

A Service Oriented Approach for an E-Assessment System

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Abstract—the term e-assessment is actually a generic term which covers a range of activities in which digital technologies are used in assessment. As assessment is an essential element in learning processes, almost all learning management systems (LMSs) strongly support an assessment by creation, execution, and evaluation of multiple choice tests. In this paper, the system designed and implemented, automatically assesses the assignments that students submit as electronic documents and multiple choice questions that student attempt as a test series. The most prominent feature of the system is that, it can be easily interfaced with different existing learning management systems.

Index Terms— Computer science education, service-oriented architecture, web services, e-Assessment, eduComponents.

I. INTRODUCTION

Teaching and learning are the most important applications of a computer science curriculum. Exercises and/or laboratory practice are important constituents of learning process, since they provide scope for students to have a perfect grip on the knowledge which they acquire in lectures and to apply it to practical problems. However, there are certain sorts of drawbacks associated with the traditional teaching methodology and assessing and evaluating schemes, which may be sketched as follows [1]:

Before classroom sessions

- the teacher designs the assignments according to the state of the course
- the exercise sheet may be distributed as a printed document could be made available online, in the form PDF files,
- Students can practice these sheets as their homework.

During classroom sessions

- students can explain the solved assignments at the blackboard,
- tutor and peers give (spontaneous) feedback,
- simultaneously peers may note down the solution,
- The tutor may keep track the student's performance.

The above mentioned learning methodology is especially not feasible for lengthy programming assignments as it requires too much time, so very small number of programming assignments can be checked out. This situation is also unsatisfactory for students, because their queries could not be discussed in detail due to time constraints. So we need a Content Management System,

we call it as a plone [3], and it can be automatically coupled with the assessment process. Due to which it is possible to give immediate feedback for students, which could be an additional motivating factor (cf. [3]). So in order to construct a full-fledged assessment system we need to couple certain important module with existing learning management system, those modules are called as eduComponents [3]. Some important eduComponents are enlisted below:

- ECLecture [5] is a portal to manage lectures, seminars, and other courses.
- ECQuiz [5] plays an important role in the creation and delivery of objective tests containing multiple choice questions.
- ECAssignmentBox [5] provides the space to write or upload essay-like assignments.

The eduComponents modules are used as standalone components, or in combination with existing learning management system so as to improve the standard functionality required in an e-learning environment.

II. LITERATURE SURVEY

The assessment process summarizes all activities those are helpful for teachers, so that they can help learners to learn and to quantify the learning progress. (cf. [8]). In other words, assessment quantifies and reports the understanding, skills, and attitudes of an individual beginner, of an educational institution.

In computer science education, what so ever systems are in existence till now, they only automatically assess and compile the programming assignments by using their own compilers and/or interpreters. For that, they just use static or dynamic

testing methodology. Also to effectively share assessment solutions already developed, these tools must be highly interoperable and portable. The first systems which support the online analysis of programming exercises were developed and used as early as 1960. But it fails to provide security, plagiarism detection, etc. A comparative study of all existing assessment systems are summarized next (see Fig. 1). Certain criteria are based on which comparison is made enlisted below [7]:

- Which assignments are evaluated: objective assignments only (e.g., multiple choices, true/false) or skewed assignments (e.g., essay like programming assignments) as well?
- Is the system premeditated for a single programming language or it can be compatible with any programming language?
- Is the system cramped to a single test method or does it support a variety of test methods?
- Is the system presented as free open source software or is it closed source only?
- Is the assessment system impartial only or it can be united with other systems?

System/Project	TRAKLA 2	Scheme-robo	Auto-Grader	Code-Lab	My-Code-Mate	Course-Marker	BOSS	AT(x)	Moodle	Black-board
Criteria										
Assessment type										
▶ objective	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> ⁶	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
▶ subjective	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Automatic assessment										
▶ programming assignments	<input type="checkbox"/>	<input checked="" type="checkbox"/> ¹	<input checked="" type="checkbox"/> ¹	<input checked="" type="checkbox"/> ²	<input checked="" type="checkbox"/> ²	<input checked="" type="checkbox"/> ³	<input checked="" type="checkbox"/> ²	<input checked="" type="checkbox"/> ³	<input checked="" type="checkbox"/> ²	<input type="checkbox"/>
▶ other formal notations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> ⁴	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
▶ different test methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> ⁶	<input type="checkbox"/> ⁶	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Integration with other learning platforms	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> ⁴	<input type="checkbox"/>	<input type="checkbox"/>
Extensibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Open source	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Support ³	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

¹ single programming language
² two or more programming languages
³ (in principle) any programming language
⁴ submissions via WebAssign
⁵ latest release is not older than two years
⁶ unknown

Fig.1. Synopsis of systems for automatic assessment [1]

Another group of such systems are mainly LMSs that work in a vice versa manner compared to the systems mentioned before. LMSs like Moodle, Blackboard, or OLAT are mainly

designed and implemented to manage structure of courses providing course materials. They also offer tools to assess questionnaire, multiple-choice tests, to uploads files (e.g., PDF files), especially for automatic testing of programming assignments.

III. PROPOSED METHOD

An e-assessment system for testing programming assignments is capable enough to satisfy the following requirements [7]:

- It flexibly integrates the test and grading functionalities in various learning ambiances without redundant user management and data storage.
- It carries out automatic evaluation of programming assignments in various dot net languages(C#, VB).
- Moreover, it automatically evaluates and assesses the multiple choice questions attempted by students as test series.
- It also provides additional plugging functionality so that easy extension is provided for additional assignment types.

1. Problem Formulation

The principle based on which the system works is Service Oriented Approach. A Service Oriented Approach (SOA) is a framework which securely integrates standardized components, which are also called as services that can be reutilized and merged to meet various changing requirements, principles of programming languages, and test methods details.

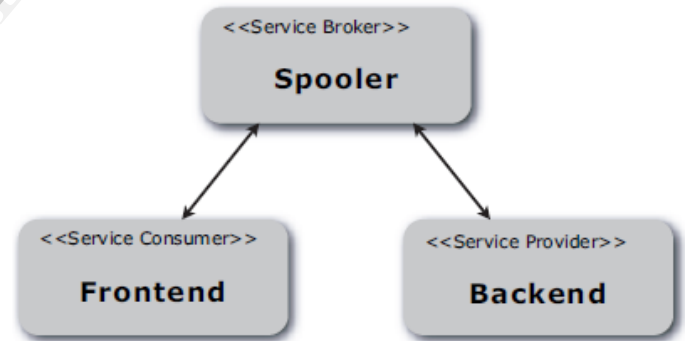


Fig.2. Roles in a service-oriented architecture and its equivalents in our approach [1].

The actual assessment of programming assignments is truly dependent on the test method that we are going to apply to, programming language, or other formal notation in case of multiple choice questionnaires. Hence, all testing related aspects are encapsulated and implemented as services and called as backends. Backends are basic utilization units of our SOA, which provide assessment services over standard Internet protocols also these services are platform independent and

programming languages. As teaching and learning are important processes within education systems, these processes must typically be supported by a specialized system called as LMS.

In the above mentioned diagram (see fig.2), we develop LMS as a frontend. Common functions of a frontend could be enlisted as follows:

- To provide storage facilities for assignments and solutions,
- To treat submission properly.
- To make results available to students or statistics for individual students and whole cohorts.

Third component in SOA approach is called as spooler. It enables uniform access to the backends and manages the loose coupling between frontends and backends and thus avoids too many point to point connections. It provides the following functions:

- To add assessment services for testing,
- Produce results of tests performed by a backend,
- Show status information s.

get required input fields for testing with a certain backend, Now if we compare our system with above mentioned approach, it is observed that a simulated web site is performing the role of Backends. It refers the services provided by Frontend by SOAP protocol. In the other words, whatever web services we require for assessment purpose, we implement it at frontend level and with the help of SOAP protocol, backend web site consumes these services. That means, SOAP protocol is acting as like a middleware between the web services at frontend side and backend web site. This approach is clearly shown in figure next.(see fig. 3).

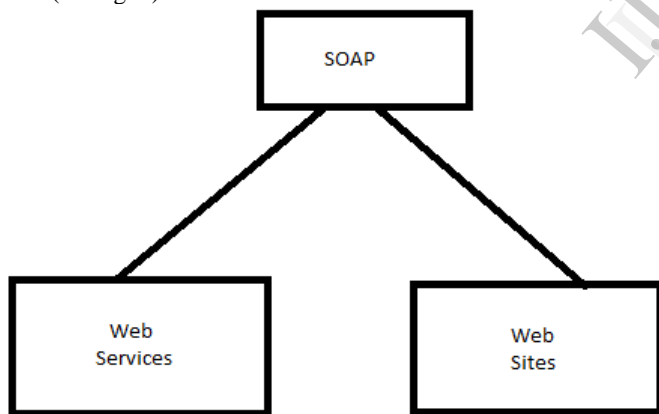


Fig.3. Systematic approach of proposed system.

2. Proposed System

As described in figure above (see fig.4), this system contains three primary modules.

- Tracking User Activities.

- Present online MCQ Test to the user and assess it.
- Present Programming Assignments to the user and evaluate it.

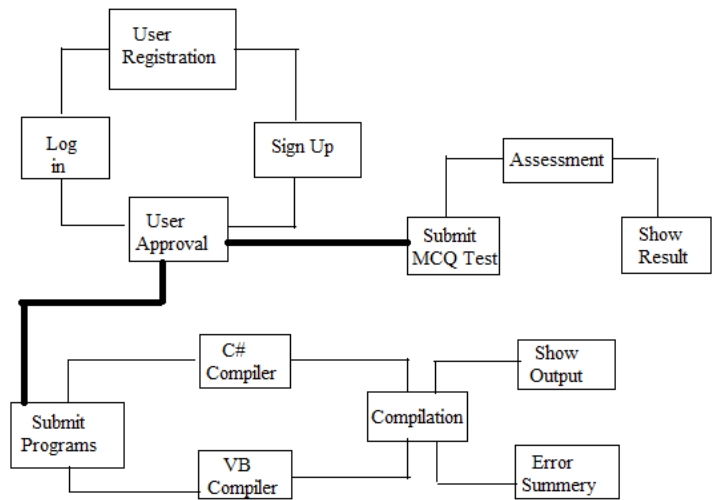


Fig.4. Flow Chart of Proposed System

As described in figure above (see fig.4), this system contains three primary modules.

- Tracking User Activities.
- Present online MCQ Test to the user and assess it.
- Present Programming Assignments to the user and evaluate it.

Tracking User Activities

In this module, we first see whether the user is already registered or a new one. In the formal case we directly provide a Log in facility for that user while in later case, user may fill up the sign up form to continue the registration. After the successful login also, user may not be approved for accessing the services so now its turn to an administrator to approve that user. For the same, administrator just changes the status associated with the user to 'yes' and then that user will be an authorized user to access the services.

Present Online MCQ Test as a Service to the user

After successful completion of previous activities, user can enter in this phase where he/she is able to access the services which expose the online MCQ test to the user. Here we expose an xml file containing questionnaire to the user. User can solve individual questions and submit it in proper time interval. After completion of test, user may get competency report with time interval details. The execution of this module is truly based on principles of SOA, where user first refers this MCQ assessment service through the web site via SOAP protocol. After the completion of test, user may log out or can switch over to the third module by staying log in. User can SMS test result to any

number via COM port connected, which will be an additional benefit of the system.

Present Programming Assignment to the user as a Service.

After successful approval by an administrator, user can directly enter in this phase. Or user can reach in this phase after the termination of second module also. That means, after the successful approval by an administrator, user has two choices either to go on dealing with MCQ assessment service or directly attempt the programming assignments. In this phase, user can upload programming assignments on various dot net languages(C# or VB) in the ECAssignmentBox developed at the web site. When user press the 'Check Syntax' button in the system, depending on what programming language is used, the assessment is carried out by an appropriate compiler(either C# or VB compiler). In case of failure, the exact error summery is presented to the user through summery box provided below the ECAssignmentBox. Or in case of successful compilation, user can see the out by pressing 'Show Output' button in the system. Thus, this system is basically helpful for both, teacher and students. By using this system, teacher can create assignments, publish those to users, also grade the assignments those are submitted by the students. If we consider student side, this system allows students to read the assignments and to solve it, and to observe the feedback if any. The above mentioned activities are described in the diagram next(see fig 5).

IV. EXPERIMENTAL RESULTS

As discussed in previous section, the first unit takes care of user management activities. The diagram above (see fig.6) shows the welcome page of the system. If the user has not already an account at our database, the he or she must have to go through the sign up activity. The sign Up page will look like (see fig.7).

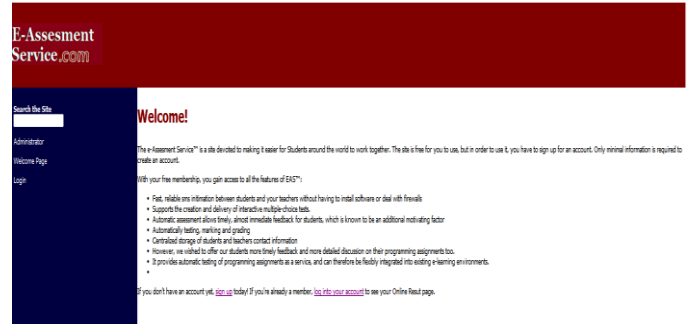


Fig.6. Home page

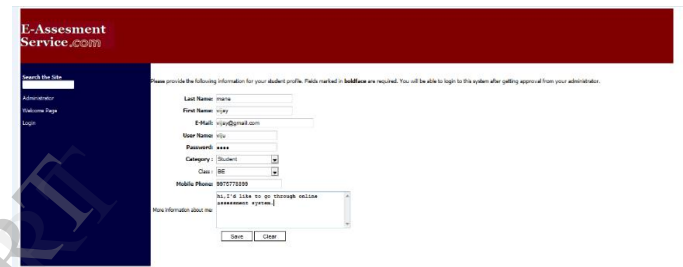


Fig.7. Sign up activity

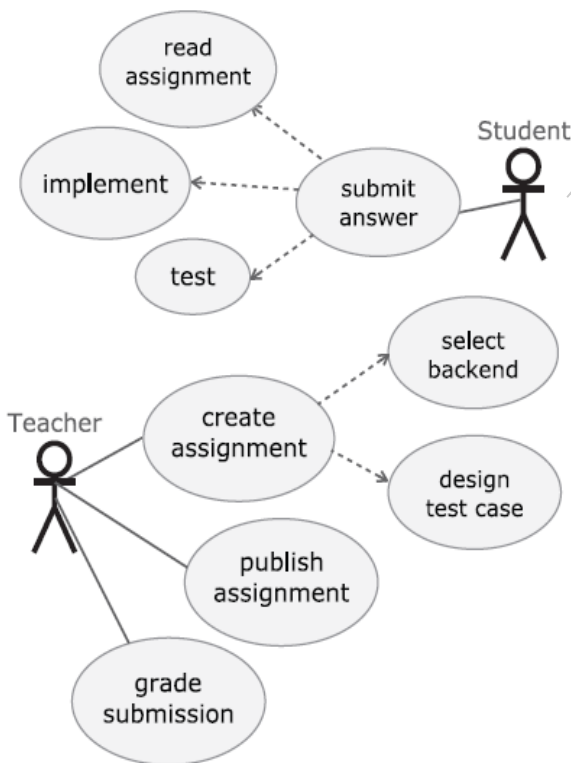


Fig.5. the task utilization by the system [1].

User enters his/her detail and also selects his category whether he is student or teacher as both of them are important constituents of our systems. After entering the details, user hit 'save' button provided below or if he wants to update some information before committing, he could catch it up with 'clear' button. After successful completion of this task, a new account is created. Though the user creates a new account, he or she will not be authorized to use our services unless administrator approves that user. The following diagram will represent this activity (see fig. 8).

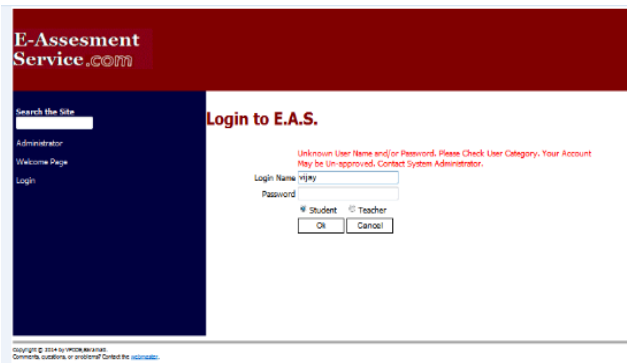


Fig.8. Restrict unauthorized user.

So next, we consult the administrator for user approval. This activity is embedded in 'adminact' page. (See fig. 9).

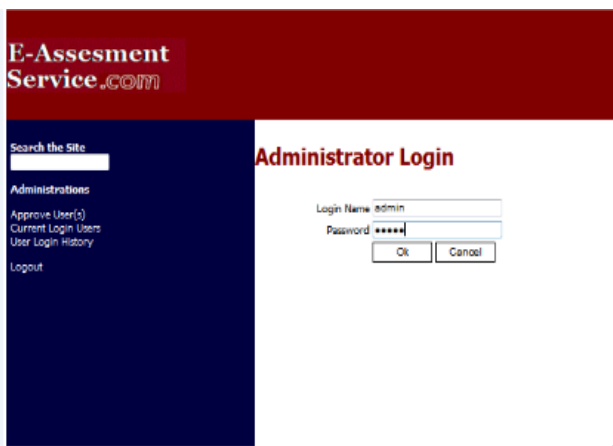


Fig.9. Admin activities.

Administrator after successful login, provides approval for the user by updating the current status of the user from 'n' to 'y'. These activities are shown in the next subsequent diagrams.

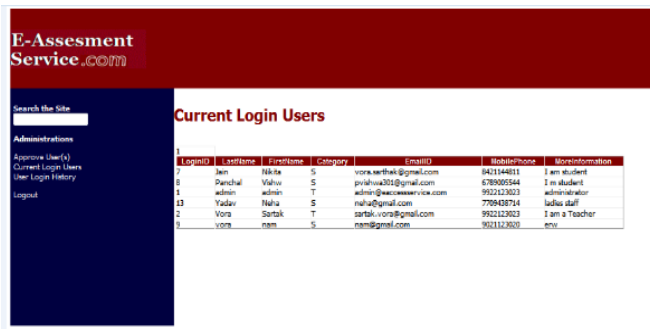


Fig.10. Current Log In users.

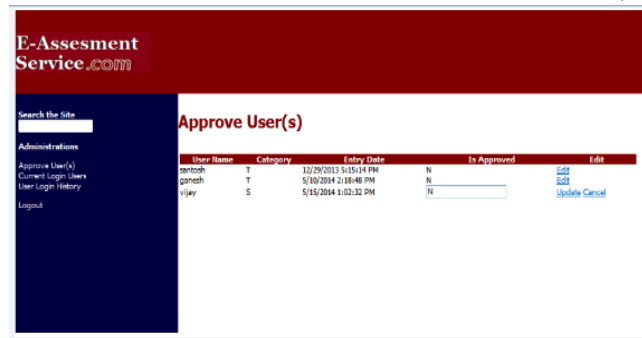


Fig.11. Authorization of user .

After successful authorization , user is allowed to access the services published by teacher. There are two important services presented in the system—the first is assessment of multiple choice test(MCQ)—and the second is the evaluation of programming assignments. These services are arranged in the left panel of the wizard in the form of tabs. When user hits 'show assignments' tab, all the questions in the input supplied file will appear on the screen in the sequential manner. User can attain the question and submit it by pressing the 'submit' button so that he can attempt the next question.



Fig.12. Format of MCQ Test.

When user completes the test, a competency record will be shown on the screen with the time estimates. These many events are described by following snapshots.

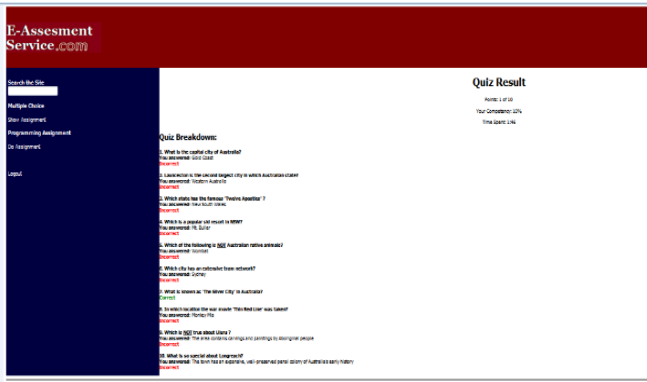


Fig.13. Quiz Result.

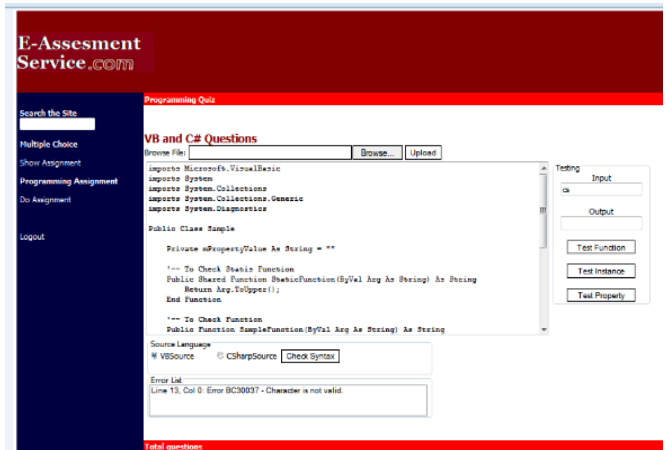


Fig.15. Feedback summary of errors

After this event, user can either log out the system or can directly switch over to solve the programming assignments. In this case, user can upload the file in solution explorer by 'browse' button or he can directly write the code in it. Then to check whether the written code is correct, he can press the 'check syntax' button. Then depending on programming language used for developing the code, the appropriate compiler comes in to the action as a Service and the code is compiled. In case of failure, the error summary is generated and presented in the error window exactly below the solution explorer. Otherwise we can see the output by giving the appropriate input through the space allocated in the system. These facts are depicted in following snapshot (see fig.13).

As shown in the snapshot (see fig. 14), it shows exact summary of errors in the error window exactly below the solution explorer. Moreover, In case of successful compilation, if demand the exe file of the code provided in the solution explorer, then it can be achieved by pressing 'make exe' button on the system (see fig.15).

V. CONCLUSION

This paper reports a novel service oriented approach for schematic E-Assessment system. E-Assessment is the process by which study materials, MCQ tests, programming assignments are made available to the learners and also evaluate and assess the test attempted by the learners. This whole functionality is encapsulated as a service. In this service-oriented architecture, all common aspects related to the assessment e.g., submission, storage, and result reporting are encapsulated as a web service. Only the specific concerns related to the testing itself e.g., for programming tasks: which programming language is used also the details of interpreter or compiler and test method etc. are realized as full fledged web site so called backends [4]. We just go on referring the service through our website via SOAP protocol which is performing the role of mediator. In short, this system works on principles of automatic testing [9].

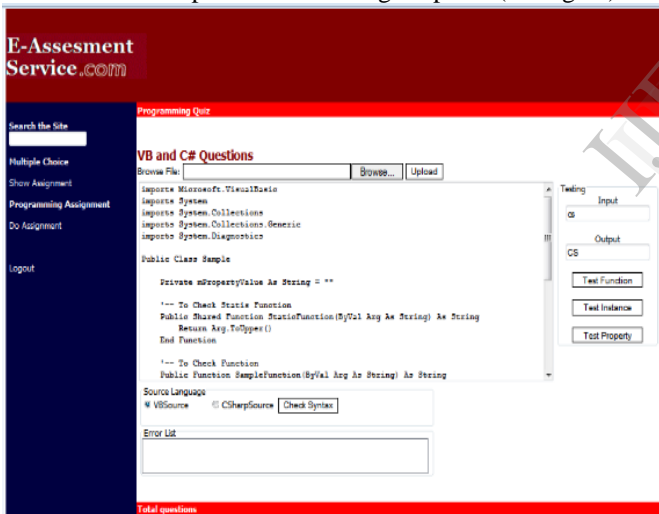


Fig.14. Successful assessment of programming Assignments.

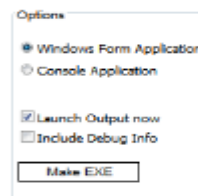


Fig 16. Component of the system to generate .exe file

VI. FUTURE WORK

The functionality of system should be extended so that we can maintain the log for tracking student's submission activity in the situation where large no of students are assembled together for the tests. This would simplify data mining process to track students working behavior. Moreover, this system could be designed in such a way so that while solving objective test, questions could be available in random manner instead of sequential approach.

ACKNOWLEDGMENT

We express great many thanks to Prof. Santosh A. Shinde, for his great effort of supervising and leading me, to accomplish this fine work. Also we would like to thank the college and department staff, as they are great source of support and encouragement for me ever. To my friends and family, for their warm, kind encourages and loves. To every person gave us something too light my pathway, we thanks for believing in me.

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