VISUAL BASIC PROGRAM WITH HARDWARE: TEACHING OF INTERFACING METHOD APPROACH FOR SERIAL COMMUNICATION

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A R T I C L E I N F O	**A B S T R A C T**
	In order to meet the requirement of Malaysian Polytechnic Education for the course of Visual Basic Programming (EC502), a technique of simple steps is introduced for developing Visual Basic programming codes that interfaces with hardware and other software. The curriculum for Diploma of Electrical Engineering courses for Malaysian Polytechnics encourages the use of computer in controlling hardware for the applications. The method of the research is implemented based on the syllabus for Project 1 (EE501) and Project 2 (EE601); allows students to develop projects under three categories; hardware, software or combination of hardware and software. In order to accomplish the task of interfacing the hardware, software and also enable data usage; Visual Basic 2010 programming language is selected with RS232 standard. It will be used for serial communication and Microsoft Excel for the data storage. A set of procedures is designed, which will guide students and lecturers with minimal knowledge in programming and serial communication operations by designing basic projects that involve hardware interface with Visual Basic program and some data manipulations.

1. INTRODUCTION

Visual Basic (VB) language's syntax is simple and easy to use and it is object-oriented. Now the "VB Programming" has become one of the compulsory basic of computer technology course for Malaysian polytechnics. This course is aimed to produce skillful students with computer programming ideas and methods, the initial application in various fields with the ability of the computer, and follow-up to create the conditions for semi-professional diploma courses.

In the traditional "VB programming" teaching, the use of"teaching oriented" teaching pedagogy, teaching method is one-way transmission of information, teachers impart knowledge and students passively accept knowledge (Qing. M, 2008). It makes students accept the VB language more easily, such as basic concepts, basic knowledge of grammatical structure, but not well improve their programming ability, not to better train students to ask questions, analyze and solve problems.

Generally, almost all of vocational college students are learning programming courses, but the result is not satisfactory. The underlying reason mainly refers to the traditional teaching method which focuses on knowledge systems - in practical teaching activities of programming course, we find this method more and more difficult to impress students and it fails to fulfill the expected teaching effects (Zhang. M, 2011). Students were unable interpret the software and hardware interface into programming codes, even though the program structure covers both software programming and hardware operations, as they are taught through different courses. Furthermore, they were unable to obtain data from the database and manipulate them for the program needs. It will be very hard for the supervising lecturers who were from pure technical background to be able to guide these students into developing such project.

To change the status quo, a tangible teaching experiment was conducted to introduce the case method associated to the interfacing of hardware with Visual Basic programming. Test to construct learning theory as a guide, emphasis on "student-centered" thinking, emphasizes that learning to build their own programming ideas, programming and programming skills for interfacing the hardware. The trial has changed the traditional "VB programming" classroom-based instruction throughout the teaching of students in the state of passive learning, which give full play to the leading role of teachers, high lighting the dominant position of students, and actively explore the practical application of educational theory and the corresponding teaching model: becomes a student passive learning to active, active learning; change mainly to teach or to study and education to both school-based; results change emphasis on teaching the importance of teaching the process or both process and outcome; change as a case example of teaching (Wu. HZ & Jiang. JF, 2005).

Currently, the Project courses in Semester 5 (EE501) & Semester 6 (EE601) for Diploma of Electronic (Communication) and Diploma in Electronic (Computer) encourage students to develop final year engineering projects of the combination between software and hardware. Project selection becomes very important and allows students to develop projects under three categories; hardware, software or combination of hardware and software. First of all, project should not be too complicated - new knowledge points should not appear too much in one project. Instead, learned points should be included. Thus students are able to deepen the understanding of learned knowledge while carrying out new projects. Second, selecting projects which are closely related to students' study and living, such as database programming project and course selection system etc., can stimulate students' strong interest in learning (Qin.X, 2010). For example, a digital communication project, it is necessary to transmit data between different devices in the applications. There are many methods of communication between devices and computer; and the most basic is the serial communication that uses the serial port. So, this platform is designed to solve the problem in serial communication and the programming language used is Visual Basic 2010 as it is the language used in one of the courses in Diploma in Electronic Engineering (Computer) structure; EC502 Visual Basic Programming. The other software that has been selected for the software interface is Microsoft Excel as it is most simple and commonly used for data storage.

The objectives of the research are to provide a technique of simple steps project based guide for students and lecturers with minimal interface and programming knowledge in developing projects; with the technique proposed, the data is obtained from the hardware and corresponding information from Microsoft Excel will be accessed for further programming actions.

2. SERIAL COMMUNICATION INTERFACE

A serial communications interface (SCI) is a device that enables the serial (one bit at a time) exchange of data between a microprocessor and peripherals such as printers, external drives, scanners, or mice. In this respect, it is similar to a serial peripheral interface (SPI). But in addition, the SCI enables serial communications with another microprocessor or with an external network. The term SCI was coined by Motorola in the 1970s. In some applications it is known as a universal asynchronous receiver/transmitter (UART).

The SCI contains a parallel-to-serial converter that serves as a data transmitter, and a serial-to-parallel converter that serves as a data receiver. The two devices are clocked separately, and use independent enable and interrupt signals. The SCI operates in a non-return-to-zero (NRZ) format, and can function in half-duplex mode (using only the receiver or only the transmitter) or in full duplex (using the receiver and the transmitter simultaneously). The data speed is programmable. Serial interfaces have certain advantages over parallel interfaces. The most significant advantage is simpler wiring. In addition, serial interface cables can be longer than parallel interface cables, because there is much less interaction (crosstalk) among the conductors in the cable.The term SCI is sometimes used in reference to a serial port. This is a connector found on most personal computers, and is intended for use with serial peripheral devices.

3. VISUAL BASIC PROGRAMMING

It is a computer programming system developed and owned by Microsoft. Visual Basic was originally created to make it easier to write programs for the Windows computer operating system. The basis of Visual Basic is an earlier programming language called BASIC that was invented by Dartmouth College professors John Kemeny and Thomas Kurtz. Visual Basic is often referred to using just the initials "VB". Visual Basic is easily the most widely used computer programming system in the history of software.

As a representative visual programming tool, Visual Basic makes it easy for programming to create professional looking user interface. It can be utilized to develop small tools for individual or group, and also to develop multimedia software, database applications, network applications, and other large software. It is one of the most popular programming languages and is first choice for learning to develop Windows-based applications (Pan. LL, 2010).

Visual Basic was one of the first systems that made it practical to write programs for the Windows operating system. This was possible because VB included software tools to automatically create the detailed programming required by Windows. These software tools not only create Windows programs, they also take full advantage of the graphical way that Windows works by letting programmers "draw" their systems with a mouse on the computer. This is why it's called "Visual" Basic. Visual Basic also provides aunique and complete software architecture. "Architecture" is the way computer programs, such as Windows and VB programs, work together. One of the major reasons why Visual Basic has been so successful is that it includes everything that is necessary to write programs for Windows.This done through the Active X control platform provided by Microsoft. ActiveX control is the technology developed under Windows platform, its core is the COM (Component Object Model). Under the COM menu, programmers can enable the connection between the VB program with serial communication port or any Microsoft software listed.

4. METHOD OF INTERFACING

An operating system is a large, complex piece of software whose primary function is the management of hardware and software resources of a data; processing system such as processors, memory and storage. Storage management, in turn, involves the organization of storage devices, such as disks, into logical groupings to achieve various performance and availability characteristics. For example, the disks may be arranged to create individual volumes or concatenations of volumes, mirror sets or stripes of mirror sets, or even redundant arrays of independent disks (RAID). The data processing platform on which the operating system executes to provide such management functions typically includes a host computer coupled to a storage adapter or controller. The operating system functionally organizes this platform by,

inter alia, invoking input/output (I/O) operations in support of software processes or applications executing on the computer. The overall structure of the interface platform is as shown in Figure 1; where the structure is separated into three parts with two types of communication.
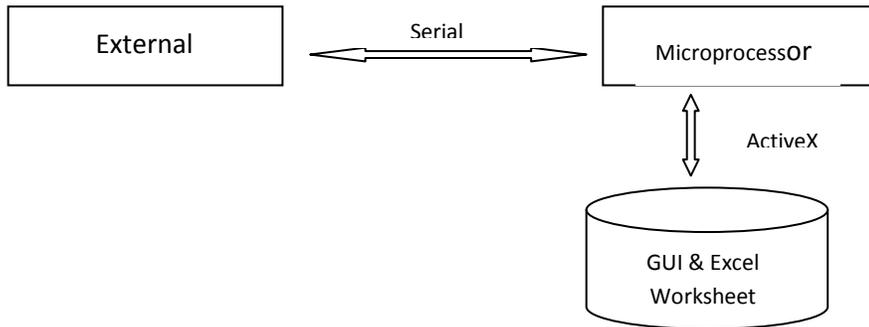

Figure 1: The overall structure of the interface platform.

4.1 Hardware Interfacing

By using Visual Basic 2010 programming language, with RS232 standard will be used for serial communication and Microsoft Excel for the data storage. The steps of interfacing serial communication with hardware are:

Step 1: Detecting ComPort number on the PC or laptop:
Serial port (ComPort) number must be detected before communication codes were written in any programming language. The Visual basic 2010 code example below enable user to identify the available ComPort number on the personal computer.
Requirements are:
The suitable driver software for the serial port must be installed in the PC. The driver software usually provided with the serial port converter or the peripherals. Figure 2 shows the serial port driver installation process.
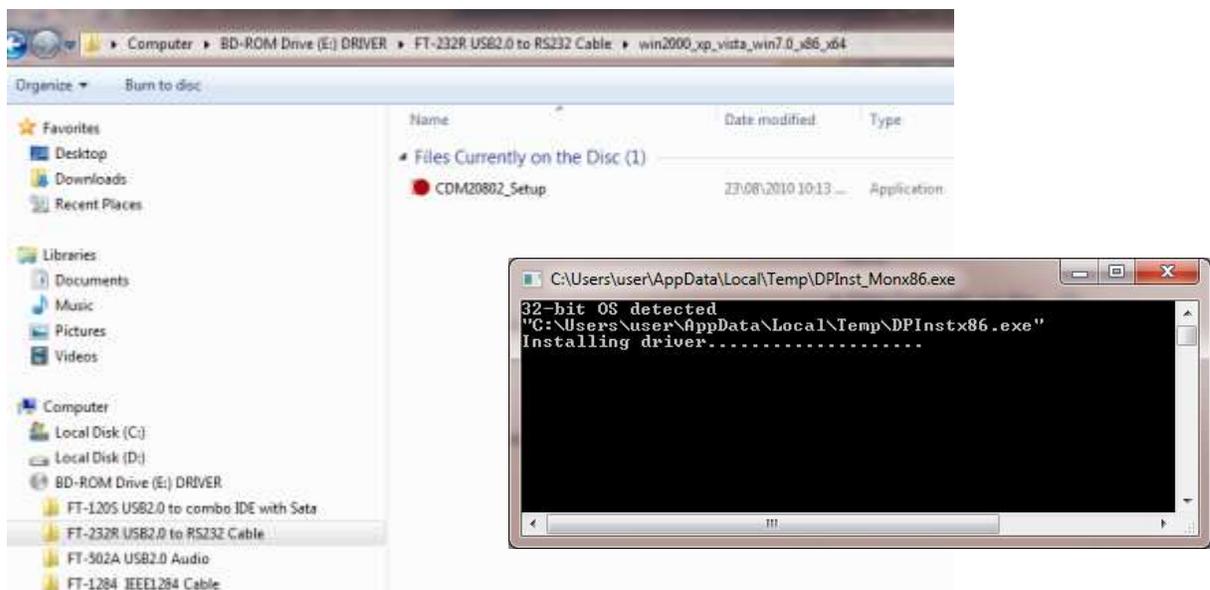

Figure 2: Serial port driver installation.

- The serial port must be connected with some device. Figure 3 shows the serial port connected to an RFID reader through USB-RS232 converter.

Figure 3: RFID reader connected via USB-RS232 converter to USB port.

Step 2: Opening serial port for reading.
Some properties of the serial port must be set to enable serial communication between personal computer and peripherals. Serial communication requires that you specify four parameters: the baud rate of the transmission, the number of data bits encoding a character, the sense of the optional parity bit, and the number of stop bits.

Step 3: Reading data from serial port.
The simplest method for communication event in MSComm control is event-driven method, the OnComm event is used in this method. OnComm event is the only one event of MSComm control event. OnComm event occurs when data arrives at the port, and port statechanges or a communication error occurs. The responsibility of the OnComm event is to catch and handleerrors in communication. It is easy to know thecircumstance clearly by checking the CommEvent property values in order to deal errors successfully.

Step 4: Closing the serial Port
It is a normal procedure to close the serial port at the end of each session.

The flowchart in Figure 4 shows the steps that should be taken in performing hardware interface in Visual Basic programming.

```
                    ┌──────────────┐
                    │    START     │
                    └──────┬───────┘
                           │
            ┌──────┬───────▼────────────┬──────┐
            │      │ RS232 DRIVER INSTALLATION │      │
            └──────┴────────────────────┴──────┘
                           │
            ┌──────┬───────▼────────────┬──────┐
            │      │        DETECT             │      │
            │      │ COMMUNICATION PORT NAME   │      │
            └──────┴────────────────────┴──────┘
                           │
            ┌───────────────▼──────────────┐
            │  OPEN SERIAL PORT FOR READING │
            └───────────────┬──────────────┘
                            │
           ╱────────────────▼────────────────╲
           ╲   READ DATA FROM SERIAL PORT     ╱
            ╲────────────────┬───────────────╱
                             │
            ┌────────────────▼─────────────┐
            │       CLOSE SERIAL PORT       │
            └────────────────┬─────────────┘
                             │
                    ┌────────▼─────┐
                    │     END      │
                    └──────────────┘
```
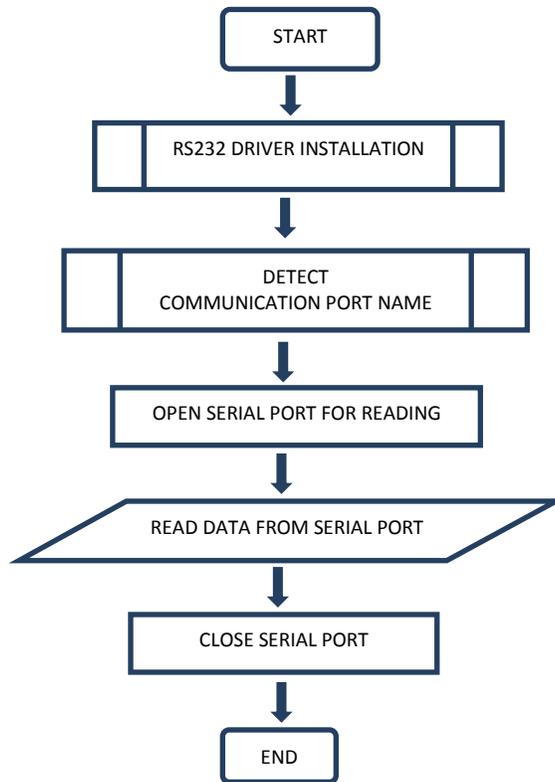
Figure 4: Flowchart for Hardware Interfacing

4.2 Software Interfacing

Once obtained from the serial port, the data can be used to refer to the corresponding information stored in Microsoft Excel file. Communicating with Microsoft Excel file require the corresponding AcxtiveX reference to be added to the program.

ActiveX Control - ActiveX is a software framework created by Microsoft that adapts its earlier Component Object Model (COM) and Object Linking and Embedding (OLE) technologies for content downloaded from a network, particularly in the context of the World Wide Web. It was introduced in 1996 and is commonly used in its Windows operating system. In principle it is not dependent on Microsoft Windows, but in practice, most ActiveX controls require either Microsoft Windows or a Windows emulator. Most also require the client to be running on Intel x86 hardware, because they contain compiled code.

Many Microsoft Windows applications, such as Internet Explorer, Microsoft Office, Microsoft Visual Studio, and Windows Media Playeruse ActiveX controls to build their feature-set and also encapsulate their own functionality as ActiveX controls which can then be embedded into other applications. Internet Explorer also allows the embedding of ActiveX controls in web pages.ActiveX will not work on all internet platforms, so using ActiveX controls to implement essential functionality of a web page restricts its usefulness.

Communicating with Microsoft Excel is done through a few steps:
Step 1: Connecting Microsoft Excel file with Visual basic program.
Reference to the Microsoft Excel file must be added to the Visual Basic program to enable the communication. The property is set within the Add Reference menu for COM components.
Step 2: Accessing data from Microsoft Excel File

The Microsoft Excel Workbook and Worksheet are declared within the program before accessing data from them. Suitable variables are assigned to represent the corresponding workbook and worksheet. The data in the worksheet is stored in cells, thus they are referred to using the coordinate of the each cell individually or in array form.

Step 3: Manipulating data for VB program.

Once the computer has access to the data from the database, they can be used for any operation by the program. For example, the program will search the data for corresponding information from the serial input, display the data onto the screen and play the corresponding audio or video files.

The flowchart in Figure 5 shows the steps that should be taken in performing interface between Visual Basic program with Microsoft Excel.
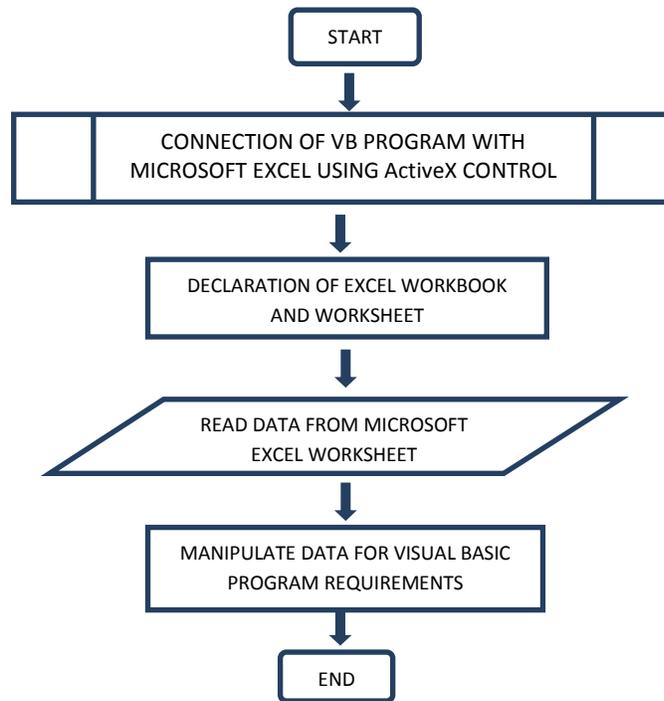

Figure 5: Flowchart for Visual Basic Program Interface with Microsoft Excel (Software Interface)

5. RESULTS AND DISCUSSIONS

5.1 Visual Basic Program for Serial port Communication

Refer to Figure 6, the form consists of a ListBox and a Button Control and a SerialPort Component which can be dragged from the ToolBox controls. The ListBox if for listing the communication ports available on the PC, and the Button is to create the event. The procedure is to get the serial port name(s) and list them in the ListBox. Then the programmer can use the name as the Serial Port identifier for the program. Listing 1 to 3 are the codes for serial port communication.
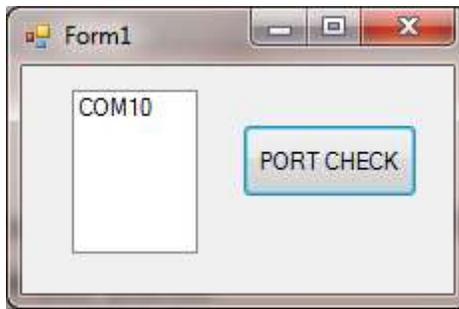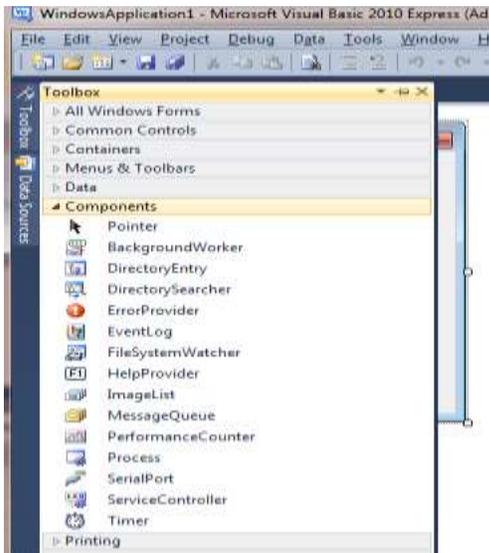
Figure 6: Serial Port Detection Form

Note: Different PC will have different serial port name(s) and different USB-RS232 converter installed will produce different CommPort name.

Listing 1: VB2010 Codes for detecting ComPort and Explanation

Visual Basic Code	Explanation

Public Class Form1
    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
        ListBox1.Items.Clear()
GetSerialPortNames()
EndSub
    Sub GetSerialPortNames()
' Show all available COM ports.
        For Each spAs StringInMy.Computer.Ports.SerialPortNames
            ListBox1.Items.Add(sp)
        Next
EndSub
EndClass
	Available serial ports on the PC are detected and the names are listed as items in the ListBox1.

Listing 2: VB2010 Codes for Opening Serial Port and Explanation

Visual Basic Code	Explanation

Private Sub btnConnect_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnConnect.Click
    SerialPort1.PortName = "COM10"'Set SerialPort1 to the selected COM port at startup
    SerialPort1.BaudRate = 9600'Set Baud rate to the selected value on
    'Other Serial Port Property
    SerialPort1.Parity = IO.Ports.Parity.None
    SerialPort1.StopBits = IO.Ports.StopBits.One
    SerialPort1.DataBits = 8   'Open our serial port
    SerialPort1.Open()
EndSub
	The properties of the serial port must be set before communication begins:
	1. Port name
	2. Parity
	3. Stop Bits
	4. Data Bits
	5. Open the serial port.

Listing 3: Reading data from serial port and Explanation

Visual Basic Code	Explanation
Private Sub SerialPort1_DataReceived (ByVal sender As Object, ByVal e As System.IO.Ports.SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived ReceivedText(SerialPort1.ReadExisting())	Any data received at the serial port will be read and stored as rich text

<table>
<tr><td>

```
EndSub

'Automatically called every time a data is received at the serialPort
Private Sub ReceivedText (ByVal [text] As String)
'compares the ID of the creating Thread to the ID of the calling Thread
        If Me.rtbReceived.InvokeRequiredThen
                Dim x As New SetTextCallback(Address Of ReceivedText)
Me.Invoke (x,  New Object() {(text)})
        Else
Me.rtbReceived.Text&= [text]
EndIf
EndSub
```

</td><td>

format. The data can be stored in RichTextBox format.

</td></tr>
</table>

5.2 Visual Basic Program for Software interface

Refer to Figure 3 for connection of Microsoft Excel file with Visual Basic program by adding the ActiveX control to the COM reference.
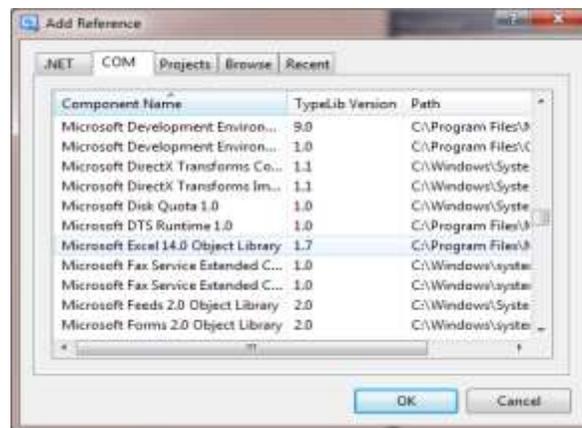

Figure 3: Adding ActiveX control

Listing 4 & 5 are the codes for Microsoft Excel interface and data manipulationin Visual Basic 2010.

Listing 4: Excel worksheet declarationand Explanation

Visual Basic Code	Explanation
Imports Excel = Microsoft.Office.Interop.Excel	Imports interoperation with excel files.
Dim APP AsExcel.Application Dim worksheet AsExcel.Worksheet Dim workbook AsExcel.Workbook	Declaration of Excel worksheet(s) to be used in VB2010 program
APP = NewExcel.ApplicationClass workbook = APP.Workbooks.Open("D:\Project1\Data1.xlsx") workbook2 = APP.Workbooks.Open("D:\Project1\Data2.xlsx")	Assigns excel file(s) location in the directory
worksheet = workbook.Worksheets("sheet1") worksheet2 = workbook2.Worksheets("sheet1")	Assign worksheet in excel file
commport("COM10")	Assign Communication port number

Listing 5: Accessing Excel Worksheet and Explanation

Visual Basic Code	Explanation
Sub search(ByValNoCardAsString) DimI AsInteger = 2 NoCard = TextBox1.Text	Loop for Searching corresponding data in worksheet.

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``
Do
IfTrim(NoCard) = Trim(worksheet2.Cells(i, 2).Value) Then
Call list(CInt(worksheet2.Cells(i, 1).Value))
EndIf
i = i + 1
LoopUntil (worksheet2.Cells(i, 1).Value = vbNullString)
EndSub
 	
Label2.Text = worksheet.Cells(listindex + 1, 2).Value
Label6.Text = worksheet.Cells(listindex + 1, 3).Value
 	
workbook.Close()
workbook2.Close()
APP.Quit()
Close()
``
	Getting corresponding data from other worksheet and store in Label control in Visual basic form.
	Closing Microsoft Excel file

6. CONCLUSIONS

Visual Basic Programming is one of major courses in the Malaysian polytechnic curriculum which is introduced by the Ministry of Education. It is an important course for students to build their programming capabilities. In order to improve situations of low teaching effectiveness which are caused by the traditional teaching method with knowledge system as its main subject, this article introduces some reforms towards teaching methods, practical teaching and teaching evaluation. The result is impressive that by adopting the project-driven teaching method, students' interests are found improve effectively. And yet, the construction of teaching materials and curriculum resources development and utilization while implementing project curriculum as well as other issues still need further researchand exploration.

7. REFERENCES

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