C-Pay: An E-Wallet Application Utilizing C-Programming

Team Members

Aswin Kandel	THA081BCT004
Dikesh Manandhar	THA081BCT008
Kishan Kumar Shah	THA081BCT014
Pujag Dallakoti	THA081BCT024

Under the Supervision of:

Er. Prajwal Pakka

Department of Electronics and Computer Engineering
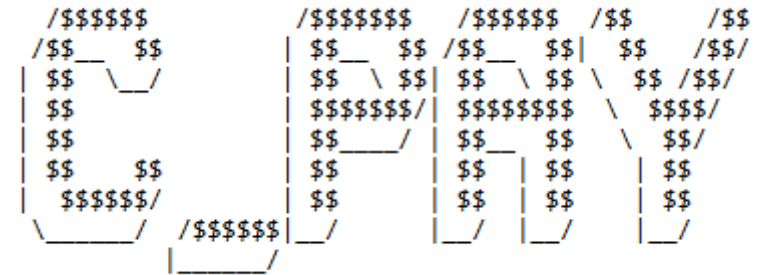
Institute of Engineering, Thapathali Campus

March 12, 2025

Presentation Outline

- Introduction
- Motivation
- Project Objectives
- Scope of Project
- Project Applications

- Methodology
- Results & Analysis
- Future Enhancements
- Conclusion
- References

Introduction

- ## What is C-Pay ?
  - ### A digital wallet prototype
- ## Why choose C programming ?
  - ### Simplicity & Efficiency and Curriculum Based
- ## Key Features
  - ### Secure User Authentication & Transaction System
- ## Security Measures
  - ### Data Encryption & Robust Validation

```
   /$$$$$$                /$$$$$$$   /$$$$$$  /$$    /$$
  /$$__  $$              | $$__  $$ /$$__  $$| $$   /$$/
 | $$  \__/              | $$  \ $$| $$  \ $$ \  $$ /$$/
 | $$        $$$$$$      | $$$$$$$/| $$$$$$$$  \  $$$$/
 | $$                    | $$____/ | $$__  $$   \  $$/
 | $$    $$              | $$      | $$  | $$    | $$
 |  $$$$$$/              | $$      | $$  | $$    | $$
  _____/  /$$$$$$      |__/      |__/  |__/    |__/
           |_____/
```

Motivation

- Global digital wallet impact

- Lack of simple & lightweight solutions

- Enhancing programming understanding

- Real-world application of C programming

- Driven by Curiosity

Problem Statement

- Security Enhancement
  - Enhance protection for users' transactional data
- Logical System Design
  - Develop efficient mechanisms for managing account transfers
- Authentication & Validation Robustness
  - Establish a secure and reliable user sign-in process
- Interface Clarity
  - Design a clear and easy-to-user interface

Project Objectives

- To develop a functional prototype by creating a working e-wallet application using C programming for basic financial transactions.

- To introduce essential features by implementing core functionalities like balance inquiry, transaction history, and school fee payments to simulate real-world e-wallet operations.

Project Scope

- Capabilities

  - Digital Wallet Operations: Supports basic user registration, login, and transactions

  - Security Implementation: Includes encryption and secure data storage

- Limitations

  - System Compatibility: Incompatible with 16-bit operating systems

  - Feature Restrictions: For now, Limited to personal and educational transactions

Project Applications

- Prototype Foundation
  - Serves as a basis for creating sophisticated digital payment platforms

- Customization Potential
  - Adaptable for various commercial and organizational financial operations

- Innovation Platform
  - Provides a framework for integrating new technologies and features into existing financial systems

Methodology [1]
(Software Requirements)

- IDEs
  - Visual Studio Code or others like Code::Blocks

- Compiler
  - GCC (GNU Compiler Collection)

- Debugger
  - GDB (GNU Debugger)

Methodology [2]
(Hardware Requirements)

- Processor
  - Dual-core (Intel Core i3 or equivalent)
- RAM
  - 4GB minimum
- Storage
  - 10GB free disk space

- Operating System
  - Windows 7 or later, Linux, macOS
- Display
  - 1024x768 resolution minimum
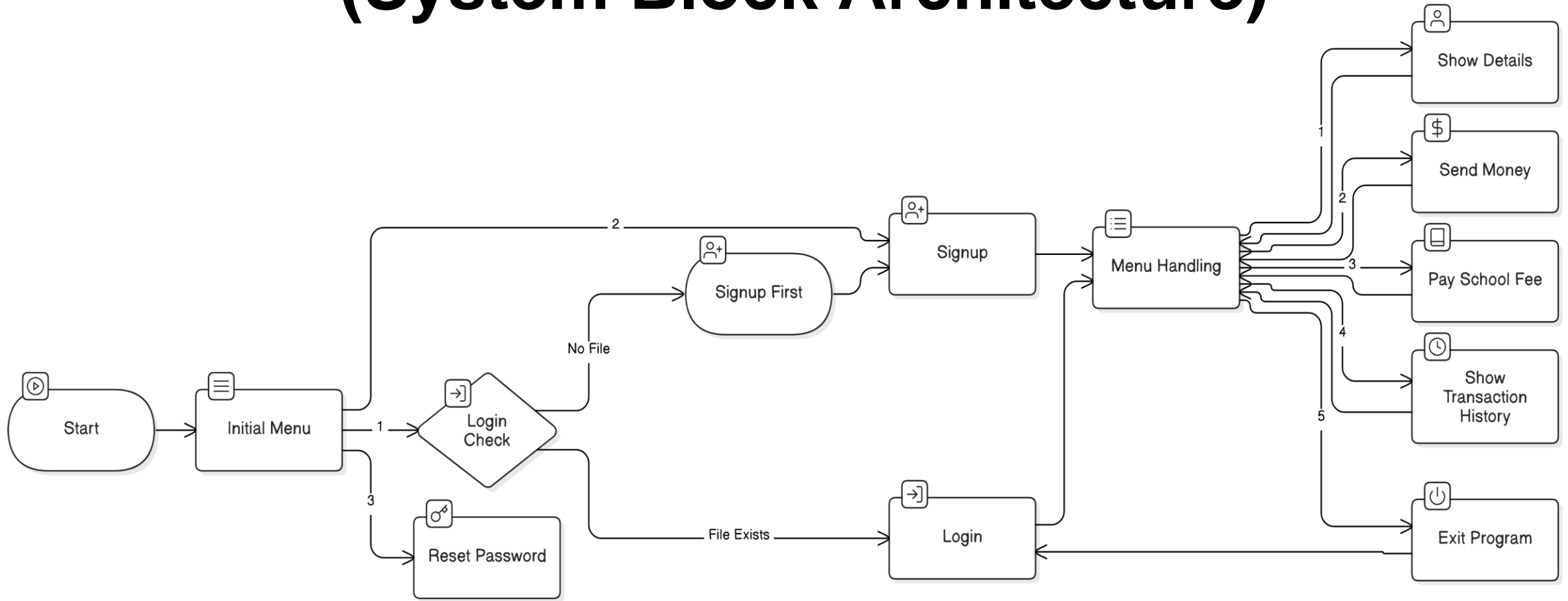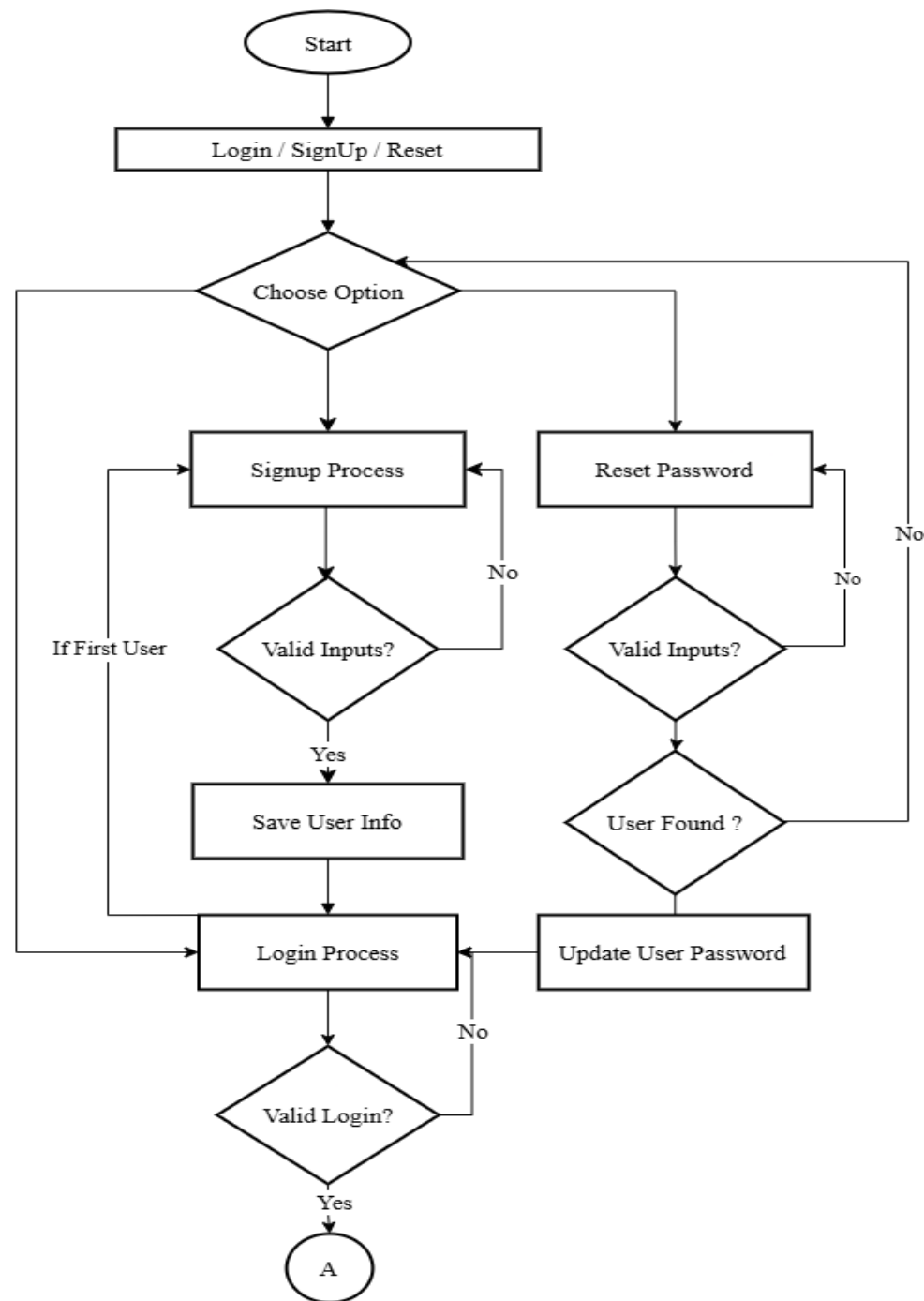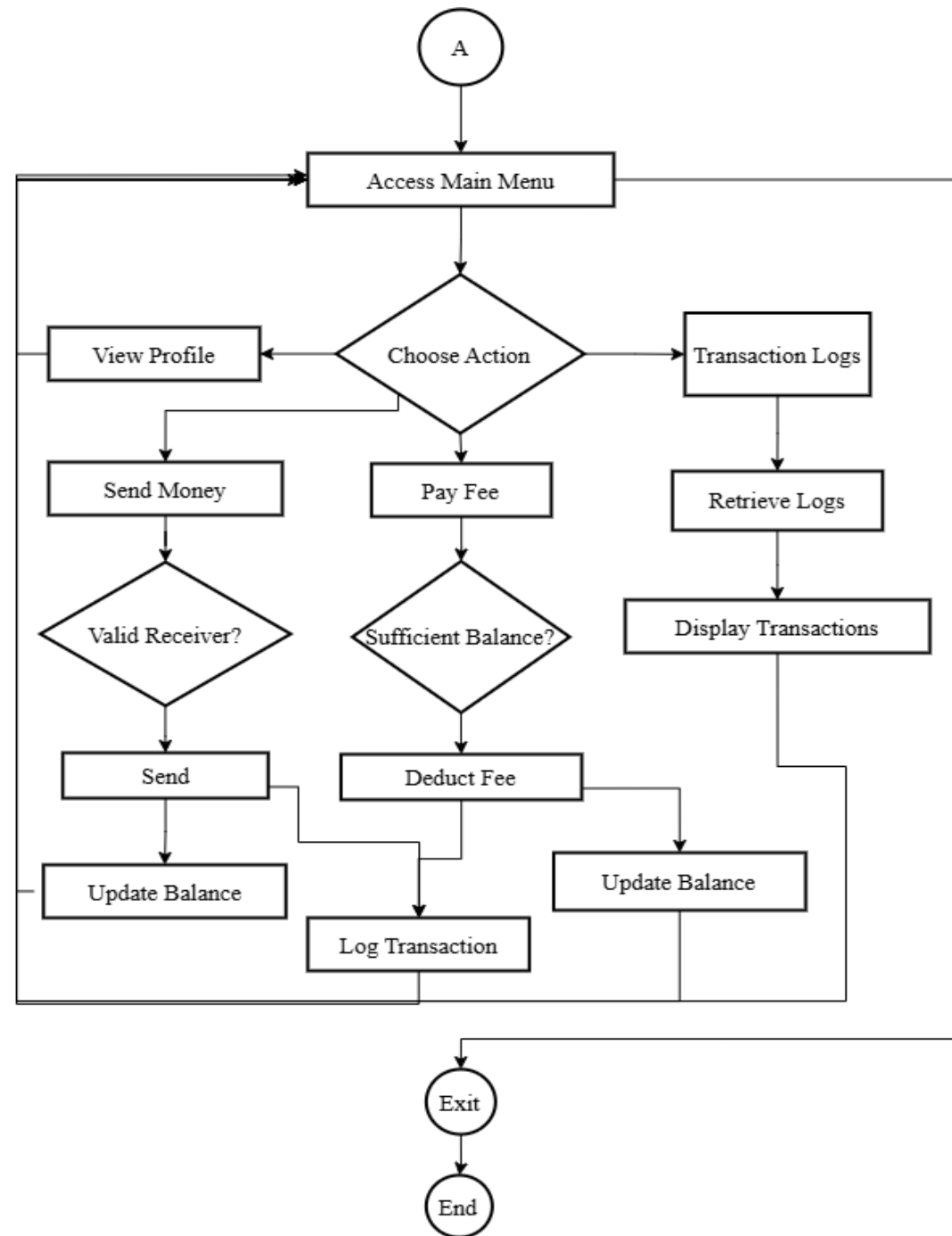
Methodology-[3]
(System Block Architecture)

Fig: Overview of the Flow

**Methodology-[4]
(Initial Menu Handling)**

**Methodology-[5]
(Main Menu Handling)**

Methodology-[6]
(Working Principle contd…)

- Overall Program Flow
  - main() Function:
    - Serves as entry point. Initializes UI & offers initial choices (Login, Sign Up, Reset Password)

- Data Management
  - File Handling Functions:
    - load_user_data() and save_user_data(): Load user profiles & save to .dat files
    - encrypt() and decrypt(): Save & retrieve user passwords by simple bitwise shift

  - Validation Functions:
    - validate_email(), validate_phone(), validate_receiver(): Check for valid input formats and existing data

Methodology-[7]
(Working Principle contd…)

- User Account Management
  - signup() Function:
    - Registers users by collecting & validating inputs , encrypting the password, and storing all information securely.
    - Calls: validate_email(), validate_phone(), encrypt(), save_user_data().

  - login() Function:
    - Authenticates users by matching input credentials against stored data.
    - Utilizes: decrypt(), transitions to menu_handling() on successful login.

  - reset_password() Function:
    - Allows users to reset passwords after verifying identity via multiple personal details.
    - Uses: validate_email(), validate_phone(), encrypt(), updates data via save_user_data().

Methodology-[8]
(Working Principle contd…)

- Menu Navigation and Operations
  - menu_handling() Function:
    - Central hub for navigation : viewing details, sending money, paying fees, viewing transaction history, or exiting.

  - User Interactions
    - show_details(): Fetches and displays current user information.
    - send_money(): Manages money transfers, checks for valid recipient and sufficiency of funds, logs the transaction.
    - pay_school_fee(): Processes fee payments, verifies sufficiency of funds, and records the transaction.
    - show_transaction_history(): Retrieves and displays a detailed log of user's past transactions.

Methodology-[9]
(Working Principle contd…)

- Transaction and Logging

  - log_transaction():
    - Called within send_money() and pay_school_fee() to record each transaction in the system, capturing details like sender, receiver, amount, and type.

- Utility and Helper Functions

  - clear_input_buffer(), delay(), password_taker():
    - Facilitate user input handling and improve the user interface experience by managing input dynamics and system responses.

- System Exit

  - exit_program():
    - Ends the program execution gracefully, providing a user-friendly shutdown process.

Methodology-[10]
(Working Principle contd…)

- Correlations and Integrations
  - Each function is designed to interact seamlessly, with data validation and security being central to all user-related operations.

  - Transaction functions integrate closely with the logging function to ensure all financial activities are accurately recorded.

  - User interface functions (like those for menu handling and details display) are directly linked to data management functions, ensuring that user interactions are both intuitive and secure.

Results & Analysis-[1]
(Initial Screen)

- User-Friendly Interface: Clear options for easy navigation.
- Visual Appeal: Engaging ASCII art and concise prompts.

```
 $$$$$$\           $$$$$$$\   $$$$$$\  $$\     $$\
$$  __$$\          $$  __$$\ $$  __$$\ \$$\   $$  |
$$ /  \__|         $$ |  $$ |$$ /  $$ | \$$\ $$  /
$$ |               $$$$$$$  |$$$$$$$$ |  \$$$$  /
$$ |               $$  ____/ $$  __$$ |   \$$  /
$$ |  $$\          $$ |      $$ |  $$ |    $$ |
\$$$$$$  |         $$ |      $$ |  $$ |    $$ |
 _____/ $$$$$$\  \__|      \__|  \__|    \__|
          _____|
```

```
[1] Login
[2] SignUp
[3] Reset Password
Choose an option [1-3]:
```

Results & Analysis-[2] (SignUp - Validation)

- Comprehensive Validation: Ensures data accuracy and uniqueness.

```
$$$$$$\  $$$$$$\  $$$$$$\  $$\   $$\         $$\   $$\ $$$$$$$\
$$  __$$\ \_$$  _|$$  __$$\ $$$\  $$ |        $$ |  $$ |$$  __$$\
$$ /  \__|  $$ |  $$ /  \__|$$$$\ $$ |        $$ |  $$ |$$ |  $$ |
\$$$$$$\    $$ |  $$ |$$$$\ $$ $$\$$ |$$$$$$\  $$ |  $$ |$$$$$$$  |
 \____$$\   $$ |  $$ |\_$$ |$$ \$$$$ |_____| $$ |  $$ |$$  ____/
$$\   $$ |  $$ |  $$ |  $$ |$$ |\$$$ |         $$ |  $$ |$$ |
\$$$$$$  |$$$$$$\ \$$$$$$  |$$ | \$$ |         \$$$$$$  |$$ |
 _____/ _____| _____/ \__|  \__|          _____/ \__|
```

```
Enter the following details:
Username: bct081
Email (e.g:user@domain.com): bct081@gmail com
Invalid email! Must be in format user@domain.com and no spaces.
Email (e.g:user@domain.com): bct081@gmail.com
Phone number (98/97xxxxxxx): 9874568524
Invalid phone number! Must be a valid Nepali number (e.g., 98/97xxxxxxx).
Phone number (98/97xxxxxxx): 9814890445
This contact is already registered. Please use another contact.

Phone number (98/97xxxxxxx): 9814890557
Password (min 4 chars): ****
Re-enter password: ***_
```

Results & Analysis-[3]
(SignUp)

- Successful Registration: Validates and confirms successful signup.

```
 $$$$$$\  $$$$$$\  $$$$$$\ $$\   $$\         $$\   $$\ $$$$$$$\
$$  __$$\ \_$$  _|$$  __$$\ $$$\  $$ |        $$ |  $$ |$$  __$$\
$$ /  \__|  $$ |  $$ /  \__|$$$$\ $$ |        $$ |  $$ |$$ |  $$ |
\$$$$$$\    $$ |  $$ |$$$$\ $$ $$\$$ |$$$$$$\ $$ |  $$ |$$$$$$$  |
 \____$$\   $$ |  $$ |\_$$ |$$ \$$$$ |_____|$$ |  $$ |$$  ____/
$$\   $$ |  $$ |  $$ |  $$ |$$ |\$$$ |        $$ |  $$ |$$ |
\$$$$$$  |$$$$$$\ \$$$$$$  |$$ | \$$ |        \$$$$$$  |$$ |
 _____/ _____| _____/ \__|  \__|         _____/ \__|
```

```
Enter the following details:
Username: bct081
Email (e.g:user@domain.com): bct081@gmail.com
Phone number (98/97xxxxxxx): 9814890557
Password (min 4 chars): ****
Re-enter password: ****

***Sign-Up Successful***
***You can now login***
```

Results & Analysis-[4]
(Reset Password)

- Security Check: Prevents unauthorized password reset attempts
- Successful Reset: Confirms password reset with matched credentials

```
$$$$$$$\   $$$$$$$$\   $$$$$$\   $$$$$$$$\ $$$$$$$$\
$$  __$$\  $$  _____|$$  __$$\  $$  _____|\__$$  __|
$$ |  $$ |$$ |     $$ /  \__|$$ |          $$ |
$$$$$$$  |$$$$$\   \$$$$$$\  $$$$$\        $$ |
$$  __$$< $$  __|   \____$$\ $$  __|       $$ |
$$ |  $$ |$$ |     $$\   $$ |$$ |          $$ |
$$ |  $$ |$$$$$$$$\ \$$$$$$  |$$$$$$$$\    $$ |
\__|  \__|_____| _____/ _____|   \__|

          Reset / Forgot Password?

-------------------------------------------
Enter the following details:
Username: anonyks
Email (e.g:user@domain.com): anonyk@gmail.com
Phone number (98/97xxxxxxx): 9814890445
No user found with the given username and email.
```

```
$$$$$$$\   $$$$$$$$\   $$$$$$\   $$$$$$$$\ $$$$$$$$\
$$  __$$\ $$  _____|$$  __$$\  $$  _____|\__$$  __|
$$ |  $$ |$$ |     $$ /  \__|$$ |           $$ |
$$$$$$$  |$$$$$\   \$$$$$$\  $$$$$\         $$ |
$$  __$$< $$  __|   \____$$\ $$  __|        $$ |
$$ |  $$ |$$ |     $$\   $$ |$$ |           $$ |
$$ |  $$ |$$$$$$$$\ \$$$$$$  |$$$$$$$$\     $$ |
\__|  \__|_____| _____/ _____|    \__|

          Reset / Forgot Password?

-------------------------------------------
Enter the following details:
Username: anonyks
Email (e.g:user@domain.com): anonyks@gmail.com
Phone number (98/97xxxxxxx): 9814890441
New Password (min 4 chars): ****
Confirm New Password: ****
Password reset successful!
```

Results & Analysis-[5]
(Login)

- Login Validation: Successfully validates user credentials and grants access, confirming system security and reliability.

```
$$\        $$$$$$\   $$$$$$\  $$$$$$\ $$\    $$\
$$ |      $$  __$$\ $$  __$$\ \_$$  _|$$$ |   $$ |
$$ |      $$ /  $$ |$$ /  \__|  $$ |  $$$$\  $$ |
$$ |      $$ |  $$ |$$ |$$$$\   $$ |  $$ $$\$$ |
$$ |      $$ |  $$ |$$ |\_$$ |  $$ |  $$ \$$$$ |
$$ |      $$ |  $$ |$$ |  $$ |  $$ |  $$ |\$$$ |
$$$$$$$$\  $$$$$$  |\$$$$$$  |$$$$$$\ $$ | \$$ |
_____| _____/  _____/ _____|\__|  \__|
```

```
Enter your login details:
Username: anonyks
Password: ****

Login Successful!
```

Results & Analysis-[6]
(Main Menu & Show Details)

- Intuitive Menu: Personalized greeting and clear navigation options.
- User Details Display: Accurately shows username, info, and balance.

```
$$\        $$\ $$$$$$$$\ $$\    $$\ $$\    $$\
$$$\      $$$ |$$  _____|$$$\   $$ |$$ |   $$ |
$$$$\    $$$$ |$$ |      $$$$\  $$ |$$ |   $$ |
$$\$$\$$ $$ |$$$$$\    $$ $$\$$ |$$ |   $$ |
$$ \$$$  $$ |$$  __|   $$ \$$$$ |$$ |   $$ |
$$ |\$  /$$ |$$ |      $$ |\$$$ |$$ |   $$ |
$$ | \_/ $$ |$$$$$$$$\ $$ | \$$ |\$$$$$$  |
\__|     \__|_____|\__|  \__| _____/

          Greetings anonyks !!!

-------------------------------------------
1. Show Details
2. Send Money
3. Pay School Fee
4. Show Transaction History
5. Exit
-------------------------------------------
Enter your choice [1-5]: _
```

```
USER DETAILS
-------------------------------------
Username: anonyks
Phone: 9814890441
Email: anonyks@gmail.com
Current Balance: Rs 88.00
-------------------------------------
Press any key to return to menu: _
```

Results & Analysis-[7] (Send Money & Fee)

- Balance Check: Alerts on insufficient funds effectively.
- Successful Transfer: Confirms transaction and updates balance immediately.

```
FUND TRANSFER
-----------------------------------------

Available Users (excluding you):
User            Phone
-----------------------------------------
anonyks2        9814890442
anonyks3        9814890443
user1           9814890449
newuser         9814890552
aswin           9814890447
update          9814890445
-----------------------------------------

Enter receiver username: user1
Enter receiver phone number: 9814890449
Enter amount to send (Rs): 12

Transaction Successful!
Your new balance is: Rs 76.00
-----------------------------------------
Press any key to return to menu:
```

```
COLLEGE FEE PAYMENT
-----------------------------------------

Available Colleges:
1. IOE Pulchowk              Rs 1000.00
2. IOE Thapathali            Rs 1500.00
3. IOE WRC                   Rs 2000.00
4. IOE ERC                   Rs 2500.00
-----------------------------------------

Enter your choice [1-4]: 1

Insufficient balance! Your current balance is Rs 76.00
Press 'x' to return to menu _ any key to re-enter
```

Results & Analysis-[8] (Transaction History)

- Detailed Record: Displays comprehensive transaction history with sender, receiver, amount, and timestamps.

```
TRANSACTION HISTORY
--------------------------------------------------------------------------------
Sender              Receiver            Amount      Date/Time                       Type
--------------------------------------------------------------------------------
anonyks2            anonyks             +98.00      Mon Mar 10 15:53:07 2025        Send Money
anonyks             IOE ERC             -2500.00    Mon Mar 10 16:26:21 2025        School Fee
user1               anonyks             +8000.00    Mon Mar 10 17:50:36 2025        Send Money
anonyks             user1               -10.00      Mon Mar 10 17:53:12 2025        Send Money
anonyks             user1               -10001.00   Mon Mar 10 17:53:28 2025        Send Money
anonyks             IOE ERC             -2500.00    Mon Mar 10 18:01:48 2025        School Fee
newuser             anonyks             +1.00       Mon Mar 10 18:23:32 2025        Send Money
newuser             anonyks             +1.00       Mon Mar 10 18:24:17 2025        Send Money
anonyks             anonyks2            -1.00       Mon Mar 10 18:35:29 2025        Send Money
anonyks             IOE Pulchowk        -1000.00    Mon Mar 10 18:38:42 2025        School Fee
anonyks             user1               -69.00      Mon Mar 10 18:39:18 2025        Send Money
anonyks             anonyks             -10.00      Mon Mar 10 19:10:28 2025        Send Money
aswin               anonyks             +69.00      Mon Mar 10 19:40:05 2025        Send Money
anonyks             user1               -12.00      Tue Mar 11 13:46:46 2025        Send Money
--------------------------------------------------------------------------------
Press any key to return to menu: _
```

Future Enhancements

- Graphical User Interface:

    Implement a simple GUI using advance libraries

- Advanced Encryption:

    Upgrade current encryption methods to more robust

- Memory Management Enhancements

- Multi-Factor Authentication:

    Enhance security features using C's cryptographic libraries.

- API Integration:

    Expand payment capabilities by integrating with banking APIs

Conclusion

- Developed a Digital Wallet Using C Programming:

    Created an e-wallet application, C-Pay, focused on basic financial transactions and user management, leveraging fundamental C-programming concepts.

- Successfully Met Project Objectives:

    Achieved the goal of integrating educational programming skills with practical application, demonstrating the feasibility and functionality of the C-Pay system in executing secure transactions and user interactions effectively.

References

[1] "Digital wallet," Wikipedia [Online]
     Available: https://en.wikipedia.org/wiki/Digital_wallet [Accessed: Mar. 11, 2025]

[2] A. Devil, "Programming-Basics," GitHub [Online]
     Available: https://github.com/Astrodevil/Programming-Basics [Accessed: Mar. 11, 2025]

[3] ECB, "2023 Report on Digital Wallets," European Central Bank, Apr. 24, 2023. [Online] Available:
     https://ecb.europa.eu/press/pr/date/2023/html/ecb.pr230424_1_annex~93abdb80da.en.pdf
     [Accessed: Mar. 11, 2025]

[4] S. A. Al-Qubati and N. A. Al-Shaibany, "E-Wallet Security Readiness: A Survey,"
     International Journal of Computer Science and Mobile Computing, vol. 13, no. 3, pp. 20-26, Mar. 2024.
     [Online] Available:
     https://ijcsmc.com/docs/papers/March2024/V13I3202410.pdf [Accessed: Mar. 11, 2025]

[5] "C-Authentication Program with Username & Password," Learn eTutorials. [Online]. Available:
     https://learnetutorials.com/c-programming/programs/authentication-program [Accessed: Mar. 11, 2025]

Thank You

Thank you for using C_PAY

Developed by:

Aswin Kandel   (081BCT004)
Dikesh Manandhar   (081BCT008)
Kishan Kumar Shah   (081BCT014)
Pujag Dallakoti   (081BCT024)