Client – Server Device Controller

(Control home electrical items through Internet/intranet connection)

By

Irwan Bin Ibrahim

Dissertation submitted in partial fulfillment
Of the requirements for the
BACHELOR OF TECHNOLOGY (Hons)
(BUSINESS INFORMATION SYSTEM)

DECEMBER 2005

University Technology of PETRONAS
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Perak Darul Ridzuan.

CERTIFICATION OF APPROVAL

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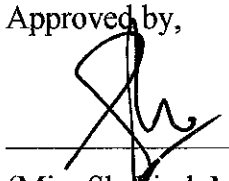
Approved by,



(Miss Shakirah Mohd Taib)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
December 2005

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 acknowledgement, and the original work contained herein have not been undertaken or by unspecified sources or persons.

IRWAN BIN IBRAHIM
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ABSTRACT

Controlling electrical appliances over the internet is the next wave of networking technology. With the existing advancements in computing power and network technology, the concept of fully automated client and server device controller is not far fetched. This idea was instigated from some situation like this; when the author went to the office and suddenly realized that he forgot to turn off the lamp at his room at home. By using the client server device controller application, the author can connect to the home network and can check the status of all the lamps. If the room's lamp is on, then the author can switch it off. This project will not only be applied to lamps but has been extended to control all the devices in the house or room from the fan, radio, television or whatever electrical appliances that can connect to the device controller. With the current advancements in computing power and network technology, the concept of fully automated more like smart homes can be achieved. In this project, it will describe how the author has simulated a client server device controller environment. The main control or interface for this project was developed using Visual Basic 6 and hook them up via a network. In this project also, the application is added with mobile integration ability where the device controller can be controlled by receiving the instruction message from the sender. Once these applications were run and once the devices got plugged in, it will announce their availability in the network. It will then automatically act as server and the client application of this client server device controller can be connected with proper access permissions. This project is a strong determined step towards delivering the notion of "Internet appliance" leading to ubiquitous computing.

ACKNOWLEGMENT

First and foremost, praise be upon to Allah s.w.t for his mercy given me the strength to complete this project within time given.

My gratitude goes to my supervisor, Miss Shakirah Mohd Taib for precious assistance and guidance throughout the project. Further thanks to all respondent that involve in doing the questionnaire and also a testing. Those responds and feedback are really valuable to this project. This appreciation also goes to all lecturers, final year students, and technicians for the ideas, assistance and support throughout completing this project. I also would like to thanks to my beloved family for their support.

Finally, thanks you for all individuals that have contributed their ideas, knowledge, support and assistance in this project.

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background of Study

It is very interesting and convenient to be able to control everything while sitting at your Personal Computer (PC) terminal. Of all millions of pages on the web, most are hosted by large servers or at minimum, desktop PCs. But these are not the only computers that can function as web servers, even very small devices can serve web pages on request, including pages that display real-time information and respond to user input. The pages can be available within network or adding the Internet connection and makes the pages available to anyone on the Internet. [1]

1.2 Problem Statement

- Network connection that installed at home is not fully utilized.

Most of users have an Internet connection installed at their home and workstation. There are several types of Internet connection such as broadband and dial-up Internet connection. For broadband users, it will be wasted if the connection not maximized used because the users pay it monthly, not time of usage.

- The usage of computer mostly limited to clerical work and entertainment.

People are familiar with computer but usage of it may not be fully used. Most of the users use the computer to perform clerical work such as writing an assignment, preparing word document and spreadsheet. For young generation especially teenager, they enjoy playing games installed at the running comper.

From the normal PC it can be as a server to serve the services to client. When the PC turn as server, the client can connect to this computer from anywhere that has Internet or intranet connection (assuming there is no network administration setting).

- To reduce cost for a remote control application.

Cost is important; people want to have something that in good quality product, but the cost is less. Cost is the factor that to be considered for the both sides, which are project developer and users (customers). The cost is depend on how user want the product works, whether they want it to turn on the lamp at garage, kitchen, store or some other places. The existing system use Infrared (IR) technology and this project only apply wired connection between electrical devices and device controller that attached to the server computer.

1.3 Objective

- To design room or home automation

This project is designed to make room or home automation easy to control when a user is not at home and spending their time for working or enjoy the holiday. It allows easy control in several way when user it not at their room or home. The ways that apply for controlling the application in this project is using another computer from different location of computer that was connected with internet. Another way to control this application is through mobile phone.

- To design a remote switching using parallel port

Another objective is to design a new way in switching the switch button of electrical appliances. The normal way in switching on or off the lamp will be replaced by clicking the button using mouse. This method can be minimized the time taken to switching several appliances without going the actual place where the electrical appliances located. This can be called as centralize control system.

- To integrate the device controller application with mobile technology

The usage of mobile phone also can be maximized when this project is included with Short Messaging Service (SMS). Therefore, home devices can be turn on or off with a command phrase likes "Lamp On" or "Lamp Off" that send from the user mobile phone.

Normally before user leaving their home for vacation, user will turn on the main lamp for security purposes. This practice triggered the idea for the remote control application where user can simply turn on or off the house lamp remotely. There is also being able to control an alarm system that was installed in their house.

1.4 Scope of Study

- Product implementation

This project implementation target is user's home. It can be use at kitchen, build a smart garage, living room or where ever they want. This project also can be implemented for home security purposes.

- Target user

The target user for this project is people who are interested in intelligent and technological home. This project also can be beneficial to people who always go traveling. Their house electrical appliances can be monitored and controlled from any locations and places by fulfilling the application requirement.

- Resource

This project is using parallel port for sending a signal to make the device controller work. In order to make the parallel port works, it needs an external file to enable the application to send the signal to the parallel port interface. Beside that, mobile phone is needed to act as Short Messaging Service (SMS) server as to

wait for incoming message to trigger the device. The connection between mobile phone and PC is using a Bluetooth connection without using serial cable.

1.4.1 The Relevancy of Project

This project is very much related to the studies in Electrical Engineering where the knowledge in circuit theory to applied at device controller circuit. This project also will combine knowledge in programming for make the application between client and server can communicate together.

1.4.2 The Feasibility of the Project

Four month given to complete the study, the scope of this project has to be reduced to accommodate the time frame. Having to fulfill the objectives within the time frame is manageable. This project will be divided into two parts, first would be the documentation and research and the second will be the development of the product.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.0 LITERATURE REVIEW AND THEORY

2.1 Introduction

This project is focusing on how to control the electrical devices from any place that install with network protocol like Internet connection and intranet connection. The network protocol commonly known as TCP/IP, so this project target is making the connection between server application and client application that run on different Personal Computer (PC). The server will installed and run at home which connected with device controller hardware and client application. Client application can be used at any computer that have network protocol and run as read-only application like PC at office, that mean the client application no need to install to run or execute.

It is very popular to connect computers to a network that is connected to the Internet. By these way users can communicate and control things remotely. This is very appropriate when controlling a device that is in a very bad environment such as radiation and noisy, when a scientist would like to take part of an experiment without being forced to travel to the experiment plant or when a technician would like to diagnose a device from home or any other place when there is a problem. [12]

2.2 Network Technology

Client-server

The normal view of a client server system is that a server is started and goes into a waiting state. A client is started and wants to perform interaction with a server. The client makes a call to the server, the server receives this call and takes some action and then send a reply/result to the client. After the reply the server goes back to waiting state, ready for taking care of new calls from servers. This type of server is called a blocking server as it deals with only one client a time. [12]

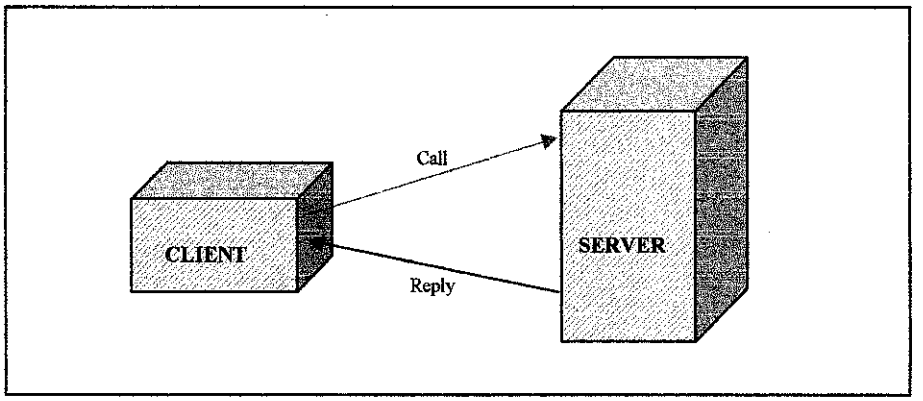

Figure 1: Client Server [12]

The server can be multithreaded, that is when a client makes a call to the server, the server spawns out a new thread that is dealing with the client and the main thread goes back to waiting state and waits for more client calls. This is a server of the non-blocking type, capable of serving many clients at the same time. [12]

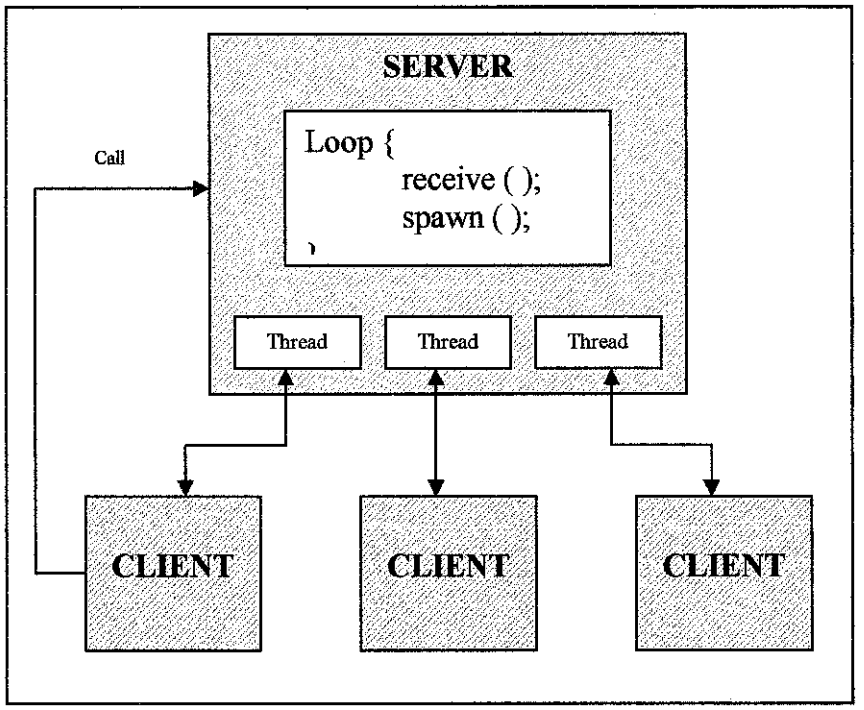

Figure 2: Client Server [12]

Sockets

The combination of an IP address and a port number is called socket. Berkeley sockets can be used to communicate using both connection-oriented protocols, such as TCP/IP, and connectionless protocols, such as UDP/IP. In both cases, fundamental operations include the creation of a socket, binding a socket to a host address and port number and sending and receiving data. Sockets require the client and server to engage in application-level protocols to encode and decode messages for exchange. The figure 2 shows an overview of setting up and using a TCP connection: [12]

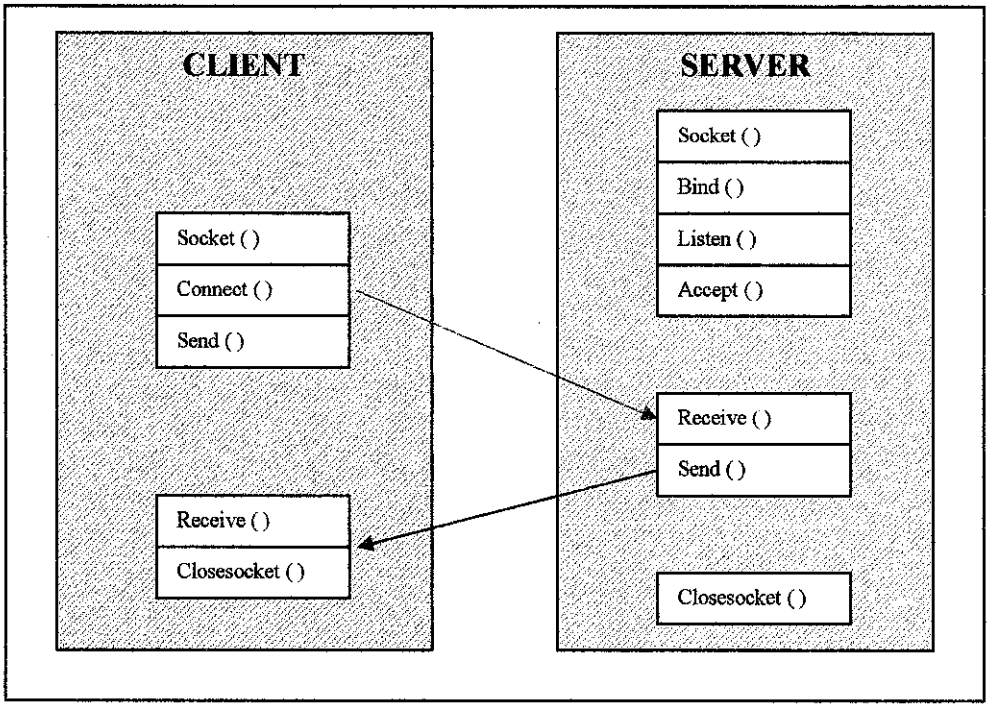

Figure 3: Socket [12]

Web server as server / Web browser as client – CGI

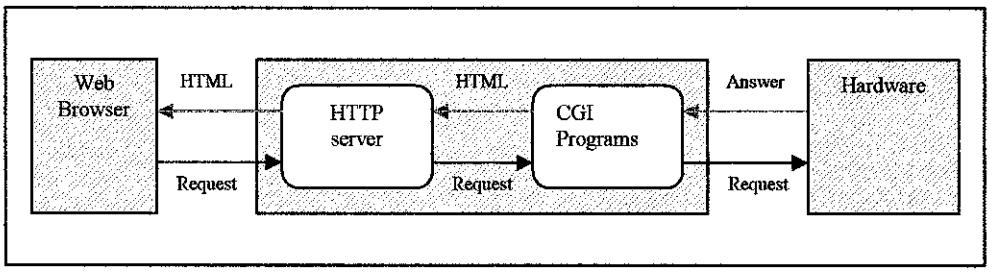

Figure 4: CGI [12]

The Web browser client sends a request to the Web server. The Web server starts a CGI program that performs some kind of access to the hardware and gets result back from the hardware. The CGI program then creates a HTML page with information based on the result from hardware. The Web server then sends this HTML page back to the Web browser client. The CGI programs can be written in almost any language that is capable of producing a HTML page on the fly. [12]

Java Applet

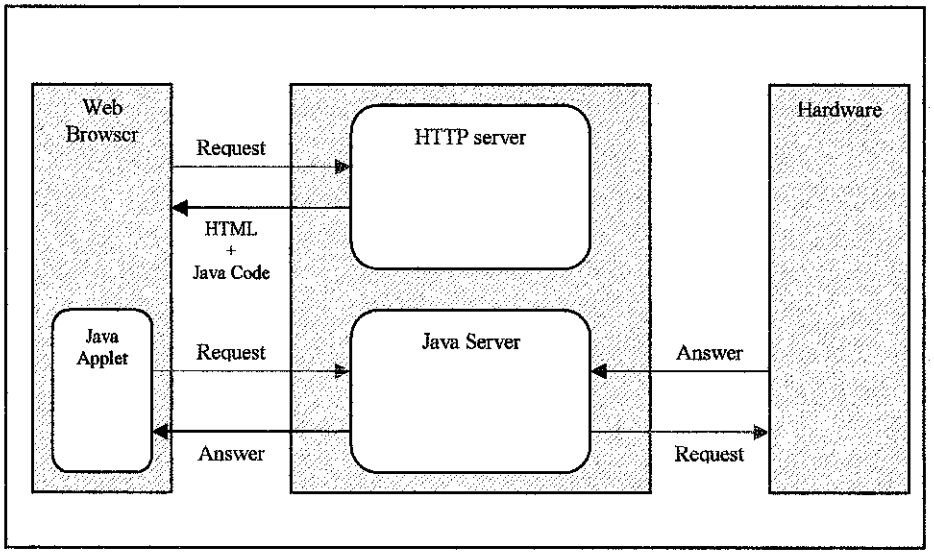

Figure 5: Java Applet [12]

Here the Web browser sends a request to the Web server. The Web servers send a HTML page back including some JAVA byte code. This JAVA byte code is executed as a JAVA applet. The JAVA applet connects to a server that is running on the same machine as the web server. The server performs some command, in this case makes access to the hardware and sends the result back to the applet. [12]

2.3 Parallel Port Device Controller

The parallel port device controller is a simple device that connects to the IBM PC's parallel port. Plugging this controller into the parallel port immediately interfaces the PC to the outside world. For instance, it can hook up motors to the box, and write computer programs to control it. The interface sensor could turn the computer into home control unit. Almost all PCs have a parallel port. The advantages of using this port are

- Control up to 8 devices simultaneously
- No need to open your computer casing to attach AT expansion BUS [7]

By using parallel port and a few cheap parts the home automation could be reality. In addition to the hardware, some knowledge of programming is helpful.

Pin No	Function	Type
1	Strobe	Control
2	Data Bit 0	Output
3	Data Bit 1	Output
4	Data Bit 2	Output
5	Data Bit 3	Output
6	Data Bit 4	Output
7	Data Bit 5	Output
8	Data Bit 6	Output
9	Data Bit 7	Output
10	Acknowledgement	Status
11	Busy	Status
12	Paper Tray Empty	Status
13	Printer OnLine	Status
14	Auto Linefeed after (CR) Carriage Return	Control
15	Printer Error	Status
16	Initialize Printer	Control
17	Select/Deselect Printer	Control
18-25	Unused/Ground	

Table 1: Parallel Port Output [6]

The parallel port has four function types for a total of 25 pins: data (8 pins), control (4), status (5) and ground (8). To understand the function of the data, control and status types, consider what happens when printing something using the printer. The printer prints out alphanumeric characters onto paper (thus using the data lines). Sometimes it does a carriage return and linefeed (hence using the control lines). Sometimes, the printer doesn't print because it ran out of paper, or the printer on-line (status lines) not working. Thus the printer has a number of input and output related function types. The 8 data lines are used for 8 digital OUTPUT lines. For example, it can turn on 8 different motors. The 5 status lines are used for 5 digital INPUT lines. Thus you can interface 5 different sensors, like pushbuttons. The 4 control lines can be used for 4 additional digital output lines. [7]

How to calculate values to send to program

The value you give to the program as a binary number. Every bit of the binary number control one output bit. The following table describes the relation of the bits, parallel port output pins and the value of those bits. [7]

Pin	2	3	4	5	6	7	8	9
Bit	D0	D1	D2	D3	D4	D5	D6	D7
Value	1	2	4	8	16	32	64	128

Table 2: Parallel Port Output Calculation

For example to set pins 2 and 3 to logic 1 (led on) then you have to output value 1+2=3. If you want to set on pins 3, 5 and 6 then you need to output value 2+8+16=26. So the outputs that want depends on the value of calculate for any bit of combination. [7]

Short Messaging Service (SMS)

The project use of mobile phones to remotely control electrical appliances that connected to device controller. The device control will control the device based on the information given to it. This feature added to this system in case the system cannot be connected when the internet connection failed or user is not in front the workstation. This will involve several options for the control: text messaging (SMS), WAP, web browser or a program written for the phone.

2.4 Conclusion

There are several ways to make the client and server applications communicate together. Meaning that the possibility for making this project is not impossible. For controlling the circuit, the input output signal to be used is a printer port; it was selected because the coding for sending the signal is not too complex compared to the Universal Serial Bus (USB) or serial port (DB9). The printer port can toggle up to 8 devices, using D0 until D7, this project can be categorized as automated home system because the electrical devices can be controlled using

computer, beside that this project also includes the network technologies that makes this system more interactive. It can be market because it is useful to user for security purpose. For the device Control System a device such as a light will be attached to the device controller. The device controller will be given its instructions by the connected parallel port (printer port) computer. The computer will be told by the software running what commands to send to the device controller. If using SMS then a phone will have to be connected to the computer and act as server that waiting for request from incoming message from other phone. When an SMS message is received, it will have to be decoded by the application software to see what instructions the message contains.

CHAPTER 3

METHODOLOGY

3.0 Methodology

For this project, the suitable methodology is start with planning, followed by analysis, then design and testing, and it will lastly monitoring and evaluation. Each phase of this methodology can be revised immediately to allow quickly corrective measures can be taken and improvement can be done quickly to the system without having to wait further or until the system is finished. Further details of this methodology are explained in the Figure 7 below. This methodology was used because the development of this project can be done in proper stages. Furthermore, this methodology allows backtracking and corrective measures can be taken to fix or tweak the system. Since this project has clear requirements and understanding, hence fewer changes are expected during the development of this project and this makes it appropriate to choose this methodology, and if there are changes to the system in the future, this methodology will enable to cater the changes.

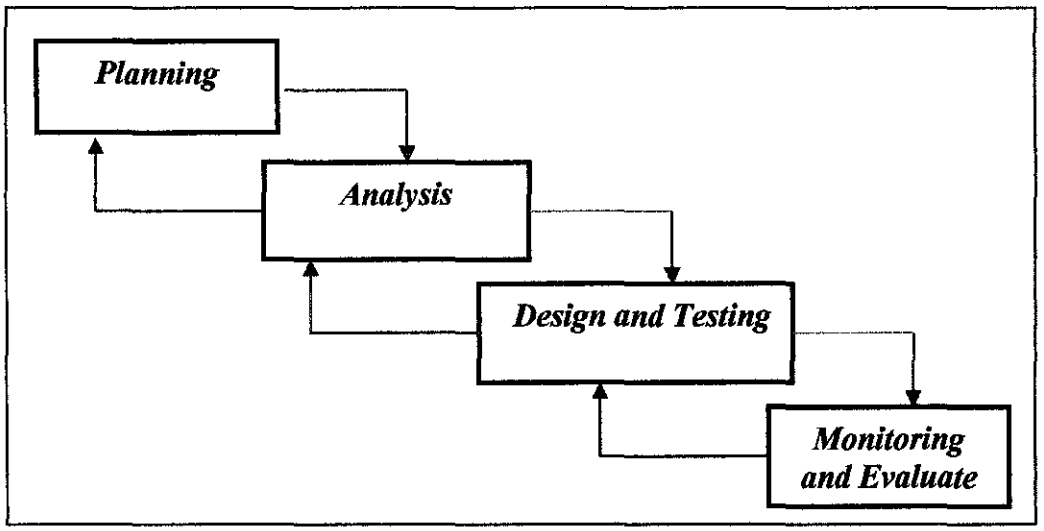

Figure 7 : Methodology

Methodology outlines:

1 Requirements definition (Planning)

2 System and module design (Analysis)

3 Design and testing

3.3 Interface design

3.4 Communication with parallel port

3.5 Communication with client and server

3.6 Coding phase

4 Monitoring and evaluate

3.1 Requirement Definition (Planning)

The first step to develop this system is evaluation of the process itself. The evaluation reflects the acceptance of the system by the end users and its performance in the field. The evaluation must be done to show the usefulness of the system.

Evaluation addresses the issue "is the system valuable?" this will reflect the acceptance of the system by its end users and the performance of the system in its application. Pertinent issues in evaluation are:

- Is the system user friendly, and do the users accept the system?
- Does the system will improve in real life?
- Is the system can be maintainable by other than developers?

In the evaluation part, the factors that also must be considered are:

- Costs of hardware and software
- Speed and capacity of hardware
- Quality and cost of support

After the evaluation and realize that the system needed to develop, and then the Project Initiation Documentation (PID) can be prepared. The PID purpose is to define the project, to form the basis for its management and assessment overall

success. The hardware and software that are planning to be used in developing the system

Hardware	Software
Pentium 4 1.6MHz	Visual Basic 6
256MB RAM	Visual Studio .NET
Less than 5GB Free Space	Information Internet Sharing (IIS)
1 Parallel Port Output	Macromedia Dreamweaver MX
Network Card	Red Hat Linux Operating System
	Windows XP Professional Operating System
	DirectX 9 or above
	Window Media Encoder 9
	Internet Browser

Table 3: Hardware and software requirement

Gathering information also must be completed before the system design and development start. There are many ways in gathering the information; a lot of time must be spent with user or respondent to collect the information regarding the project. Some of the practical method can be use is questionnaire. The data that gathered from answer completed by users or respondents are important because from those data, the project target and mission can be set.

3.2 System Development

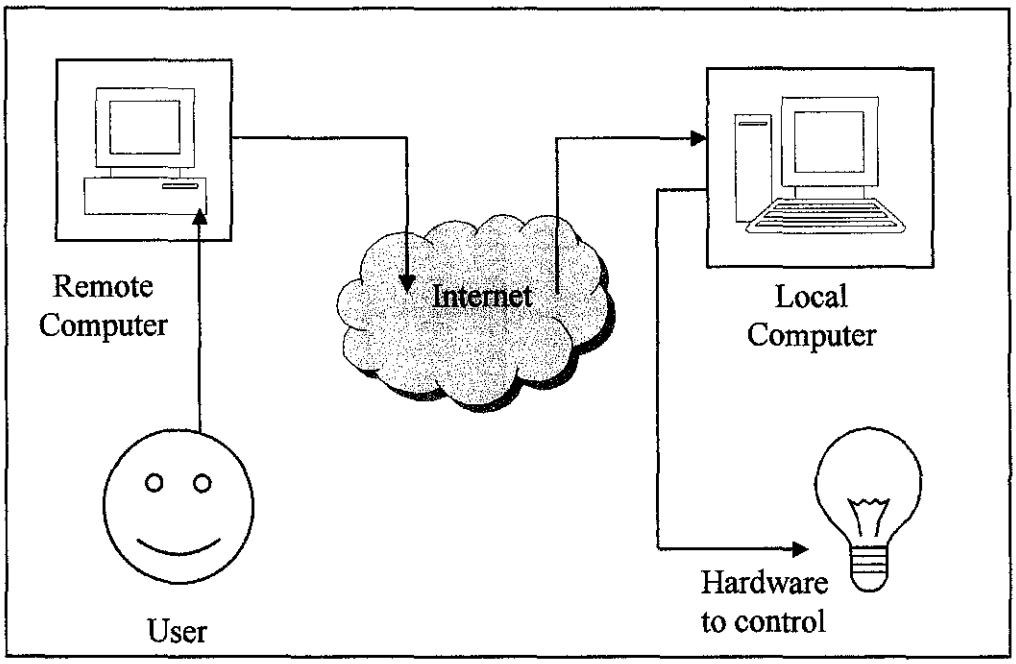

Figure 8: System Design

3.2.1 Interface Design

The interface design is based on the user requirement that have been gathered during the questionnaire session. The interfaces will need to be easy to use, clear and simple. The simplicity depends on the device that the software is on. For the SMS chose there should be a simple list of commands that can be typed in and sent. The interface for software on the PC should have basic security especially it is available over the internet. The software should be more versatile than with the phone and offer more settings. For the response, a simple SMS message could be sent from the computer.

Server Application Interface

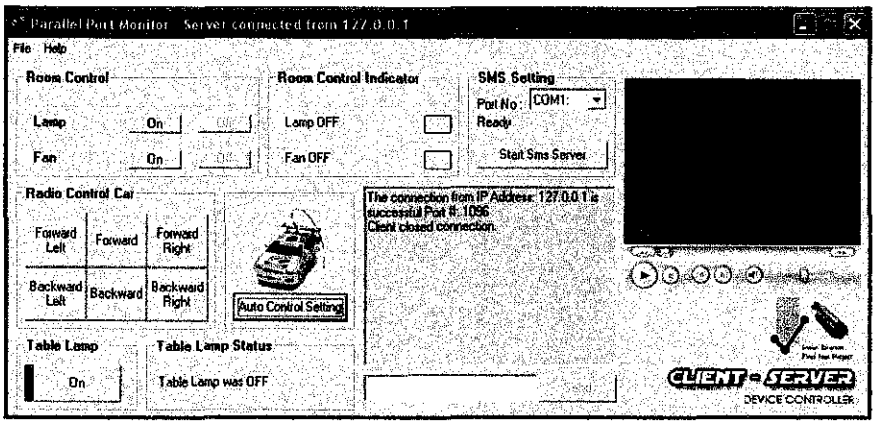

Figure 9: Server Application Interface

Client Application Interface

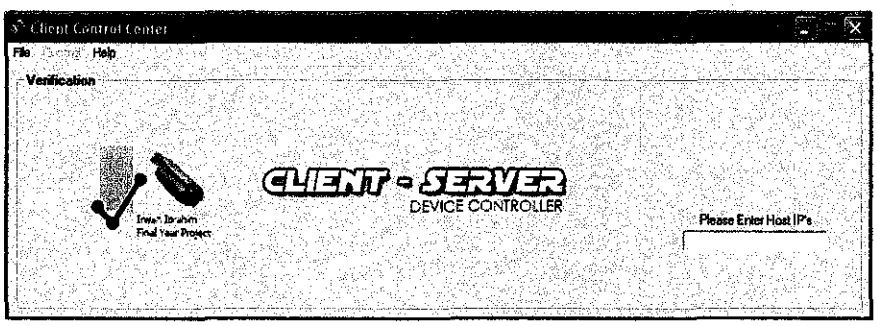

Figure 10: Client Application Interface

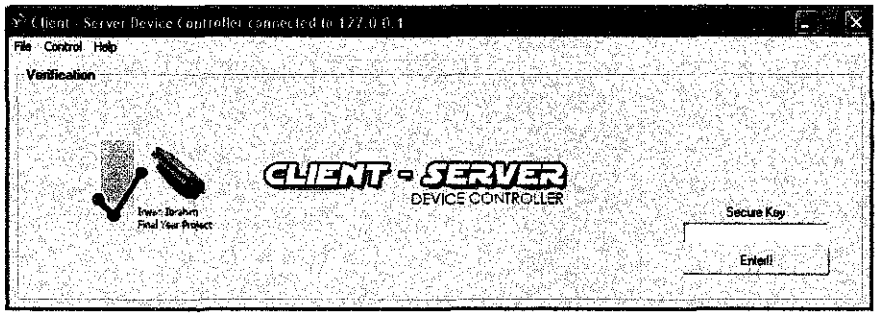

Figure 11: Client Application Interface (Request Secure Key)

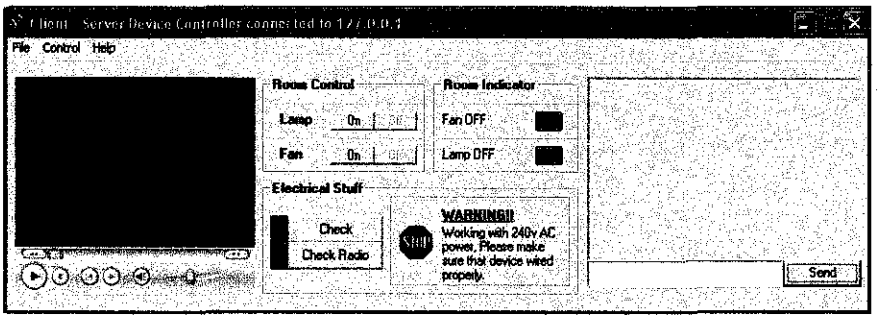

Figure 12: Client Application Interface (Control Page)

3.2.2 Communication with Parallel Port

The parallel port will be controlled by the server application, the parallel port control using module declaration in the coding to make the parallel port data library communicate with the application, the data library that is used to communicate with the parallel port is inpout32.dll. That file is needed if the server is running on the latest windows 32 bits operating system platform.

3.2.3 Communication with Client and Server

The client and server application use "mswinsck.osx" where the data component is an add-on component that can be found in Visual Basic 6 programming platform. The add-on component has the ability to connect between two application using TCP/IP, the client will request the connection to server by entering the correct server Internet Protocol (IP) addresses.

3.2.4 Coding Phase

For the coding phase VB 6 programming language has been used. There are different coding for client and server. The server coding is to trigger the signal to parallel port and the client coding is to send the data to server, then server will execute the data from the client command.

3.2.4.1 Parallel Port

The system development use windows XP as a platform, so the additional Dynamic Link Language (DLL) is needed to make the operating system communicate between the input and output port, so inpout32.dll files was added to system32 directory. The source for the file was downloaded from http://www.logix4u.net/. Before parallel port programming started, the register of LPT resource must be known. The figure below indicates the register port that is active.

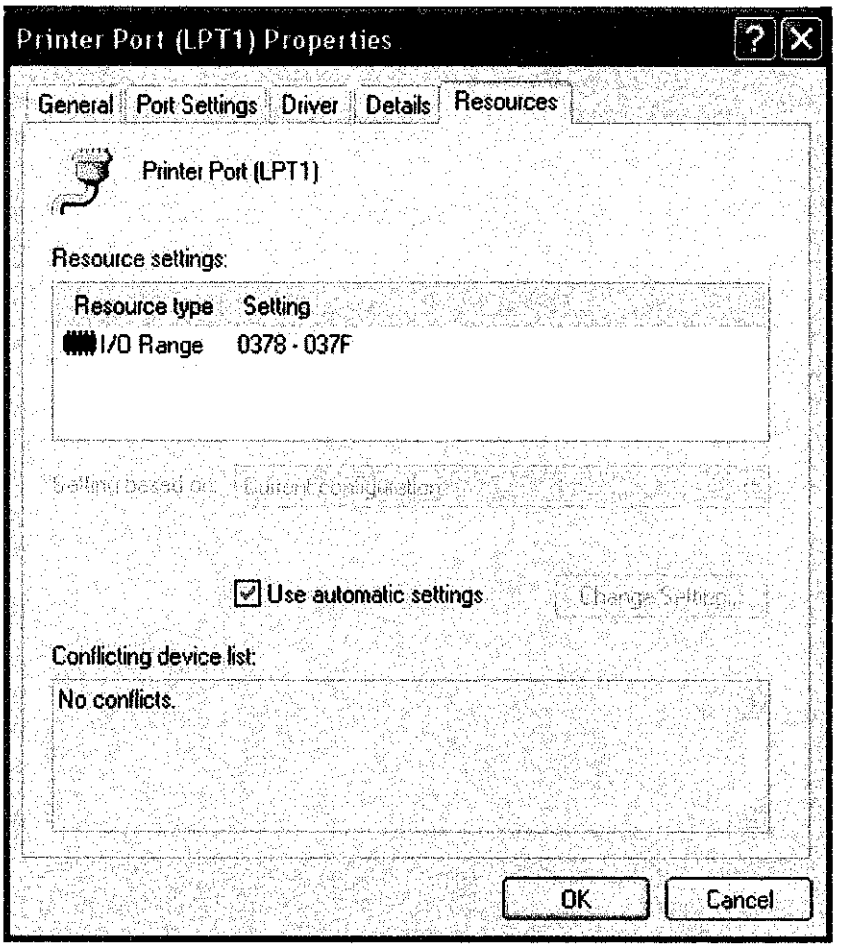

Figure 13: Parallel Port Resources

```
Private Sub Form_Load()

    ..
    'Read data register
    PortAddress = &H378
    cmdSend.Enabled = False
    tcpServer.LocalPort = 5000

    Call tcpServer.Listen
    Dim registerCheckLoad As Byte
    ...

..End Sub
```

3.2.4.2 Server

There are two main component must be added for the server application. The first component is inpout32.dll for communication between computer and input output PC interface. This file is important for windows XP and 2K platform because this Dynamic Link Language (dll) is not included for the new version of windows platform. The second component is the Winsock. This component is use for make connection between two applications to communicate together. The server will use this component and set as listen mode to wait the request that will do by client application software.

(See appendix for server coding)

3.2.4.3 Client

The client application software interface using only one component, the component is Winsock. The connection that establish is depend on this component. The client will send the decode message to the server and will turn the application that request by the button that was pressed from user.

(See appendix for client coding)

3.2.4.4 Short Messaging Service (SMS)

For the SMS functionalities the shareware, activeX "wample.ocx" was used. The activeX used for synchronized between mobile phone and computer. The function was state with a few instruction message likes, "Lamp On" to switch on the lamp; "Lamp Off" to switch off the lamp and, "Lamp Status" to check the lamp status either it is on or off.

3.2.4.5 System Testing

Thorough testing will need to be carried out to ensure the system is reliable and functions correctly. Testing communication between each of the devices will be carried out ensuring that they communicate correctly and consistently without errors. If errors are occurring in communication then the user may be confused or the operation they requested may not happen. If for example for the SMS that sent a text message a response text message must ensure that the request has been carried out. Also an unreliable system would result in users not trusting the system. Testing also needs to be carried out trying to break the software to test the error handling of the software. Unexpected results need to be eliminated as errors could lead to problems within the system. The security features also need to be tested. Although only basic security is needed it would still be desirable to prevent other people from changing things in the home. Various type of different users form different level and location to ensure the system is really meet the developer requirement. Starting with advanced users who are more

3.3 Monitoring and evaluation

The monitoring and evaluating phases are performed to confirm that the application being tested meet its objective. Apart from that, they are also conducted in order to provide confidence to the user as well as developer and to ensure that the system work efficiently before it is formally delivered to real life. To provide confidence and work efficiently before it is formally delivered to real life. If any problem occurs at this phase the application must be recode to

overcome the errors. The questionnaire is also being distributed during this phase as to ensure the quality of the application meet the user's needs.

Interface

The issue is more into human computer interaction concept. User will be asked regarding their satisfaction about the creativity and interactivity of the design. The elements that are going to be focused are font usage, color, and button arrangement. The unimportant things such as text picture or button must be deleting or exclude to the application interface. The simple interface is better to user because it easy to understand.

Reliability

This questionnaire is to make sure that the application is error free, so the application can run smoothly and to avoid any conflict later. The system will test frequently after small changes that made at the system to ensure the updated version will not make the system not running smoothly or the overall system will corrupted and cannot used anymore.

Video streaming

The questionnaire is about camera streaming quality, focusing on time and image that will be played in the application. There are two videos user can view for the client application interface and one video at the server application. The applications that play at embedded Windows Media Player at both applications are the image that captured from static web cam and stream using Media Encoder 9. For another one capture camera that can view at client application interface was captured from wireless camera, this image was stream using TOMCAT server.

Device Controller response

Time taken for device controller to response when user triggers the button at client application, it also examines the network connectivity. However user will

not see the response because the controller is located at the server, the user can evaluate it depend on the message that user will reply after action that was made by user.

Technological

The questionnaire will be soliciting from a user about application technology, whether or not it can be applied at real world and whether this application is useful to them. This evaluation also based on user acceptance for this application between existing products. Maybe there are several product can be found at the market nowadays but the feature or interface may different.

Overall

Overall rating for the application, if the application design is outstanding user will give the 5 stars. The evaluation is considering on overall impression from user either get from tangible or intangible question that was asked. From this result it will cause the developer to enhance the product.

CHAPTER 4

RESULT AND DISCUSSION

4.0 Introduction

There are two questionnaires stages given during the survey. First questionnaire is for information gathering and second questionnaire at testing, monitoring and maintaining phase. The result from the survey stated in the following section.

4.1 Data Gathering questionnaire

The questionnaire is done because it was a one of the step to get the view or ideas and interest from user that will use this project. Based on the result that gained from the session it will help in analyzing phase and the consideration of usage can be design later on.

Question 1

How frequent do you utilize internet connection?

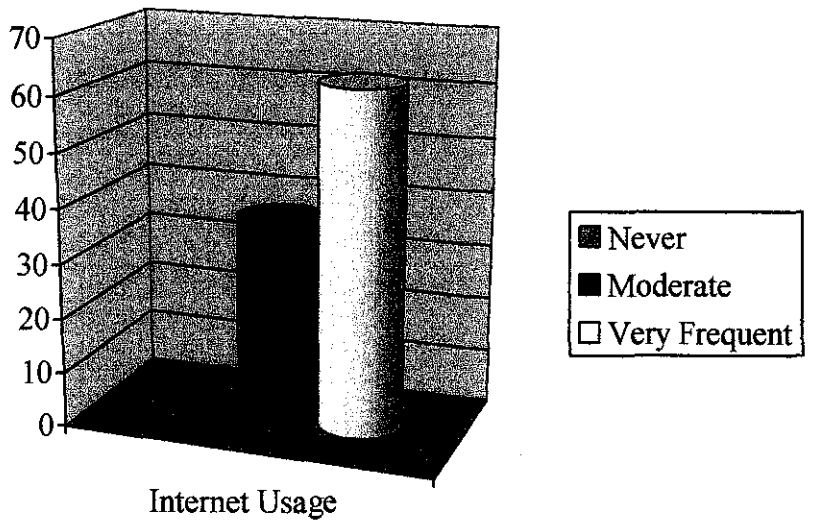

Figure 14: Internet Usage

From the graph above, it show the percentage of how frequent the user using an Internet connection, the yellow graph was indicate at the 62% of user was use the Internet very frequent. It shows user will use internet connection every day during working day, from the result is show from the graph, the project regarding to the Internet connection can be proceed and may achieve the target. This statement can be proved because the user of the system can monitor their house at office eight hours non stop beside online the chatting program like Yahoo Messenger all the time during work hours.

Question 2

Where that you get the internet connection (outside your home)?

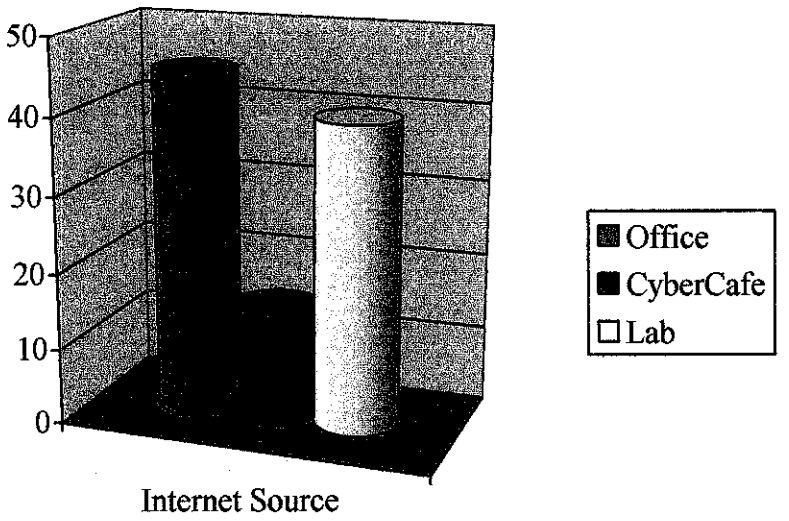

Figure 15: Internet Connection Place

The Figure 15 is indicating the result that was gathered from user about the workplace that they use an Internet connection. There were three common places stated for questionnaire survey; office where place for user do their work, cybercafé where to user go if they want use the Internet if the user out of workplace or home and the lab. The lab was stated in the questionnaire because same of the respondents students or people who were work at computer lab. The most popular place where the users use an Internet connection besides their home is office, and the second is lab and the least is cybercafé.

Question 3

Do you know your computer can control your electrical appliances?

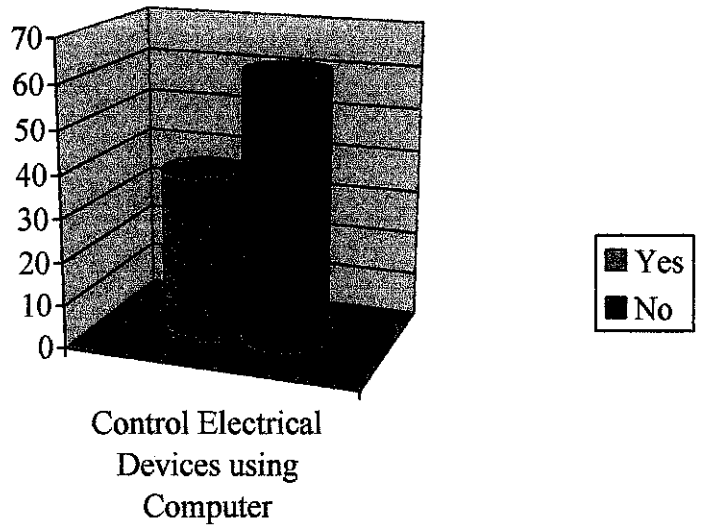

Figure 16: Control Electrical Device using Computer

The results that showed from the graph in figure 16 indicate the percentage of user that aware about computer has ability to control the electrical appliances, 62% of user did not know was that computer can control the electrical appliances. From the result, the summarization can be made is, computer user doesn't know most of the user are not realize the overall ability of personal computer instead of typing document, playing games, chatting and many other entertainment.

Question 4

Are you aware of the electrical appliances at your home can be control from network or internet?

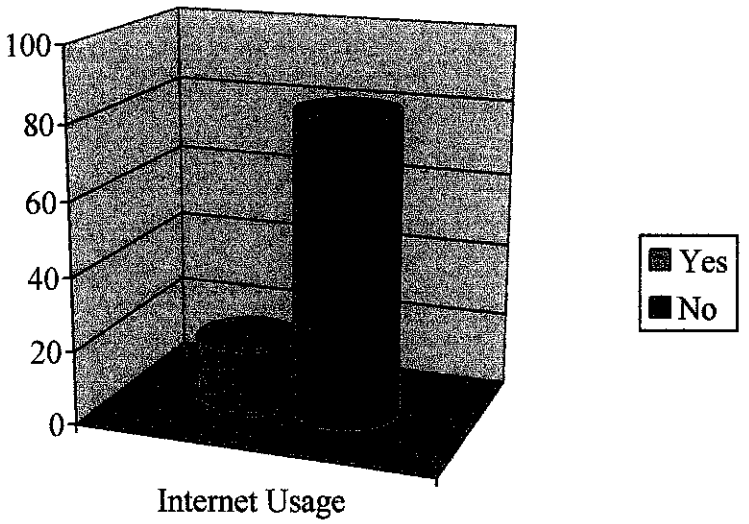

Figure 17: Control Electrical Device through Internet

Figure 17 shows the result from the data gathering questionnaire number four which asking about the familiarity of user that known the ability to control the electrical appliances over the Internet. From the result it indicates 83% of user not familiar with that technology, only a few of them was familiar with it and majority that known with the technology is IT literate people who updates with computer technology, and some of then that has electrical engineering background.

Question 5

How long you working with you personal computer with internet connection for one day?

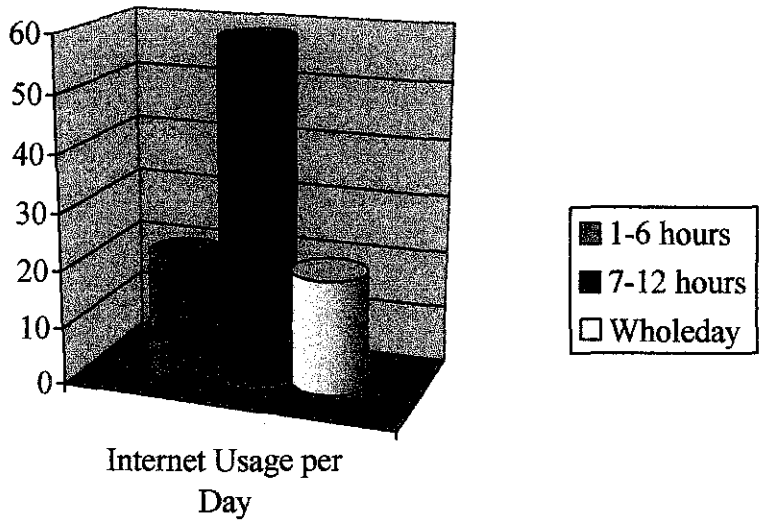

Figure 18: Internet Usage per day

Figure 18 refers the result gather from question number 5 in data gathering phase. There are 3 criteria that can be selected by respondent to state the range of time that they use and Internet connection. The highest percentage is criteria number 2 which the usage range is 7 to 12 hours per day. This is the highest result because most of the respondents use the Internet during working hours. From the result show most of the respondents use an Internet connection about 1 hour.

Question 6

If you leave your home for holiday purpose, who did you call to monitor your house?

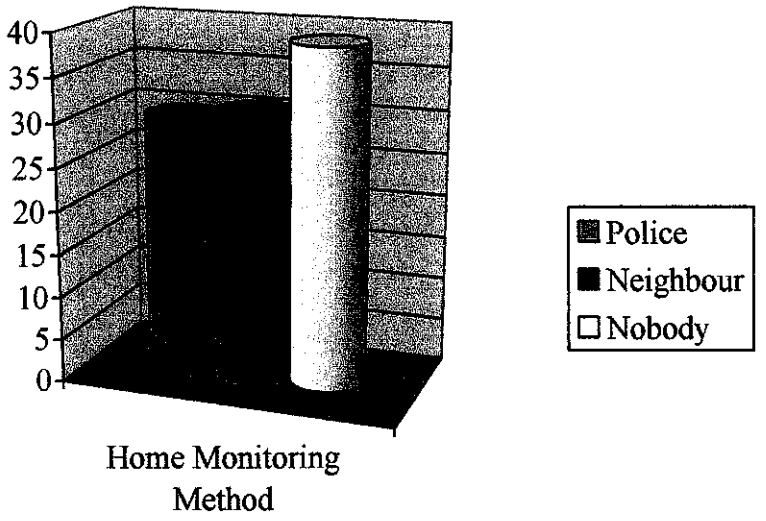

Figure 19: Home Monitoring Method

Figure 19 is indicating the result that was gathered from question 6 in data gathering phase. The percentage show the user will not ask for help from other people to monitoring their home when leaving for vacation or out-station. The respondent who that ask help from police and neighbors share same percentage. So the application that will be developed may help the user who not asking for helps from neighbors to keep an eye on their house while they leave there are not at home.

4.2 Testing Monitoring

The questionnaire has been done to get the opinions from the user about the user acceptance of the application that has been developed. Based on the data gathered from the questionnaire, the result was is very useful in making this project reliable. The data that gathered have been analyzed and the result is shown in Figure 20.

GROUP A – Information Technology Building 2 Respondent
GROUP B – V4A Boy Residential Respondent
GROUP C – V4C Girl Residential Respondent
GROUP D – V4D Girl Residential Respondent
GROUP E – V4E Boy Residential Respondent

Interface

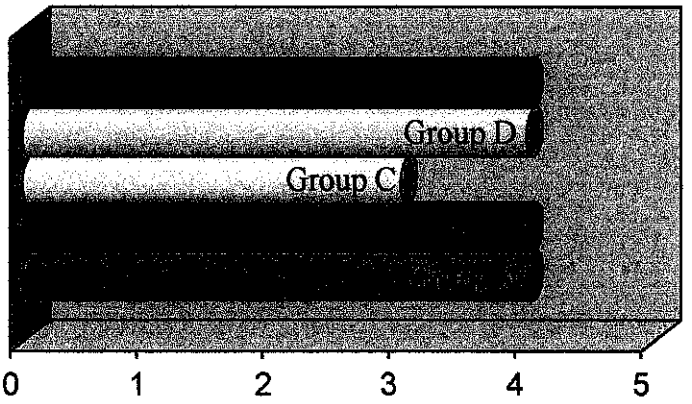

Figure 20: Interface Evaluation

From the figure 20, it shows the rating of the interface that was given by the users. The lowest rating is three and the highest rating is four, from the graph it also indicates four group was rate the interface at four star, it means the users accept the interface and it may be a friendly application to them. User from group C leaved a comment why they gave only the three star of rating range because the

interface that controls the movement of remote control camera is not using a keyboard.

Camera streaming

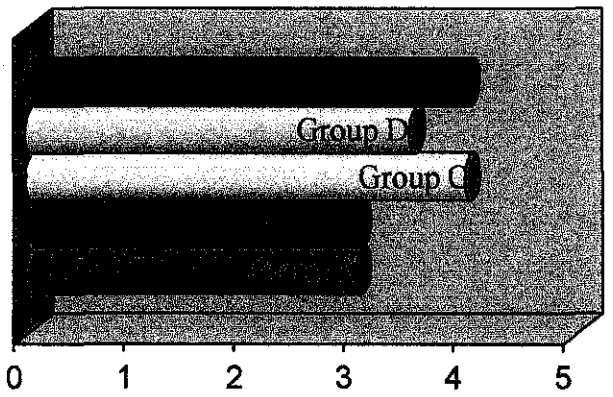

Figure 21: Camera Streaming Evaluation

From the figure 21, it is indicates the respond from user about the camera streaming that can view at client application. Average mark given for camera streaming evaluation is three, and a few comments that stated that the streaming is not an efficient real time; it was lagging about 6 – 7 sec and this problem occurs because of the limitation from the encoder. For the encoder that has been used by this application, it is the normal for camera to take about 6 – 7 seconds to refresh the captured image. Thus, to overcome the problem new algorithms focus on streaming the image only.

Connection response

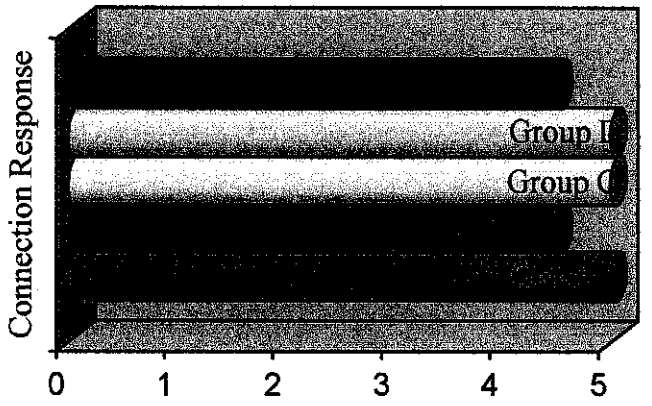

Figure 22: Connection Response Evaluation

The graph that shows in figure 22 shown indicates the connection response in order for client to connect to the server. The rate that was given by user is almost 5, because the users just run the application within intranet connection. The traffic for the intranet network is not too busy or peak. But if the testing is done using Internet connection the result may be not the same because internet connection needs some time to wait for connection success and it is busier than intranet connection. It is also depend on bandwidth and transfer rate byte per second (dial –up and broadband) in a connection

Device Controller response

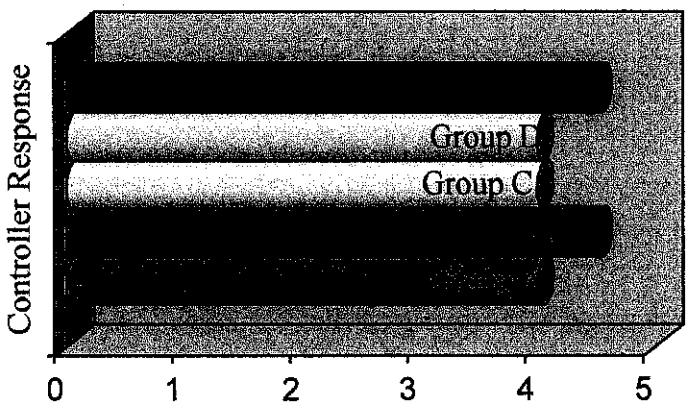

Figure 23: Controller Response Evaluation

The device controller response is intended in evaluation done to indicate how efficient and the data transmit from server to device controller questionnaire. The average rating that was given is four. The device controller normally responds on every single click, means when the device one button is pressed, immediately application sends a signal to device controller through parallel port a lagging time for the response is very diminutive.

Technological

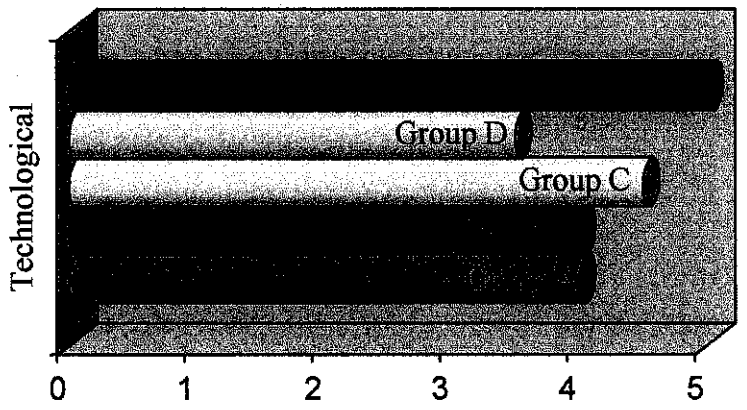

Figure 24: Technological Evaluation

The technological evaluation purpose is to know how good the application is. From the result that shown on the graph, it indicates one user give a 5 star level range means it is outstanding and the lowest is 3.5. From the result, the assumption that can be made is the application is acceptable as a new technological application and it meets the user need for the decade nowadays.

Overall

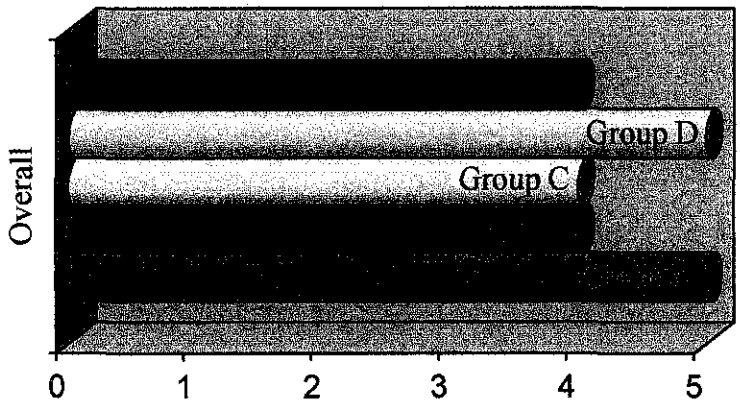

Figure 25: Overall Evaluation

The overall rating that shown by the graph above indicates the satisfaction from the user about the application that was developed. It also shows that most of the users were impressed by the performance and functionalities of the system. They believe that it is suitable to assist users for daily purposes.

4.3 Conclusion

based on all result of data that was gathered at evaluation phase, it can concluded that most of the user who answered the questionnaire are not familiar or had an experience in using the remote control application. Some of them know that electrical devices can be controlled using a personal computer, however the controlling devices application over Internet is still new for them..

CHAPTER 5

5.0 Conclusion and recommendation

Based on result and discussion, it shows that users can maximize the usage of Internet and the ability of the Internet connection beside browsing the web page to get information or checking the e-mail or some business matter likes e-commerce, e-business and online banking.

The implementation of this application will help a user or people who most of the time was not at their home. By using remote control application the user can monitor the electrical appliances at home, however but not all appliances that user can monitor, they only can monitor those are connected to the device controller through printer port at PC. For this project there are only eight devices can be connected to the device controller.

The are some limitation for this application, if the user who has a router at their house to share the Internet connection from one cable or modem, the application must be reprogrammed to allow the user set the port. The application needs the port forwarding. The case is, when the one line Internet connection shared together the Internet IP the client application cannot recognize which PC declared as a server, so the port forwarding will identify which PC that has been setup as server for the application.

Besides that, the network setting at some work place also must be considered. For example, the big corporate office normally has settings that filter the connection to some servers. When this case happened the user cannot make connection to the some particular servers any more. This limitation only can overcome if network administrator allows the outgoing connection, from the office network.

As a conclusion, this application may help the user in monitoring their room or home and fully utilize the internet connection. Somehow a few improvements must be performed to ensure the more effective functionalities and user satisfaction in using the application especially on streaming an image. The interface upgrade that was requested by user also must be considered to make the system easier to control and understand. The last enhancement is Network limitations, it must be focused to make this system able to run or access in corporate network administrative setting.

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Books

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[2] Petroutsos, E. (1998). *Mastering Visual Basic 6.* Alameda, CA: SYBEX

[3] Brown, S. (1999). *Visual Basic ® 6 Complete.* Alameda, CA: SYBEX

[4] Petroutsos, E. (1999). *Visual Basic 6 Developer's Handbook.* Alameda, CA: SYBEX

Journals

[5] Gadre, D.V. and Stein, L.A. (1997), *Revisiting the parallel printer adapter.*

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[6] Boondog's tutorial provides you with do-it-yourself-style articles. These WebPages show to interface devices to your PC. Devices like motors, relays, A/D and D/A converters, LCDs, keypads etc. http://www.boondog.com

[7] Computerize room and house : http://www.aaroncake.net/circuits/crombuld.htm

[8] Parallel port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes parallel port popular in electronics hobbyist world. http://www.logix4u.net/

[9] Control LED using parallel port example : http://www.codeproject.com/csharp/csppleds.asp

[10] Appying the parallel port to drive a LED and read a switch from tcl by Theo : http://wiki.tcl.tk/10431

[11] www.iiit.net/research/vlsi/projects/ LSIReports/AbstractControlling.pdf

[12] http://www3.tsl.uu.se/~micke/WASA/Control_via_Internet/control _via_net.html; Author: Micke Pettersson, pettersson@tsl.uu.se, ph 3178

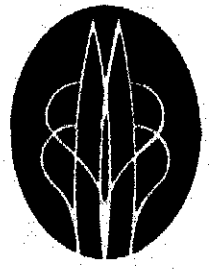
[13] www.controlanything.com

[14] www.lvr.com/devicecontroller.htm

[15] www.epanarama.net/circuits/parallel_output.html

APPENDIXES

Questionnaire sample for user acceptance testing



UNIVERSITI
TEKNOLOGI
PETRONAS

JULY 2005 FINAL YEAR PROJECT

"CLIENT – SERVER DEVICE CONTROLLER
(Control home electrical items through Internet/intranet connection)"

IRWAN BIN IBRAHIM

2206

INFORMATION TECHNOLOGY

irwanbibrahim@gmail.com

Questionnaire example

Questionnaire for analysis purposes

Respondent background

Name : _____ Course: _____

Instruction: Please tick [x] your respond for each question.

How frequent do you utilize Internet connection?

[ ] Never [ ] Moderate [ ] Very frequent

Where that you get the Internet connection (outside your home)?

[ ] Office [ ] Cybercafé [ ] Lab

Do you know your computer can control your electrical appliances?

[ ] Yes [ ] No

Are you aware of the electrical appliances at your home can be control from network or Internet?

[ ] Yes (if yes) How:

[ ] No

How long you working with you personal computer with Internet connection for one day?

[ ] 1- 6 hours [ ] 7 – 12 hours [ ] whole day

If you leave your home for holiday purpose, who did you call to monitor your house?

[ ] Police [ ] Neighborhoods [ ] Nobody

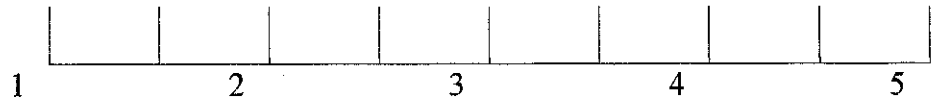
Questionnaire for testing purposes

Respondent background

Name : _____ Course: _____

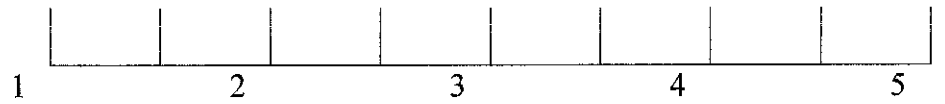
Instruction: Please tick [Φ] your respond for each question.

Rate for application interface



Comments: _____

Rate for camera streaming

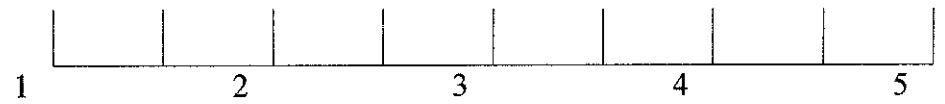


Comments: _____

Rate for connection response

Comments: _____

Rate for controller response

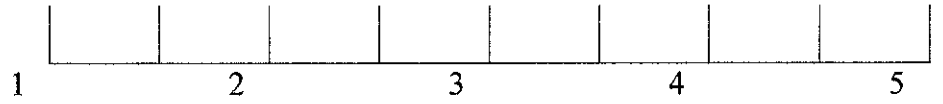


Comments: _____

Rate for technological

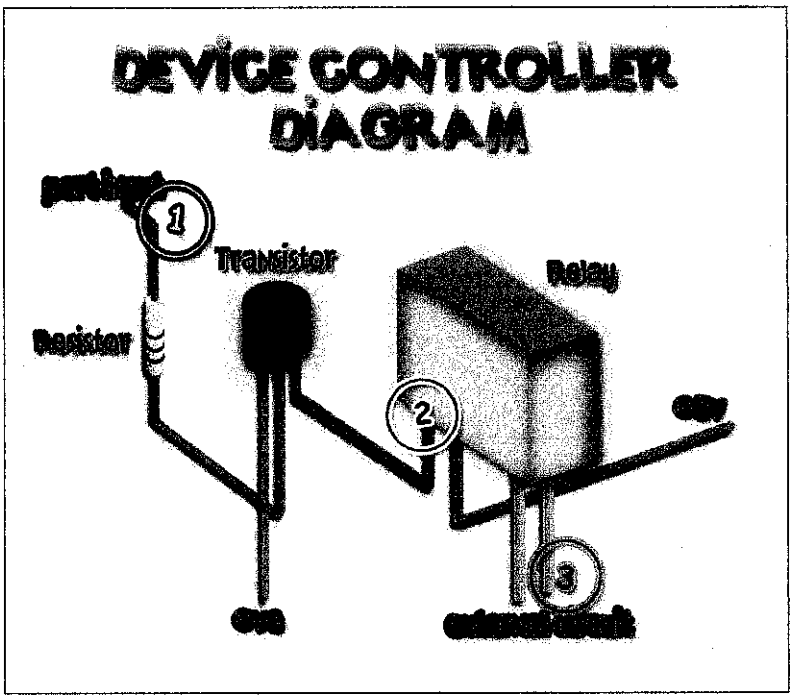
Comments: _____

Rate for overall

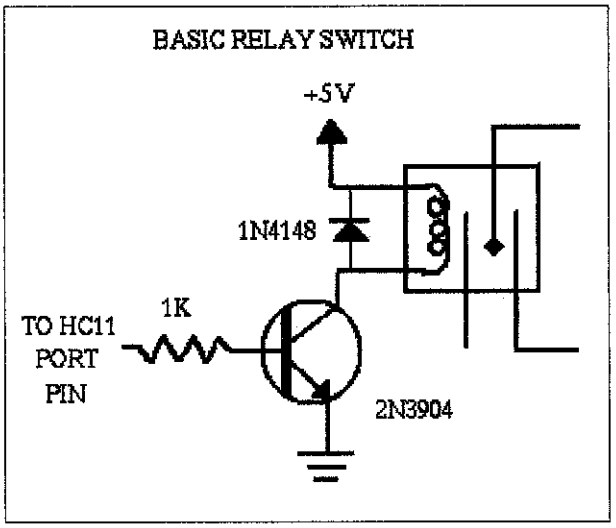


Comments: _____

Device Controller Circuit

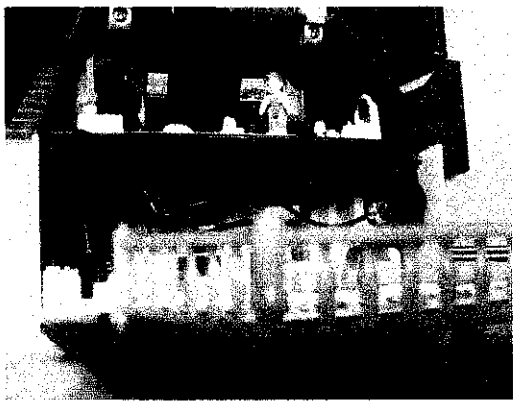


Appendix 1: Relay Circuit

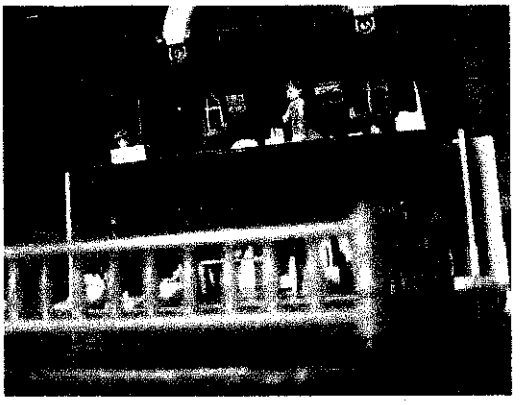


Appendix 2: Relay Circuit Diagram

Final Product

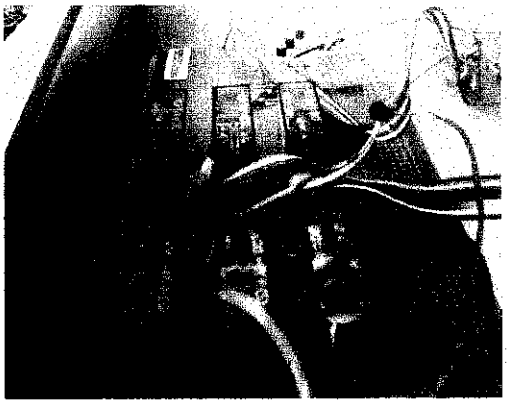


Appendix 3: Final Product

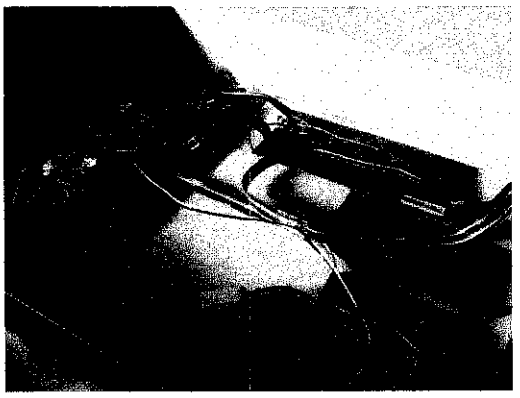


Appendix 4: Final Product

Appendix 5: Final Product

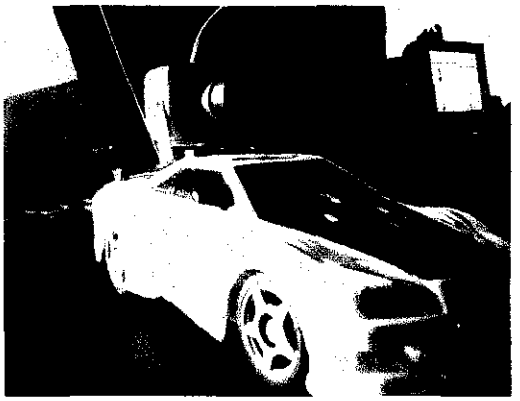


Appendix 6: Device Controller

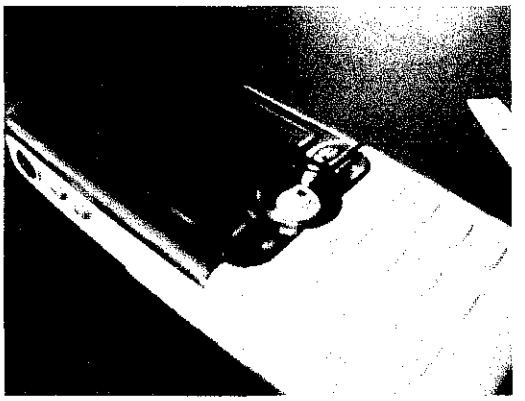


Appendix 6: Device Controller

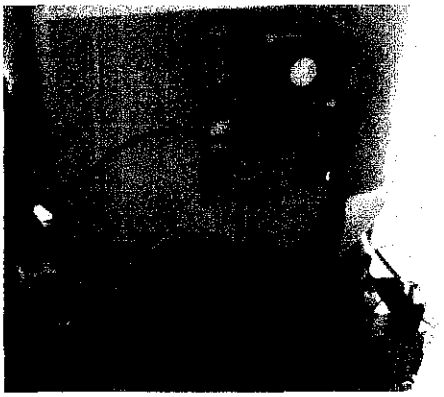
Appendix 7: Device Controller



Appendix 8: Remote Camera



Appendix 9: SMS phone server



Appendix 10: Client Server Device Controller Server

Coding Phrase

SERVER

```
Module
LPT declaration

Public Declare Function Inp Lib "inpout32.dll" _
Alias "Inp32" (ByVal PortAddress As Integer) As Integer
Public Declare Sub Out Lib "inpout32.dll" _
Alias "Out32" (ByVal PortAddress As Integer, ByVal Value As Integer)
Public Declare Sub Sleep Lib "Kernel32" (ByVal dwMilliseconds As Long)
```

```
Main Form Coding

Option Explicit
Dim PortAddress As Integer
Dim Self As Boolean

Private Sub ControlCheck_Click(Index As Integer)
  If Self Then Exit Sub
  Dim register As Byte
  register = Inp(PortAddress + 2)
  register = register Xor 2 ^ Index
  Out PortAddress + 2, register
End Sub

Private Sub bitLabel_Click(Index As Integer)
End Sub

Private Sub ActiveXPlugin1_GotFocus()

End Sub

Private Sub Auto_Click()
    controlSetting.Visible = True
End Sub

Private Sub camLeft_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
    DataCheck(0).Value = 1
End Sub

Private Sub camLeft_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
    DataCheck(0).Value = 0
End Sub

Private Sub camRight_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
    DataCheck(1).Value = 1
End Sub

Private Sub camRight_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
    DataCheck(1).Value = 0
End Sub

Private Sub checksms_Timer()

    StatusLabel.Caption = "Downloading messages"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)

End Sub

Private Sub check_Timer()

    check.Enabled = False
    recheck.Enabled = True
    StatusLabel.Caption = "checking messages"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)

End Sub

Private Sub cmdFanOff_Click()
    FanStatus.Caption = "Fan OFF"
    DataCheck(7).Value = 0
    cmdFanOff.Enabled = False
    cmdFanOn.Enabled = True
End Sub

Private Sub cmdFanOn_Click()
    FanStatus.Caption = "Fan ON"
    DataCheck(7).Value = 1
    cmdFanOn.Enabled = False
cmdFanOff.Enabled = True
End Sub

Private Sub cmdLampOff_Click()
```

```
    lampStatus.Caption = "Lamp OFF"
    DataCheck(6).Value = 0
    cmdLampOff.Enabled = False
    cmdLampOn.Enabled = True
End Sub

Private Sub cmdLampOn_Click()
    DataCheck(6).Value = 1
    lampStatus.Caption = "Lamp ON "
    cmdLampOn.Enabled = False
    cmdLampOff.Enabled = True
End Sub

Private Sub cmdReset_Click()

    Dim t As Integer
    For t = 0 To 5
    direction(t).Text = "static"
    motion(t).Text = 0
    sec(t).Text = 0
    Next

    cmdReset.Enabled = False
    set2.Enabled = False
    set3.Enabled = False
    set4.Enabled = False
    set5.Enabled = False
    set6.Enabled = False

    Dim resetoption As Integer

    For resetoption = 0 To 5
    Option1(resetoption).Value = False
    Option2(resetoption).Value = False
    Option3(resetoption).Value = False
    Option4(resetoption).Value = False
    Option5(resetoption).Value = False
    Option6(resetoption).Value = False
    Next

End Sub

Private Sub cmdStart_Click()

    Dim dataArray(6) As Single
    Dim Control As Integer

    dataArray(0) = motion(0).Text
    dataArray(1) = motion(1).Text
    dataArray(2) = motion(2).Text
    dataArray(3) = motion(3).Text
    dataArray(4) = motion(4).Text
    dataArray(5) = motion(5).Text
    dataArray(6) = 0

    For Control = 0 To 1
    Out PortAddress, dataArray(Control)
    Sleep (sec(0).Text * 500)
    Next

    For Control = 1 To 2
    Out PortAddress, dataArray(Control)
    Sleep (sec(1).Text * 500)
    Next

    For Control = 2 To 3
    Out PortAddress, dataArray(Control)
    Sleep (sec(2).Text * 500)
    Next

    For Control = 3 To 4
    Out PortAddress, dataArray(Control)
    Sleep (sec(3).Text * 500)
    Next

    For Control = 4 To 5
    Out PortAddress, dataArray(Control)
    Sleep (sec(4).Text * 500)
    Next

    For Control = 5 To 6
    Out PortAddress, dataArray(Control)
    Sleep (sec(5).Text * 500)
    Next

    MsgBox ("Auto Sequence Completed!!")

End Sub
```

```
Private Sub Command4_Click()
    seq3.Visible = True
End Sub

Private Sub Command5_Click()
    Seq4.Visible = True
End Sub

Private Sub Command6_Click()
    seq5.Visible = True
End Sub

Private Sub Command7_Click()
    seq6.Visible = True
End Sub

Private Sub Command1_Click()
    controlSetting.Visible = False

    seq1.Visible = False
    seq2Control.Visible = False
    seq3.Visible = False
    Seq4.Visible = False
    seq5.Visible = False
    seq6.Visible = False

End Sub

Private Sub connected_Timer()

    StatusLabel.Caption = "Auto Check"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)
    connected.Enabled = False

End Sub

' Change one bit in the data register.

Private Sub DataCheck_Click(Index As Integer)
    If Self Then Exit Sub

    Dim register As Byte
    register = Inp(PortAddress)
    register = register Xor 2 ^ Index
    Out PortAddress, register

    'device indicator

    If (DataCheck(0).Value) = 1 Then
    Shape1(1).FillStyle = 0
    Shape1(0).FillStyle = 1
    Else
    Shape1(0).FillStyle = 0
    Shape1(1).FillStyle = 1
    End If

    If (DataCheck(1).Value) = 1 Then
    Shape1(3).FillStyle = 0
    Shape1(2).FillStyle = 1
    Else
    Shape1(2).FillStyle = 0
    Shape1(3).FillStyle = 1
    End If

    If (DataCheck(2).Value) = 1 Then
    Shape1(5).FillStyle = 0
    Shape1(4).FillStyle = 1
    Else
    Shape1(4).FillStyle = 0
    Shape1(5).FillStyle = 1
    End If

    If (DataCheck(3).Value) = 1 Then
    Shape1(7).FillStyle = 0
    Shape1(6).FillStyle = 1
    Else
    Shape1(6).FillStyle = 0
    Shape1(7).FillStyle = 1
    End If

    If (DataCheck(4).Value) = 1 Then
    Shape1(9).FillStyle = 0
    Shape1(8).FillStyle = 1
    Else
    Shape1(8).FillStyle = 0
    Shape1(9).FillStyle = 1
    End If
```

```
    If (DataCheck(5).Value) = 1 Then
    Shape1(11).FillStyle = 0
    Shape1(10).FillStyle = 1
    Else
    Shape1(10).FillStyle = 0
    Shape1(11).FillStyle = 1
    End If

    If (DataCheck(6).Value) = 1 Then
    Shape1(13).FillStyle = 0
    Shape1(12).FillStyle = 1
    Else
    Shape1(12).FillStyle = 0
    Shape1(13).FillStyle = 1
    End If

    If (DataCheck(7).Value) = 1 Then
    Shape1(15).FillStyle = 0
    Shape1(14).FillStyle = 1
    Else
    Shape1(14).FillStyle = 0
    Shape1(15).FillStyle = 1
    End If
  End Sub

Private Sub disconnect_Timer()

    disconnect.Enabled = False
    reconnect.Enabled = True
    MemList.Clear
    WAMPLE1.disconnect

End Sub

' Start on parallel port #1.
Private Sub Form_Load()

    PortList.ListIndex = 0
    PortConfigText.Text = WAMPLE1.portconfig

    'Read data register

    PortAddress = &H378
    cmdSend.Enabled = False
    tcpServer.LocalPort = 5000

    Call tcpServer.Listen
    Dim registerCheckLoad As Byte
    Dim k As Byte, l As Byte, m As Byte, op As Byte
    Self = True ' avoid recursive changes

    registerCheckLoad = Inp(PortAddress)
    k = 6
    l = 7
    m = 0
    op = 1

    If registerCheckLoad And 2 ^ op Then
    DataCheck(op).Value = 1
    radiostatus.Caption = "Radio is ON "
    RadioInd.FillColor = &HFF00&
    RadioOn.Visible = False
    radioOff.Visible = True
    Else
    DataCheck(op).Value = 0
    radiostatus.Caption = "Radio is OFF"
    RadioInd.FillColor = &HFF&
    RadioOn.Visible = True
    radioOff.Visible = False
    End If

    If registerCheckLoad And 2 ^ k Then
    DataCheck(k).Value = 1
    lampStatus.Caption = "Lamp ON "
    Shape1(13).FillStyle = 0
    cmdLampOn.Enabled = False
    cmdLampOff.Enabled = True
    Else
    DataCheck(k).Value = 0
    lampStatus.Caption = "Lamp OFF"
    cmdLampOn.Enabled = True
    cmdLampOff.Enabled = False
    End If

    If registerCheckLoad And 2 ^ l Then
    FanStatus.Caption = "Fan ON"
    Shape1(15).FillStyle = 0
    DataCheck(l).Value = 1
    cmdFanOn.Enabled = False
```

```
    cmdFanOff.Enabled = True
    Else
    DataCheck(1).Value = 0
    FanStatus.Caption = "Fan OFF"
    cmdFanOn.Enabled = True
    cmdFanOff.Enabled = False
    End If

    If registerCheckLoad And 2 ^ m Then
    DataCheck(m).Value = 1
    tablampind.Caption = "Table Lamp was ON "
    tablampstatus.FillColor = &HFF00&
    tabLampOff.Visible = True
    TabLampOn.Visible = False
    Else
    DataCheck(m).Value = 0
    tablampind.Caption = "Table Lamp was OFF "
    tablampstatus.FillColor = &HFF&
    tabLampOff.Visible = False
    TabLampOn.Visible = True
    End If

End Sub

Private Sub lampTimer_Click()

    timeSetFrame.Visible = True

End Sub

Private Sub mnuAbout_Click()

    About.Show

End Sub

Private Sub mnuDisconnect_Click()

    Unload Server_Form
    frmSplash.Show

End Sub

Private Sub mnuExit_Click()
    frmSplash.Show
    Unload Me
End Sub

Private Sub mnuTurnOff_Click()

    MsgBox ("Are you sure to shutdown the device controller?")
    Unload Me
    shutdown.Show

End Sub

Private Sub Option1_Click(Index As Integer)

    If Option1(0).Value = True Then
    motion(0).Text = 4
    seq1.Visible = False
    direction(0).Text = "Forward"
    End If

    If Option1(1).Value = True Then
    motion(0).Text = 36
    seq1.Visible = False
    direction(0).Text = "Forward Left"
    End If

    If Option1(2).Value = True Then
    motion(0).Text = 20
    seq1.Visible = False
    direction(0).Text = "Forward Right"
    End If

    If Option1(3).Value = True Then
    motion(0).Text = 8
    seq1.Visible = False
    direction(0).Text = "Backward"
    End If

    If Option1(4).Value = True Then
    motion(0).Text = 40
    seq1.Visible = False
    direction(0).Text = "Backward Left"
    End If

    If Option1(5).Value = True Then
```

```
    motion(0).Text = 24
    seq1.Visible = False
    direction(0).Text = "Backward Right"
    End If

End Sub

Private Sub Option2_Click(Index As Integer)

    If Option2(0).Value = True Then
    motion(1).Text = 4
    seq2Control.Visible = False
    direction(1).Text = "Forward"

End If

    If Option2(1).Value = True Then
    motion(1).Text = 36
    seq2Control.Visible = False
    direction(1).Text = "Forward Left"

End If

    If Option2(2).Value = True Then
    motion(1).Text = 20
    seq2Control.Visible = False
    direction(1).Text = "Forward Right"
    End If

    If Option2(3).Value = True Then
    motion(1).Text = 8
    seq2Control.Visible = False
    direction(1).Text = "Backward"
    End If

    If Option2(4).Value = True Then
    motion(1).Text = 40
    seq2Control.Visible = False
    direction(1).Text = "Backward Left"
    End If

    If Option2(5).Value = True Then
    motion(1).Text = 24
    seq2Control.Visible = False
    direction(1).Text = "Backward Right"
    End If

End Sub

Private Sub Option3_Click(Index As Integer)

    If Option3(0).Value = True Then
    motion(2).Text = 4
    seq3.Visible = False
    direction(2).Text = "Forward"
    End If

    If Option3(1).Value = True Then
    motion(2).Text = 36
    seq3.Visible = False
    direction(2).Text = "Forward Left"
    End If

    If Option3(2).Value = True Then
    motion(2).Text = 20
    seq3.Visible = False
    direction(2).Text = "Forward Right"
    End If

    If Option3(3).Value = True Then
    motion(2).Text = 8
    seq3.Visible = False
    direction(2).Text = "Backward"
    End If

    If Option3(4).Value = True Then
    motion(2).Text = 40
    seq3.Visible = False
    direction(2).Text = "Backward Left"
    End If

    If Option3(5).Value = True Then
    motion(2).Text = 24
    seq3.Visible = False
    direction(2).Text = "Backward Right"
    End If

End Sub
```

```
Private Sub Option4_Click(Index As Integer)

    If Option4(0).Value = True Then
    motion(3).Text = 4
    Seq4.Visible = False
    direction(3).Text = "Forward"
    End If

    If Option4(1).Value = True Then
    motion(3).Text = 36
    Seq4.Visible = False
    direction(3).Text = "Forward Left"
    End If

    If Option4(2).Value = True Then
    motion(3).Text = 20
    Seq4.Visible = False
    direction(3).Text = "Forward Right"
    set5.Enabled = True
    End If

    If Option4(3).Value = True Then
    motion(3).Text = 8
    Seq4.Visible = False
    direction(3).Text = "Backward"
    End If

    If Option4(4).Value = True Then
    motion(3).Text = 40
    Seq4.Visible = False
    direction(3).Text = "Backward Left"
    End If

    If Option4(5).Value = True Then
    motion(3).Text = 24
    Seq4.Visible = False
    direction(3).Text = "Backward Right"
    End If

End Sub

Private Sub Option5_Click(Index As Integer)

    If Option5(0).Value = True Then
    motion(4).Text = 4
    seq5.Visible = False
    direction(4).Text = "Forward"
    End If

    If Option5(1).Value = True Then
    motion(4).Text = 36
    seq5.Visible = False
    direction(4).Text = "Forward Left"
    End If

    If Option5(2).Value = True Then
    motion(4).Text = 20
    seq5.Visible = False
    direction(4).Text = "Forward Right"
    End If

    If Option5(3).Value = True Then
    motion(4).Text = 8
    seq5.Visible = False
    direction(4).Text = "Backward"
    End If

    If Option5(4).Value = True Then
    motion(4).Text = 40
    seq5.Visible = False
    direction(4).Text = "Backward Left"
    End If

    If Option5(5).Value = True Then
    motion(4).Text = 24
    seq5.Visible = False
    direction(4).Text = "Backward Right"
    End If

End Sub

Private Sub Option6_Click(Index As Integer)

    If Option6(0).Value = True Then
    motion(5).Text = 4
    seq6.Visible = False
    direction(5).Text = "Forward"
    End If
```

```
    If Option6(1).Value = True Then
    motion(5).Text = 36
    seq6.Visible = False
    direction(5).Text = "Forward Left"
    End If

    If Option6(2).Value = True Then
    motion(5).Text = 20
    seq6.Visible = False
    direction(5).Text = "Forward Right"
    End If

    If Option6(3).Value = True Then
    motion(5).Text = 8
    seq6.Visible = False
    direction(5).Text = "Backward"
    End If

    If Option6(4).Value = True Then
    motion(5).Text = 40
    seq6.Visible = False
    direction(5).Text = "Backward Left"
    End If

    If Option6(5).Value = True Then
    motion(5).Text = 24
    seq6.Visible = False
    direction(5).Text = "Backward Right"
    End If

End Sub

' Repeat Len times a second.
Private Sub Poll_Timer()

  Dim register As Byte
  Dim i As Byte
  Self = True ' avoid recursive changes

  ' Read data register
  register = Inp(PortAddress)
  For i = 0 To 7
  If register And 2 ^ i Then
  DataCheck(i).Value = 1
  Else
  DataCheck(i).Value = 0
  End If
  Next i
  Self = False

End Sub

  Private Sub cmdSend_Click()
  ' Send following text data to the client
  Call tcpServer.SendData("<< Server >> " & txtSend.Text & vbCrLf)
  ' Repeat text data in server's txtOutput.Text window
  txtOutput.Text = txtOutput.Text & "<< Server >> " & txtSend.Text & vbCrLf
  txtOutput.SelStart = Len(txtOutput.Text)
  ' Clear the txtSend.Text window"
  txtSend.Text = ""
  'txtOutput.SelStart = Len(txtOutput.Text)

  End Sub

  Private Sub Form_Terminate()

  Call tcpServer.Close

  End Sub

Private Sub radioOff_Click()

    RadioInd.FillColor = &HFF&
    radiostatus.Caption = " Radio is OFF "
    DataCheck(1).Value = 0
    RadioOn.Visible = True
    radioOff.Visible = False

End Sub

Private Sub RadioOn_Click()

    RadioInd.FillColor = &HFF00&
    radiostatus.Caption = " Radio is ON "
    DataCheck(1).Value = 1
    RadioOn.Visible = False
    radioOff.Visible = True

End Sub
```

```
Private Sub rcBL_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 1
    DataCheck(5).Value = 1

End Sub

Private Sub rcBL_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 0
    DataCheck(5).Value = 0

End Sub

Private Sub rcBR_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 1
    DataCheck(4).Value = 1

End Sub

Private Sub rcBR_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 0
    DataCheck(4).Value = 0

End Sub

Private Sub rcBW_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 1

End Sub

Private Sub rcBW_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(3).Value = 0

End Sub

Private Sub rcFL_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 1
    DataCheck(5).Value = 1

End Sub

Private Sub rcFL_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 0
    DataCheck(5).Value = 0

End Sub

Private Sub rcFR_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 1
    DataCheck(4).Value = 1

End Sub

Private Sub rcFR_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 0
    DataCheck(4).Value = 0

End Sub

Private Sub RCFW_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 1

End Sub

Private Sub RCFW_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)

    DataCheck(2).Value = 0

End Sub

Private Sub recheck_Timer()

    recheck.Enabled = False
    disconnect.Enabled = True
    StatusLabel.Caption = "checking messages 2"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)
```

```
End Sub

Private Sub reconnect_Timer()

    WAMPLE1.Connect
    WAMPLE1.Port = PortList.ItemData(PortList.ListIndex)
    WAMPLE1.portconfig = PortConfigText.Text
    ConnectButton.Visible = False
    StatusLabel.Caption = "Connecting.."
    reconnect.Enabled = False

End Sub

Private Sub sec_Change(Index As Integer)

    If IsNumeric(sec(0).Text) Then
    set2.Enabled = True
    direction(1).Enabled = True
    sec(1).Enabled = True
    End If

    If IsNumeric(sec(1).Text) Then
    set3.Enabled = True
    direction(2).Enabled = True
    sec(2).Enabled = True
    End If

    If IsNumeric(sec(2).Text) Then
    set4.Enabled = True
    sec(3).Enabled = True
    direction(3).Enabled = True
    sec(3).Enabled = True
    End If

    If IsNumeric(sec(3).Text) Then
    set5.Enabled = True
    sec(4).Enabled = True
    direction(4).Enabled = True
    sec(4).Enabled = True
    End If

    If IsNumeric(sec(4).Text) Then
    set6.Enabled = True
    sec(5).Enabled = True
    direction(5).Enabled = True
    sec(5).Enabled = True
    End If

End Sub

Private Sub send_Timer()

    WAMPLE1.SMSsend SendNumber.Text, SendMessage.Text
    send.Enabled = False
End Sub

Private Sub seq1set_Click()

    seq1.Visible = True

End Sub

Private Sub seq2_Click()

    seq2Control.Visible = True

End Sub

Private Sub set2_Click()

    seq2Control.Visible = True
    cmdReset.Enabled = True

End Sub

Private Sub set3_Click()

    seq3.Visible = True
    cmdReset.Enabled = True

End Sub

Private Sub set4_Click()

    Seq4.Visible = True
    cmdReset.Enabled = True

End Sub
```

```
Private Sub set5_Click()

    seq5.Visible = True
    cmdReset.Enabled = True

End Sub

Private Sub set6_Click()

    seq6.Visible = True
    cmdReset.Enabled = True

End Sub

Private Sub smscheck_Timer()

    StatusLabel.Caption = "Checking Messages check1"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)
    smscheck.Enabled = False
    'reconnect.Enabled = True

End Sub

Private Sub smsrefresh_Timer()

    StatusLabel.Caption = "Checking Messages check1"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)

End Sub

Private Sub tabLampOff_Click()

    DataCheck(0).Value = 0
    tablampstatus.FillColor = &HFF&
    tablampind.Caption = " Table Lamp is OFF "
    tabLampOff.Visible = False
    TabLampOn.Visible = True

End Sub

Private Sub TabLampOn_Click()

    tablampstatus.FillColor = &HFF00&
    tablampind.Caption = " Table Lamp is ON "
    DataCheck(0).Value = 1
    TabLampOn.Visible = False
    tabLampOff.Visible = True

End Sub

  Private Sub tcpServer_Close()
    cmdSend.Enabled = False
    Call tcpServer.Close ' client closed, server should too
    txtOutput.Text = txtOutput.Text & "Client closed connection." & vbCrLf & vbCrLf
    txtOutput.SelStart = Len(txtOutput.Text)

    Call tcpServer.Listen ' listen for next connection
  End Sub

  Private Sub tcpServer_ConnectionRequest(ByVal requestID As Long)

    ' Ensure that tcpServer is closed
    ' before accepting a new connection

    If tcpServer.State <> sckClosed Then
    Call tcpServer.Close
    End If

    cmdSend.Enabled = True
    Call tcpServer.Accept(requestID)
    ' accept connection Display following message on server application:

    Server_Form.Caption = "Parallel Port Monitor - Server connected from " &
tcpServer.RemoteHostIP
    txtOutput.Text = "The connection from IP Address: " & _
    tcpServer.RemoteHostIP & " is successful" & _
    " Port #: " & tcpServer.RemotePort & vbCrLf

    Dim registerStatus As Byte
    Dim m As Byte, n As Byte
    Self = True ' avoid recursive changes

    registerStatus = Inp(PortAddress)
    m = 6
    n = 7
    If registerStatus And 2 ^ m Then
    DataCheck(m).Value = 1
```

```
    Call tcpServer.SendData("L1")
    Else
    DataCheck(m).Value = 0
    Call tcpServer.SendData("L0")
    End If

    If registerStatus And 2 ^ n Then
    DataCheck(n).Value = 1
    Call tcpServer.SendData("F1" & vbCrLf)
    Else
    DataCheck(n).Value = 0
    Call tcpServer.SendData("F0" & vbCrLf)
    End If

End Sub

Private Sub tcpServer_DataArrival(ByVal bytesTotal As Long)

  Dim message As String
  Call tcpServer.GetData(message)

  txtOutput.Text = txtOutput.Text & message & vbCrLf
  txtOutput.SelStart = Len(txtOutput.Text)

  If message = "<< Client >> /time" Then
  Call tcpServer.SendData("<< Time >> " & Format(Now, "hh:mm AM/PM"))
  End If


  ' status check
  If message = "<< Client >> /status" Then
  Dim registerCheck As Byte
  Dim e As Byte
  Self = True ' avoid recursive changes

  ' Read data register
  registerCheck = Inp(PortAddress)
  For e = 0 To 7
  If registerCheck And 2 ^ e Then
  DataCheck(e).Value = 1
  Call tcpServer.SendData("[on]")
  Else
  DataCheck(e).Value = 0
  Call tcpServer.SendData("[off]")
  End If
  Next e
  Self = False
  End If

  ' Auto Control

  If message = " ! Auto Control Status " Then
  Call tcpServer.SendData("[controller] Car Auto Controlled" & vbCrLf)
  End If

  If message = " ! Auto Control " & vbCrLf Then
  Dim AutoControl(3) As Single
  Dim counter As Integer

  AutoControl(1) = 20
  AutoControl(2) = 0
  AutoControl(3) = 0

  For counter = 1 To 2
  Out PortAddress, AutoControl(counter)
  Sleep (3000)
  Next

  For counter = 2 To 3
  Out PortAddress, AutoControl(counter)
  Sleep (100)
  Next

  If AutoControl(3) = 0 Then
  Call tcpServer.SendData("[controller] Car Auto Control stopped " & vbCrLf)
  End If
  End If

  ' Device trigged
  ' Device 1
  If message = " ! Device 1 On " Then
  Call tcpServer.SendData("Device 1 turn on")
  DataCheck(0).Value = 1
  Shape1(0).FillStyle = 1
  Shape1(1).FillStyle = 0
  End If

  If message = " ! Device 1 Off " Then
  Call tcpServer.SendData("Device 1 turn off")
```

```
DataCheck(0).Value = 0
Shape1(1).FillStyle = 1
End If

'Device 2
If message = " Radio On " Then
Call tcpServer.SendData("[controller] Radio turn on" & vbCrLf)
DataCheck(1).Value = 1
RadioOn.Visible = False
radioOff.Visible = True
RadioInd.FillColor = &HFF00&
radiostatus.Caption = "Radio is On"
End If

If message = " Radio Off " Then
Call tcpServer.SendData("[controller] Radio turn off" & vbCrLf)
DataCheck(1).Value = 0
RadioOn.Visible = True
radioOff.Visible = False
RadioInd.FillColor = &HFF&
radiostatus.Caption = "Radio is Off"
End If

'device 3
If message = " forward " Then
Call tcpServer.SendData("[controller] move forward" & vbCrLf)
DataCheck(2).Value = 1
Shape1(4).FillStyle = 1
Shape1(5).FillStyle = 0
End If

If message = " remote release forward " Then
Call tcpServer.SendData("[controller] remote release " & vbCrLf)
DataCheck(2).Value = 0
Shape1(5).FillStyle = 1
End If

'device 4
If message = " backward " Then
Call tcpServer.SendData("[controller] move reverse" & vbCrLf)
DataCheck(3).Value = 1
Shape1(6).FillStyle = 1
Shape1(7).FillStyle = 0
End If

If message = " remote release backward " Then
Call tcpServer.SendData("[controller] remote release " & vbCrLf)
DataCheck(3).Value = 0
Shape1(7).FillStyle = 1
End If

'device 5
If message = " rightf " Then
Call tcpServer.SendData("[controller] moving to right" & vbCrLf)
DataCheck(4).Value = 1
DataCheck(2).Value = 1
Shape1(8).FillStyle = 1
Shape1(9).FillStyle = 0
End If

If message = " remote release rightf " Then
Call tcpServer.SendData("[controller] remote release" & vbCrLf)
DataCheck(4).Value = 0
DataCheck(2).Value = 0
Shape1(9).FillStyle = 1
End If

If message = " rightb " Then
Call tcpServer.SendData("[controller] moving to right" & vbCrLf)
DataCheck(4).Value = 1
DataCheck(3).Value = 1
Shape1(8).FillStyle = 1
Shape1(9).FillStyle = 0
End If

If message = " remote release rightb " Then
Call tcpServer.SendData("[controller] remote release" & vbCrLf)
DataCheck(4).Value = 0
DataCheck(3).Value = 0
Shape1(9).FillStyle = 1
End If

'device 6
If message = " leftf " Then
Call tcpServer.SendData("[controller] moving to left" & vbCrLf)
DataCheck(5).Value = 1
DataCheck(2).Value = 1
Shape1(10).FillStyle = 1
Shape1(11).FillStyle = 0
```

```
End If

If message = " remote release leftf " Then
Call tcpServer.SendData("[controller] remote release " & vbCrLf)
DataCheck(5).Value = 0
DataCheck(2).Value = 0
Shape1(11).FillStyle = 1
End If

If message = " leftb " Then
Call tcpServer.SendData("[controller] moving to left" & vbCrLf)
DataCheck(5).Value = 1
DataCheck(3).Value = 1
Shape1(10).FillStyle = 1
Shape1(11).FillStyle = 0
End If

If message = " remote release leftb " Then
Call tcpServer.SendData("[controller] remote release " & vbCrLf)
DataCheck(5).Value = 0
DataCheck(3).Value = 0
Shape1(11).FillStyle = 1
End If

'device 7
If message = " Lamp On " Then
Call tcpServer.SendData("[controller] Lamp turned On" & vbCrLf)
DataCheck(6).Value = 1
Shape1(12).FillStyle = 1
Shape1(13).FillStyle = 0
cmdLampOn.Enabled = False
cmdLampOff.Enabled = True
End If

If message = " Lamp Off " Then
Call tcpServer.SendData("[controller] Lamp turned Off" & vbCrLf)
DataCheck(6).Value = 0
Shape1(13).FillStyle = 1
cmdLampOff.Enabled = False
cmdLampOn.Enabled = True
End If

'device 8
If message = " Fan On " Then
Call tcpServer.SendData("[controller] Fan turned on" & vbCrLf)
DataCheck(7).Value = 1
Shape1(14).FillStyle = 1
Shape1(15).FillStyle = 0
cmdFanOn.Enabled = False
cmdFanOff.Enabled = True
End If

If message = " Fan Off " Then
Call tcpServer.SendData("[controller] Fan turned off" & vbCrLf)
DataCheck(7).Value = 0
Shape1(15).FillStyle = 1
cmdFanOff.Enabled = False
cmdFanOn.Enabled = True
End If

If message = " Lamp Table On " Then
Call tcpServer.SendData("[controller] Table Lamp was On " & vbCrLf)
DataCheck(0).Value = 1
tablampstatus.FillColor = &HFF00&
End If

If message = " Camera Right " Then
Call tcpServer.SendData("[controller] Camera rotate to right " & vbCrLf)
DataCheck(1).Value = 1
DataCheck(0).Value = 0
End If

If message = " Lamp Table Off " Then
Call tcpServer.SendData("[controller] Table Lamp was Off " & vbCrLf)
DataCheck(0).Value = 0
tablampstatus.FillColor = &HFF&
End If

If message = " Table Lamp Status " Then

Dim registerLampStatus As Byte
Dim z As Integer
Self = True ' avoid recursive changes
registerLampStatus = Inp(PortAddress)
z = 0
If registerLampStatus And 2 ^ z Then
DataCheck(z).Value = 1
tablampstatus.FillColor = &HFF00&
Call tcpServer.SendData("[controller] Table Lamp is On" & vbCrLf)
```

```
    Else
    DataCheck(z).Value = 0
    tablampstatus.FillColor = &HFF&
    Call tcpServer.SendData("[controller] Table Lamp is Off" & vbCrLf)
    End If
    End If

    If message = " Radio Status " Then
    Dim RadioStatusRegister As Byte
    Dim zi As Integer
    Self = True ' avoid recursive changes
    RadioStatusRegister = Inp(PortAddress)
    zi = 1
    If RadioStatusRegister And 2 ^ zi Then
    DataCheck(zi).Value = 1
    Call tcpServer.SendData("[controller] Radio is On" & vbCrLf)
    Else
    DataCheck(zi).Value = 0
    Call tcpServer.SendData("[controller] Radio is Off" & vbCrLf)
    End If
    End If

    End Sub

  Private Sub tcpServer_Error(ByVal Number As Integer, Description As String, ByVal Scode As
Long, ByVal Source As String, ByVal HelpFile As String, ByVal HelpContext As Long,
CancelDisplay As Boolean)

    Dim result As Integer
    result = MsgBox(Source & ": " & Description, _
    vbOKOnly, "TCP/IP Error")
    End

  End Sub

Private Function GetDateString(time As Date) As String

    GetDateString = Str(Hour(time)) + ":" + Str(Minute(time)) + ":" + Str(Second(time)) + " "
+ Str(Day(time)) + "/" + Str(Month(time)) + "/" + Str(Year(time))

End Function

Private Sub ConnectButton_Click()

    WAMPLE1.Port = PortList.ItemData(PortList.ListIndex)
    WAMPLE1.portconfig = PortConfigText.Text
    WAMPLE1.Connect
    ConnectButton.Visible = False
    StatusLabel.Caption = "Connecting.."
    connected.Enabled = True

End Sub

Private Sub DeleteButton_Click()

    WAMPLE1.SMSdelete MemList.List(MemList.ListIndex), EntryList.selectedItem.Tag

End Sub

Private Sub DisconnectButton_Click()

    WAMPLE1.disconnect
    ConnectButton.Visible = True
    DisconnectButton.Visible = False

End Sub

Private Sub DownloadButton_Click()

    StatusLabel.Caption = "Downloading messages"
    EntryList.ListItems.Clear
    WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)

End Sub

Private Sub EntryList_DblClick()

    MsgBox "Number: " + EntryList.selectedItem.Text + Chr(13) + "Message: " +
EntryList.selectedItem.SubItems(1) + Chr(13) + "Time: " + EntryList.selectedItem.SubItems(2),
vbOKOnly, "SMS message " + Str(EntryList.selectedItem.Tag)

End Sub


Private Sub SendButton_Click()

    WAMPLE1.SMSsend SendNumber.Text, SendMessage.Text
    SendNumber.Text = ""
    SendMessage.Text = ""
```

```
End Sub


Private Sub WAMPLE1_Connected()

Dim max, i As Integer

    DisconnectButton.Visible = True
    StatusLabel.Caption = "Connected!"
    MemList.Clear
    max = WAMPLE1.MemCount(SMS)
    For i = 0 To max - 1
        MemList.AddItem WAMPLE1.MemName(SMS, i)
    Next
    MemList.ListIndex = 0
     connected.Enabled = True
    'StatusLabel.Caption = "Downloading messages"
    'EntryList.ListItems.Clear
    'WAMPLE1.SMSdownload MemList.List(MemList.ListIndex)
    check.Enabled = True

End Sub

Private Sub WAMPLE1_ConnectFailed()

    StatusLabel.Caption = "Connection failed"

End Sub

Private Sub WAMPLE1_ConnectLost()

    StatusLabel.Caption = "Connection lost"
    ConnectButton.Visible = True
    DisconnectButton.Visible = False

End Sub

Private Sub WAMPLE1_SMSdownloaded(ByVal memory As String, ByVal memoryposition As Long, ByVal
phonenumber As String, ByVal smsmessage As String, ByVal time As Date, ByVal crc As Long)

    Dim item As Object
    Set item = EntryList.ListItems.Add(, , phonenumber)
    item.Tag = memoryposition
    item.SubItems(1) = smsmessage
    item.SubItems(2) = GetDateString(time)

    If smsmessage = "Lamp On" Then
    DataCheck(0).Value = 1
    TabLampOn.Visible = False
    tabLampOff.Visible = True
    txtOutput.Text = "SMS Triggered - Lamp On" & vbCrLf
    tablampstatus.FillColor = &HFF00&
    End If

    If smsmessage = "Lamp Off" Then
    tabLampOff.Visible = False
    TabLampOn.Visible = True
    txtOutput.Text = "SMS Triggered - Lamp Off" & vbCrLf
    tablampstatus.FillColor = &HFF&
    End If

    If smsmessage = "Lamp Status" Then
    Dim registerLampStatusSMS As Byte
    Dim zs As Integer
    Self = True ' avoid recursive changes
    registerLampStatusSMS = Inp(PortAddress)
    zs = 0
    If registerLampStatusSMS And 2 ^ zs Then
    DataCheck(zs).Value = 1
    SendNumber.Text = phonenumber
    SendMessage = "Lamp is on"
    send.Enabled = True
    Else
    DataCheck(zs).Value = 0
    phone.Caption = phonenumber
    SendNumber.Text = phonenumber
    SendMessage = "Lamp is off"
    send.Enabled = True
    End If
    End If

End Sub

Private Sub WAMPLE1_TaskComplete(ByVal task As Integer)

    Dim s As String
    Select Case task
    Case MODEM_NOT_CONNECTED
```

```
        s = "Device is not connected"
    Case SMS_BANK_FAIL
        s = "Failed to select memory bank"
    Case SMS_DELETE_FAILED
        s = "Failed to delete message"
    Case SMS_DELETED
        s = "Message deleted!"
        Rem Update display by downloading again
        DownloadButton_Click
    Case SMS_DOWNLOAD
        s = "Messages downloaded!"
        'smscheck.Enabled = True
    Case SMS_SEND_FAIL
        s = "Message failed to send"
    Case SMS_SEND_SUCCESS
        s = "Message sent!"
    Case Else
        s = "Unknown notification (" + Str(task) + ")"
    End Select
    StatusLabel.Caption = s
End Sub
```