

Configuration Manual

MSc Research Project
Programme Name

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MSc Project Submission Sheet
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Submission

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I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

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Signature: Mamidi Snehith Reddy

Date: 12/8/2024

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Configuration Manual

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1 Introduction:

- Welcome to the configuration manual for the data encryption with access control. It is a python-based implementation which encrypts solutions often impose high computational overhead, making them less practical for widespread use and inadequate for addressing evolving security threats in cloud environments. This manual is divided into several sections of the project which includes system configuration, code setup. This will help to deploy and manage the project.

2 System Configurations:

Python: Version 3.12

Libraries: Install all the libraires using the command below `pip install -r requiriemnts.txt`

A screenshot of a code editor window with a dark background. The window has three tabs at the top: 'acc_encryption.py', 'app.py', and 'requirements.txt' (which is active). The 'requirements.txt' file contains a list of 32 Python packages and their versions, each on a new line. The packages include asttokens, async-timeout, azure-core, azure-storage-blob, backcall, bleach, blinker, boto3, botocore, click, colorama, comm, coreapi, coreschema, debugpy, defusedxml, distlib, Django, django-annoying, django-cors-headers, django-debug-toolbar, django-extensions, django-filter, django-model-utils, django-rest-swagger, django-rq, django-user-agents, djangorestframework, drf-generators, drf-yasg, ecdsa, and entrypoints.

```
1 asttokens==2.2.1
2 async-timeout==4.0.2
3 azure-core==1.26.2
4 azure-storage-blob==12.14.1
5 backcall==0.2.0
6 bleach==5.0.1
7 blinker==1.6.2
8 boto3==1.16.63
9 botocore==1.19.63
10 click==8.1.4
11 colorama==0.4.6
12 comm==0.1.2
13 coreapi==2.3.3
14 coreschema==0.0.4
15 debugpy==1.6.6
16 defusedxml==0.7.1
17 distlib==0.3.6
18 Django==3.2.16
19 django-annoying==0.10.6
20 django-cors-headers==3.6.0
21 django-debug-toolbar==3.2.1
22 django-extensions==3.1.0
23 django-filter==2.4.0
24 django-model-utils==4.1.1
25 django-rest-swagger==2.2.0
26 django-rq==2.5.1
27 django-user-agents==0.4.0
28 djangorestframework==3.13.1
29 drf-generators==0.3.0
30 drf-yasg==1.20.0
31 ecdsa==0.18.0
32 entrypoints==0.4
```

Anaconda setup:

Download Anaconda from the online website link given below:

- <https://www.anaconda.com/download>

- Install the .exe and run the program.

3 Code Setup

app.py

```
from flask import Flask, render_template, request, redirect, url_for, session, flash
from datetime import datetime
from flask_mysql import MySQL
from flask_mail import Mail, Message
from werkzeug.utils import secure_filename
from lib_file import lib_path
from rsa_encryption import get_keys, rsa_encryption, rsa_decryption
from ecc_encryption import generate_keys, ecc_encryption, ecc_decryption
import os
import ftplib
import nltk
import mysql.connector
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from collections import Counter

application = Flask(__name__)
application.secret_key = 'new'

application.config['MYSQL_HOST'] = 'localhost'
application.config['MYSQL_USER'] = 'root'
application.config['MYSQL_PASSWORD'] = '0812'
application.config['MYSQL_DB'] = 'ehr_tf_final'
```

ECC Decryption Function Code:

```

import hashlib
import secrets
from Crypto.Cipher import AES
from tinyec import registry
import pickle as pkl
from hashlib import md5
from os import urandom
import random

curve = registry.get_curve('brainpoolP256r1')

3 usages
def generate_keys():
    private_Key = secrets.randbelow(curve.field.n)
    public_key = private_Key * curve.g
    return private_Key, public_key

2 usages
def ecc_point_to_256_bit_key(point):
    sha = hashlib.sha256(int.to_bytes(point.x, 32, 'big'))
    sha.update(int.to_bytes(point.y, 32, 'big'))
    return sha.digest()

1 usage
def encrypt_AES_GCM(msg, secretKey):
    aesCipher = AES.new(secretKey, AES.MODE_GCM)
    ciphertext, authTag = aesCipher.encrypt_and_digest(msg)
    return ciphertext, aesCipher.nonce, authTag

def encrypt_ECC(msg, pubKey):
    msg = bytes(msg, 'utf-8')
    pubKey = int(pubKey) * curve.g
    ciphertextPrivKey = secrets.randbelow(curve.field.n)
    sharedECKey = ciphertextPrivKey * pubKey
    secretKey = ecc_point_to_256_bit_key(sharedECKey)
    ciphertext, nonce, authTag = encrypt_AES_GCM(msg, secretKey)
    ciphertextPubKey = ciphertextPrivKey * curve.g
    return ciphertext, nonce, authTag, ciphertextPubKey

1 usage
def decrypt_AES_GCM(ciphertext, nonce, authTag, secretKey):
    aesCipher = AES.new(secretKey, AES.MODE_GCM, nonce)
    plaintext = aesCipher.decrypt_and_verify(ciphertext, authTag)
    return plaintext

1 usage
def decrypt_ECC(encrypted_msg, p2_key):
    (ciphertext, nonce, authTag, ciphertextPubKey) = encrypted_msg
    sharedECKey = int(p2_key) * ciphertextPubKey
    secretKey = ecc_point_to_256_bit_key(sharedECKey)
    plaintext = decrypt_AES_GCM(ciphertext, nonce, authTag, secretKey)
    return plaintext

```

```

def ecc_encryption(in_file, out_file, public_key, p_file_name, key_length=32):
    pickle_file_name = p_file_name.split('.')[0] + '.pkl'
    bs = AES.block_size # 16 bytes
    salt = urandom(bs) # return a string of random bytes
    password = str(random.randint(1000, 10000))
    key, iv = derive_key_and_iv(password, salt, key_length, bs)
    cipher = AES.new(key, AES.MODE_CBC, iv)
    out_file.write(salt)
    finished = False

    while not finished:
        chunk = in_file.read(1024 * bs)
        if len(chunk) == 0 or len(chunk) % bs != 0: # final block/chunk is padded before encryption
            padding_length = (bs - len(chunk) % bs) or bs
            chunk += str.encode(padding_length * chr(padding_length))
            finished = True
        out_file.write(cipher.encrypt(chunk))
    encrypted = encrypt_ECC(password, public_key)
    file_path = "static/pickle_files/" + pickle_file_name
    with open(file=file_path, mode="wb") as file:
        pickle.dump(obj=encrypted, file=file)
    return file_path

2 usages

def ecc_decryption(in_file, out_file, pkl_filename, private_key, key_length=32):
    pickle_file_name = pkl_filename.split('.')[0] + '.pkl'
    pickle_file_location = 'static/pickle_files/' + pickle_file_name
    with open(file=pickle_file_location, mode="rb") as file:
        res_msg = pickle.load(file=file)

def ecc_decryption(in_file, out_file, pkl_filename, private_key, key_length=32):
    pickle_file_name = pkl_filename.split('.')[0] + '.pkl'
    pickle_file_location = 'static/pickle_files/' + pickle_file_name
    with open(file=pickle_file_location, mode="rb") as file:
        res_msg = pickle.load(file=file)

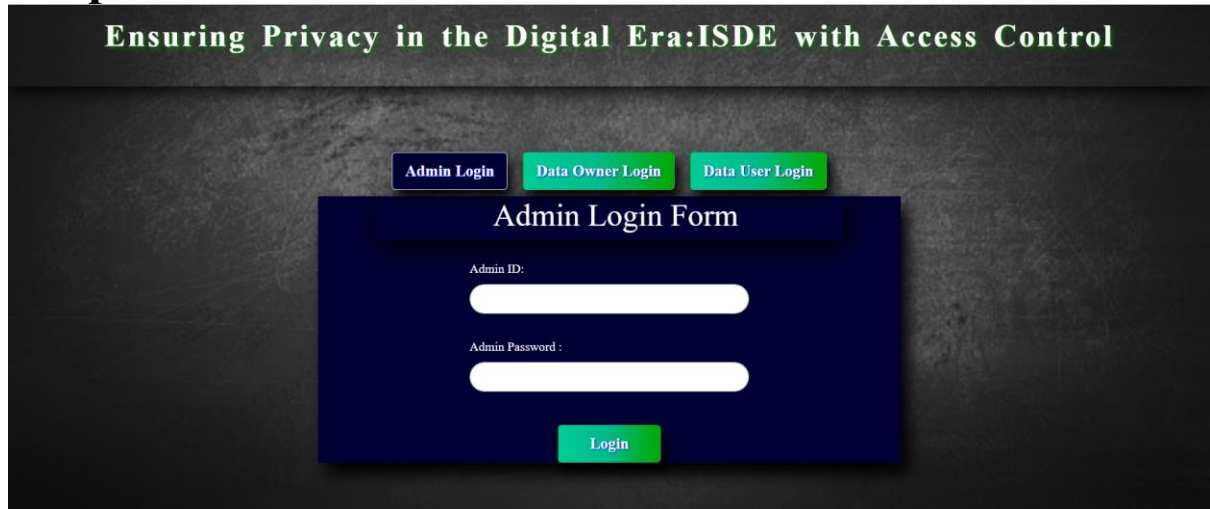
    dec_text = decrypt_ECC(res_msg, private_key)
    dec_text = dec_text.decode()
    bs = AES.block_size
    salt = in_file.read(bs)
    key, iv = derive_key_and_iv(str(dec_text), salt, key_length, bs)
    cipher = AES.new(key, AES.MODE_CBC, iv)
    next_chunk = ''
    finished = False
    while not finished:
        chunk, next_chunk = next_chunk, cipher.decrypt(in_file.read(1024 * bs))
        if len(next_chunk) == 0:
            padding_length = chunk[-1]
            chunk = chunk[:-padding_length]
            finished = True
        out_file.write(bytes(x for x in chunk))

```

RSA Encryption and Decryption Code:

```
rsa_encryption.py x ecc_encryption.py app.py requirements.txt ehr_final_m_admin.sql ehr_final_m_d
1 import random
2 from hashlib import md5
3 from Crypto.Cipher import AES
4 from os import urandom
5 import rsa
6
7 # import docx
8 # import PyPDF2
9
10 3 usages
11 def get_keys():
12     public_key, private_key = rsa.newkeys(128)
13     print(public_key)
14     print(private_key)
15     pub_key = public_key.save_pkcs1()
16     pri_key = private_key.save_pkcs1()
17     pub_key_str = pub_key.decode()
18     pri_key_str = pri_key.decode()
19     return pub_key_str, pri_key_str
20
21 2 usages
22 def derive_key_and_iv(password, salt, key_length, iv_length): # derive key and IV from password and salt.
23     d = d_i = b''
24     while len(d) < key_length + iv_length:
25         d_i = md5(d_i + str.encode(password) + salt).digest() # obtain the md5 hash value
26         d += d_i
27     return d[:key_length], d[key_length:key_length + iv_length]
28
29 def rsa_encryption(in_file, out_file, public_key, key_length=32):
30     bs = AES.block_size # 16 bytes
31     salt = urandom(bs) # return a string of random bytes
32     password = str(random.randint(1000, 10000))
33     key, iv = derive_key_and_iv(password, salt, key_length, bs)
34     cipher = AES.new(key, AES.MODE_CBC, iv)
35     out_file.write(salt)
36     finished = False
37
38     while not finished:
39         chunk = in_file.read(1024 * bs)
40         if len(chunk) == 0 or len(chunk) % bs != 0: # final block/chunk is padded before encryption
41             padding_length = (bs - len(chunk) % bs) or bs
42             chunk += str.encode(padding_length * chr(padding_length))
43             finished = True
44         out_file.write(cipher.encrypt(chunk))
45     new_public_key = rsa.PublicKey.load_pkcs1(public_key.encode())
46     enc_text = rsa.encrypt(password.encode(), new_public_key)
47     print(password)
48     return enc_text
49
50 2 usages
51 def rsa_decryption(in_file, out_file, enc_text, private_key, key_length=32):
52     new_private_key = rsa.PrivateKey.load_pkcs1(private_key.encode())
53     dec_text = rsa.decrypt(enc_text, new_private_key)
54     dec_text = dec_text.decode()
55     # print('dec_text', dec_text)
56     bs = AES.block_size
57     salt = in_file.read(bs)
58     key, iv = derive_key_and_iv(str(dec_text), salt, key_length, bs)
59     cipher = AES.new(key, AES.MODE_CBC, iv)
60     next_chunk = ''
61     finished = False
62
63     while not finished:
64         chunk, next_chunk = next_chunk, cipher.decrypt(in_file.read(1024 * bs))
65         if len(next_chunk) == 0:
66             padding_length = chunk[-1]
67             chunk = chunk[:-padding_length]
68             finished = True
69         out_file.write(bytes(x for x in chunk))
```


Output:



The image displays a web application interface for an Admin Login Form. At the top, a dark header bar contains the text "Ensuring Privacy in the Digital Era:ISDE with Access Control" in a green, monospace-style font. Below the header, three buttons are arranged horizontally: "Admin Login" (dark blue), "Data Owner Login" (green), and "Data User Login" (green). The "Admin Login" button is selected, leading to a dark blue login form. The form has a title "Admin Login Form" and two input fields: "Admin ID:" and "Admin Password:". A green "Login" button is positioned at the bottom of the form.

Ensuring Privacy in the Digital Era:ISDE with Access Control

Admin Login Data Owner Login Data User Login

Admin Login Form

Admin ID:

Admin Password :

Login