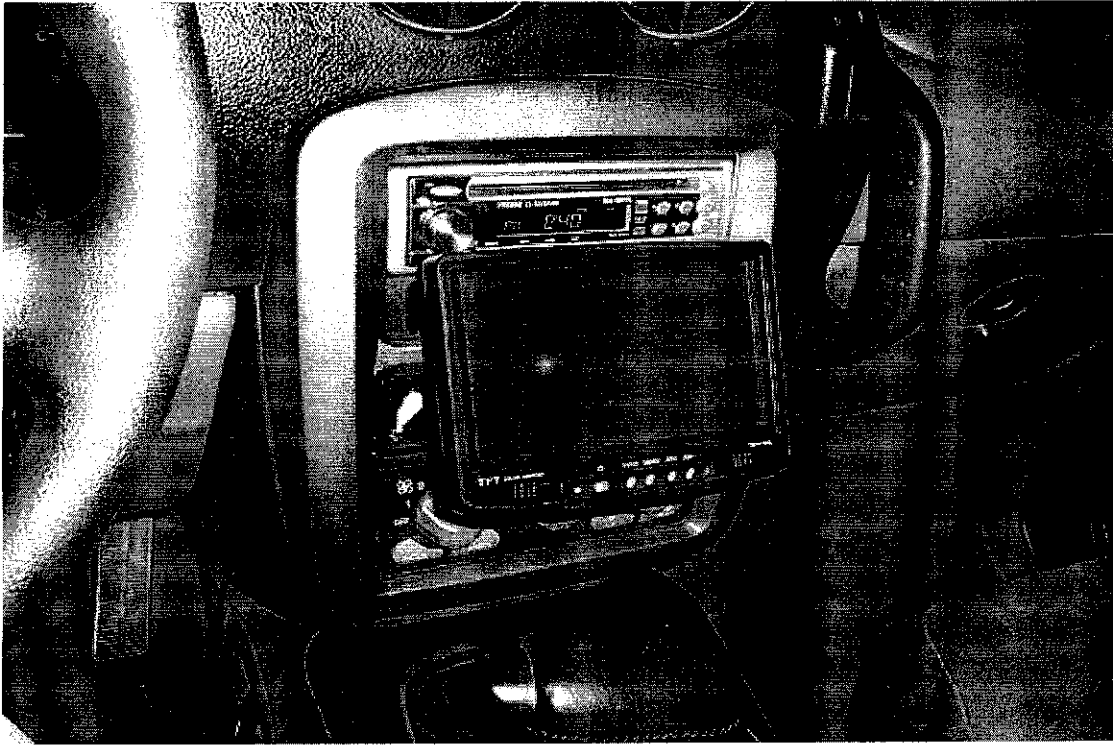


Figure 8: Example of a Carputer

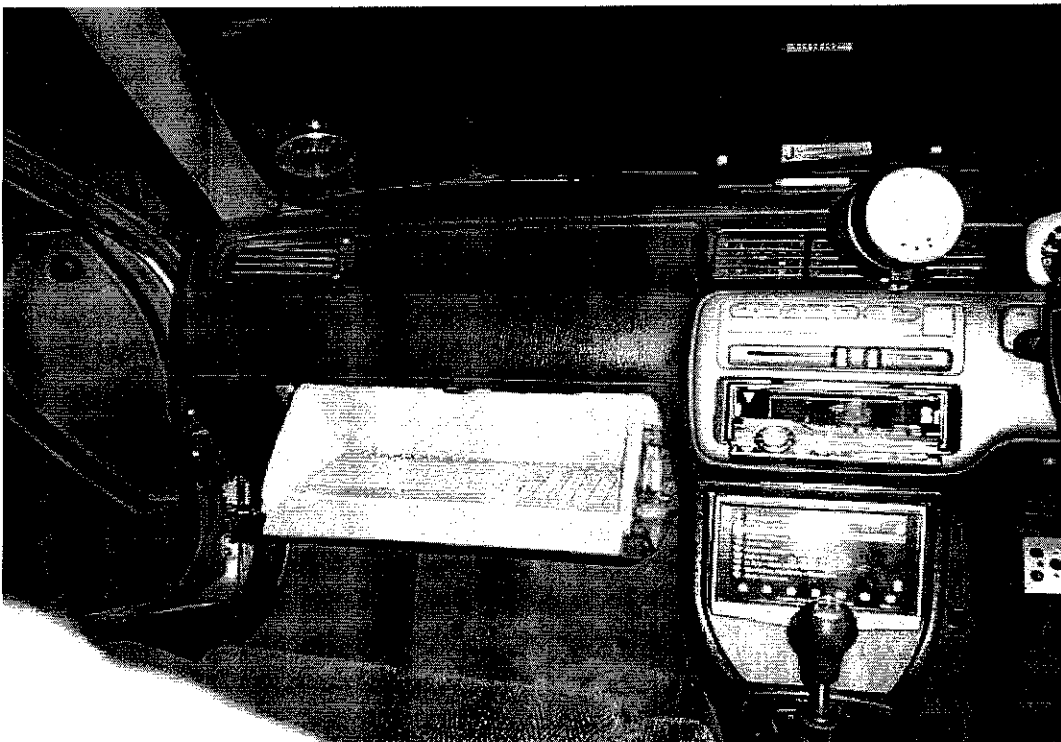


Figure 9: Another Example of a Carputer

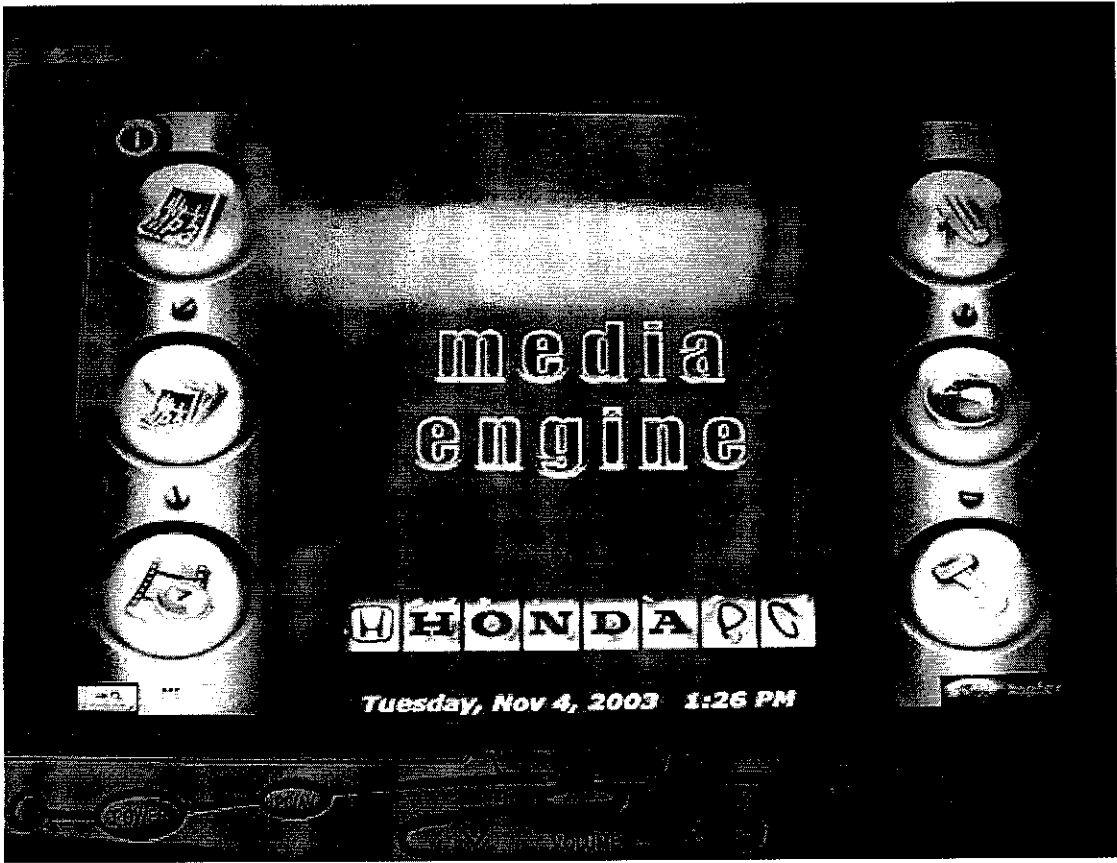


Figure 10: Interface of a Carputer using Media Engine



Figure 11: Final result on computer components placed in the box

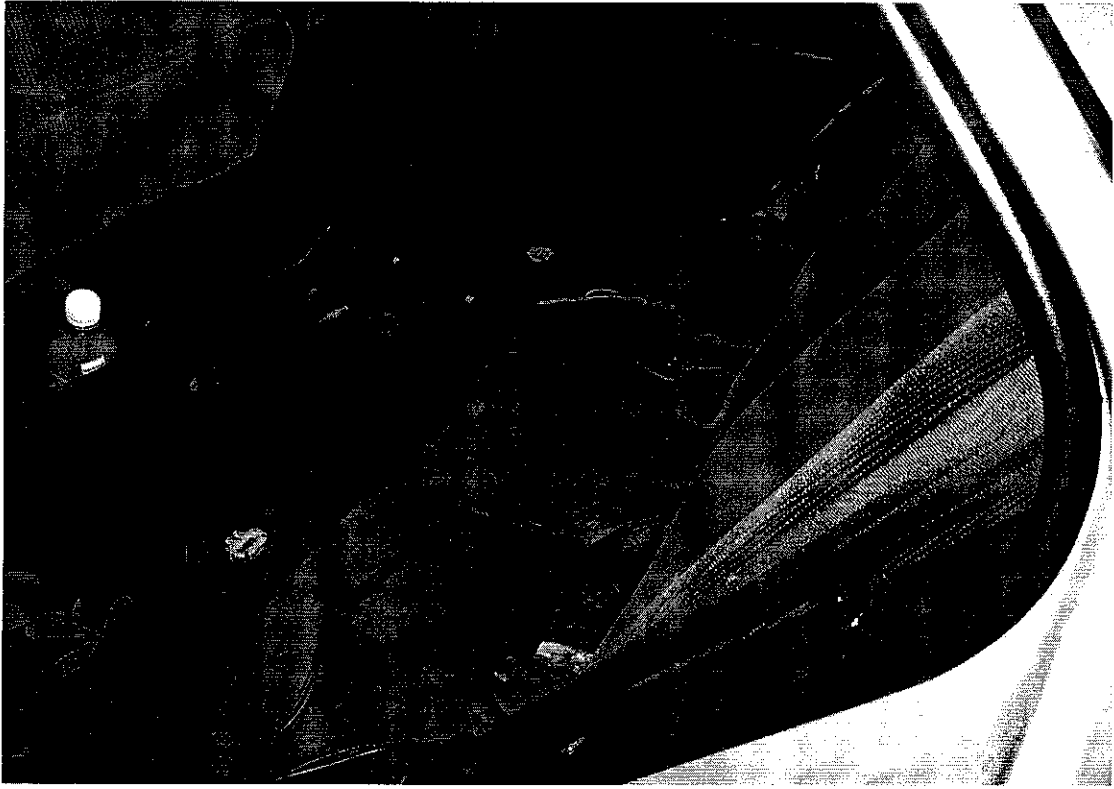


Figure 12: RCA cables and other wirings covered underneath the carpet and rear seats

Appendix B

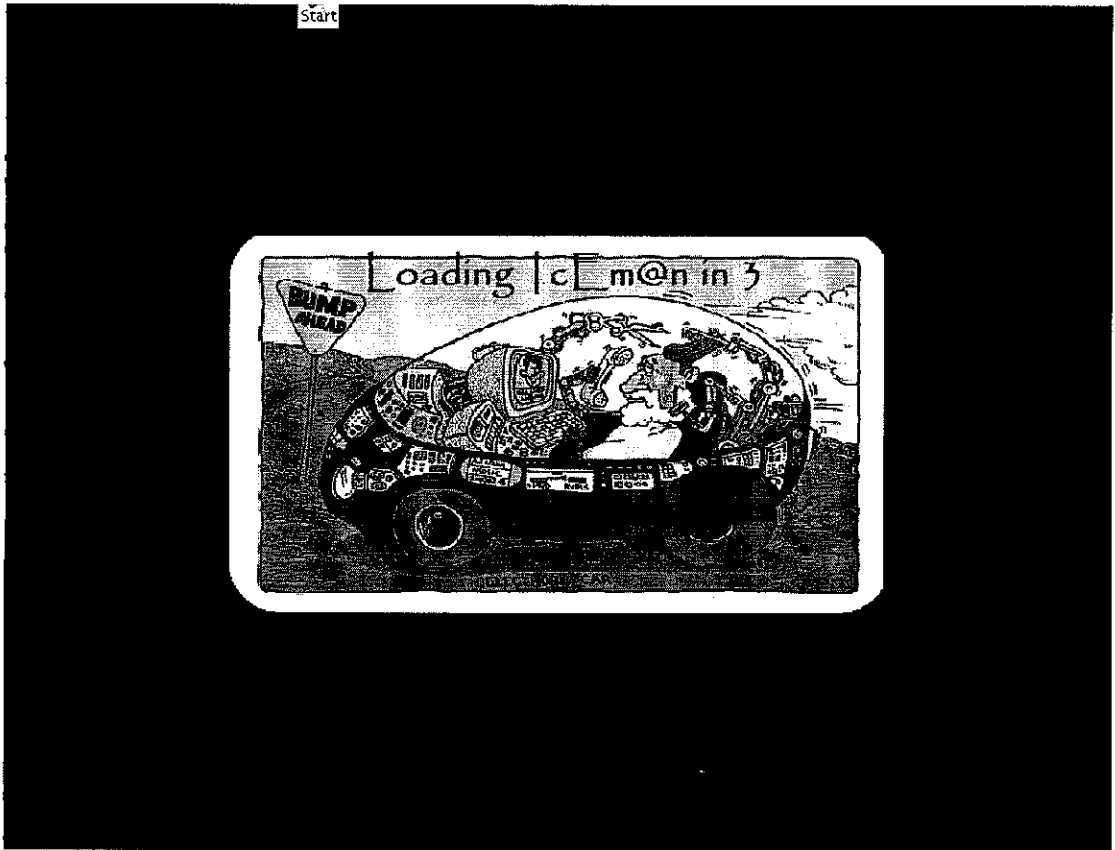


Figure 13: Splash Screen of ICEMAN

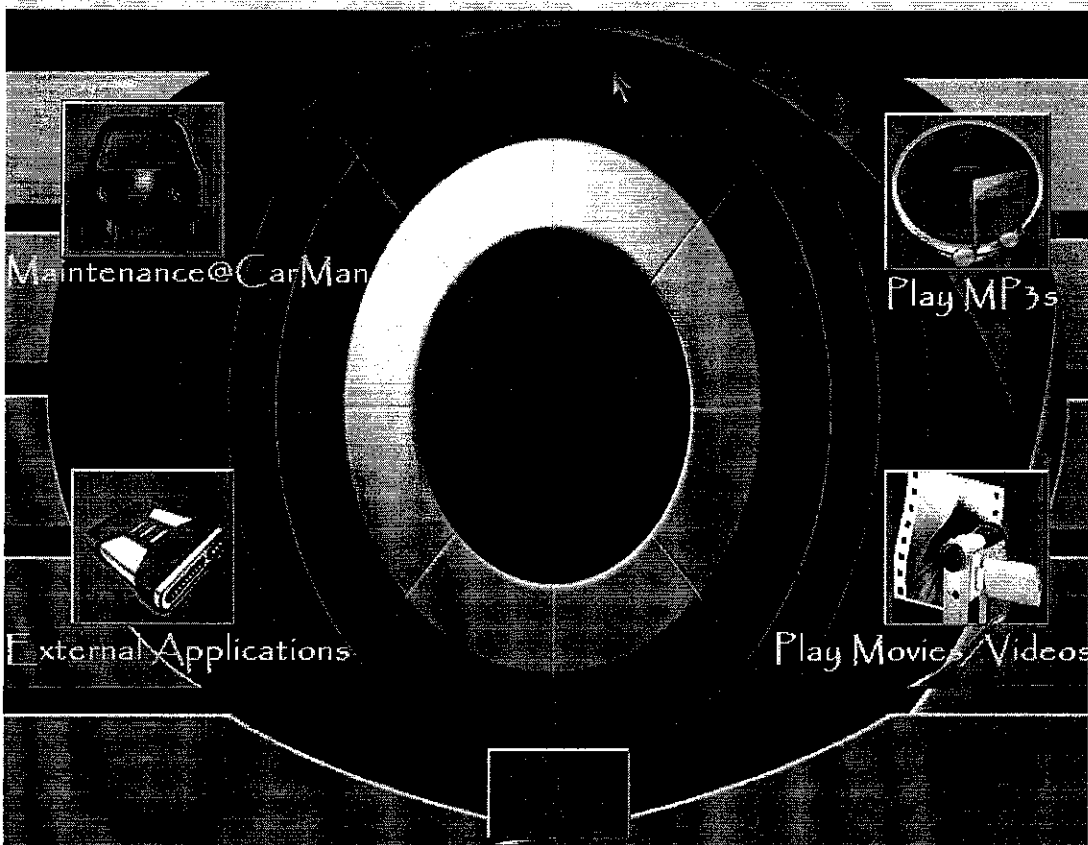


Figure 14: Main Menu of ICEMAN

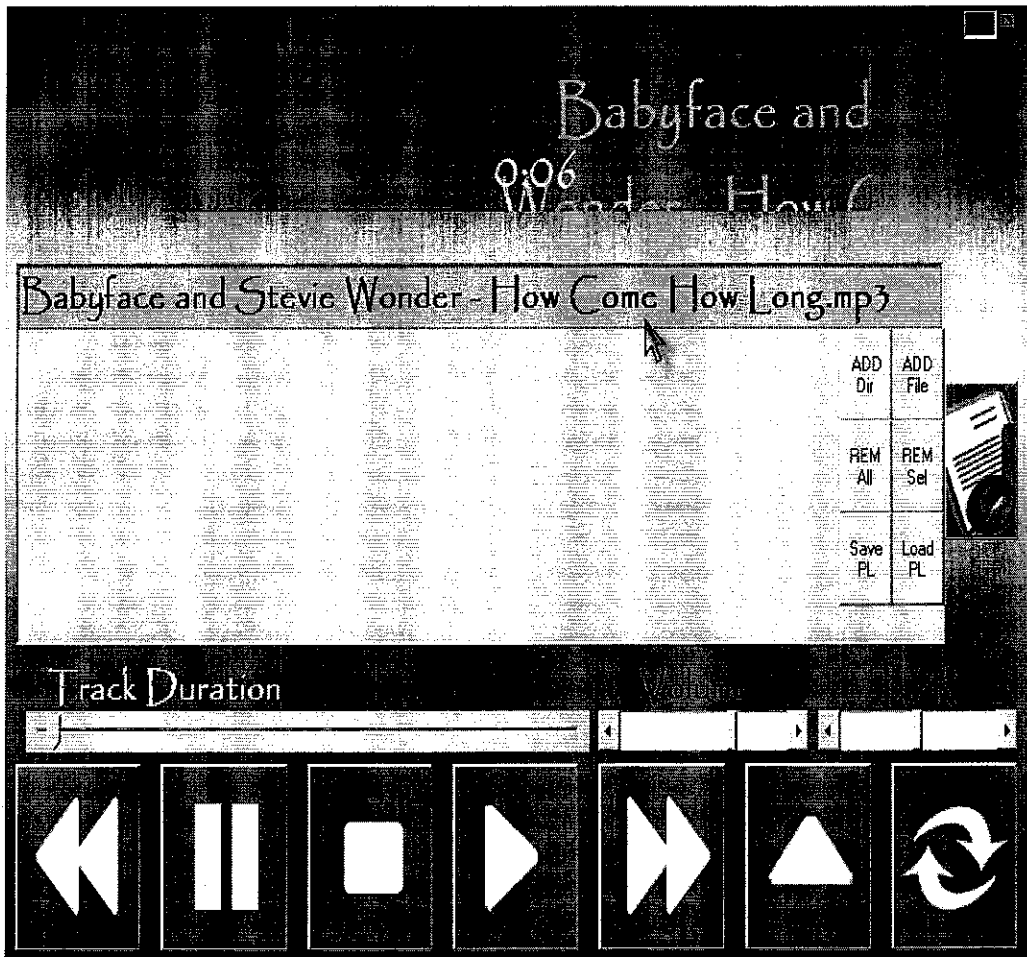


Figure 15:MediaBox MP3 Player

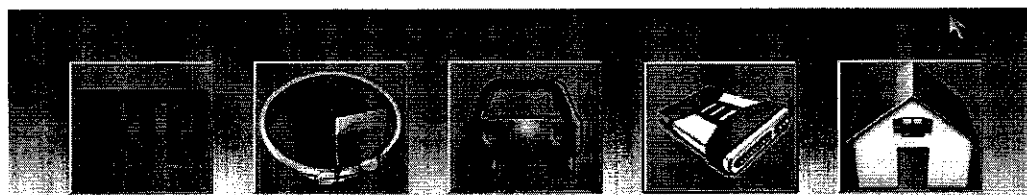


Figure 16: One of the Drop Down Menu

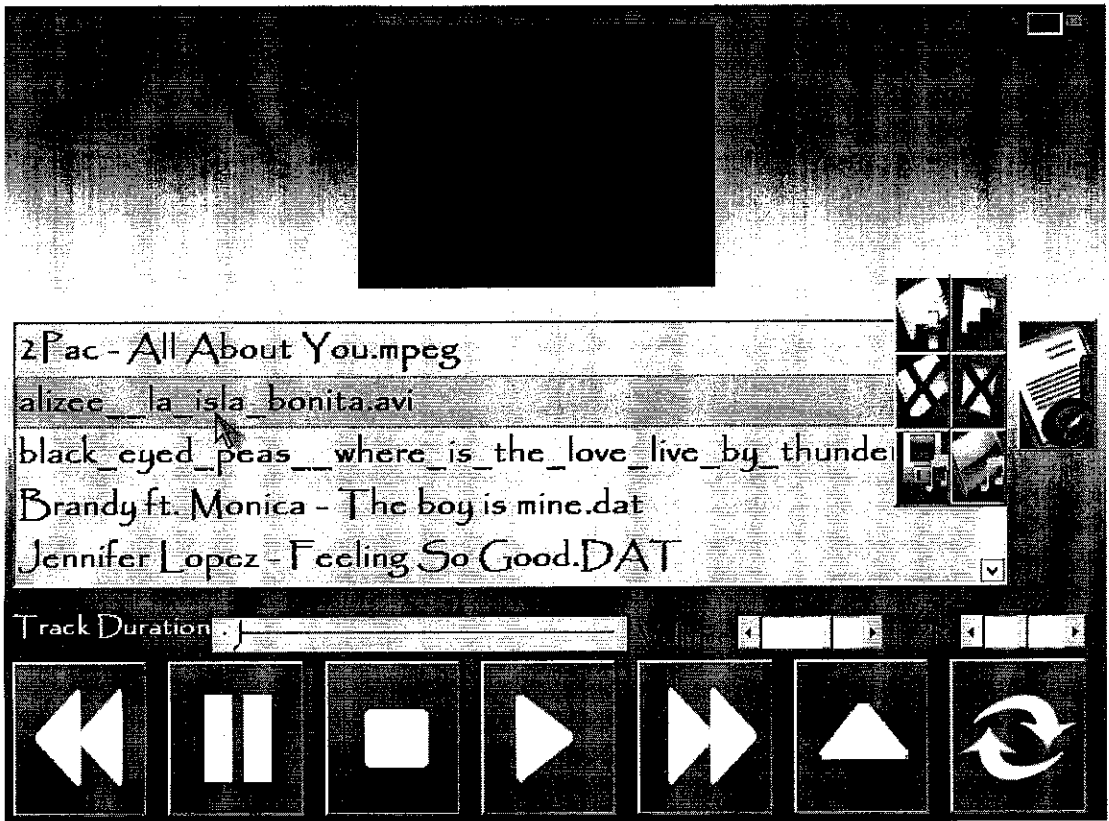


Figure 17: MediaBox Movie Player

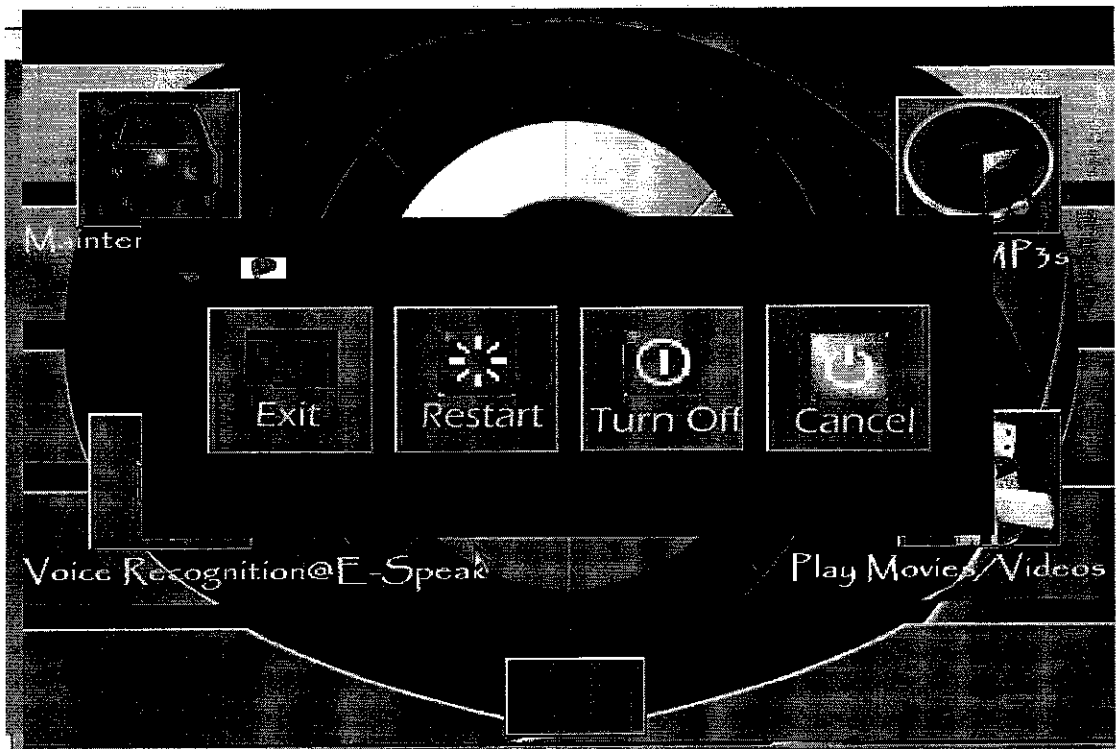


Figure 17: Exit Menu

