

DEVELOPMENT OF BUILDING CONDITION ASSESSMENT SYSTEM (B-CAS) BY USING VISUAL BASIC .NET APPLICATION

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Abstract - Building inspection is traditionally conducted by using descriptive information. These are time consuming, particularly during site inspections. The problem with this method of assessment is that the time needed to write all the defect description on site in addition to translate and analyse descriptive data to presentable information. The development of Condition Survey Protocol (CSP) 1 Matrix has been proven to be effective by researcher as it able to save on-site time during building inspection. Although the result achieved using CSP1 Matrix is considered quick and precise, the system still requires analysis and computation by human hand. To make condition assessment more effective, thus the utilization of computer application must be considered. Using computer application, surveyor will not only able to get result quick and precise, but also can reduce error during computation. This study focuses on the development of Visual basic programming that utilizes CSP1 Matrix to help improve building inspection efficiency.

Index Terms - Building condition assessment, CSP 1-Matrix, MySQL, Visual Basic .NET.

I. INTRODUCTION

Building inspection is traditionally conducted by using descriptive information. These are time consuming, particularly during site inspections [1]. The problem with this method of assessment is that the time needed to write all the defect description on site in addition to translate and analyse descriptive data to presentable information. By using building condition rating approach suggested by Royal Institution of Chartered Surveyors (RICS) Homebuyers Service 2009 (3rd Edition Practice Notes) [2], surveyor able to conduct on-site inspection at faster rate as there is no need to write the long description as well as knowing the condition of building instantly by referring to the building's condition and computing its rating number. The development of Condition Survey Protocol (CSP) 1 Matrix has been proven to be effective by researcher. Study conducted by Hamzah N. et al., (2010) [3] shows that CSP 1 Matrix able to save on-site time during building inspection in addition to employ score numerical analysis that gives the building an overall score.

With the utilization of rating instead of description, computation of result can be done with more precise and quick; data will be able to be present instantly as there is no need translate complex descriptive into presentable outcome. Although the end result achieved is considered quick and precise, the system still requires analysis and computation by human hand. Thus, in order to make condition assessment more effective, the utilization of computer application must be considered. Using computer application,

surveyor will not only able to get result quick and precise, but also can reduce error during computation.

A. Objective of Study

Computing of building rating by using hand calculation can be confusing and time consuming. Especially when there are a lot of defects exist. In this case, the development of visual basic programming can be very effective. This study was conducted with following objectives:

- [1] To develop computer application that can compute score of building based on CSP 1 Matrix.
- [2] To assess evaluate the efficiency of CSP program.

B. Scope of Study

Utilization of building rating for building inspection not only able to produce numerical value for statistical analysis. It also enables surveyor to collect data within the shortest possible time by avoiding descriptive, longhand write-ups during fieldwork. Even though that's the case, the computation, storing and reporting of the existing defects still require a manual operation. These manual operations still consume time especially when there are a lot of defects involved. In this case, computer programming solution can be a great effort. With Visual Basic and MySQL database, existing building defect not only can be stored, overall building rating can be computed as well as final executive summary can be produced. This will significantly cut the time taken to come up with building rating.

II. LITERATURE REVIEW

A. Visual Basic .Net

A Computer cannot understand any person's spoken language. A spoken language such as English,

French, is simply too general and ambiguous for computers to understand. Therefore, we must adapt to the machine and learn the computer language so that the computer can understand. Modern programming languages allow the programmer to quickly design screen panels and easily reuse code [4].

Visual Basic .NET is a visual programming language because programming is done in a graphical environment. In Visual Basic .NET, programmers only need to drag and drop any graphical object anywhere on the form and click on the object to enter the code window and start programming. Visual Basic .NET is an event driven program where programmers must assign code to response to certain event triggered randomly by the user via the control on the form. The events usually comprise but not limited to the user's inputs. Some of the events are load, click, double click, drag and drop, pressing the keys and more [5]. Because of the functionality that Visual Basic language developed over its generation and the simplicity that remains, Visual Basic language is chosen for this project.

Microsoft Visual Basic.NET for Windows (VB.NET) allows Engineers to develop engineering applications that run in the Windows environment [4]. This is beneficial as Windows operating system is flexible and easy to use. With Visual Basic, engineer can quickly create simple programs based on their needs as it is relatively easy to learn and use. Development of a Windows-like user interface is easy to do and there is a growing base of users and add-in applications [4]. Visual Basic .NET is a powerful, graceful, fully object-oriented modern language, every bit the equal of C# or Java [6]. Furthermore, because it is descendent of the original BASIC language, it is simple to use. Visual Basic somehow manages to preserve the simplicity of syntax that always been hallmark of BASIC family languages [6].

B. Condition survey protocol (CSP) 1 matrix

The CSP 1 matrix was primarily developed as a rating tool for a reasonable property condition assessment. However, because of the data input relies on the condition and damage assessments. CSP 1 matrix is also suitable for all types of buildings. Depending on element of building based on assets hierarchy, the format of the matrix will still able to accommodate any condition of survey work. The goals of CSP 1 Matrix are:

- To enable the surveyors to collect data within shortest possible time by avoiding descriptive, longhand write-ups during fieldwork.
- To record the existing defects of the building, the main source of data, by assessing the condition and assigning priority to each defect recorded.
- To obtain an overall rating of the building's condition. The proposed remedial work is not the main concern of this matrix. Moreover, the repair work usually cannot be carried out immediately

after the survey's completion because of budget constraints.

- To use the numerical rating acquired from the survey work to perform statistical analysis.

There are two data required for the CSP 1 Matrix which are the condition and the priority assessment. Like previous rating scale, CSP 1 also incorporates numerical score and linguistic representations. The scale values and their descriptions depend on the maintenance standard of the building being evaluated. For instance, the scale can be made more stringent than the example provided here. The examples given in Tables 1 and 2 are the most basic scales used in the CSP 1 Matrix [1].

Condition	Scale Value	Description
1	Good	Minor Servicing
2	Fair	Minor Repair
3	Poor	Major Repair/Replacement
4	Very Poor	Malfunction
5	Dilapidated	Damage/Replacement of Missing Part

Table 1: Condition Assessment Protocol 1.

Condition	Scale Value	Description
1	Normal	Functional; cosmetic defect only
2	Routine	Minor defect, but could become serious if left unattended
3	Urgent	Serious defect, doesn't function at an acceptable standard
4	Emergency	Element/structure doesn't function at all; or Presents risks that could lead to fatality and/or injury

Table 2: Priority Assessment.

Each recorded defect is assigned with a condition and priority rating. Each rating is then multiplied to determine the total score for each defect. The total score which ranges from 1 to 20 is then matched with the matrix, as shown in Fig 1. A colour gray (originally green), white (originally yellow) or black (originally red) is then applied to indicate the score in each of the 3 parameters: Plan Maintenance (1 to 4), Condition Monitoring (5 to 12) and Serious Attention (13 to 20), as shown in Table 3 [1].

Scale	Priority Assessment			
	E 4	U 3	R 2	N 1
5	20	15	10	5
4	16	12	8	4
3	12	9	6	3
2	8	6	4	2
1	4	3	2	1

Fig 1: The Matrix.

No.	Matrix	Score
1	Planned Maintenance	1 to 4
2	Condition Monitoring	5 to 12
3	Serious Attention	13 to 20

Table 3: The descriptive value according to score.

After scoring every defect, the overall building rating which summaries the building's condition will be calculated, as shown in Table 4. Average value of score will be calculated by adding all scores and dividing to number of elements. The building is then

rated Good, Fair or Dilapidated, according to the score (out of 20) [1]. Lastly, an executive summary is produced and presented. Fig 2 shows an example of executive summary produced after analysis.

No.	Building Rating	Score
1	Good	1 to 4
2	Fair	5 to 12
3	Dilapidated	13 to 20

Table 4: Overall building rating.

**BUILDING CONDITION SURVEY FOR ECSTRUCT™,
PULAU LANGKAWI, KEDAH DARUL AMAN**

CONDITION SURVEY PROTOCOL (CSP) 1

EXECUTIVE SUMMARY

1.0 Property Information

Building Address : ECSTRUCT™ Pulau Langkawi, Kedah Darul Aman
Owner Name : Ministry of Science, Technology and Innovation (MOSTI)
Date of inspection : 26.06.2009
Weather : Clear and Fair

2.0 Condition Survey Protocol (CSP) 1 Matrix

No.	Matrix	Score	Color Code	Finding(s)
1.	Planned Maintenance	1 to 4		25
2.	Condition Monitoring	5 to 12		4
3.	Serious Attention	13 to 20		0
Total Defects				29

3.0 Overall Building Rating

No.	Building Rating	Score
1.	Good	1 to 4
2.	Fair	5 to 12
3.	Dilapidated	13 to 20

Total marks - 127
Number of defects - 29
Total score - 4.38
Overall building rating - Good

4.0 Recommendation

This building is in Good condition.

However, the total score is close to 5, indicating that, if the defects identified in this inspection, especially the ones coded yellow, are left unattended, the building's condition will fall to Fair.

Therefore, it is recommended that periodical inspections be carried out on this building and that any actions recommended by this report are carried out to prevent further dilapidation to the building.

Fig 2: Example of Executive Summary

III. METHODOLOGY

Computer program using visual basic language can easily be made with the help of Visual Studio. Visual Studio is Microsoft's Integrated Development Environment (IDE) for creating, running and debugging programs (also called applications) written in verity of programming languages.

For this project there are several stages in visual basic programming. The steps include, program design, implementation and coding and testing.

(i) Program design

Program was designed so that a novice surveyor could operate with just short guidance. Based on litreture research conducted, the program also need to meet the CSP1 Matrix requirement such as, displaying buildings name, ownwer, date and weather condition during the time of inspection. For this, a wimdown form (form 1) is needed to show all these information in a table form. Additionally, MySql database is used in

this project in order to save all the data and information obtained from a building inspection.

Next, the program must be able to display list of defects of the selected building. The defect list contains information of a defect such as defect's location, condition, assessment, description and image file. For this, another window form (Form 2) is needed to display all the defects and its information. To display all the defects, information of the defect is required in the first place. For this, a new window form (Form 3) is used to add new defect into a database and displaying it in the defect list table (Form 2). Last but no least, The program must be able to print an executive summary of the bulding. This can be achieve by producing a receipt form or producing new Microsoft Word Document. Opening new Microsoft Word Document is preferred for this project it allows the user to edit the document before printing. Furthermore, user will be able to save the document into any format the user desires for purpose of future

reference rather than opening the application and previewing or printing the executive summary again.

(ii) Implementation & coding

The implementation and coding stage starts with creating new project in Microsoft Visual Studio. Fig 3 shows the New Project window.

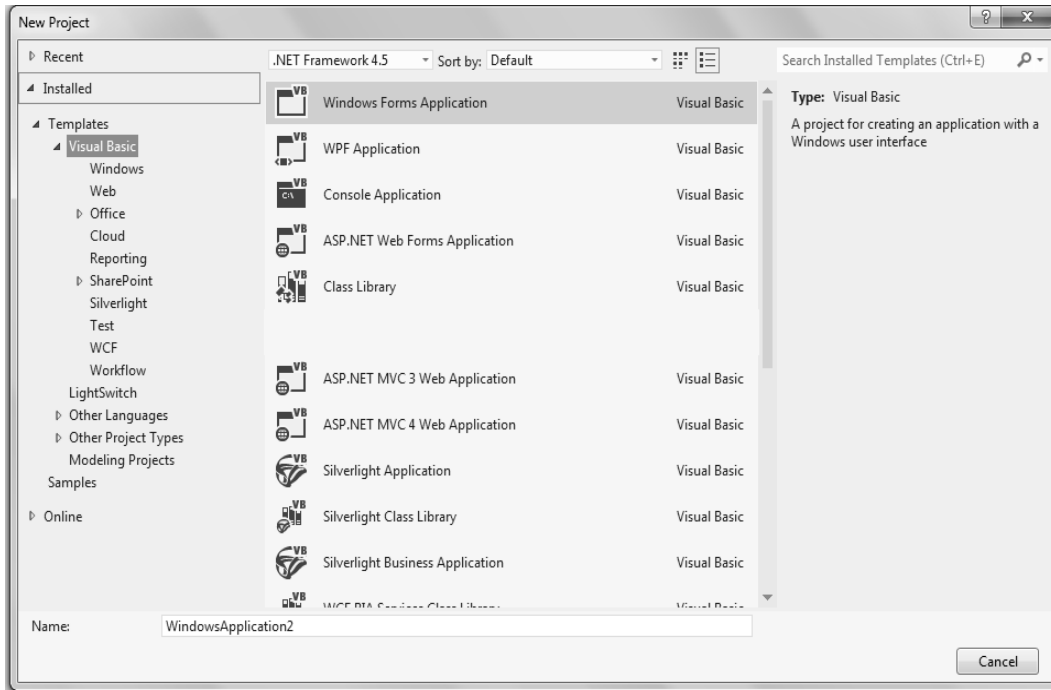


Fig 3: Creating new Windows Form Application in New Project.

After new project is created, an empty application form is filled with all the required tools by dragging and dropping the required tool from the toolbox into

the empty form. This includes, a DataGridView, comboboxes, textboxes and buttons. Fig 4 shows an empty application form design and tools available.

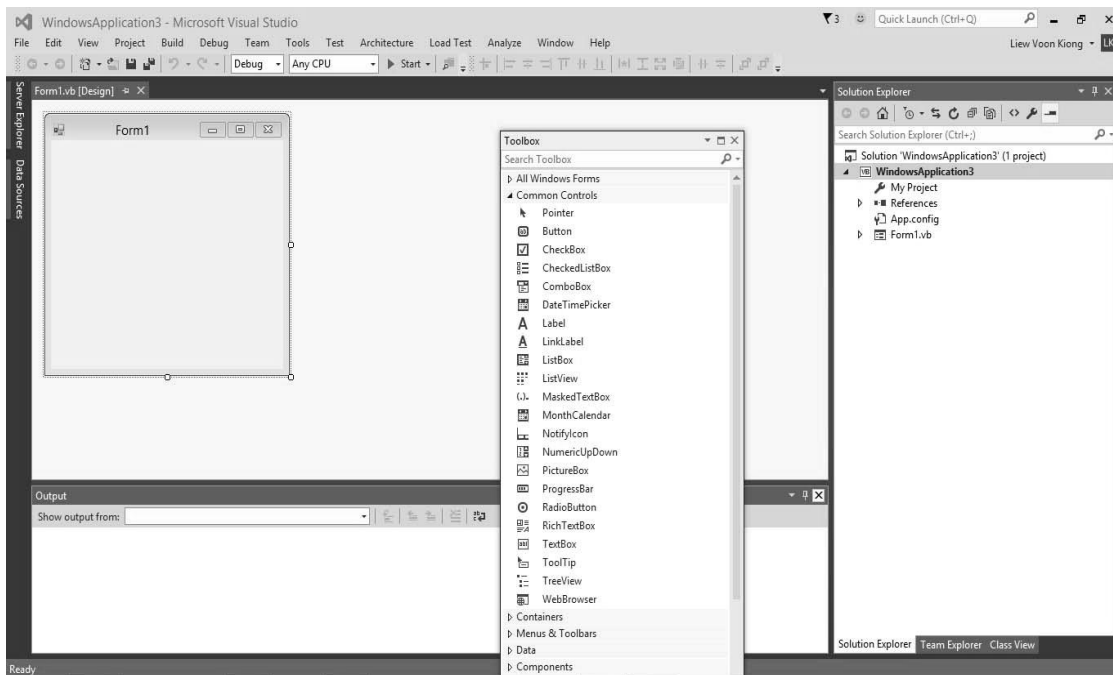


Fig 4: Adding New Item into Empty Form.

From there, code is assigned to the form and specific tool for it to work as the user intended. When assigned to the form, the code will execute as soon as the form is

opened. When assigned to a button, the code will execute as soon as the button is pressed. Fig 5 shows the code editing window.

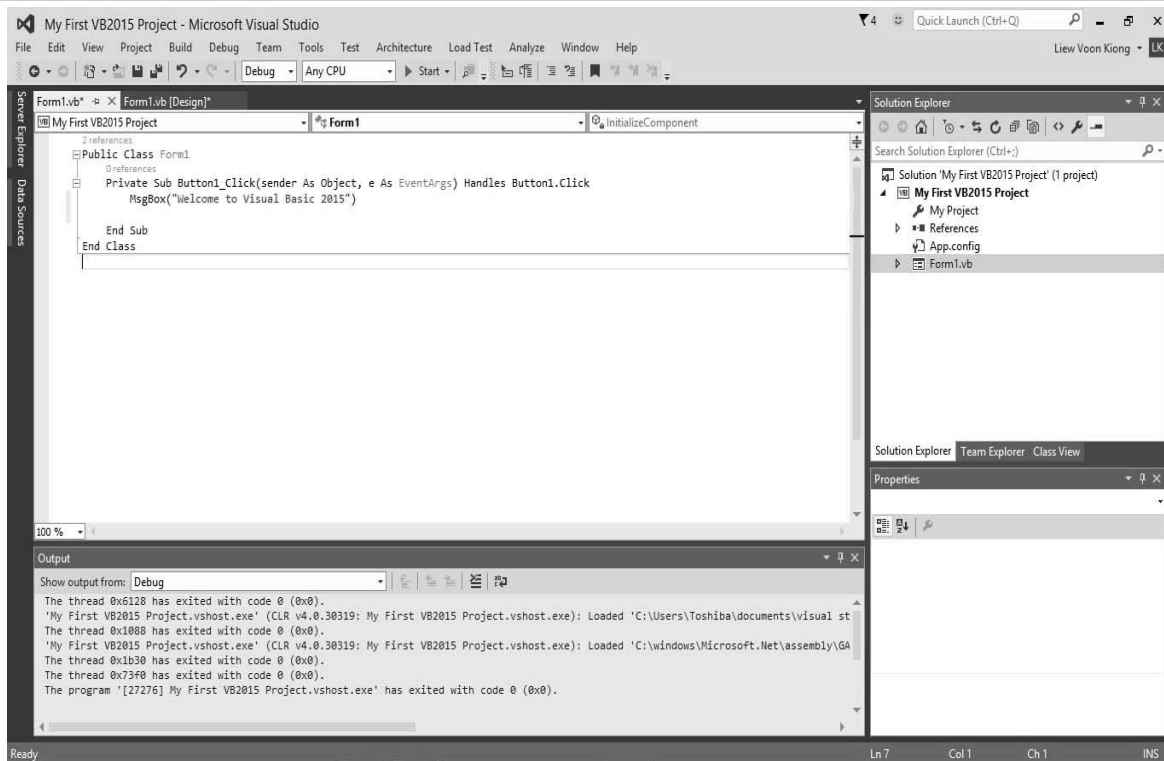


Fig 5: Code editing window.

In order to achieve the requirement of displaying information in the program, a connection code is required to connect and communicate to MySQL Server. New connection code as shown below is used in for the program to connect with the MySQL Server. This code allows the program to access specific database inside the server using ID and password set. In order display information of the selected database from MySQL server, The data must first be selected by using a query id used telling MySQL sever to select data which data from the database. To displaying the selected information from database to the window requires a fill code.

Displaying image in an image box is different from other data. This is because the data need to be translating from binary file into presentable image file. For all the data that is displayed, all the data must be keyed in in the first place. To do so, an "INSERT TO" query is used in the program to let the sever know the data user want to save.

However, before the image file can be saved into MySQL database, it needs to be converted into LONGBLOB binary large object form using memory stream. To delete and edit data in the database on the other hand, query using "DELETE FROM" and "UPDATE were used. The difference between delete and edit is just the query.

(iii) Testing

The testing of the developed program was conducted using a laptop computer with the following specification:

- Intel® Core™ i5-2430M 2.4GHz processor.

- NVIDIA® GeForce GT520M, 1 GB VRAM graphic processor.
- 2 GB DDR3 Memory.
- 500 GB 7200 RPM Hard Disk Drive.
- 14" display with 1366×768 resolution.
- Pre-installed Microsoft Office 2013
- Pre-installed MySQL Server

Testing is the process of evaluating a system or its component with the intent to find whether it satisfies the specified requirements or not. For this project, software testing is done by the execution of a software component or system component to evaluate not just one but other properties of interest. Mock-up data were used as input for the CSP Program. Total of 30 mock-up defects were keyed into the program. Based on the software testing performed, programmer will able identify wether the component and system:

1. Meet the requirements that guided its design and development.
2. Responds correctly to all kinds of inputs.
3. Performs its functions within an acceptable time.
4. Sufficiently usable.
5. Can be installed and run in its intended environments.
6. Achieve the general result its user's desire.

IV. RESULTS AND DISCUSSION

A. Developed Program Interface

The developed program will greet user with custom splash screen when it is opened. When it finishes

loading, the program will bring user to its main form (Main Window), as shown in Fig 6. In this window, the program shows user building list in addition to

enabling user to add, delete and update inspected building.

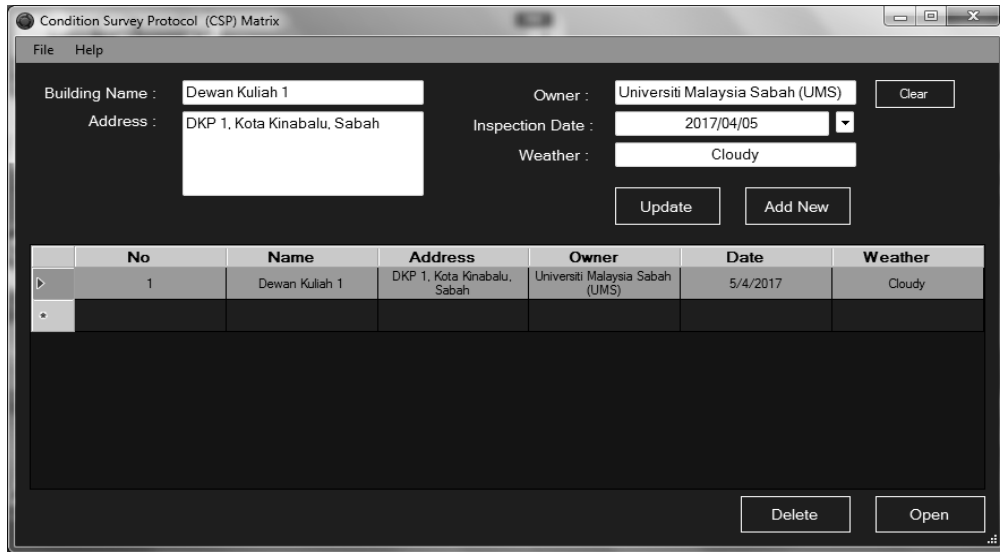


Fig 6: Form 1 (Main Window).

The program enable user to open and display list of defects for the selected building. This is done by selecting building and clicking “Open” button. Several information such as; Category, Element, Sub-Element, Condition, Assessment, Description,

Score and even Image is shown in the defect list, as shown in Fig 7.

There are several functions embedded in this window. It allows user to add, edit or view a defect. In addition to that, user also will be print the result by navigating to the menu strip, Print > Print Result.

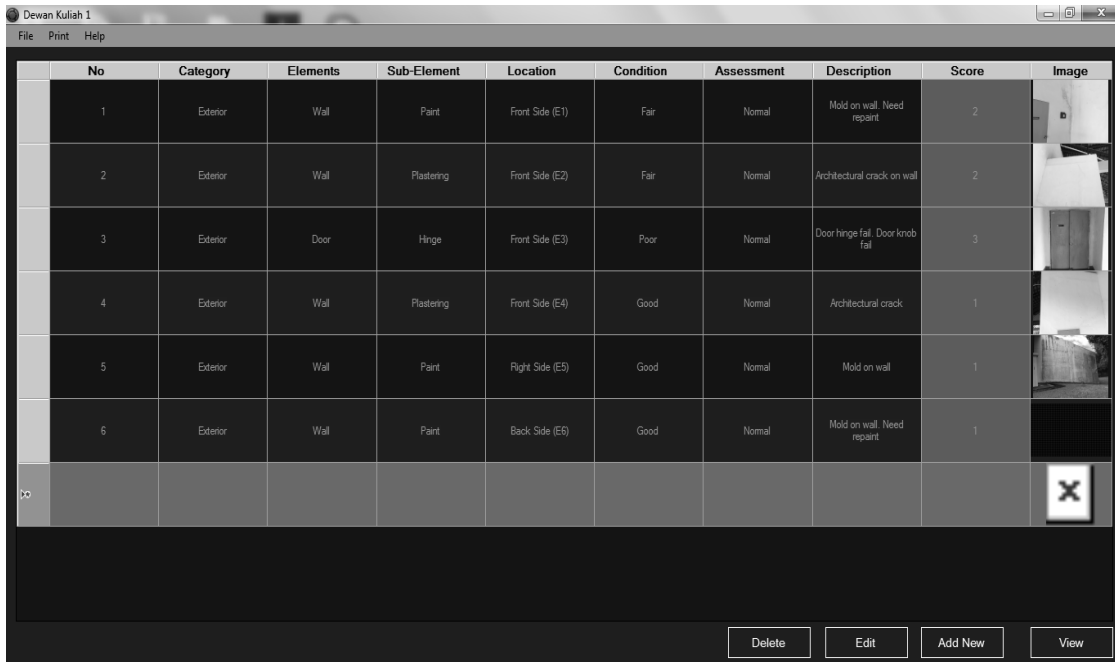


Fig 7: Form 2 (Defect List Window).

If preferred, the program also grants user the ability to view detail of a defect from the defect list. This is done by clicking the “View” button in the Defect list form. This in return opens a new window. Fig 8 showing all the information of the specific defect chosen. Details

displayed are; category, element, sub-element, condition, assessment, description, score of the defect and two images.

The description given should be given precisely. Some of the building element such as concrete flat roof, can

be explained depending on the category of defect or damage. There are a number of defects that can be grouped in category. Moldy surface, pounding water, low gradient at the surface, the rough and uneven surfaces are defects that often occur in concrete flat roof element [7].

As mentioned, the program allows user to print the result from the defect list window. The operation of creating executive summary in a new Microsoft Word

Document, as shown in Fig 9 is achieved by navigating to the menu strip, Print > Print Result, giving more flexibility to the user.

Clicking “Add New” button from the second window will open a new window called New Defect Form Fig 10. Allowing user to add new defect by filling all the information required. This information will then be saved into MySQL database by clicking “Add” button.

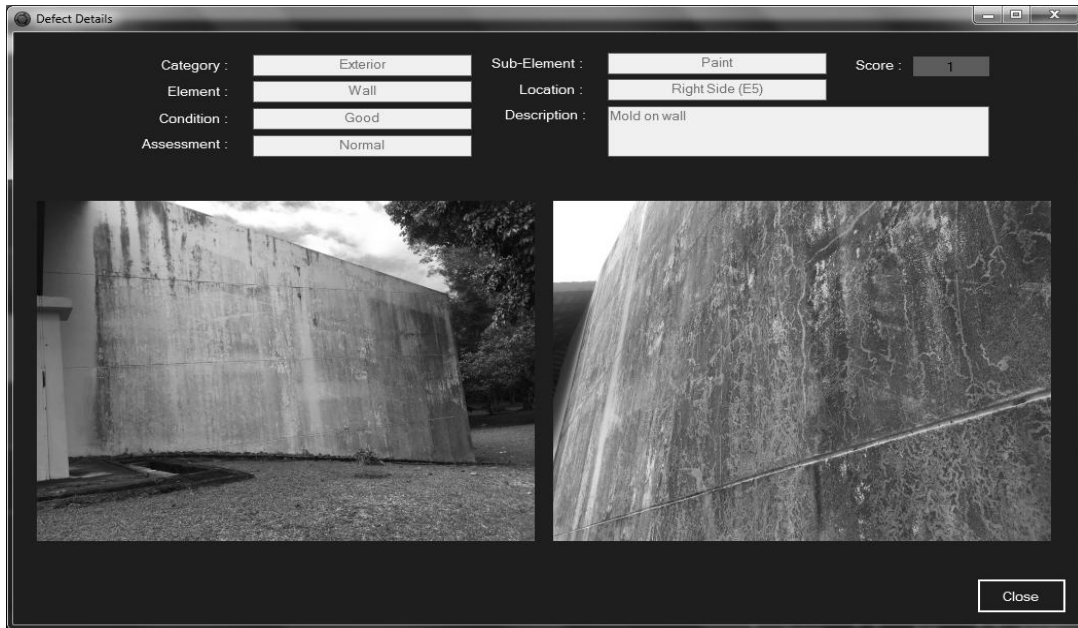


Fig 8: Form 3 (Detail View Window).

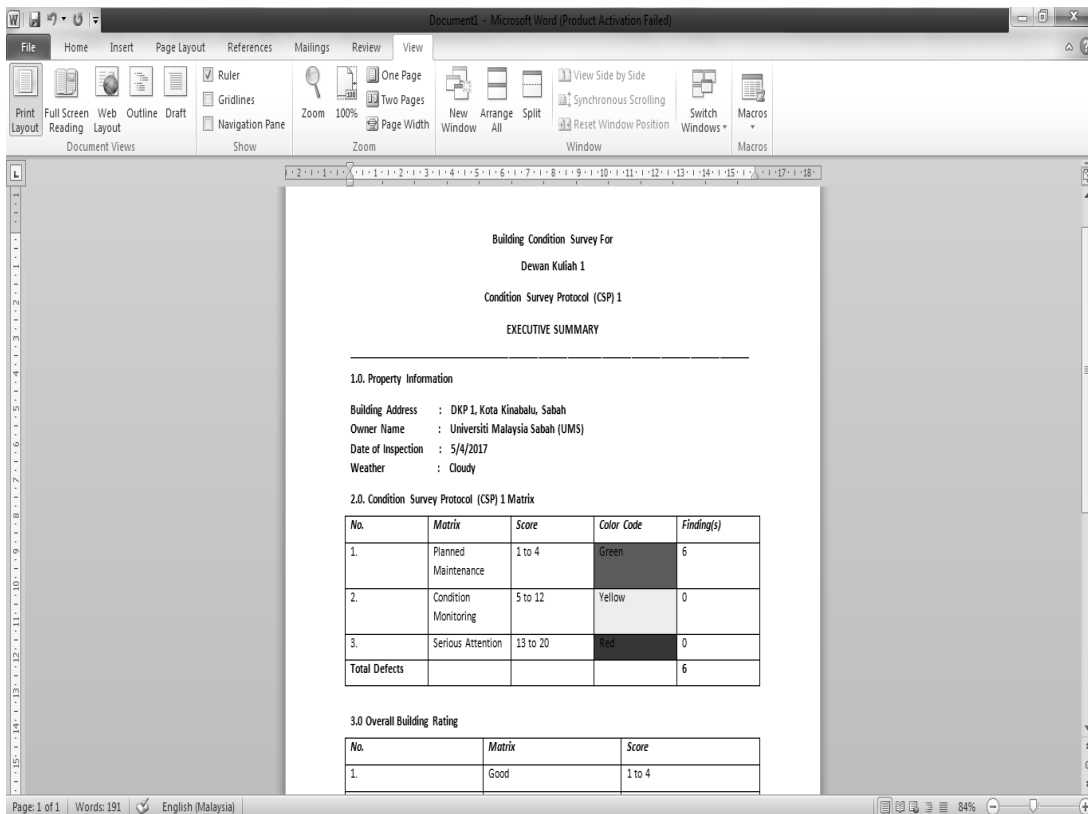


Fig 9: Microsoft Office Document.

Fig 10: Form 4 (Add Defect Window).

The program also gives flexibility to the user to edit individual defect clicking “Edit” button from the Defect List window. When clicked, a new window called Edit Defect Form, as shown in Fig 11. This

form is like the New Defect Form. By clicking the “Update” button; new information from all the combo boxes and textboxes will replace the old information.

Fig 11: Form 5 (Edit Defect Window).

Lastly, there is also a small future embedded in the program that allows user is given power to add a new element and sub-element into database when an element or sub-element does not exist in building element database. This is performed by navigating to

tool strip menu, File > Add New Element in either Add Defect or Edit Defect window. In this window shown in Fig 12, user can add, delete and edit both element and sub-element that are in the database.

Fig 12: Form 6 (Element Window).

B. Discussion

Visual Basic .NET language is chosen for this study due to its versatility. In addition, Visual Basic .NET also is proven to be efficient as giving programmer quick way to come with a solution. However, some programming knowledge is required to program the CSP program. Visual Basic .NET and My Sql syntax need to be understood in order to connect CSP program to database that holds the data. Selected image file is converted by the program into a long binary large object (LONGBLOB) and saves into the database. When the image is called by use, the program will fetch the binary and turn it into image format to be displayed.

The program interface is found to be user friendly. New user will be familiar with the program with short guidance and through experimenting with the program by the user itself. Combo boxes is used in “Add New Defect” window is one way to make sure the user would not miss any category or building element when data is keyed in into the program. User only need to key in data obtained during building inspection. The keying in of 30 mock-up defects only took about 40 minutes. After all data is keyed in, the program will sort and store the data automatically thus considerably shortening time required to produce a final report.

CONCLUSION

With the development of new rating system such as CSP1 Matrix, building inspection on site can be shortens considerably. With the addition of computer programming, the process of building inspection can

be enhanced even more. As the case study has shown, the CSP program is able to save, sort and compute data automatically in addition to producing final report instantly. This will significantly shorten the time required for surveyor to come up with the final report of the current building condition. However, the computer program need a continuous development in order to catch up with new materials and element used in construction of a building.

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