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An Adaptive Secret QR Code Message Passing Method Using Video Steganography

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Abstract*: *Steganography is covert communication between the sender and the intended receiver with no evidence to the outer world that the communication has happened. The paper proposes an multi-layer protection approach in steganography to adaptively embed the message in the cover medium and exploit the efficiency of the Diffie-Hellman key exchange method to be passed on to a secure channel and to be extract the secret data without being detected. Hence the proposed system has a shade of hybrid crypto stego scehme. The study proposes a new and adaptive steganography method that provides multiple layers of security and adaptiveness in passing secret data which emphasizes on Imperceptibly and robustness.

Index Terms*: *Steganography, Diffie-Hellman, QR code

I. INTRODUCTION

Steganography is a concealed, covert and protected writing technique. The secret message ideally should not attract any attention to itself in a communication channel. Plainly visible encrypted messages no matter how breakable arouse interest and the fact that communication has happened between sender and the receiver is of pivotal information to the attacker. Steganography is concerned with protecting the fact that secret message is being sent as well concealing the message. Steganography and cryptography are different based upon their objectives even though both follow almost same principle of security.

The idea of this paper is to develop an adaptive steganography method and robust model for passing secret information embedded in the QR code and the obtained stego QR code to be embedded in the frames of the video, through a secure channel making use of Diffie–Hellman key exchange algorithm.

Adaptive Video steganography uses the combination of image and audio techniques. Adaptive steganography can select the various areas in the cover image and adapt accordingly to the cover the information and makes the modified cover unnoticeable to the outer world. The video files comprises of pictures and audio. Steganographic techniques can be applied to video and sound. The volume of any video file and statistical features indicates the scope for hiding large amounts of payload which can be secret information and yet go undetected.

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With Steganography, the idea is to conceal a message within an image, audio or video and can make use of password schemes to protect the secret messages to make it even more secure and imperceptible. Common Embedding data techniques include transformed content used for compression include as discrete cosine, wavelet and fractal transforms.

Any modification or alteration done to the stego cover should not be perceptible to the attackers, the very essence of steganography is to hide the fact that the information has been passed without been detected and communication has happened in the first place. There is huge scope in hiding the data in a video than in an image, but as the payload increases so does the chances of attackers to attack as there are statistical approaches. Video steganography is an important due to the emergence of social media networking and video streaming as it can also lead to Pandora of threats. An effective algorithm tries hiding the secret information into the carrier data by making use of an encoding and encryption techniques prior to the embedding stage for improving the security of the system.

II. RELATED WORK

The steganography scheme for QR tag is spilt into secret embedding procedure and extracting procedure. The proposed scheme embeds the confidential secret into the data codewords of the given QR tag and retains the remaining QR regions unmodified. The proposed scheme will modify at most tolerant capacity, tc modules of QR tag[1].

The main problem of QR code is that they are not human readable, they can only be read using specific machines. The system can be represented using three blocks. QR code generator application, QR code reader application and Public Key Infrastructure. The solution must build specific authentication system for QR code Generators, guarantee data integrity, verify online contents and isolate QR code malicious contents [2].

Combination of cryptography and steganography is an effective way to add more layers to undetectability. The system introduces a steganography based on QR code and block based Haar DWT[3]. This technique hides the secret message in QR code inside the cover image, the QR code saved as black and white images as I bit per pixel and is stored in array of bytes to be encrypted using AES. Discrete Wavelet Transformation (DWT) method is an effective way to embed the QR code, also increases the security level by protecting it with Advanced Encryption Standard (AES) cipher algorithm[4].

Data embedding scheme to camouflage the existence of QR code[5]. Vector Quantization is efficient technique for data compression The method adopted an VQ compression and edge detection techniques to embed data in QR code.

The steps are extract the ROI region out of the image, edge map is generated to find out the complicated image block and these blocks are hidden in QR code by VQ compression. Obtained at the receiver side for identifying the frame containing the secret message and extract the information hidden.

III. METHODOLOGY

To build a steganography algorithmic program there are factors that must be thought into when developing a secured system. It widely depends upon the choice of cover medium, a tangible embedding and extracting algorithmic program, embedding modification and stego key. Adaptivity implies the frame chosen for embedding is adaptively chosen to avoid pattern based attacks. Selecting suitable frame approach will be by focusing on perceptibility and capacity of the cover video. Select the cover video file and convert the files into consequent image frames. Count the total image frames that have been extracted from the cover video. The embedding algorithm will determine how the covert data is embedded in the container file. The extraction algorithm will retrieve the embedded data from the container. Diffie-Hellman Key Exchange is used for secure message passing. Algorithms are based on selecting suitable frame approach by focusing on perceptibility and capacity of the cover video.

For Encryption, Diffie-Hellman key exchange, also called exponential key exchange, is a method of digital encryption used to generate a shared private key exchange information across an insecure channel. For example, two users A and B to exchange the information agree on two prime numbers m and n, where n is a large prime number and m is the primitive root of n.

The task of breaking the code is mathematically overwhelming. Video for adaptive steganography is converted into frames. Users agree on the prime number and primitive root of prime number. The Prime number 'm' chosen is the largest prime number less than the total number of frames into which the video is split and 'm' is the primitive root of 'n'. The generated secret key is the location of the frame in which data is to be embedded.

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a. *Data Embedding Process*:

Step 1: Convert the input video to image frames.
Step 2: Select the frame at location 'x' chosen using Diffie-Hellman Algortithm.
Step 3: Message is embedded and converted into QR code.
Step 4: Resize the QR code to match the size of the frame chosen.
Step 5: Embed the data into the selected frame at the desired position.
Step 6: Add the private key for the sender. From the private key we will derive the public key. The private key of sender is known only to the sender. Public key is found out as follows: public key = (G ^ private key) mod N.
Step 7: Send the video to the receiver in a secure channel.

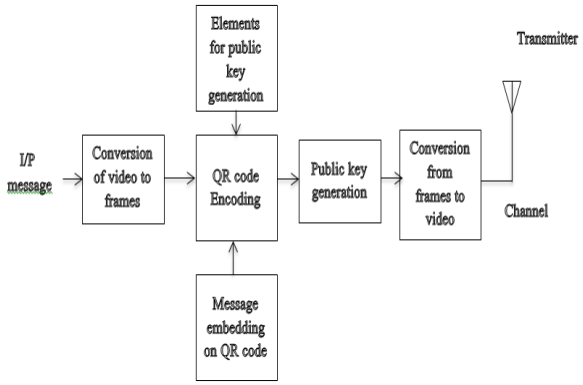

Fig 1.: Data Embedding at Sender Side

b. Data Extraction at Receiver Side:

At the receiver side, the video is split into frames. The frame in which the data is embedded is identified using the secret key generated using Diffie-Hellman Algorithm. The data is extracted from the identified frame as shown in Fig [2].

Data Extraction Process:

Step 1: Convert the video into frames.
Step 2: Identify the frame at which data is embedded using Diffie-Hellman Algorithm.
Step 3: Using the public key of the receiver type find the frame to embed the QR code. This frame number will be the secret key
Step 4: Extract the data from the frame using the identified frame and the frame previous to the data embedded frame. The frames will be extracted successfully and a stego QR code is obtained from the identified frame.
Step 5: Desteg the frame to extract QR code from the frame and decode the QR code to obtain the secret message. Along with this an added security layer of expiration limit can be set for this QR code which further enhances the security mechanism.

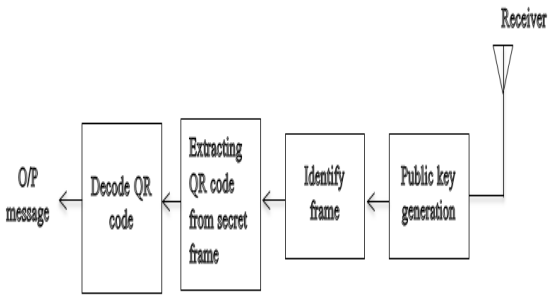

Fig 2. Data Extraction at Receiver Side

IV. EXPERIMENTAL ANALYSIS

The video file used to embed the secret message is split into 240 image frames as shown in table [1]. Standard image with channel 3 is chosen as the reference image and MSE and SSIM of the remaining 240 frames are calculated. It is found that the MSE and SSIM of all 240 frames including the frame at position 30 which contains the hidden secret message does not differ much which makes the detection of the presence of secret message impossible for an intruder to attack as shown in graph fig [3]. The excellence of the cover data will be changed fluctuating from a slightest of modification to a very visible distortion and in order to evaluate whether the distortion level is acceptable or not, statistically, different metrics have been used such as MSE and SSIM.With Proper Authentication mechanism, the Diffie-Hellman key exchange protocol can counterattack impersonation attack, man-in-the-middle attacks and replay attack. Steganographic modifications must not noticeably change characteristics of the cover data known to an attacker. For experimental analysis purpose the video is analysed with a reference image which can be a random frame in the video to compute the efficiency of the proposed work which ensures the communication is undetected and imperceptible in nature.

MSE

Mean Square Error (MSE) can be calculated as the mean of the squared difference error between the original image and the stego image. In general, lesser MSE is better. Low MSE is the primary priority, unbiasedness is the secondary priority while selecting the estimator. A larger MSE means that the data values are dispersed widely around its central mean, and a smaller MSE is the preferred as it shows that the data values are dispersed closely to its central mean which is the ideal case. It reflects on the distribution of the data values and it is centralized, and that it is not skewed or manipulated, and most of all, that it has very negligible errors. It implies that the MSE is the mean of the squares of the errors. Standard measure (MSE) does not agree with human visual perception. MSE is one of the widely used Image Quality Assessment metric

$$MSE = \frac{\sum_{M,N}[I1(m,n) - I2(M,N)]^2}{M * N}$$

SSIM

Structural Similarity Index Method is based upon the idea of perception model. The change in perception values in the structural data is due to the detrition. Perception based model also includes various masking techniques.

Structural pixels constitute additional information upon the visual objects in video and image domain. SSIM predicts the perceived quality of images and videos based on the parameters. The structural similarity index metric is one of the most used quality measure which is often being compared with other image to refer near perfect quality. This metric calculates the apparent quality frames of images and videos. It measures the similarity of the original and the stego image.

Table I: Mse Values Of Video Frames

Frame 1 9.00617E+03	**Frame 2** 9.02455E+03	**Frame 3** 9.04105E+03	**Frame 4** 9.08000E+03	**Frame 5** 9.11168E+03	**Frame 6** 9.10945E+03	**Frame 7** 9.11337E+03	**Frame 8** 9.13770E+03
Frame 9 9.13776E+03	**Frame 10** 9.06408E+03	**Frame 11** 8.90940E+03	**Frame 12** 8.76469E+03	**Frame 13** 8.70072E+03	**Frame 14** 8.64033E+03	**Frame 15** 8.64189E+03	**Frame 16** 8.63954E+03
Frame 17 8.70865E+03	**Frame 18** 8.82084E+03	**Frame 19** 8.87526E+03	**Frame 20** 8.96193E+03	**Frame 21** 9.02538E+03	**Frame 22** 9.10552E+03	**Frame 23** 9.12857E+03	**Frame 24** 9.13832E+03
Frame 25 9.13157E+03	**Frame 26** 9.12852E+03	**Frame 27** 9.13131E+03	**Frame 28** 9.13367E+03	**Frame 29** 9.13109E+03	**Frame 30** 9.12444E+03	**Frame 31** 9.13134E+03	**Frame 32** 9.16483E+03
Frame 33 9.20029E+03	**Frame 34** 9.20540E+03	**Frame 35** 9.21148E+03	**Frame 36** 9.20634E+03	**Frame 37** 9.21012E+03	**Frame 38** 9.22834E+03	**Frame 39** 9.22423E+03	**Frame 40** 9.22381E+03
Frame 41 9.22241E+03	**Frame 42** 9.22226E+03	**Frame 43** 9.21974E+03	**Frame 44** 9.22969E+03	**Frame 45** 9.23547E+03	**Frame 46** 9.23806E+03	**Frame 47** 9.23826E+03	**Frame 48** 9.22104E+03
Frame 49 9.21953E+03	**Frame 50** 9.22448E+03	**Frame 51** 9.24450E+03	**Frame 52** 9.25736E+03	**Frame 53** 9.26138E+03	**Frame 54** 9.27439E+03	**Frame 55** 9.25803E+03	**Frame 56** 9.25577E+03
Frame 57 9.26042E+03	**Frame 58** 9.26749E+03	**Frame 59** 9.27211E+03	**Frame 60** 9.27192E+03	**Frame 61** 9.28161E+03	**Frame 62** 9.28905E+03	**Frame 63** 9.29905E+03	**Frame 64** 9.31304E+03
Frame 65 9.30097E+03	**Frame 66** 9.26475E+03	**Frame 67** 9.23218E+03	**Frame 68** 9.18530E+03	**Frame 69** 9.15709E+03	**Frame 70** 9.14302E+03	**Frame 71** 9.11467E+03	**Frame 72** 9.08790E+03
Frame 73 9.06846E+03	**Frame 74** 9.03892E+03	**Frame 75** 9.01897E+03	**Frame 76** 9.01302E+03	**Frame 77** 8.99306E+03	**Frame 78** 8.98173E+03	**Frame 79** 8.97064E+03	**Frame 80** 8.97270E+03
Frame 81 8.97641E+03	**Frame 82** 8.97350E+03	**Frame 83** 8.95542E+03	**Frame 84** 8.96086E+03	**Frame 85** 8.96926E+03	**Frame 86** 8.98412E+03	**Frame 87** 9.01493E+03	**Frame 88** 9.03854E+03
Frame 89 9.05028E+03	**Frame 90** 9.04504E+03	**Frame 91** 9.03247E+03	**Frame 92** 9.02608E+03	**Frame 93** 9.04054E+03	**Frame 94** 9.04819E+03	**Frame 95** 9.06398E+03	**Frame 96** 9.10377E+03
Frame 97 9.14441E+03	**Frame 98** 9.18779E+03	**Frame 99** 9.21683E+03	**Frame 100** 9.21696E+03	**Frame 101** 9.19394E+03	**Frame 102** 9.18405E+03	**Frame 103** 9.16705E+03	**Frame 104** 9.13786E+03
Frame 105 9.11103E+03	**Frame 106** 9.08959E+03	**Frame 107** 9.05223E+03	**Frame 108** 9.01760E+03	**Frame 109** 8.99148E+03	**Frame 110** 8.97743E+03	**Frame 111** 8.99379E+03	**Frame 112** 8.98636E+03
Frame 113 8.96438E+03	**Frame 114** 9.06574E+03	**Frame 115** 9.08591E+03	**Frame 116** 9.10173E+03	**Frame 117** 9.12044E+03	**Frame 118** 9.12503E+03	**Frame 119** 9.13500E+03	**Frame 120** 9.12500E+03
Frame 121 9.10989E+03	**Frame 122** 9.10784E+03	**Frame 123** 9.10918E+03	**Frame 124** 9.12560E+03	**Frame 125** 9.15041E+03	**Frame 126** 9.18639E+03	**Frame 127** 9.21610E+03	**Frame 128** 9.24914E+03

Frame 129	Frame 130	Frame 131	Frame 132	Frame 133	Frame 134	Frame 135	Frame 136
9.27703E+03	9.29465E+03	9.30382E+03	9.30116E+03	9.29478E+03	9.30380E+03	9.31480E+03	9.31561E+03
Frame 137	**Frame 138**	**Frame 139**	**Frame 140**	**Frame 141**	**Frame 142**	**Frame 143**	**Frame 144**
9.30353E+03	9.30581E+03	9.29464E+03	9.27897E+03	9.26044E+03	9.25207E+03	9.24381E+03	9.23481E+03
Frame 145	**Frame 146**	**Frame 147**	**Frame 148**	**Frame 149**	**Frame 150**	**Frame 151**	**Frame 152**
9.19765E+03	9.19408E+03	9.19722E+03	9.19824E+03	9.20440E+03	9.20856E+03	9.21407E+03	9.23190E+03
Frame 153	**Frame 154**	**Frame 155**	**Frame 156**	**Frame 157**	**Frame 158**	**Frame 159**	**Frame 160**
9.24157E+03	9.23916E+03	9.24248E+03	9.25387E+03	9.25413E+03	9.24046E+03	9.22881E+03	9.22984E+03
Frame 161	**Frame 162**	**Frame 163**	**Frame 164**	**Frame 165**	**Frame 166**	**Frame 167**	**Frame 168**
9.22571E+03	9.23285E+03	9.24667E+03	9.24200E+03	9.22505E+03	9.22096E+03	9.21472E+03	9.21152E+03
Frame 169	**Frame 170**	**Frame 171**	**Frame 172**	**Frame 173**	**Frame 174**	**Frame 175**	**Frame 176**
9.20379E+03	9.18823E+03	9.16172E+03	9.13356E+03	9.10620E+03	9.09370E+03	9.07215E+03	9.06875E+03
Frame 177	**Frame 178**	**Frame 179**	**Frame 180**	**Frame 181**	**Frame 182**	**Frame 183**	**Frame 184**
9.05663E+03	9.07755E+03	9.05272E+03	9.05748E+03	9.05775E+03	9.05919E+03	9.04084E+03	9.04652E+03
Frame 185	**Frame 186**	**Frame 187**	**Frame 188**	**Frame 189**	**Frame 190**	**Frame 191**	**Frame 192**
9.03684E+03	9.04256E+03	9.04162E+03	9.04387E+03	9.05996E+03	9.08384E+03	9.11369E+03	9.17861E+03
Frame 193	**Frame 194**	**Frame 195**	**Frame 196**	**Frame 197**	**Frame 198**	**Frame 199**	**Frame 200**
9.21540E+03	9.25674E+03	9.31521E+03	9.34690E+03	9.36099E+03	9.36655E+03	9.35784E+03	9.32905E+03
Frame 201	**Frame 202**	**Frame 203**	**Frame 204**	**Frame 205**	**Frame 206**	**Frame 207**	**Frame 208**
9.33211E+03	9.34838E+03	9.37630E+03	9.41017E+03	9.43459E+03	9.45385E+03	9.46732E+03	9.46562E+03
Frame 209	**Frame 210**	**Frame 211**	**Frame 212**	**Frame 213**	**Frame 214**	**Frame 215**	**Frame 216**
9.46889E+03	9.45582E+03	9.44813E+03	9.44411E+03	9.43463E+03	9.43000E+03	9.43477E+03	9.43016E+03
Frame 217	**Frame 218**	**Frame 219**	**Frame 220**	**Frame 221**	**Frame 222**	**Frame 223**	**Frame 224**
9.44497E+03	9.45870E+03	9.46534E+03	9.46112E+03	9.44787E+03	9.44598E+03	9.45439E+03	9.46176E+03
Frame 225	**Frame 226**	**Frame 227**	**Frame 228**	**Frame 229**	**Frame 230**	**Frame 231**	**Frame 232**
9.47420E+03	9.46765E+03	9.47143E+03	9.48509E+03	9.48729E+03	9.50790E+03	9.51195E+03	9.50545E+03
Frame 233	**Frame 234**	**Frame 235**	**Frame 236**	**Frame 237**	**Frame 238**	**Frame 239**	**Frame 240**
9.50509E+03	9.49945E+03	9.48463E+03	9.44196E+03	9.20314E+03	9.099192e+03	9.06816E+03	8.98237E+03

TABLE 2: SSIM VALUES OF VIDEO FRAMES

Frame 1	Frame 2	Frame 3	Frame 4	Frame 5	Frame 6	Frame 7	Frame 8
9.00654E-02	8.83851E-02	8.44849E-02	8.27801E-02	8.18237E-02	8.10300E-02	7.79936E-02	7.27156E-02
Frame 9	**Frame 10**	**Frame 11**	**Frame 12**	**Frame 13**	**Frame 14**	**Frame 15**	**Frame 16**
7.11185E-02	7.30932E-02	7.88309E-02	8.60857E-02	8.44294E-02	8.09052E-02	8.11245E-02	7.92564E-02
Frame 17	**Frame 18**	**Frame 19**	**Frame 20**	**Frame 21**	**Frame 22**	**Frame 23**	**Frame 24**
7.30511E-02	7.14928E-02	7.51454E-02	7.43800E-02	7.41687E-02	7.74245E-02	7.96503E-02	7.93342E-02
Frame 25	**Frame 26**	**Frame 27**	**Frame 28**	**Frame 29**	**Frame 30**	**Frame 31**	**Frame 32**
7.98155E-02	7.94665E-02	7.92663E-02	7.80023E-02	7.69095E-02	7.74002E-02	7.87087E-02	7.92980E-02
Frame 33	**Frame 34**	**Frame 35**	**Frame 36**	**Frame 37**	**Frame 38**	**Frame 39**	**Frame 40**
7.80907E-02	7.84237E-02	7.81887E-02	7.93171E-02	7.84125E-02	7.69934E-02	7.72074E-02	7.70350E-02
Frame 41	**Frame 42**	**Frame 43**	**Frame 44**	**Frame 45**	**Frame 46**	**Frame 47**	**Frame 48**
7.76479E-02	7.82086E-02	7.91896E-02	7.93196E-02	7.84967E-02	7.81591E-02	7.86967E-02	7.91791E-02
Frame 49	**Frame 50**	**Frame 51**	**Frame 52**	**Frame 53**	**Frame 54**	**Frame 55**	**Frame 56**
7.86259E-02	7.92702E-02	7.91696E-02	7.89031E-02	7.85980E-02	7.71830E-02	7.63478E-02	7.61570E-02
Frame 57	**Frame 58**	**Frame 59**	**Frame 60**	**Frame 61**	**Frame 62**	**Frame 63**	**Frame 64**
7.87405E-02	7.92964E-02	7.94461E-02	7.93071E-02	7.85628E-02	7.93769E-02	7.92350E-02	7.81322E-02
Frame 65	**Frame 66**	**Frame 67**	**Frame 68**	**Frame 69**	**Frame 70**	**Frame 71**	**Frame 72**
7.89326E-02	7.90976E-02	7.79188E-02	7.78392E-02	7.76438E-02	7.66206E-02	7.55201E-02	7.49157E-02
Frame 73	**Frame 74**	**Frame 75**	**Frame 76**	**Frame 77**	**Frame 78**	**Frame 79**	**Frame 80**
7.60903E-02	7.66309E-02	7.71642E-02	7.65773E-02	7.52118E-02	7.45541E-02	7.66283E-02	7.70033E-02
Frame 81	**Frame 82**	**Frame 83**	**Frame 84**	**Frame 85**	**Frame 86**	**Frame 87**	**Frame 88**
7.82272E-02	7.84421E-02	7.91199E-02	7.96138E-02	7.76717E-02	7.74399E-02	7.85812E-02	7.78121E-02
Frame 89	**Frame 90**	**Frame 91**	**Frame 92**	**Frame 93**	**Frame 94**	**Frame 95**	**Frame 96**
7.88560E-02	8.05849E-02	8.17945E-02	8.30523E-02	8.31969E-02	8.53970E-02	8.62808E-02	8.52722E-02
Frame 97	**Frame 98**	**Frame 99**	**Frame 100**	**Frame 101**	**Frame 102**	**Frame 103**	**Frame 104**
8.34215E-02	8.23520E-02	8.03347E-02	8.06422E-02	7.93017E-02	7.91236E-02	8.03921E-02	8.09811E-02
Frame 105	**Frame 106**	**Frame 107**	**Frame 108**	**Frame 109**	**Frame 110**	**Frame 111**	**Frame 112**
8.18360E-02	8.08894E-02	8.09585E-02	8.09840E-02	7.98535E-02	7.95365E-02	7.87354E-02	7.95267E-02
Frame 113	**Frame 114**	**Frame 115**	**Frame 116**	**Frame 117**	**Frame 118**	**Frame 119**	**Frame 120**
8.20199E-02	8.32837E-02	8.25487E-02	8.19737E-02	8.27698E-02	8.25369E-02	8.21688E-02	8.31763E-02
Frame 121	**Frame 122**	**Frame 123**	**Frame 124**	**Frame 125**	**Frame 126**	**Frame 127**	**Frame 128**
8.50410E-02	8.65799E-02	8.81785E-02	8.80226E-02	8.76795E-02	8.66438E-02	8.59789E-02	8.59608E-02
Frame 129	**Frame 130**	**Frame 131**	**Frame 132**	**Frame 133**	**Frame 134**	**Frame 135**	**Frame 136**
8.51372E-02	8.48151E-02	8.44890E-02	8.47459E-02	8.52415E-02	8.48851E-02	8.18470E-02	8.13517E-02
Frame 137	**Frame 138**	**Frame 139**	**Frame 140**	**Frame 141**	**Frame 142**	**Frame 143**	**Frame 144**
8.23041E-02	8.17993E-02	8.39594E-02	8.38823E-02	8.30430E-02	8.30250E-02	8.30381E-02	8.20316E-02
Frame 145	**Frame 146**	**Frame 147**	**Frame 148**	**Frame 149**	**Frame 150**	**Frame 151**	**Frame 152**
8.26638E-02	8.26595E-02	8.18282E-02	8.20962E-02	8.17234E-02	8.16337E-02	8.11495E-02	8.09712E-02
Frame 153	**Frame 154**	**Frame 155**	**Frame 156**	**Frame 157**	**Frame 158**	**Frame 159**	**Frame 160**
8.00089E-02	8.10272E-02	8.07466E-02	8.02608E-02	8.03647E-02	8.14478E-02	8.13844E-02	8.12349E-02
Frame 161	**Frame 162**	**Frame 163**	**Frame 164**	**Frame 165**	**Frame 166**	**Frame 167**	**Frame 168**
8.14820E-02	8.07610E-02	8.05431E-02	8.11521E-02	8.12106E-02	8.10039E-02	8.13908E-02	8.12507E-02

Frame 8.11765E-02	**Frame 170** 8.01133E-02	**Frame 171** 8.11552E-02	**Frame 172** 8.16032E-02	**Frame 173** 8.12631E-02	**Frame 174** 7.98138E-02	**Frame 175** 8.08914E-02	**Frame 176** 8.02488E-02
Frame 177 8.32624E-02	**Frame 178** 8.28913E-02	**Frame 179** 8.17120E-02	**Frame 180** 8.11040E-02	**Frame 181** 8.08625E-02	**Frame 182** 8.28294E-02	**Frame 183** 8.25033E-02	**Frame 184** 8.14268E-02
Frame 185 8.28327E-02	**Frame 186** 8.27981E-02	**Frame 187** 8.29898E-02	**Frame 188** 8.49148E-02	**Frame 189** 8.56167E-02	**Frame 190** 8.47457E-02	**Frame 191** 8.64342E-02	**Frame 192** 8.36170E-02
Frame 193 8.28805E-02	**Frame 194** 8.23989E-02	**Frame 195** 8.12566E-02	**Frame 196** 8.04952E-02	**Frame 197** 8.00860E-02	**Frame 198** 8.05042E-02	**Frame 199** 8.05436E-02	**Frame 200** 8.13117E-02
Frame 201 8.07217E-02	**Frame 202** 8.06758E-02	**Frame 203** 8.04907E-02	**Frame 204** 8.10823E-02	**Frame 205** 8.11136E-02	**Frame 206** 8.15478E-02	**Frame 207** 8.20784E-02	**Frame 208** 8.09845E-02
Frame 209 8.04735E-02	**Frame 210** 8.09986E-02	**Frame 211** 8.16324E-02	**Frame 212** 8.24904E-02	**Frame 213** 8.39233E-02	**Frame 214** 8.50087E-02	**Frame 215** 8.36170E-02	**Frame 216** 8.42505E-02
Frame 217 8.41738E-02	**Frame 218** 8.37326E-02	**Frame 219** 8.20972E-02	**Frame 220** 8.00197E-02	**Frame 221** 8.04596E-02	**Frame 222** 8.08029E-02	**Frame 223** 8.12775E-02	**Frame 224** 8.28601E-02
Frame 225 8.21834E-02	**Frame 226** 8.15783E-02	**Frame 227** 8.21585E-02	**Frame 228** 8.28718E-02	**Frame 229** 8.39805E-02	**Frame 230** 8.42359E-02	**Frame 231** 8.38191E-02	**Frame 232** 8.38169E-02
Frame 233 8.34420E-02	**Frame 234** 8.27588E-02	**Frame 235** 8.31207E-02	**Frame 236** 8.29119E-02	**Frame 237** 9.09627E-02	**Frame 238** 9.13583E-02	**Frame 239** 9.43314E-02	**Frame 240** 9.88530E-02

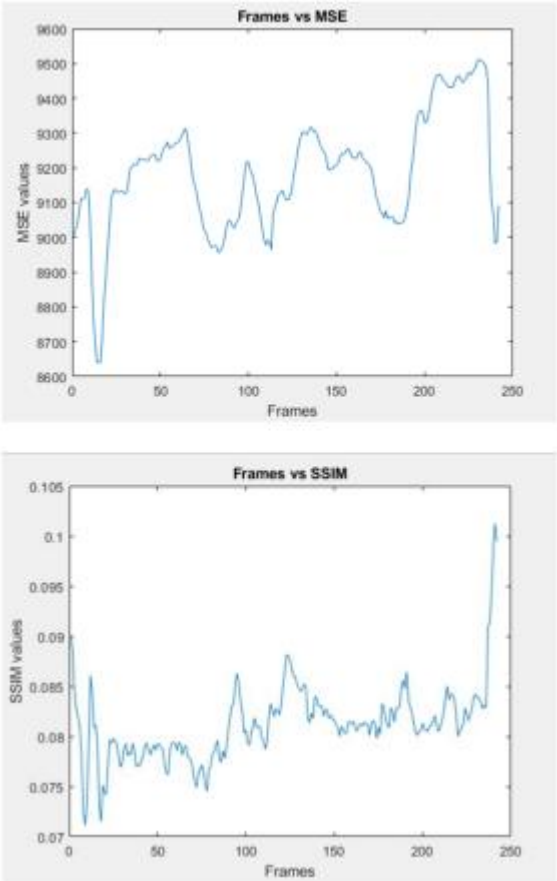

FIG [3] MSE AND SSIM VALUES OF VIDEO FRAMES

V. CONCLUSION

Embedding Payload, Embedding efficiency, undetectability, and robustness are crucial in an adaptive framework nature and the proposed system makes it difficult for the attacker to identify that the communication has taken place or not in the cover medium, which in true sense is the primary objective of any steganography scheme. The system presented in the work embeds the information into the frame images by modifying them in such a way that it is not easily distinguishable. Multiple layers of security levels have been added to encode the secret message using Quick Response Code (QR) into image frames of the video. Diffie-Hellman secure key exchange is been intimated for communicating to the receiver the frame number in which the message is hidden.

Efficiency of the proposed method is measured by Mean Square Error (MSE) and Structural Similarity Index Metrics (SSIM) indicates that it has insignificant difference value in MSE and SSIM which is evenly distributed over the image frames makes it imperceptible for covert communications.

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