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Evaluating and Designing a Secure Text-Based CAPTCHA and Picture Password for Online Examinations

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***Abstract*:-** Online Examination System is a software solution, which allows any industry or institute to arrange, conduct and manage examinations via an online environment. It can be done through the Internet/Intranet and/ Local Area Network environments. Problems arising from human hacking or technical difficulties may lead to questioning of reliability and efficiency of the online exams. The system architecture proposed in this paper provides integrated management of passwords that prevent unauthorized access by the other users who nowadays are a havoc for security of the portals. In this paper, the combination of CAPTCHA and picture password system is proposed which improved the capability of resistance to the attack by malicious programs. CAPTCHAs are used to improve the security of Internet based applications in order to ensure that a web based application which is intended to be used by a human being is not maliciously used by Artificially Intelligent programs called bots. Graphical passwords, which consist of clicking on images rather than typing alphanumeric strings, may help to overcome the problem of creating secure and memorable passwords. Our results showed that this combination is practical in the aspects of security and usability.

Keywords: CATCHA, Online Exam Portal, Picture Password, Security.

I. INTRODUCTION

Following the rapid developments in the information technologies and increased number of students the online examination gains importance as an alternative to the traditional examination and evaluation models [1]. Besides the testing system merits being fair and open, it's also the best way to measure academic performances. Structural problems of classical evaluation such as requiring too much time and resources [2] can be eliminated owing to the functions of online test system such as efficient management of evaluation process, diversity and pace of student evaluation [3]. The Online Examination System is an electronic application that helps the institution to assess the inquiry have different alternative with one right reply and give remotely access to portals. In this process the administrator could set the number of different types of questions according to their need and generate an exam paper randomly in accordance with the requirements and taking into account the development of course content. It could easily update and add questions, to make the teaching content developing with the technology synchronously. Finally, the paper in standard format could be outputted along with its answers [4]. It assists the invigilator with reducing the work of leading exam, checking answer sheets and producing result [5]. All this work is finished by the machine and information is put away on the server. It also provided online testing capability for students [6] Students could log in the system at any time in the campus network, test themselves, understand their learning level, and adjust their learning progress [7].

The security challenges we face during online examination are challenge of identity and unauthorized interference of other users in the network using other clients. Keeping this in view CAPTCHA and graphical methods of security have been a great help. CAPTCHA (Completely Automatic Public Turing Test to Tell Computer and Human Apart) is a Human Interactive Proof (HIP) system which is used to distinguish between human users and computer programs automatically [8] . The thumb rule of CAPTCHA is that it should be solved easily by a human but not by a bot. Sometimes CAPTCHA is also referred as Reverse Turing test.It helps to prevent artificially intelligent automated software programs known as bots (that pose as human users) from performing malicious activities like spamming and other fraudulent activities.Among visual CAPTCHAs, Text-based CAPTCHA is one of the most popular types [9]. It exploits the ability of people to read images of text more reliably than

Optical Character Recognition (OCR) or other machine vision system. As these CAPTCHAs are becoming more difficult for genuine users, attackers are also getting better at breaking existing CAPTCHAs [10].

Graphical passwords (GP) use pictures instead of textual passwords and are partially motivated by the fact that humans can remember pictures more easily than a string of characters [11]. The idea of graphical passwords was originally described by Greg Blonder in 1996. An important advantage of GP is that they are easier to remember than textual passwords. Thus, graphical passwords provide a means for making more user-friendly passwords while increasing the level of security [12]

The challenges we face during online examination are challenge of identity and unauthorized interference of other users in the network using other clients.Keeping the security, time efficiency and authorization view the web portal will be framed and secured with the following objectives:

1. Creation of a two layered generic web portal (Administrator and User) for the conduct of the online examination to ensure flexible approach during testing process.
2. Securing the web portal to stop unauthorized interference or access using CAPTCHA and graphical password.

Henceforth in the upcoming sections we would describe the review of literature, methodology and architechture, result discussions and conclusion.

II. REVIEW OF LITERATURE

In the study of online examination system, to overcome some security issues of the system and the issue of cheating by all parties by establishing a basic framework. This framework combines the online examination web application, network system configuration, and communication protocol as an integrated system. In the context of web page application, cheating prevention like Fisher-Yates random question, automatic scheduling, and seating arrangement were used and in the context of network configuration, the combination of firewall in the server system, proxy and MMC in the client become a security guarantee [13].

To delineate CAPTCHA is an vital mechanism to gain admission to the needed system.Though, there are a little difficulties forusers in typing CAPTCHA even though they are authorized persons[14]. CAPTCHA has been extensively utilized for stopping malicious plans to admission web resources automatically. In this paper, a new kind CAPTCHA (Click spell) joined the features of text-based and image-based CAPTCHAs.Passwords are a common form of authentication and are often the only barrier between a user and your personal information [8]. There are several programs attackers can use to help guess or "crack" passwords, but by choosing good passwords and keeping them confidential, you can make it more difficult for an unauthorized person to access your information. We propose a new Password Guessing Resistant Protocol (PGRP), derived upon revisiting prior proposals designed to restrict such attacks [16].

Paper Reference	Domain	Merits	Drawbacks
Wayne *et al*., 2003 [15]	A visual logic technique, Graphical Passwords, CBT	▪ Gives users flexibility in choosing a predefined theme that suits their personality and taste or providing their own set of images for display and increase the level of security.	▪ The size of the image matrix limits the effective alphabet size to only 30 elements, assuming a one-to-one mapping, which in turn results in weak passwords.
Wazir et al, 2011 [16] Okolie and Adetoba , 2016. [22]	Graphical Passwords, Authentication, Network Security.	▪ Graphical passwords (GP) can beeasily rememberedby human as compared to string of characters.	▪ The Shoulder surfing problem: an onlooker can steal user's graphical password by watching in the user's vicinity.
Tugrul et al, 2014 [1] Kumari and Nand, 2017. [21]	Architectures for educational technology system, Intelligent tutoring systems for CBT	▪ Proper execution of exams aimed at assessment & evaluation. ▪ Provides for integrated management of main functions (question pool creation,update, execution and evaluation).	▪ Human-centered errors or technical difficulties may lead to questioning of exams, and thus of reliability and efficiency of the distance education systems.

		▪ Provides Architectural flexibility and strong information technology infrastructure of online examinations systems.	
Andrew et al, 2009 [17] and Fagbola et al, 2013 [18].	*e*-Assessment for CBT	▪ Time analysis of responses to the question level to better discriminate between candidates. ▪ Question banks and randomization of questions and response orders to reduce cheating. ▪ Automated analysis of results from entire candidate cohorts.	▪ Lack of scalability and robustness. ▪ Automated logging-off and expiration of allotted time is a challenge. ▪ Insecure application domain in terms of data security and integrity . ▪ These stand-alone applications run on distributed networks making such applications restricted to the networked geographical domain.
William et al, 2008 [19]	Graphical passwords Turing Tests , WebSOS	▪ Providesguaranteed access to a web server that is targeted by a denial of service (DoS) attack by use of graphical turing tests, web proxies, and client authentication using the SSL/TLS protocol.	▪ Points on the physical network may need to pass high volumes of traffic. ▪ In case of insufficient processing power, hardware support for the gateway functionality may be required in physical switches.
Kiranjot et al, 2015 [9]	CAPTCHA	▪ Protects from losing data through bots and other hackers as only human users does have the ability to sense.	▪ Optical character recognition can be used for breaking the captcha so its less reliable and cannot be used for high performance based applications.
Yogdhar et al, 2014 [8]	CATCHA (Clickspell), Internet Security, Image Processing.	▪ Its more secure than other CAPTCHA's because it can add an advertisement image optionally and of these advertisement image covered the distortedletters, malicious programs are harder to attack Clickspell. ▪ The distorted letters cannot be segmented and recognized by several OCR tools.	▪ It is costly as it requires largerweb page area, and an image database maintained atthe server.
Greg et al, 2002 [20]	CAPTCHA (Gimpy and EZ-Gimpy).	▪ Gives a program that can generate and grade tests that most computerprograms can't pass giving better security,reliability and flexibilty.	▪ Clutter that involves other real objects, like the words inthe Gimpy images, makes recognition much more difficultthan the heavily textured backgrounds of EZ-Gimpy

III. METHODOLOGY/ WORKING OF PROPOSED SYSTEM

Creation of a two layered generic web portal (Administrator and user) for the conduct of the online examination to ensure flexible approach during testing process administrator of online exam has multiple features such as add, delete, update questions (Plate 1). Users are categorized into two: instructor and students.The user will automatically get the updated version by logging using the user ID, password and captcha provided at the time of login. Instructor sets up examination by logging into the domain (Plate 2) and students can register themselves for online examination,can select the subject for examination, and can view results online after examination (Plate 3).Securing the web portal to stop unauthorized interference or access through CAPTCHA (Completely Automated Public Test to Tell Computers and Humans Apart) and picture password. Integration of database is conducted with the programs allowing administrator for easy addition ofquestions,creation of test and evaluation of results is done through application program interface which enables the application program to move data in and out of the database regardless of the programs logic and modeling algorithms. Generation of the automated results in order of merit.

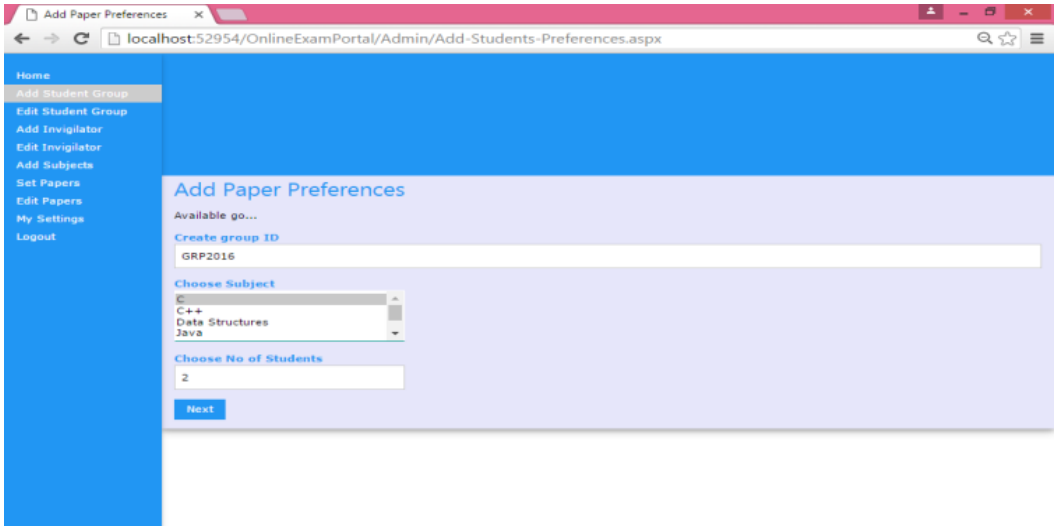

Plate 1.:Admin Add paper refrence

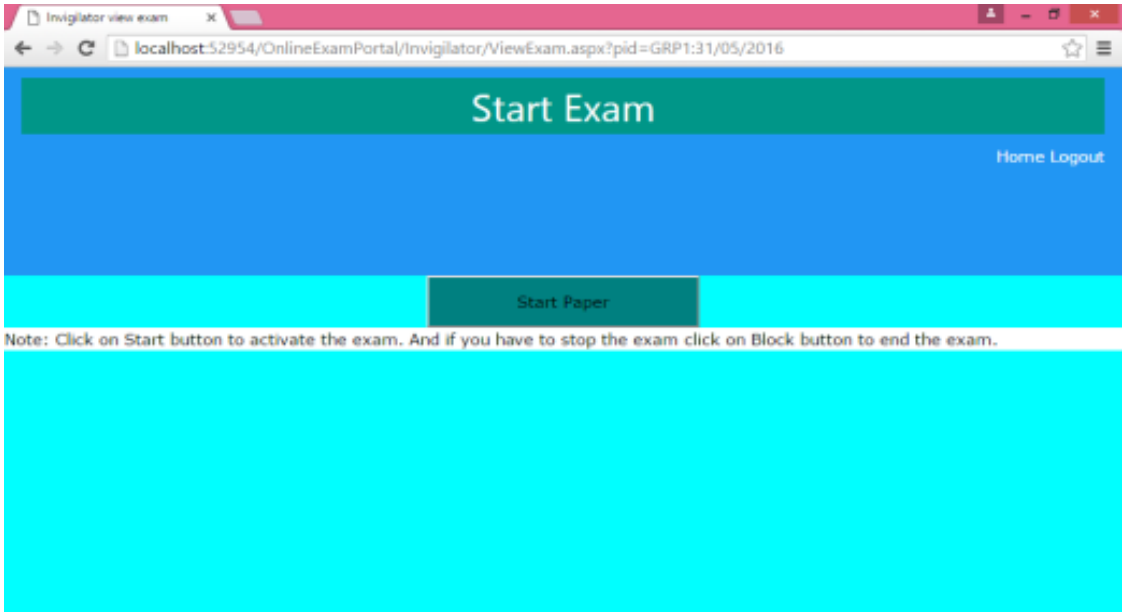

Plate 2: Invigilator Start Exam

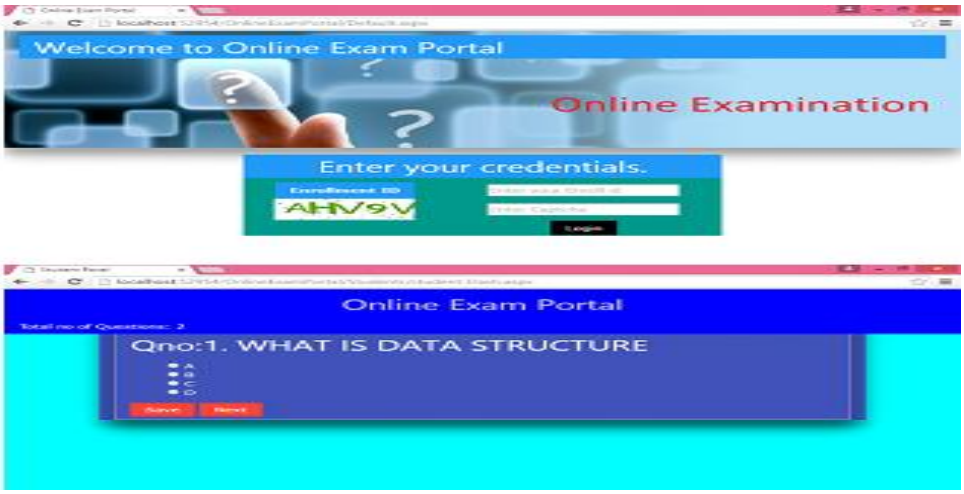

Plate 3 : Student login page and question paper page.

IV. RESULTS AND MODEL FOLLOWED IN PROPOSED SYSTEM

The Waterfall Model was adopted for the development of the online examination portal. The model views the process of software development in five stages viz. requirement analysis and definition, system and software design, implementation and testing, system testing, maintenance.

The conceptual design including the data flow diagram, Use Case diagram and the Entity-Relationship Model (ERM) for the system developed is also presented. The programming tools used for the front-end development of the system are ASP.NET and Microsoft Visual Studio 2013 integrated development environment while Microsoft SQL Server 2010 is used as the database backend.

a. Data Flow Diagram (DFD).

A data flow diagram (DFD) uses a very limited number of primitive symbols to represent the functions performed by a system and the data flow among the functions. Starting with a set of high-level functions that a system performs, a DFD model hierarchy represents various sub-functions. The entity "student" can take examination after he or she gains access to the system. The entity "invigilator" can start the exam that are already uploaded by "administrator", to be answered by student into the online examination database using any preferred question format, Invigilator set the examination instructions. The entity "administrator" is saddled with the responsibility of inserting students, lecturer and setting the default password for the users of the system. The entity "server" is responsible for authenticating the users of the system and also provides the timing functionality for the examination. The system logs off a student upon expiration of duration for the examination (Fig 1).

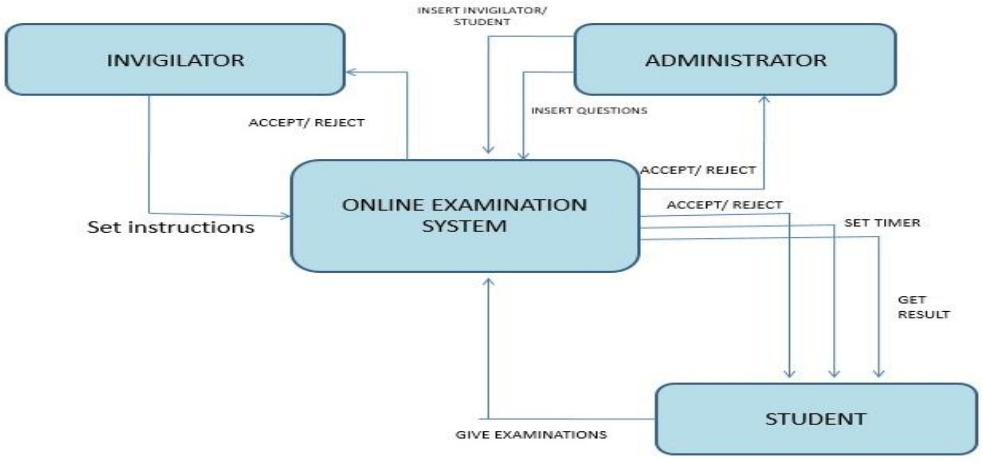

Fig1. Data flow diagram for online examination system.

b. Use Cases Diagram.

These include use cases diagram for the administrator, invigilator, system and student. The use cases diagram for the administrator is presented(Fig2.a,b,c). It shows the activities that are required of the administrator including the upload of students, invigilator details and creation of default passwords for users.

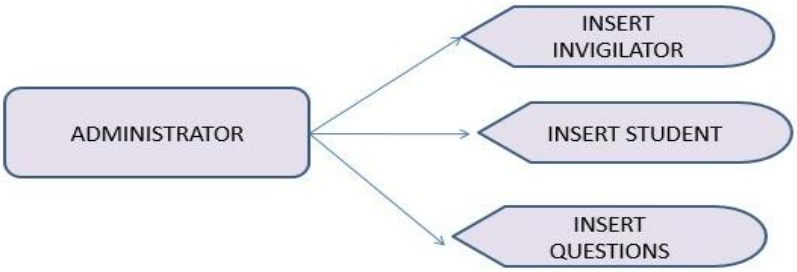

Fig 2a. Use case diagram for administrator.

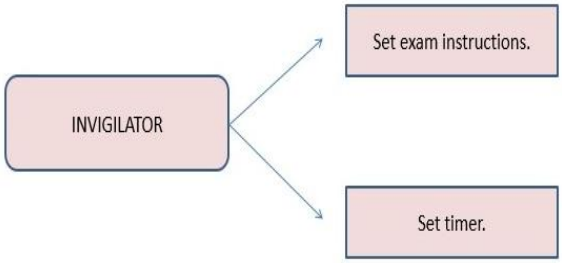

Fig. 2b. Use case diagram for invigilator.

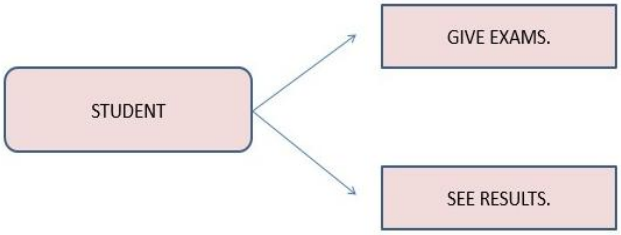

Fig. 2c. Use case diagram for student.

c. Entity relationship model:

It describes the interrelationship between administrator,invigilator and student in this web portal (Fig3).

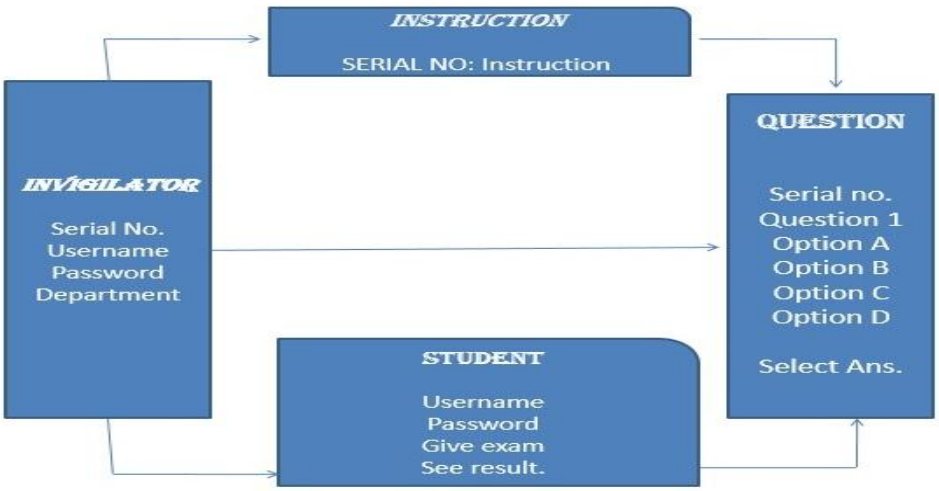

Fig 3. Entity relationship model.

a. CAPTCHA

Among visual CAPTCHA's text-based CAPTCHA was used to secure the portal. It exploits the ability of people to read images of text more reliably than machine vision system (Fig. 4a). Various fonts and word arts can be used to distort the text based CAPTCHA (Fig 4b.)

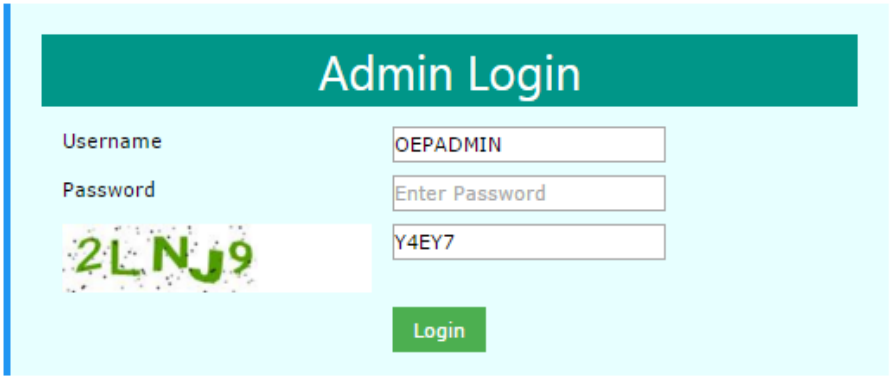

Fig 4a. ADMIN login CATCHA.

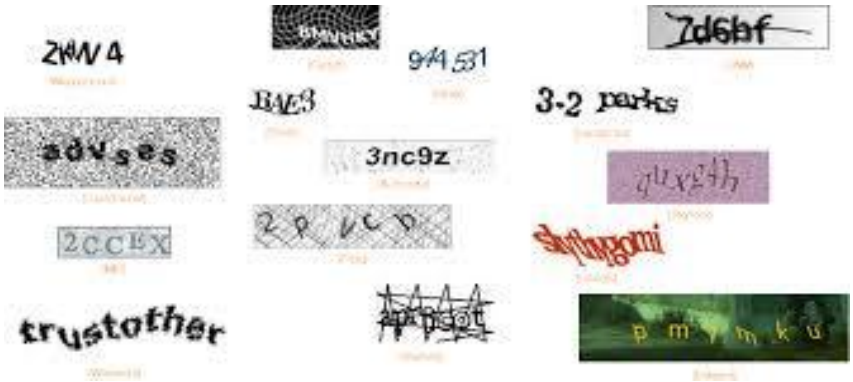

Fig 4b. Different distorted CATCHA.

SECURITY MECHANISM

b.Picture password:

Picture Password used here allows users flexibility in choosing a predefined theme that suits their personality and taste or providing their own set of images for display. All thumbnail images were in a predefined digital format, which were created using Photoshop (Fig 5.)

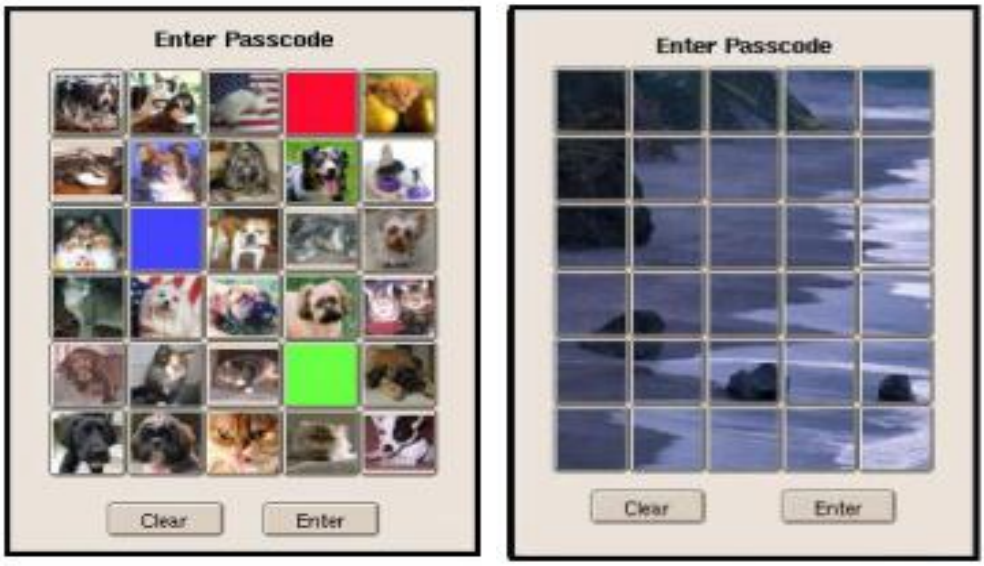

Fig 5. Picture password of different themes.

V. CONCLUSION

Challenges including examination malpractices, low capacity examination venues, inadequate invigilators and examination materials, omission of student's results and human error during the marking / grading process will be automatically eliminated following the adoption of this online examination system. Providing Strong Security through two factor authentication like text password CAPTCHA and integrating images (picture password) substantially increases protection to shoulder surfing attacks and tackles the security problems. The web portal is designed to provide a safe, secure medium for conduct of examination, giving admin complete authority over test questions preventing illegal means and easy and fair evaluation of results. It is user friendly and time efficient as it also gives flexibility to the students to view answer the questions easily.

Security of web portals can be achieved by various methods usually dominated by biometric authentication. Internet firewall, cryptography. Networkprotocol, object oriented paradigms. While as, in this project preferred methods for security were captcha and picture password.

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