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RESEARCH ARTICLE

SECURE ONLINE VOTING SYSTEM USING VISUAL CRYPTOGRAPHY: A COMPARATIVE ANALYSIS

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Abstract

Visual cryptography (VC) is a technique in cryptography where visual information such as text, pictures videos, etc. can be encrypted in a prominent way that the decryption information is shown as a visual image. Electronic voting or e-voting is a process of voting that is done by the means of internet or electronic way as it becomes easy to caste, count and monitor the votes in an accurate, professional and also a scam free manner. Hereby this paper is a compared study of e-voting and VC. I came across a few interesting techniques that were involved and hence would be framing a survey and a review upon all the ongoing techniques. Further we can be using a fresh technique to implement the process. Techniques like cryptography, steganography and many other objectives are the most important ones that are put together for an important search and a survey.

Introduction:-

Visual cryptography (VC) is a technique in cryptography where visual information such as text, pictures videos, etc. can be encrypted in a prominent way that the decryption information is shown as a visual image. The visual secret keeping is a scheme that is by sharing the system in a secured way. It is splitting of the data and then sharing it rather than encrypting the data and saving it in one single place. Hence there are several ways of securing the data such as keeping it in 2 places by splitting it into 2 shares or by n shares. Here as an example of all the papers that I have gone through most of the authors allow 2 secret shares where 1 is kept with the voter in email or in the system logged in and the other 1 is kept in the database of the voting system. This helps in the system being transparent and also allows the system to run in a prominent manner. Here there is no cipher text as the shares act as them. VC is the expansion of the requirement that is done with the space as there is not much space required. It becomes 100% secured and increases the efficiency of working as it involves a regulatory structure. Some antecedents of visual cryptography are in patents from the 1960s [1]. VC can be put into a lot of systems as it performs to be a greater evolution towards the secure mechanisms to pay a larger impact of growth.

Electronic voting or e-voting is a process of voting that is done by the means of internet or electronic way as it becomes easy to caste, count and monitor the votes in an accurate, professional and also a scam free manner. This type of voting is voting with a system that is storing its data on the computer system which makes the system fast and also flawless while counting and also helps in the system to not stop. Fewer places is enough but the problem is it can be a misused and the system can allow multiple casting of vote and hence the process is enumerated as online

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voting and a better e-voting. Most of the present e-voting systems are worthy of having being working as it includes the mechanism of VC along with it. Some of the other techniques used are the steganography, some encryption algorithms along with VC and some of the decryption algorithms. The evaluation of the system needs to be very particular and hence a few more techniques and the admin involvement are included to avoid the natural forgery. This type of system can be used in both lower and higher forum of election. People away from the place can also vote as this brings in the accuracy of the right person who has to be elected for the particular position. Involvement of a voter and a votee should be given in a proper legislative manner.

An example of online voting was taken as a survey which can help for the future growth in the system. In March 2000 the Arizona Democratic Party ran its Presidential Primary over the internet using the private company votation.com. [2] Here the system had given the right to register for the polling and then the credentials were shared to the registered person in email or message to be saved format. By this the person needs to just sit at home and vote with the right credentials and also answer few questions before entering into the system as a security. After the verification of the user is done the user is led to the voting platform to vote. On the other hand in 2009 in Estonia a little more advanced feature was introduced which involved few ID proofs and which allows people to enrol with that so that tampering can be denied and hence it worked out at that time. All these things were included in the system to avoid forgery and voting more than one time.

There was an impact turn out that was calculated by a study that was done in 2017 which said it has no effect. This was done by two Swiss cantons. It said a paper on "remote electronic voting and turnout in the Estonian 2007 parliamentary elections" made a point of involving the maximum number of people and also digitalizing the system so that it can be stored for a longer time. The difference between the high and the low class was eliminated with respect to this system coming into existence. As per the study people who were unavailable at the time of 2007 are now fully available and that this system is completely not required. On the other hand while the system was held and to the people who lived in the higher income regions it was more better as a turnout was high from those kind of places.

As a result of the enumeration that is done towards the system the researchers and the people who are constructing the system should take care that security should be given the highest priority, the user friendly details should be characterized as it involves the performance, cost efficiency, speed and usability of the system.

Literature Survey:

Remote Voting System for Corporate Companies using Visual Cryptography:

This paper aims in casting vote while the confidential and critical conditions in corporate decisions are to be looked after in a very prominent way. In this particular method it makes it so flexible that it allows casting of vote from any remote place, the time when key stakeholders of the election process are unavailable in workplace. Voting via internet, keeping a track of the system, designing proper security goals, keeping stuff transparent while compared to the present work, makes the work a success and brings over accurate results. From the lowercase letters and also the numbers available 12 characters are selected randomly and that is encoded with a 64-bit key. SSL certification is asked to be checked by the users by sending them a valid Ki value by the election server. This kind of protocol is flexible and is capable of serving to both authenticate the voter to the election server and vice versa. From the result of this paper I understand that voting system should be taken care in a very careful way considering the security measures and also the accuracy of the voting. The system should be tested and made sure that it provides the process with reliability and intuitive indications for the voter.

On the Development of Electronic Voting, A Survey:

This paper involves in a survey of the e-voting schemes which provides the information in regards to system, advantages and many more forums. It also involves a comparative study and mentions the best from the recent ones which can be trusted and improvises the system of e-voting. The result here involves more interest towards the security features of the system chosen, which has higher acceptance level. There were three gaps that were comprehended from the past security development for the system. They are the technological gap, the sociotechnical gap and the social gap.[5] Hereby the below image shows the objective and algorithm used in this particular paper.

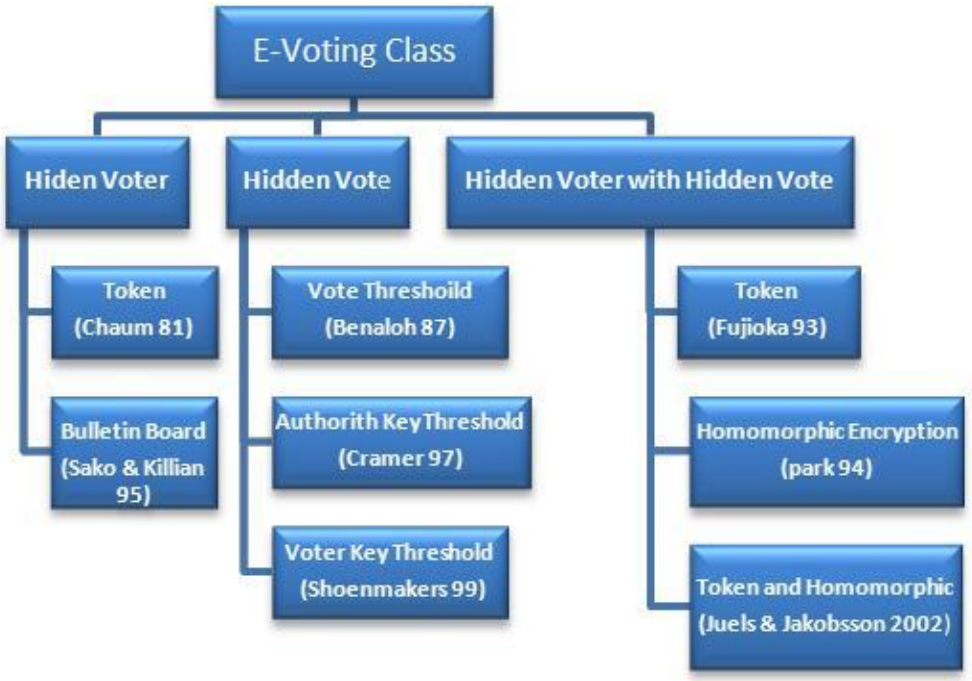

Fig 1:- Process of E-Voting in a survey written by the author Hutchison D.

Developing a Visual Cryptography Tool for Arabic Text:
This paper involves the Arabic language exposure towards the VC technique, according to the author there are so many studies that are researched and are undergone in VC but Arabic is not been focused, it is now a day's holding a lot of importance, many places the language is used henceforth the author is into putting in VC techniques towards it. The tool designed can be similarly followed for electronic voting, anti-phishing, Captcha, watermarking, biometric privacy, online payment systems, and digital signature in the Arabic environment. Arabic is written from right to left unlike English which is written from left to right. The Arabic letters look complicated as they seem to be attached while written or printed. Although the study concluded a lot of techniques that had been developed identifying and putting it into a live one makes up a value for keeping the data safe and legible as there are many Arabic-speaking internet users. A size of image is set in canvas as a function foe the start. Location is drawn and background colour is set to be white. Later it calls createTextImage() [6] function for the text to be embedded and created in Arabic text. The position for the image is chosen in a random way as the text is written. The limitation which was considered was the number of participants that were relatively small. This paper shows that how much the average time and effectiveness has been recognized over the text and its satisfaction. The tool is also advanced and is capable of being helpful in practical security appliances like the Arabic CAPTCHAs. This way the study is also an enhanced way of understanding the language which is growing prominently with its usability.

A Novel Approach for Online Voting System using Visual Cryptography and Face Detection:
This paper discusses about the advantages, disadvantages and comparison of a few e-voting systems. It also proposes a system that overcomes a drawback where the VC can be introduced along with the face detection as it can provide more suitable way of voting, comprised user friendly and has more security. Helpful for people to vote from anywhere as they need not wait in queues and also allow them not to bring an instinct if not voting because of work, as it makes an urge to a person making lethargic. To get the maximum number of votes, the system involves Face detection and VC as the algorithm technique. A person need not go anywhere rather stay back home and caste vote. This becomes easy to get lot of votes and in fact all the votes. Hence whoever is convenient in whichever way the vote can be casted. E-voting becomes secured with some safe algorithms being used and allowing people to cast vote only once. Things taken care are providing security, avoiding phishing attackers and also decrease in the bogus voting. As a result it pays off being easy for the voters to vote via internet. Counting of vote becomes very easy. Registration brings in the voter and provides Id through which the process can be done and it can allow the voting to be done in a very prominent way. Admin permissions are different from the user, where the admin only can view the results. Fake or wrong details do not allow citizens to register for e-vote.

Visual cryptography in internet voting for extended security:
This paper aims in e-voting as it makes the process to be automatic and easy to vote from anywhere across the limits of voting. VC and steganography are used to keep secrecy in advance. A secret password is enabled inside one image where its split in two, where once both are shared correctly by the user allows to vote. This system becomes user friendly as it is safe and admin permissions are separate from the users. By this it is available to cast vote from any location without any problem. Elections happen in both large and small scale ways as it helps in appointing the right person without any partiality. Since elections are restricted towards a location or area e-voting removes the barrier of inconvenience. This is being done with VC along with enough security.

1. User registers.
2. Admin Checks and views with ID proof.
3. Valid is accepted otherwise rejected to vote.
4. User login with credentials, download security image.
5. User has to send it to email id and upload both the shares.
6. Admin checks again if it matches with the VC.
7. User votes, only once cannot vote again even if any mistake is done.
8. User logs out automatically and can view the result only once it is published.

As a result of this paper its design is being used in many large forums of voting. This particular system uses a two way client-server authentication process which provides more security. By this system people can cast vote from wherever they are. The VC technique used allows decryption visually as it becomes easier for the user. By this way it becomes more secure.

Online Polling System Using Extended Visual Cryptography:
This paper offers benefits such as cost efficiency and increase of voters. In simple terms it allows the people to vote from wherever they are irrespective of their location along with security. The VC technique gives rise to more secure way of online polling. The system considers human factors in a careful way. It becomes very flexible for the vote to be casted from any remote place, even when they are unavailable for the process. This kind of feature is provided by VC. It also takes care of the human factors and also the security measures of voting. It shares the secret image in a registration phase as a part of creating security within server. Here the technique of VC is used as a security scheme. This scheme allows giving credentials to user which is accepted by the server only if the correct ones are entered for participation of voting. As a result of this paper we come to know that the government is spending a lot of money towards election apart from this we come to know that % of voting is less when compared to the money put in. It can be a chance to stop fraud. The percentage of voting can be increased as also the amount spent can also be reduced.

Online Voting System Using Visual Cryptography and Face Detection- A Survey:
This paper compares the existing e-voting systems, its drawbacks and also their advantages. It proposes the mechanism where the VC along with the face detection is collaboratively used. It also provides more efficiency, appropriate voting and user friendly secured mechanism. Some of the misleads in the present methods are privacy-breach, fake votes, result distortion, disturbance in election, ballot snatching. Made to be effective, efficient that enumerate the system as estimated. Fingerprint way of voting has become an automated way of personal identification which allows verification and also security. Rather than this the face detection using VC is used to make it easier and feasible to vote from anywhere. The secret sharing scheme does not allow ant information to be exposed. As a result of this paper it involves in sharing some prominent technologies that can solve the voting methods. The efficient mechanism of VC reduces the efforts and also makes the system smooth. It also provides security and mutual authentication for client and server involved.

Anti-Phishing I-Voting System using Visual Cryptography:
This paper aims on working for voting to be easy from remote places. A user can cast vote using credentials with security. Password is generated using a VC technique. Election committee sends 2 secret keys, one user and one system. Both match and then vote can be casted. This is from the VC technique. It is supposed to be so secured and has to be kept away from anyone, otherwise will not be accepted. Phishing is attempting to get personal information from any possible way. It mostly happens by email or spoofing by the users whose information can be used in a fake website. Network security has been growing in larger scale. It is used for accessing data with a secure platform where the admin rights are given with proper credentials. Phishing is stealing of private and sensitive information for malicious reason. The date stolen by phishing can be used in any forum in a fake format or rule out the data for

the purpose of a lump sum amount. A method is proposed to prevent and detect phishing. It is basically based on Anti-phishing Image Captcha using VC technique. Only the authorized people will be allowed to vote where it prevents phishing. Server picks text image as password for registration the same is used for login. Then the secret key should be shared. Hence using the username and captcha can be generated and phishing can be prevented as per the authentication being done. The verification is done and it has to be prominent for the work that is done to be Anti-Phishing. As a result of the paper it uses the VC technique to prevent phishing. Once done it can be used in many large and small scale places. This allows to caste vote in a safe way do as to be utilised in all the places for casting vote. The voter can caste only once cannot redo it. The verification of being it genuine rather than it being a phishing attacked one. The phishing website does not display image if it is real. Intruder is not allowed to enter the website even by knowing the credentials.

Internet Voting System using Visual Cryptography:
This paper helps in more security using VC technique also using a secured password. "ONLINE VOTING SYSTEM" [13] to be the latest one. It makes voting easy to vote from anywhere. All the data is stored in a maintained server in a much secured way. E-voting becomes easier and also involves more people. It makes it user friendly and particular in providing the voters with reliability. It is proposed with the VC technique. It is proposed that this system will be used in many lower and higher places for voting as its cost efficient and time managing. It has client server system. Both the admin and the user have different rights as per required. Data is stored and removed within the stipulated time. As a result this system can be used in company's election or also the government voting, it will be very easy for all the citizens to vote in e-voting method from anywhere they are as it becomes secured by using the VC technique.

Novel Authentication System Using Visual Cryptography:
This paper aims on a study which compares the VC technique with some of its methods like pixel expansion, no of shares, size and quality of reconstructed image, etc. It improvises the cost efficiency along with the level of security it upholds. Security is taken care where nothing could be faked. This technique can also be used in safe systems of debit cards. This system helps in protecting the fraud of the card if tends to be done. This full method is similar to being handled by the CA and the bank. Every authorization is given through the CA and the bank is accepting, then each request made by the bank is confirmed by the CA from the customer and processed for verification. As a result of this system this brings in the VC technique of colour which was proposed to have more security towards the system to be away from forgery. This can be put into the systems like credit/ debit card and also voting.

Security of Remote Voting System based on Visual Cryptography and SHA:
The paper involves a technique that allows the user to vote from anywhere. The security measures taken are high. The encryption algorithm that is used for the votes is the AES which is secured and fast. Time is saved and also becomes easy for anyone to vote with less cost efficiency of the system. The Advanced Encryption Standard (AES) is used for encryption of votes. By using this technique the process of storing the votes and also keeping it secured helps along with it being done quicker than it normally takes. It is an advantage two ways by performance and data keeping. As a result of this system it provides more security along with lots of votes in a time consuming way. It prevents robustness in security and is kept in a secured way. The system used here uses the VC technique and the AES algorithm to encrypt the data and have it heavily secured. Hereby the process followed in remote voting is described in the below image.

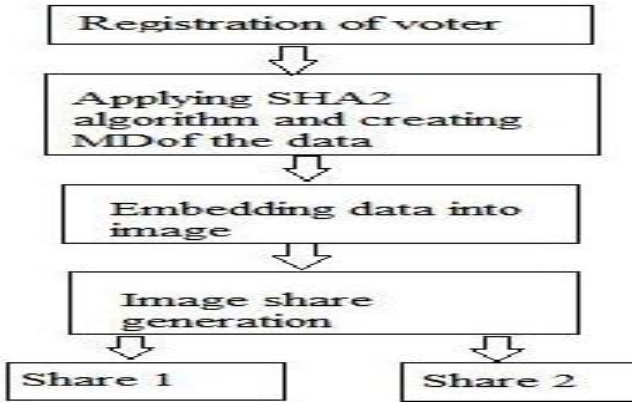

Fig 2: Process involved is security of remote voting system based on VC and SHA.

E-Voting System Using Visual Cryptography Secure Multi-party Computation:
This paper aims on the identification proofs to be monitored so that any fakes can be prevented and cross checked to deny the approval. Multi party system is used to keep the system secured and also allows it to be reliable and transparent. It also monitors that it allows a person to vote only once. The four phases of the system used are 1.the voter's enrolment, 2.voter's authentication, 3.vote casting and recording and 4.vote counting and election result publication. It provides the model to be achieved towards the time complexity and smoothness of voting as it helps to be done from anywhere. Security is also kept in the highest priority. The system uses the VC technique and biometric stuff so as to follow the authentication to be kept in a very relevant and a structured way. The process id about constructing and reconstructing a biometric as each ones is a unique one; they have two parts of it. One is stored in voter's Id card and the other is in the database hence both will be activated only if it is done live so as to prevent some forging. The algorithm that is used also does not allow reconstruction if there is only one thing available. Here security plays a very important role. As a result of the system that is used it's known that two ways of authentication make the votes and the voters to be secured and away from falsification. It improvises the system to involve the data to be stored in multiple places rather than putting it in one place and making it easy for it to be traced. Hence this system is one of the recent and the most effective ones.

Visual Cryptography in Internet Voting System:
This paper brings in the system which involves the technique of VC into the internet voting system (IVC). It helps in voting from anywhere and it also focuses on the security measures that are taken for the system to stay confidential. Only the correct credentials will allow the user to use the portal. The password is generated by 2 merge share (Black and White share) [17] from VC technique. The system provides 2 shared secrets where one is given to the voter and one is in the database that is launched. Hence the voter has to login with right credentials and get into the system to vote. It is kept in a secured way so that forgery and falsification can be eliminated in the system. The VC technique used to get the high security into the system is the 2 to 2 sharing system as there are many more. Here even if one part of the secret key is available it does not allow in cracking the system unless it has both. Hence this is one of the most secured mechanisms to store and get the vote from an enrolled citizen. The VC technique used is to authenticate the right one. As a result the method and the systems used in this project allows a person to vote from anywhere without any disturbance and inconvenience. The system is secured and cross checks with the identification proofs so that user does not falsify. Time complexity and cost efficiency have also been considered as a matter of fact.

Online Voting Verification with Cryptography and Steganography Approaches:
This paper brings in the system of e-voting with VC and steganography techniques. User should enrol and will know about the process step by step; nothing will be hidden and be flawed. The system makes the process to be secured and is also cost and time efficient. This system allows a person to vote from any place of allowed limits. The system is beheld with the three main processes that are undergone in the system. The steps are registration and authentication, tallying and verification of vote. The eligibility is checked with the email id and also forgery is denied. An E2E (end-to-end) voting system is constructed with the help of the image steganography technique of DCT co-efficient which is prominent than the other techniques that are available for data hiding. This kind of security makes highly secured and makes the forger to be dazzled in finding the original data. This way data is stored in multiple fragments and places with VC and also is kept encrypted. As a result of the system proposed lot of vulnerabilities have been overcome. It helps in cost efficiency and also in the fast performance. Some of them are trustworthiness; reduce of other hardware use, particular device procurement, installation, upgrades and maintenance which allow the system to be secured.

Implementation and Evaluation of Steganography Based Online Voting System:
This paper being one of the best and the recent ones from the others involves many techniques such as E2E steganography and VC for security. The encryption is with hash based and decryption is threshold based. Performance and usability is improved. Voter can vote from any place as the limits will also be featured as per the officials. This is a type of client server process where the vote can only be casted once and only by the registered user as there will be verification. On the other hand the server is left up to the trustworthy environment to be liable to system. The method of image steganography and VC are included as it is more secured and forgery is highly impossible. Three factors of monitoring are included - voter, polling officer and system admin. The system of security here is different as in normal cryptography it was a cipher text given but here a stego-object is released that is more secured. As a result of this system firstly this system was put into a drill and then survey was taken and then implemented. Secondly the system has 2 share secret which is not kept in one place, one with user and the other in

the server. Hence the system cannot be easily fooled. Hereby makes the system user friendly, secured, high performing, cost and time efficient and also easily usable.

Graphs Represented:

There are two graphs that are described below. The graphs are made for the 2,5,9,13,15 papers only. This is because these are the papers stand in the category of comparing and also evolving the relative measures of the factors used in each graph. It is important for the voting system to have all these particular measures in a higher level so as to compare and be utilised in the real time based scenario work that can be progressed. The graph 1 shows the relative measures of the papers which involves the performance, Security and Usability. On the other hand the graph 2 shows the comparison of the standards of speed, cost and Visual cryptography that is involved in the particular papers. Herewith as they come into the category they are just compared and given a value where 0 states lowest and 3.5 states highest. Hence followed by the graph:

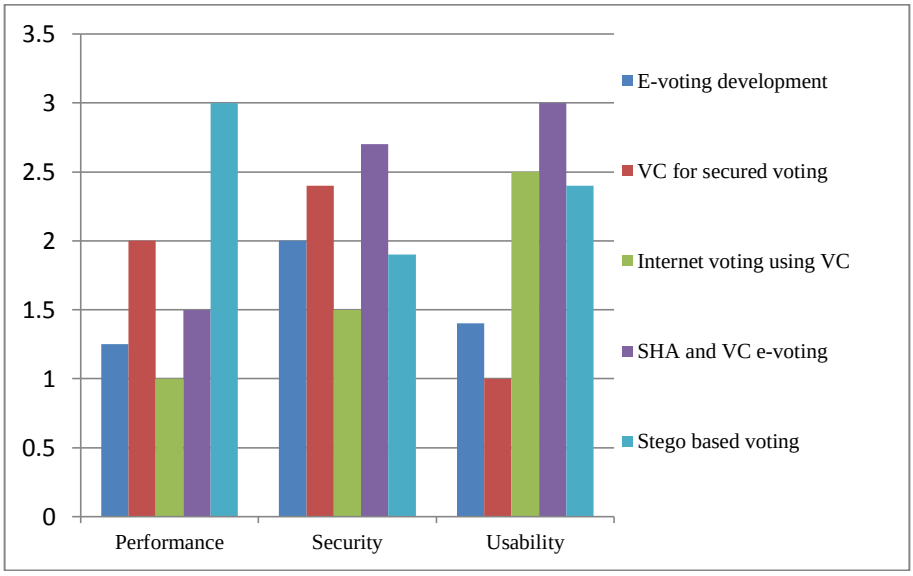

Fig 3:- Relative measures of the system.

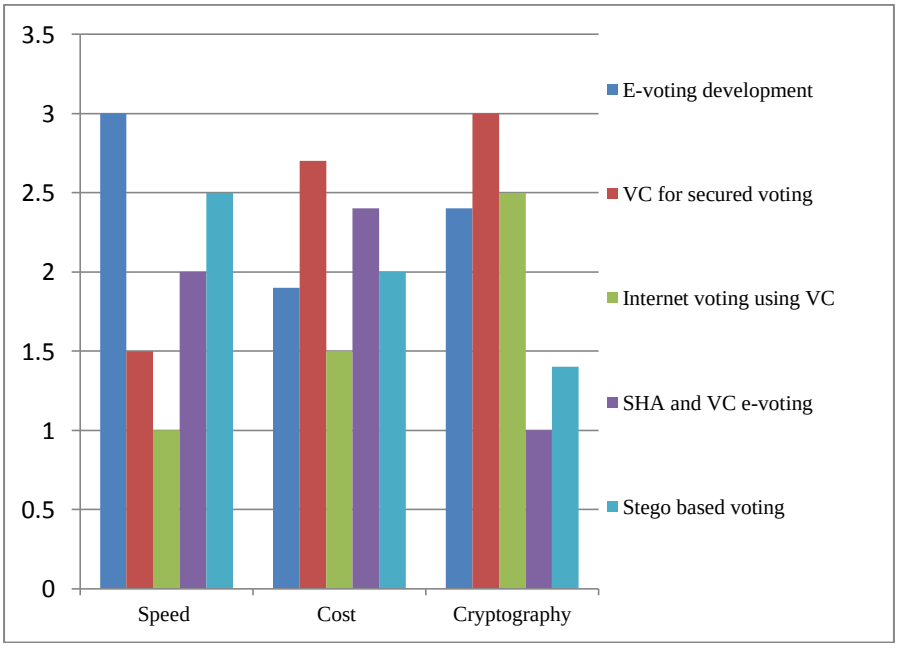

Fig 4: Comparison of the specific.

Factors Involved:
This particular table involves the factors that are involved in each paper and if the particular factor had been discussed in the paper it is checked to be yes, otherwise is checked to be no as it would not have been discussed. This gives a smaller comparative study of having the factors to be monitored in every paper that are discussed.

TITLE	Performance	Speed/Time	Cost	Security	User Friendly	Usability	VC	Other
Remote Voting System for Corporate Companies using Visual Cryptography	No	No	No	Yes	Yes	No	Yes	Yes SSL
On the Development of Electronic Voting: A Survey	No	Yes	No	Yes	Yes	Yes	Yes	No
Developing a Visual Cryptography Tool for Arabic Text	No	No	No	Yes	No	No	Yes	No
A Novel Approach for Online Voting System using Visual Cryptography and Face Detection	Yes	No	No	Yes	Yes	No	Yes	Yes Phishing
Visual cryptography in internet voting for extended security	Yes	No	No	Yes	Yes	Yes	Yes	Yes Steganography
Online Polling System Using Extended Visual Cryptography	Yes	No	Yes	Yes	Yes	No	Yes	No
Online Voting System Using Visual Cryptography and Face Detection- A Survey	Yes	Yes	No	Yes	Yes	No	Yes	Yes Face Detection
Anti-Phishing I-Voting System using Visual Cryptography	No	No	Yes	Yes	Yes	No	Yes	Yes Phishing, Captcha, NS
Internet Voting System using Visual Cryptography	Yes	No	No	Yes	Yes	Yes	Yes	No

Novel Authentication System Using Visual Cryptography	No	No	No	Yes	Yes	No	Yes	No
Security of Remote Voting System based on Visual Cryptography and SHA	No	Yes	Yes	Yes	Yes	No	Yes	Yes AES
E-Voting System Using Visual Cryptography Secure Multi-party Computation	Yes	No	No	Yes	Yes	No	Yes	No
Visual Cryptography in Internet Voting System	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Online Voting Verification with Cryptography and Steganography Approaches	Yes	No	Yes	Yes	Yes	No	Yes	Yes Steganography, DCT
Implementation and Evaluation of Steganography Based Online Voting System	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes Steganography

Conclusion:-

A prominent survey on the voting systems along with the visual cryptography techniques have been kept in mind so as to get the accurate figure of the progression in the field. The growth towards the VC is very high but each and every author explains a different type and the way by which there can be a proper online voting system. According to me the simple way and also an effective way should be carried out and in the future phase of research there can be a comparative study in accordance to the percentage of success rate and the failure rate that can be calculated. This is the proper elaborated study that is done in respect to a few articles, papers and special editions that are released towards the interest of online voting with the concept of VC.

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