List of Figures

No.	Figures	Page No.
1.1	Example of CAPTCHA Code	3
1.2	OTP based Authentication Scheme	4
1.3	Cryptography Scheme	6
1.4	Private Key Encryption Process	7
1.5	Public Key Encryption Process	8
1.6	RGB Color Model	10
1.7	CMY Color Model	11
1.8	Structure of 32-bit Pixel	11
1.9	Basic Digital Watermarking Techniques	12
1.10	Basic Steganographic Scheme	14
4.1	Overall Procedure for CCUPL based Authentication Scheme	67
4.2	Representation of Character String generated from User Personal Information and Selected Options	71
4.3	Random Number Generation for Character Repositioning	72
4.4	Representation of Character Repositioning based on Random Sequence	72
4.5	Acceptance of Inputs by CAPTCHA Generation Method	73
4.6	Image based CAPTCHA Generation for CCUPL Scheme	74
4.7	Valid User Authentication based on Selection of Proper Images and Sequences for CCUPL Scheme	75
4.8	Fake Authentication based on Selection of Proper Images but wrong Sequences for CCUPL Scheme	76
4.9	Fake Authentication based on Selection of Wrong Images and Wrong Sequences for CCUPL Scheme	77
4.10	Graphical Representation of Security Analysis for CCUPL Scheme	80
4.11	Overall Procedure for SVROTP based Authentication Scheme	83
4.12	Logical Structure of Intermediate OTP	85
4.13	Generation of Modified User-Id	87
4.14	Generation of Modified Password	87

4.15	Inputs of Security Questions and their Answers	88
4.16	Inputs of Biometric Image of User	88
4.17	Intermediate OTP Generation	89
4.18	Final OTP Generation	89
4.19	Distribution of Final OTP through Email and Text Message	90
4.20	Generation of Final OTP at User End	90
4.21	Generation of Intermediate OTP at User End	91
4.22	Value Extraction from Modified User-Id/Password defined by Intermediate OTP	91
4.23	Generation of Secret Value used for Authentication	92
4.24	Login Attempt by Fake User for SVROTP Scheme	92
4.25	Login Attempt by Valid User for SVROTP Scheme	93
4.26	Overall Procedure for NIOTP based Authentication Scheme	96
4.27	Receiving of Biometric Image Input	99
4.28	Biometric Image of User (BioImg.jpg)	100
4.29	Generation of Encrypted Image based OTP at Server End	100
4.30	First Level of Numeric OTP Generation	101
4.31	Second Level of Numeric OTP Generation	101
4.32	Value of Intermediate Numeric OTP	102
4.33	Selection of Digit Repositioning Scheme for Final Numeric OTP Generation	102
4.34	Value of Final Numeric OTP	102
4.35	Intermediate Numeric OTP and Encrypted Image OTP Distribution	103
4.36	Image based OTP extraction at User Side	104
4.37	Final Numeric OTP extraction at User Side	104
4.38	User Authentication for Fake Login Attempts for NIOTP Scheme	105
4.39	User Authentication for valid Login Attempts for NIOTP Scheme	105
4.40	Security Measurement over Cryptographic Attacks by SVROTP and NIOTP Schemes	110
5.1	Overall Procedure for Prime number with Alphabetic Group based text encryption scheme(PAG)	114
5.2	Structure of 256 bits Private Key	115
5.3	Representation of Relationship between Encryption Time and File Size	118

5.4	Comparison between PAG Algorithm, AES and Twofish Algorithm in respect of Chi-Square value	121
5.5	Comparison between PAG Algorithm, AES and Twofish Algorithm in respect of Degree of Freedom	121
5.6	Overall Procedure for Palindrome number with Alphabetic Group and Operator based text encryption scheme (PAGO).	123
5.7	Structure of 256 bits Private Key	124
5.8	Graphical Representation of Relationship between Encryption Time and File Size	128
5.9	Comparison between PAGO Algorithm, AES and Serpent Algorithm in respect of Chi-Square Value	131
5.10	Comparison between PAGO Algorithm, AES and Serpent Algorithm in respect of Degree of Freedom	131
5.11	Overall Procedure for Armstrong and Perfect number with Cipher Sequencing based text encryption scheme (APCS)	133
5.12	Structure of 256 bits Private Key	134
5.13	Representation of Relationship between File Size and Encryption Time	139
5.14	Comparison between APCS Algorithm, AES and Blowfish Algorithm in respect of Chi-Square value	142
5.15	Comparison between APCS Algorithm, AES and Blowfish Algorithm in respect of Degree of Freedom value	142
5.16	Overall Procedure for Amicable number with Cipher Sequencing based text encryption scheme(ACS)	144
5.17	Structure of 256 bits Primary Key	146
5.18	Relationship between Encryption Times with File Size of Plain Text	150
5.19	Comparison between ACS Algorithm, AES and Triple DES Algorithm in respect of Chi-Square value	153
5.20	Comparison between ACS Algorithm, AES and Triple DES Algorithm in respect of Degree of Freedom value	153
6.1	Overall Procedure of Multiple Operator and Even Odd position based text encryption Scheme (MOEO)	157
6.2	Structure of 256 bits Private Key	159
6.3	Representation of Relationship between File Size and Encryption Time	163

6.4	Representation of Chi-Square Values generated by MOEO Scheme on Different Files	165
6.5	Representation of Degree of Freedom Values generated by MOEO Scheme on Different Files	165
6.6	Overall Procedure for Multiple Operator and ASCII Value based text encryption Scheme (MOAV)	167
6.7	Structure of 256 bits Private Key	168
6.8	Representation of Impact of File Size over Encryption Time	172
6.9	Representation of Resultant Chi-Square Values from MOAV Scheme	174
6.10	Representation of Degree of Freedom Values generated from MOAV Scheme	174
6.11	Overall Procedure for Multiple Operator and number of Zeros and Ones based text encryption Scheme (MOZO)	176
6.12	Structure of 256 bits Private Key	177
6.13	Representation of Relationship between Encryption Time and File Size	181
6.14	Representation of Chi-Square Values generated from MOZO Scheme	183
6.15	Representation of Degree of Freedom Values generated from MOZO Scheme	183
7.1	Overall Procedure for Even Odd block based Digital Enveloping Scheme (EODE)	187
7.2	Mapping between Pixels of Original Image and Blocks of Envelope Image	187
7.3	Mapping between the bits of Original Image's Pixels and Blocks of Envelope Image	188
7.4	Original Image (Twinparrot.jpg)	190
7.5	Envelope Image (Greenscenery.jpg)	191
7.6	Envelope Image after Embedding(Egreenscenery.jpg)	191
7.7	Input Image for Decryption (Egreenscenery.jpg)	192
7.8	Original Image after De-Enveloping (dtwinparrot.jpg)	192
7.9	Relationship between the PSNR Values and inputted Image Size	194
7.10	Relationship between SSIM Values with inputted Image Size	196
7.11	Graphical Representation of Correlation Coefficient Values vs. Image Size for EODE Scheme.	197

7.12	Graphical Representation of Encryption Time vs Image Size for EODE Scheme	198
7.13	Overall Procedure for Cumulative Image encryption using Digital enveloping, Key based encryption with image Partitioning Scheme (CIDKP)	200
7.14	Representation of Encryption and Decryption Procedures for CIDKP Scheme	201
7.15	Original Image	205
7.16	Generation of Image Pieces from Image Portioning Procedure	205
7.17	Representation of Output of Text Key Encryption Procedure	206
7.18	Representation of Output of Image Key Encryption Procedure	207
7.19	Representation of Output of Digital Enveloping Procedure	208
7.20	Representation of Output of De-Enveloping Procedure	209
7.21	Representation of Output of Image Key Decryption Procedure	210
7.22	Representation of Output of Text Key Decryption Procedure	211
7.23	Representation of Output of Image Reconstruction Procedure	212
7.24	Representation of Image Size vs. PSNR Graph for CIDKP Scheme	214
7.25	Representation of Image Size vs. Q-Index Value Graph for CIDKP Scheme	216
7.26	Graphical Representation of Inputted Image Size vs. Correlation Coefficient Values for CIDKP Scheme	217
7.27	Graphical Representation of Image Size vs Encryption Time for CIDKP Scheme	219
7.28	Overall Procedure for Cumulative Image encryption approach using Steganographic scheme with Pixel repositioning (CISP)	220
7.29	Original Image (Ori.jpg)	224
7.30	Envelope Image (Env.jpg)	225
7.31	Pixels Sequence of Original or Envelope Image after applying Prime and Non-Prime positioned Pixels Rearrangement Algorithm	225
7.32	User Inputs for Pixel Repositioning Algorithm for Original and Envelope Image at Encryption Time	226
7.33	Sequence of Pixels of Original Image after applying PRONE Algorithm	226
7.34	Sequence of Pixels of Envelope Image after applying PRENO Algorithm	227
7.35	Envelope Image after Embedding Original Image (Eenv.png)	227
7.36	Input Image for Decryption (Eenv.png)	228

7.37	Pixel Sequence for Original Image generated from Algorithm for Steganographic Technique using BWMAS Operation for Decryption	228
7.38	User Inputs for Pixel Repositioning Algorithm for Original and Envelope Image at Decryption Time	229
7.39	Pixel Sequence for Original Image after applying Reverse Positional Reverse Odd Normal Even (R_PRONE) Algorithm	229
7.40	Pixels Sequence for Original Image after applying Reverse Prime and Non-Prime positioned Pixels Rearrangement Algorithm	230
7.41	Original Image after De Enveloping (De_Ori.jpeg)	230
7.42	Representation of CISP Scheme's PSNR Values vs. Image Size Graph	232
7.43	Representation of Image Size vs SSIM Value Graph for CISP Scheme	233
7.44	Representation of CISP Scheme's Image Size vs Correlation Coefficient Graph	235
7.45	Representation of CISP Scheme's Encryption Time vs Image Size Graph	236
8.1	System Structure of 'Security Toolkit'	239
8.2	Diagrammatic Representation of PRONE, PRENO, CRONE and CRENO Sequencing Methods	245
8.3	Diagrammatic Representation of EEFR, EEFL, EOFR and EOFL Sequencing Methods	246
9.1	Graphical Representation of Security Measurement of CCUPL, SVROTP and NIOTP Schemes over Cryptographic Attacks	250
9.2	Graphical Representation of CAPTCHA and OTP Generation Time and User Authentication Validation Time by CCUPL, SVROTP and NIOTP Schemes	251
9.3	Representation of Encryption Time for Different Files by APCS, PAG, PAGO, MOEO, MOAV, MOZO and ACS Schemes	254
9.4	Graphical Representation of Chi-Square Values of Different Files encrypted by APCS, PAG, PAGO, MOEO, MOAV, MOZO and ACS Schemes.	256
9.5	Graphical Representation of Degree of Freedom Values of Different Files encrypted by APCS, PAG, PAGO, MOEO, MOAV, MOZO and ACS Schemes	258

9.6	Graphical Representation of PSNR Values of Different Files encrypted by EODE, CIDKP and CISP Schemes.	260
9.7	Graphical Representation of SSIM Values of encrypted Files using EODE, CIDKP and CISP Schemes	261
9.8	Representation of Q-INDEX Values of Encrypted Files using EODE, CIDKP and CISP Schemes.	262
9.9	Representation of Correlation Coefficient Values of Encrypted Files using EODE, CIDKP and CISP Schemes	263
9.10	Representation of BER Values of Encrypted Files using EODE, CIDKP and CISP Schemes	264
9.11	Representation of Encryption Time of Files encrypted using EODE, CIDKP and CISP Schemes	265