

# Image Captcha Based Authentication Using Visual Cryptography

Mrs. A.Angel Freeda<sup>1</sup>, M.Sindhuja<sup>2</sup>, K.Sujitha<sup>3</sup>

<sup>1</sup>Asst. professor, Information Technology, Kings Engineering College, Chennai, India.

<sup>2,3</sup>Students, Information Technology, Kings Engineering College, Chennai, India.

## ABSTRACT

Anti-phishing mechanisms in the websites currently focus on helping users to verify whether a web site is genuine or not. Phishing on the web pages is an attempt by an individual or a group to threats/hackers trying to retrieve an individual's personal confidential information such as passwords, usernames/confidential info, credit card information etc. In this project, we are proposing a new approach named as "Image Captcha Based Authentication Using Visual Cryptography" to solve the problem of phishing. Textual keyword validation along with visual cryptography is a major advantage of this project. To increase more security "Blowfish Algorithm" can be used to divide the original image captcha into many blocks and rearrangement can be done. Then "Splitting and Rotating Algorithm" can be used to rotate the rearranged blocks. The use of visual cryptography technique((2,2) VCS scheme) is explored to preserve the privacy of image captcha by degenerating the original image captcha into two different image shares by manipulating the black and white pixel value of the image captcha. Part of the image share will be stored in the servers such that the original image captcha can be revealed only when both (client,server) of the shares are simultaneously available. The individual share images do not reveal the identity of the original image captcha. Once the original image captcha is revealed after merging different shares, which can be used as the password. Dynamically generating the Captcha image by the system is one of the major advantage of the system.

**Keywords-** Phishing, visual cryptography, image captcha, shares, Security, Blowfish and Splitting & Rotating algorithm.

## I. INTRODUCTION

Online transactions are nowadays become very common and there are various attacks present behind this. In these types of various attacks, phishing is identified as a major security threat and new innovative ideas are arising with this in each second so preventive mechanisms should also be so effective. Thus the security in these cases be very high and should not be easily tractable with implementation easiness.

Today, most applications are only as secure as their underlying system. Since the design and technology of middleware has improved steadily, their detection is a difficult problem. As a result, it is nearly impossible to be sure whether a computer that is connected to the internet can be considered trustworthy and secure or not. Phishing scams are also becoming a problem for online banking and e-commerce users. The question is how to handle applications that require a high level of security. Phishing is a form of online identity theft that aims to steal sensitive information such as online banking passwords and credit card information from users. Phishing scams have been receiving extensive press coverage because such attacks have been escalating in number and sophistication. One definition of phishing is given as "it is a criminal activity using social engineering techniques. Phishers attempt to fraudulently acquire sensitive information, such as passwords and credit card details, by masquerading as a trustworthy person or business in an electronic communication". Another comprehensive definition of phishing, states that it is "the act of sending an email to a user falsely claiming to be an established legitimate enterprise into an attempt to scam the user into surrendering private information that will be used for identity theft". The conduct of identity theft with this acquired sensitive information has also become easier with the use of technology and identity theft can be described as "a crime in which the impostor obtains key pieces of information such as Social Security and driver's license numbers and uses them for his or her own gain".

Phishing[1] attacks rely upon a mix of technical deceit and social engineering practices. In the majority of cases the phisher must persuade the victim to intentionally perform a series of actions that will provide access to confidential information. Communication channels such as email, web-pages, IRC and instant messaging services are popular. In all cases the phisher must impersonate a trusted source (e.g. the helpdesk of their bank, automated support response from their favourite online retailer, etc.) for the victim to believe. To date, the most successful phishing attacks have been initiated by email – where the phisher impersonates the sending authority (e.g. spoofing the source email address and embedding appropriate corporate logos). For example, the victim receives an email supposedly from support@mybank.com (address is spoofed) with the subject line 'security update', requesting them to follow the URL www.mybank-validate.info (a domain name that belongs to the attacker – not the bank) and provide their banking PIN number. So here introduces a new method which can be used as a safe way

against phishing which is named as "A novel approach against Anti-phishing using visual cryptography". As the name describes, in this approach website cross verifies its own identity and proves that it is a genuine website (to use bank transaction, E-commerce and online booking system etc.) before the end users and make the both the sides of the system secure as well as an authenticated one.

The concept of image processing and an improved visual cryptography is used. Image processing is a technique of processing an input image and to get the output as either improved form of the same image and/or characteristics of the input image. Visual Cryptography (VC) is a method of encrypting a secret image into shares, such that stacking a sufficient number of shares reveals the secret image.

This paper is organized as follows: Section II deals with the related work using Visual Cryptography and Section III & IV presents the current and proposed Methodologies. Section V presents the implementation and Section VI deals with Results and Discussions. Section VII contains the conclusion.

## II. VISUAL CRYPTOGRAPHY

One of the best known techniques to protect data is cryptography. It is the art of sending and receiving encrypted messages that can be decrypted only by the sender or the receiver. Encryption and decryption are accomplished by using mathematical algorithms in such a way that no one but the intended recipient can decrypt and read the message. Naor and Shamir [2] introduced the visual cryptography scheme (VCS) as a simple and secure way to allow the secret sharing of images without any cryptographic computations.

A brief survey of the related work in the area of visual cryptography is presented. Visual cryptography schemes were independently introduced by Shamir [3] and Blakley [4], their original motivation was to safeguard cryptographic keys from loss. These schemes also have been widely employed in the construction of several types of cryptographic protocols [5] and consequently, they have many applications in different areas such as access control, opening a bank vault, opening a safety deposit box, or even launching of missiles. A segment-based visual cryptography suggested by Borchert [6] can be used only to encrypt the messages containing symbols, especially numbers like bank account number, amount etc. The VCS proposed by Wei-Qi Yan et al., [7] can be applied only for printed text or image.

A recursive VC method proposed by Monoth et al., [8] is computationally complex as the encoded shares are further encoded into number of sub-shares recursively. Similarly a technique proposed by Kim et al., [9] also suffers from computational complexity, though it avoids dithering of the pixels. Most of the previous research work on VC focused on improving two parameters: pixel expansion and contrast [10],[11],[12]. In these cases all participants who hold shares are assumed to be honest, that is, they will not present false or fake shares during the phase of recovering the secret image. Thus, the image shown on the stacking of shares is considered

as the real secrete image. But, this may not be true always. So cheating prevention methodologies are introduced by Yan et al., [13], Horng et al., [14] and Hu et al., [15]. But, it is observed in all these methodologies, there is no facility of authentication testing.

Visual Cryptography Scheme is a cryptographic technique that allows for the encryption of visual information such that decryption can be performed using the human visual system. We can achieve this by one of the following access structure schemes.

1.(2,2) Threshold VCS scheme- This is a simplest threshold scheme that takes a secret message and encrypts it in two different shares that reveal the secret image when they are overlaid. No additional information is required to create this kind of access structure.

2.(2,n) Threshold VCS scheme-This scheme encrypts the secret image into n shares such that when any two(or more) of the shares are overlaid the secret image is revealed. The user will be prompted for n, the number of participants.

3.(n,n) Threshold VCS scheme-This scheme encrypts the secret image to n shares such that when all n of the shares are combined will the secret image be revealed. The user will be prompted for n, the number of participants.

4.(k,n) Threshold VCS scheme- This scheme encrypts the secret image to n shares such that when any group of at least k shares are overlaid the secret image will be revealed. The user will be prompted for k, the Threshold,, and n, the number of participants.

In the case of (2, 2) VCS, each pixel P in the original image is encrypted into two sub pixels called shares. Fig.1 denotes the shares of a white pixel and a black pixel. Note that the choice of shares for a white and black pixel is randomly determined (there are two choices available for each pixel). Neither shares provide any clue about the original pixel since different pixels in the secret image will be encrypted using independent random choices.

When the two shares are superimposed, the value of the original pixel P can be determined. If P is a black pixel, we get two black sub pixels; if it is a white pixel, we get one black sub pixel and one white subpixel.

Pixel	Probability	Shares		Superposition of the two shares	
		#1	#2		
□	$p = 0.5$	▣	▣	▣	White Pixels
	$p = 0.5$	▣	▣	▣	
■	$p = 0.5$	▣	▣	■	Black Pixels
	$p = 0.5$	▣	▣	■	

Fig. 1 Illustration of a 2-out-of-2 VCS scheme with 2 subpixel construction.

### III. CURRENT METHODOLOGY

In the current scenario as shown in the Fig. 2, when the end user wants to access his confidential information online (in the form of money transfer or payment gateway) by logging into his bank account or secure mail account, the person enters information like username, password, credit card no. etc.

on the login page. But quite often, this information can be captured by attackers using phishing techniques (for instance, a phishing website can collect the login information the user enters and redirect him to the original site). There is no such own identity and proves that it is a genuine website (to use bank transaction, E-commerce and online booking system etc.) before the end users and make the both the sides of the system secure as well as an authenticated one.

Information that cannot be directly obtained from the user at the time of his login input. All the users are unaware that they are now redirected to the phishing website. By giving all the confidential informations like password, account number, bank name, branch, card number etc in the fake website page they easily post the data to their database and they enroll in the fraud activity.

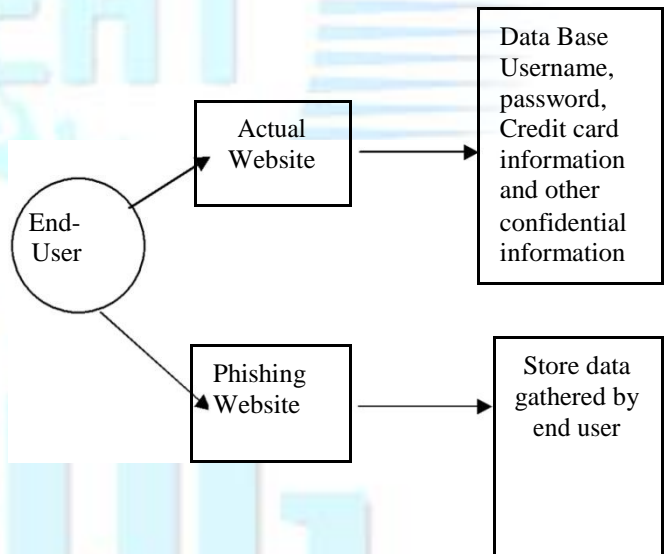


Fig.2 Current scenario

### IV. PROPOSED METHODOLOGY

For phishing detection and prevention, we are proposing a new methodology to detect the phishing website. Our methodology is based on the Anti-Phishing Image Captcha validation scheme using visual cryptography. It prevents password and other confidential information from the phishing websites.

The proposed approach can be divided into two phases:

#### A. Registration Phase

**B. Login Phase**

**A. Registration Phase**

In the registration phase, a key string(password) is asked from the user at the time of registration for the secure website. The key string can be a combination of alphabets and numbers to provide more secure environment. According to the key given by the user this string is concatenated with randomly generated string in the server and an image captcha[16][17] is generated. So the new image captcha is processed behind. By this dynamic generation the theft by camera can be easily avoided. Then "Blowfish Algorithm" is applied to divide the original image captcha into many blocks and rearranged. Then "Splitting and Rotating Algorithm" is applied to rotate the rearranged blocks. The image captcha is divided into two shares by (2,2) visual cryptography scheme such that the image captcha is divided according to black and white pixels. Then one of the share is kept with the user and the other share is kept in the server. The user's share and the original image captcha is sent to the user for later verification during login phase. The image captcha is also stored in the actual database of any confidential website as confidential data. Because the image captcha is used as the password later. After the registration, the user can change the key string dynamically when it is needed. Registration process with sequence of encryption is depicted in Fig.3.

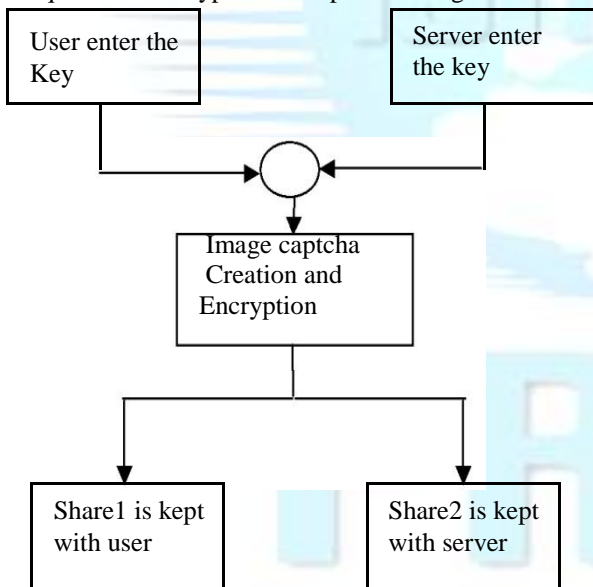


Fig.3 When user performs registration process for the website

**B. Login Phase**

When the user logs in by entering his confidential information for using his account, then first the user is asked to enter his username (user id). Then the user is asked to enter his share which is kept with him. This share is sent to the server where the user's share and share which is stored in the database of the website for each user, is stacked together to produce the image captcha. The image captcha is displayed to the user. Here the end user can check whether the displayed image

captcha matches with the captcha created at the time of registration. The end user is required to enter the text displayed in the image captcha and this can serve the purpose of password and using this, the user can log in into the website. Using the username and image captcha generated by stacking two shares one can verify whether the website is genuine/secure website or a phishing website and can also verify whether the user is a human user or not. This phase is depicted in Fig.4.

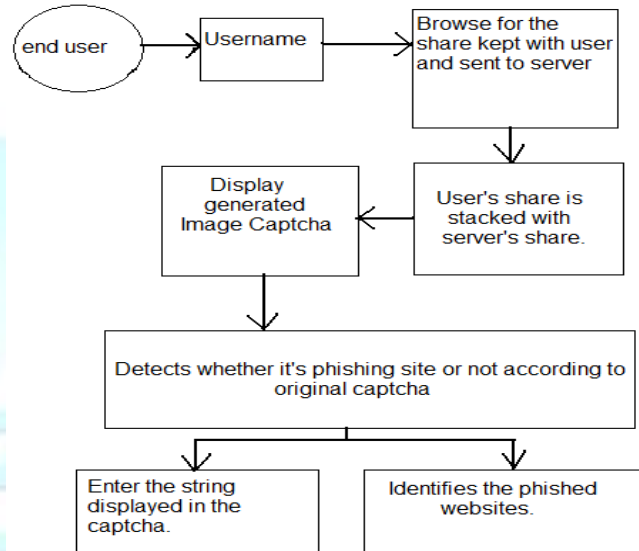


Fig.4 When user attempts to log in into site In order to increase more security the image captcha is encrypted using many algorithms. This encryption Phase contains many algorithms like Blowfish, Splitting and Rotating algorithm and (2,2) Visual Cryptography Scheme. First the "Blowfish Algorithm" is applied to the original image captcha then the image captcha is divided into many blocks and rearranged. After the image captcha blocks are rearranged, the "Splitting and Rotating Algorithm" is applied to the image captcha, then the rearranged blocks are rotated. Then the rearranged and rotated blocks are combined. Then (2,2) VCS scheme is applied to the combined blocks. This scheme is used to divide the encrypted image captcha into two shares based on white and black pixels. When the two subpixels are identical blocks it consider as a white pixel. Likewise when the two subpixels are different the original pixel is consider as black pixel. This VCS scheme adds more complication to the image captcha. At last one of the share is kept with user and another part of the share is kept with server. When two shares are stacked together and the reverse process of encryption taken place the original image captcha is revealed. From this the user can check whether the website is original or fake. At the same time the server can verify that whether the user is human being or robot.

The sequence of encryption process (Block Transformation, Rotation, and Subpixel dividence) is depicted in the Fig 5.

Order to login to the website. The entire process is depicted in Case.3 Fig.5 as different cases. Case1 and Case 2 illustrates the creation and stacking of two shares.

Case.1

Original Captcha	Share 1	Share 2	Reconstructed Captcha

Share 1 of Case1	Share 2 of Case2	Reconstructed Captcha

Fig.5 Creation and stacking of shares

Case.2

Original Captcha	Share 1	Share 2	Reconstructed Captcha

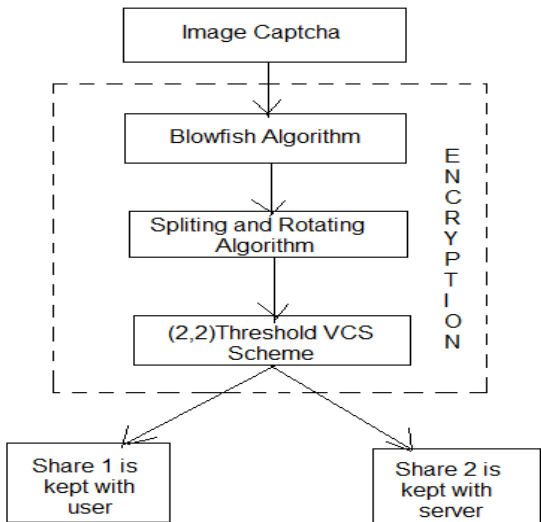


Fig.5 Image Captcha Encryption

**V. IMPLEMENTATION & ANALYSIS**

The proposed methodology is implemented using Matlab. Fig 5, Shows the result of creation and stacking of shares.

In the registration phase the most important part is the creation of shares from the image captcha where one share is kept with the user and other share can be kept with the server.

For login, the user needs to enter a valid username in the given field. Then he has to browse his share and process. At the server side the user's share is combined with the share in the server and an image captcha is generated. The user has to enter the text from the image captcha in the required field in

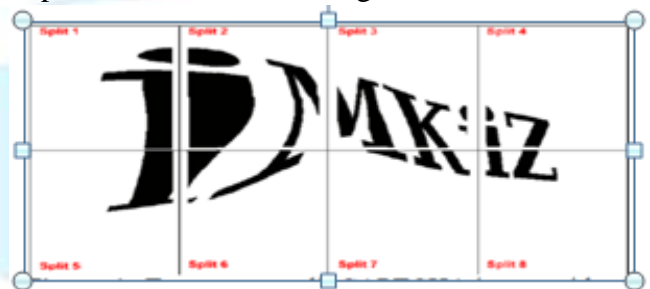
**VI. RESULTS AND DISCUSSIONS**

When ~~2000/A~~ image captcha ~~2000/A~~ processed under Blowfish Algorithm, Splitting and Rotating Algorithm and Visual Cryptography (2,2) scheme the sequence of splitted image captcha, rotated image captcha and the final image captcha shares with difficulty is produced.

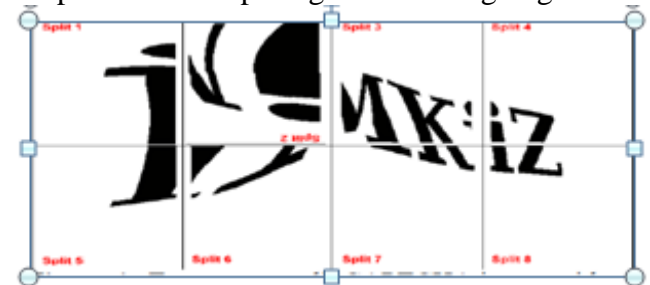
It is observed that both original and reconstructed image captcha's are related with high degree of correlation. The correlation coefficient of original captcha and reconstructed captcha are shown in TABLE I. Also when two different shares are stacked their corresponding correlation co-efficient is obtained as -0.0073. This shows that there will be zero degree of correlation between original and output images for two different shares.

When the two image captcha shares are available then the original image captcha is revealed using the decryption method.

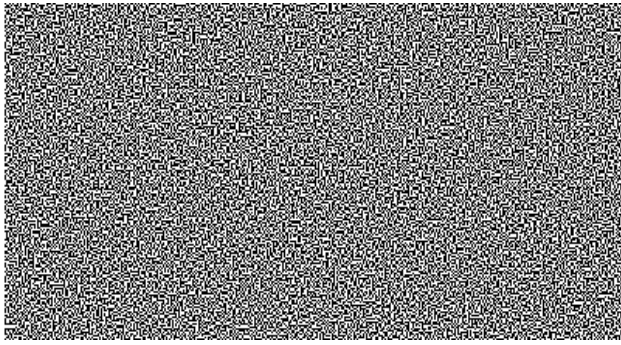
Captcha under Blowfish Algorithm :



Captcha under Splitting and Rotating Algorithm :



Captcha under VC(2,2) Scheme :



## VII. CONCLUSION

Currently phishing attacks are so common because it can attack globally and capture and store the users' confidential information. This information is used by the attackers which are indirectly involved in the phishing process. Phishing websites as well as human users can be easily identified using our proposed "Anti-phishing framework based on Visual Cryptography". The proposed methodology preserves confidential information of users using 3 layers of security. 1st layer verifies whether the website is a genuine/secure website or a phishing website. If the website is a phishing website (website that is a fake one just similar to secure website but not the secure website), then in that situation, the phishing website can't display the image captcha for that specific user (who wants to log in into the website) due to the fact that the image captcha is generated by the stacking of two shares, one with the user and the other with the actual database of the website.

Second layer cross validates image Captcha corresponding to the user. The image Captcha is readable by human users alone and not by machine users. Only human users accessing the website can read the image Captcha and ensure that the site as well as the user is permitted one or not. So, using image Captcha technique, no machine based user can crack the password or other confidential information of the users. And as a third layer of security it prevents intruders' attacks on the user's account. This method provides additional security in terms of not letting the intruder log in into the account even when the user knows the username of a particular user. The proposed methodology is also useful to prevent the attacks of phishing websites on financial web portal, banking portal, online shopping market.

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