# THE SUPPORTING TOOL FOR C PROGRAMMING IN TEACHING AND LEARNING ENVIRONMENT: AN ENHANCEMENT OF HYPERBOOK AND COURSE MANAGEMENT SYSTEM (CMS)

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*Abstract*: The use of Hyperbook concept in the teaching and learning of C Programming has previously been developed in several higher educational institutions, which acts as notes or reference. The development of Hyperbook was based on the traditional book learning format. While this application is primarily developed for students, another application has also been developed for instructors, known as CMS (Course Management System). CMS helps instructors to properly organize and manage courses. Starting with the registration of students, assessment of assignments and also assignment grading can be executed by CMS. The integration of the two packages, Hyperbook and CMS, will provide a total solution system which will further enhance the effectiveness and efficiency of the teaching and learning processes. Upgrading has been done to both packages so that the application can be adapted in the learning of C Programming as well as supporting the smoothness of management process on the part of the instructors. The upgraded packages will also help in the management process for the instructors. This paper will introduce the enhancement of the student module, the Hyperbook so that it will not only be used as a reference but also useful for doing exercises, mailing capabilities, facilities for upgrading exercises or notes and also facilities for receiving assignments from instructors. The instructor module on the other hand, will be furnished with the capabilities of receiving, marking and grading programming assignments. The deliverable will be a package that can be adapted in the teaching and learning process of C Programming thus making a leap from a traditional learning process to a digital learning experience

Keywords: Hyperbook, Course Management System, Marking tool.

## INTRODUCTION

The influence of Information and Communication Technology (ICT) has been enormous in plenty of fields including the education field. ICT helps by enhancing the teaching and learning process and also garnishing interest among students towards learning. To achieve an excellence in teaching and learning, especially in higher educational level, can no longer be endured using unaided conventional methods [2]. [4] believes instructors need to have variety pedagogy in order to improve their teaching effectiveness in a dynamic education environment. Therefore, the step towards computerization, particularly the computer-based systems being developed increasingly, will help students in their learning process and assist instructor in teaching [5]. This computer-based system acts as an intermediary between instructors and students [2]. The focus of this paper is to introduce the enhancement of Hyperbook (Student Module) and CMS (Instructor Module). Also, to discuss the marking tools incorporated in the CMS that can be used in the process of marking the C programming assignments automatically.

Previously, Hyperbook for C Programming was developed mainly as a reference module which covered all topics for C Programming course offered in one of the higher educational institutions. The approach uses in the Hyperbook is a combination of a basic format of a traditional and an electronic book, which uses an electronic medium as the main platform [4]. There are three methods in explaining the materials in the Hyperbook. They are notes, programs' syntaxes and programs' animations [7]. Primarily, Hyperbook was developed to assist and improve the understandability of the students in the programming course. Also, by using an interactive electronic medium, the process of learning is believed can be more interesting [6].

Along with the application of Hyperbook, CMS was also developed in order to assist instructors in the course management. CMS offers facilities for students' online registration for the course, online submission of assignments, marking of assignments and tabulation of marks for each of the assignment [1]. Course registration need to be done before any assignments can be submitted. Student can register by sending his or her details via email. From there, CMS makes a name list of the students registered. This name list is used in monitoring the process of sending and receiving the assignments, which are given through CMS. The question and assessment criteria of the assignment can be done systematically since the CMS is well equipped with the facilities of constructing, sending, receiving and marking essay-type assignments, regardless the assignment is written in English or Malay. For those who failed to submit the assignments, a reminder will be sent via an email

Nevertheless, the original CMS can only be used appropriately in managing the non-programming courses since it neither have the capability nor the tools to administer the programming assignments given to the students. Meanwhile, [3] believes through programming exercises and assignments, students could build a strong and firm foundation towards the concepts, syntax's constructions and semantic programming which they have learned theoretically. However, with the enormous number of students in the field of Information Technology, it would take quite sometimes to handle, check and mark the students' assignments. Clearly, it is an essence for the students to have a quick feedback from their instructor in order to measure their level of understanding and performance [1].

In this paper, the new improved and enhanced Hyperbook and CMS are presented. The proposed former model acts as a reference together with exercises, mailing capabilities, facilities for upgrading exercises or notes and also facilities for receiving assignments from instructors. Whereas the latter model would be benefiting to use in the course of C Programming if an automatic marking tool is incorporated.

## MATERIALS AND METHODS

*The Model*

After a thorough analysis, authors have found that, there are few requirements need to be added in order to improve the level of usability of the Hyperbook and CMS. The requirements for new proposed Hyperbook are as follows:

- Exercises and solutions at the end of every chapter.
- Automatic update for notes, exercises or both which can be done chapter by chapter.
- Capable of receiving question of the assignments through email.
- Capable of sending and receiving email.
- Student registration facility. This process needs to be done only once in order for the instructor to record all the information needed in monitoring and administering the course.

Below are the requirements needs to enhance the usability of the CMS.

- Facility to construct programming assignments.
- Assessment criteria for programming assignments whether the assessment is done automatically or semi- automatic.
- Automatic marking. This process is done automatically by using the marking tool, which have been developed by the previous researcher. The programming assignment can be marked based on typographic analysis, dynamic correctness or even a combination of both approaches.
- Semi-automatic marking. This process will evaluate the assignments based on items that need to be included in the program. The chosen items are based on the element in typographic and dynamic assessment approaches.

Generally, figure 1 shows the integrated system model of Hyperbook and CMS which consists of four major components. The components are server, mailbox, instructor and student. The components of server and mailbox are used mainly in the process of updating notes/exercises and checking email, respectively. The other two components, instructor and student, involve in other processes such as registration, building and marking assignments. The details of the processes will be presented later in this paper.

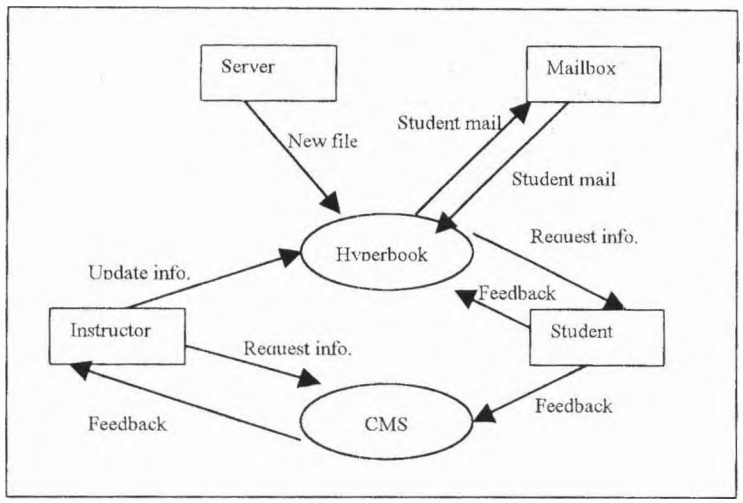


Figure 1. The Integrated System Model of Hyperbook and CMS

*The Implementation of Hyperbook*

The new enhanced Hyperbook still maintains almost all elements previously developed. Figure 2 illustrates the summarized functions offered.

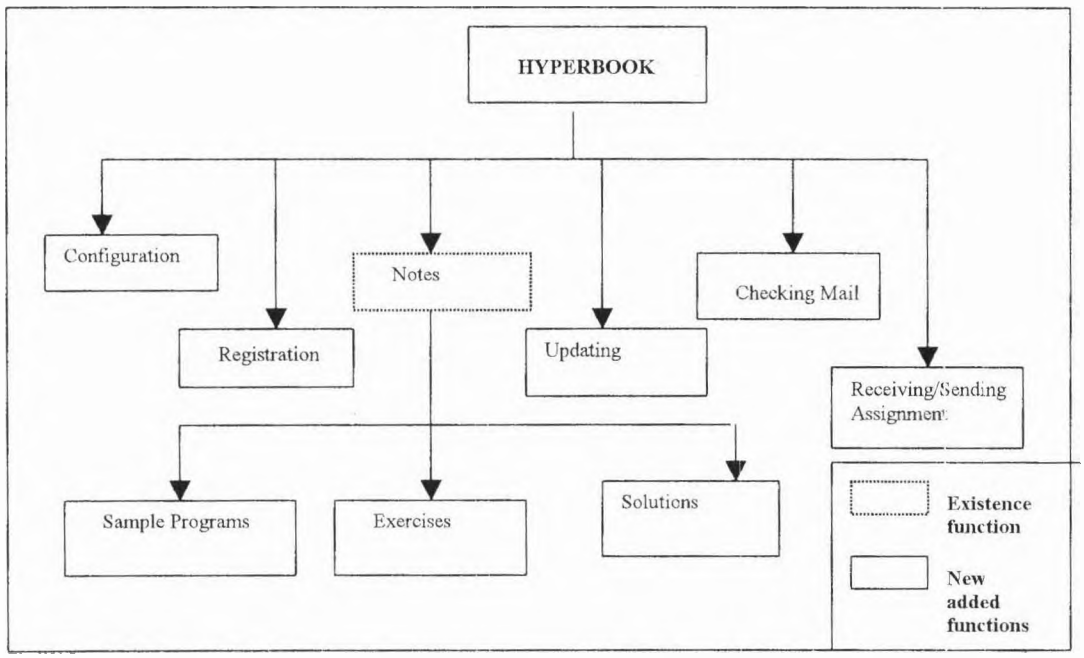


Figure 2: Overview of an enhanced Hyperbook

Based on figure 2. the function of configuration is to configure the system by providing the system with information in regards of mailing activities such as addresses of the server and recipient, directory and the path for all additional applications also need to be specified.

A one-time registration will be required through out the respective semester. For any student, who would like to register for C Programming course, will send an email giving all the information needed. This information will be read and recorded in the database by the CMS.

The updating process will unzip all '*.zip' files using the Pkunzip application. The '*.zip" files which consist of an updated notes or exercises, is later unzipped to the original unit directory after the current contents of the directory being copied to a new directory known as OLD. The contents of OLD directory will be needed in the undo process where it will be copied back to the original directory. Checking, sending and receiving emails is done by transferring the system's control to the Qualcomm Eudore applications.

Next is the process of receiving assignments and sending the answers to the assignments. This process can also be done via email where students can receive assignments and each of the assignment can be saved in a separate file. This is to provide easy reference in the future. Depending on the nature of the assignment given, TURBO C application is required for any programming assignments whereas for non-programming assignment any kind of software editor can be utilized. All finished assignment can be send back to the respective instructor via email.

Exercises will be provided at the end of each unit. The exercises can be comprised of basic exercises - which involve multiple choice questions and answer or short answers questions; and some programming exercises. All exercises will be stored in files.

*The Implementation of CMS*

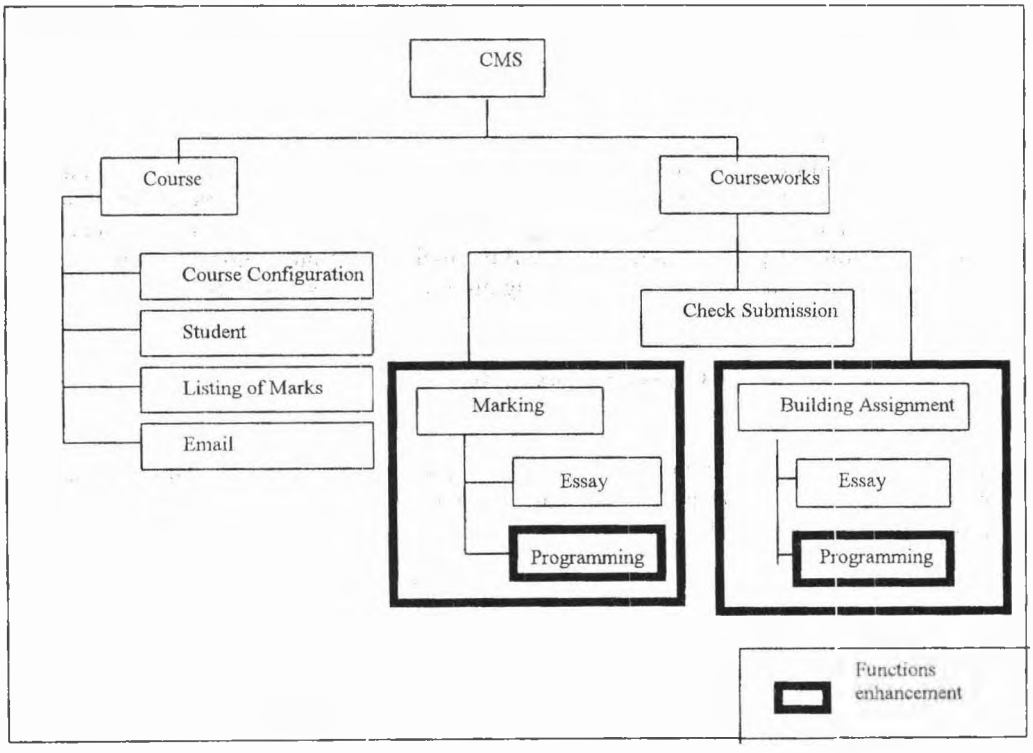


Figure 3: A Summary of An Enhanced Course Management System (CMS)

In figure 3, an enhancement of the functions happened in the function of building and marking the assignment. Two automatic and a semi-automatic marking systems have been applied in the marking process of the programming assignment. The two marking systems are the typography analysis and the evaluation of dynamic correctness

Before the marking process can be started, instructor needs to build up the assignments. Few information is needed in order to complete setting up the assignments. They are type of assignments, date of submission, question of the assignment and the type of marking. The marking process starts when the finished assignment is compiled and send to the right to the instructor via email. The respective instructor will record all assignment received with the help of CMS.

A type of marking based on typographic analysis emphasizes on the way a program source code is presented. Here, a program source code refers to a completed programming assignment send by a student. A typographic program will analyze a program source code in order to evaluate the program's understandability and maintainability. Several factors are being considered in marking the program source code. Some of the factors are percentage of indented lines, average characters per line and average module length. Then, the score for each factor is determined which later, a specific mark is given for each separate score [1].

Another type of marking the programming assignment automatically is a program dynamic correctness. By using this marking tool, each program source codes need to undergo the dynamic correctness testing. The score is given based on the correctness of the output when the program is run by using several sets of test data provided by the instructors. The score of the dynamic correctness testing may be any value from 0 to 100 percent [1].

Also, the programming assignments can be semi-automated marked which is either marked as a whole or itemized. In itemized marking, the division of marks is based on combination factors being considered in typographic analysis and dynamic correctness testing. Those factors are percentage of comments, percentage of declaration/define, identifiers, module, indentation and output.

## RESULTS AND DISCUSSION

In this paper, the enhancement of Hyperbook and CMS has been proposed in order to act as a supporting tool for C programming teaching and learning process. Several new functions are added to the existing Hyperbook and CMS so that they can be used as to provide the valuable feedback to the instructors as well as to the students about the strengths and weaknesses of the course especially in programming skills. For this purpose, an automated marking tool is integrated into a previous CMS in order to promote effectiveness and uniformity in marking programming assignments.

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