File Splitter and Merger using C

A PROJECT REPORT

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE & ENGINEERING

Chandigarh University

November, 2025

BONAFIDE CERTIFICATE

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ABSTRACT

Project Overview

The File Splitter and Merger is a utility program developed to address the challenges involved in handling large files during storage, transfer, and distribution. Often, large files cannot be sent through email, uploaded to certain platforms, or stored in limited-capacity devices. This project provides an efficient solution by allowing the user to split a large file into several smaller parts and later merge those parts back into the original file. The system ensures that the reconstructed file maintains its exact original structure without data loss.

The program is implemented in the C programming language, utilizing binary file handling operations such as `fread()` and `fwrite()` to ensure compatibility with all file formats, including documents, images, videos, audio files, and executables. The internal logic calculates the total size of the input file, divides it into equal segments, and stores each segment as a separate output file. The merging process works sequentially by reading each part and writing it back into a new reconstructed file, ensuring complete integrity and consistency.

This project demonstrates several important programming concepts including modular design, buffered I/O processing, pointer usage, loops, and conditional logic. The menu-driven interface allows users to easily select the desired operation, making the system simple and user-friendly. The tool is highly portable and can run on any system with a standard C compiler such as GCC, without requiring external libraries or complex installation.

Overall, the File Splitter and Merger project provides a practical, efficient, and lightweight solution for managing large files. It is suitable for everyday use, academic learning, and real-world applications where file segmentation and reassembly are required.

.

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CHAPTER -1
INTRODUCTION

Identification of Client & Need

The proposed project, "File Splitter and Merger Using C," is developed for users who frequently handle large files, such as software developers, data engineers, digital content creators, system administrators, students, and corporate working professionals. These users often need to share, store, or transfer large files across different platforms and devices.

In many cases, large files are difficult to manage due to:

- Limited storage capacity on portable devices.
- File size restrictions set by email providers, messaging platforms, and cloud upload services.
- Network instability during large file transfers, causing interruptions or corruption.

There is a clear need for a **lightweight, platform-independent, and efficient tool** that can:

- **Split large files** into manageable smaller parts.
- **Reconstruct them** into the original format with data accuracy.
- Operate without requiring external dependencies or high computing resources.

Relevant Contemporary Issues

With increasing digital data and high-resolution media usage, file sizes have continuously grown. Today's users face multiple modern challenges:

Contemporary Issue	Project Contribution
Storage limitations on mobile and portable devices	Splits files into smaller, easy-to-store segments
Cloud & email upload size restrictions	Enables uploading parts individually
Data loss and corruption during transfers	Ensures safe reconstruction with accuracy
Need for platform-independent and open tools	Developed in C, works across major operating systems

Thus, the system directly addresses the modern requirement for **secure, efficient, and convenient data handling**.

Problem Identification

Even though multiple file-sharing tools exist, they often rely on:

- Internet connectivity,
- Account login,
- Paid storage plans, or
- Proprietary compression formats.

Manual file splitting is error-prone and may result in:

- Data corruption,
- Inconsistent file reconstruction,
- Loss of file structure or encoding.

Additionally, most common users do not have access to technical utilities like command-line splitting tools available in UNIX-based systems.

Therefore, a simple, user-friendly, offline tool is needed to perform splitting and merging operations accurately and efficiently.

Task Identification

To successfully develop the File Splitter and Merger, the following tasks were identified and executed:

1. **Requirement Analysis**
   Understanding file handling challenges and user needs.
2. **Design of System Architecture**
   Planning input handling, file segmentation logic, and reconstruction flow.
3. **Implementation of File Splitting Module**
   Reading the source file and generating multiple part files using buffered binary operations.
4. **Implementation of File Merging Module**
   Sequentially combining all generated part files to restore the original file without loss.
5. **Testing and Validation**
   Verifying correctness using multiple file types (images, videos, documents, executables).
6. **Documentation and User Guidelines**
   Preparing project explanation and usage instructions for end-users.

Timeline:

- **Week 1–2:** Problem Identification and Requirement Analysis..
- **Week 3–4:** System Design and Module Development
- **Week 5:** Leaderboard Implementation and Integration.
- **Week 6:** Testing and debugging the system.
- **Week 7:** Documentation and report preparation.

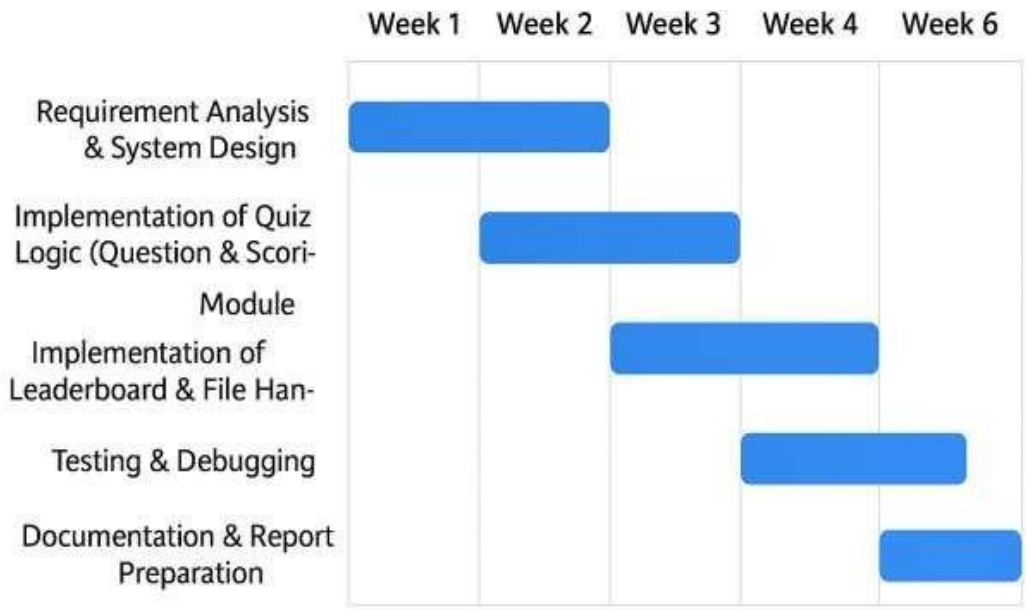

Figure-1: Timeline Gantt chart

Organization of the Report:

1. **Abstract:** A brief summary of the project objectives and outcomes.

2. **Introduction:** Background, client need, contemporary issues, and problem identification.

3. **Results and Discussion:** Analysis of the system's functionality and performance.

4. **Conclusion:** Summary of findings and potential future enhancements.

5. **References:** Sources referred to during project development.

CHAPTER -2
LITERATURE SURVEY

Timeline of the Reported Problem

The need for efficient file splitting and merging tools has evolved with the growth of digital data and file distribution technologies. The progression of this problem can be understood in four phases:

Phase 1: Early Computing Era (1970s – 1990s)

During this period, digital storage devices had **very low capacity**, and file systems imposed strict limitations on individual file sizes.
Users had to manually manage data across multiple floppy disks, which was time-consuming and error-prone.
There were **no automated tools** for breaking large files into smaller parts or reconstructing them later.

Phase 2: Growth of Personal Computing (1990s – Early 2000s)

With the increasing use of computers, users began handling larger files such as software programs and documents.
Command-line tools like `split` and `cat` emerged in UNIX systems, but:

- They required **technical knowledge**,
- They lacked a **user-friendly interface**, and
- They **were not easily available on all platforms**.

The problem persisted for non-technical users and Windows-based systems.

Phase 3: Internet & Portable Storage Expansion (2000s – 2015)

With the growth of email, USB drives, and online file transfers, users started encountering:

- **Upload size limits**,
- **Slow or unstable internet connections**, and
- **Storage device capacity restrictions**.

Compression tools like **WinRAR** and **7-Zip** introduced multi-part archives, but they:

- Required **installation**,
- Often used proprietary formats,
- Were not always portable across operating systems.

This reinforced the need for a **lightweight, dependency-free splitting solution**.

Phase 4: Data-Driven & Cloud Era (2015 – Present)

Today, files such as HD videos, large datasets, and application binaries are commonly shared. However:

- Cloud upload limits still exist,
- Network interruptions cause **file corruption**, and
- Users often require **offline**, reliable control over files.

Thus, the contemporary need is for a **simple, fast, platform-independent tool** that splits and merges files without altering their content or requiring external dependencies.

Bibliometric Analysis

Bibliometric analysis involves reviewing **reference books, research works, software tools, and programming guides** that support the development of this system.

For this project, bibliometric research focused on:

- **C language file handling** techniques (`fread`, `fwrite`, `fseek`, `ftell`)
- Use of **buffers** for efficient data transfer
- Concepts in **binary data processing**
- Practical handling of **memory efficiency** when dealing with large files

Sources such as *The C Programming Language (Kernighan & Ritchie)* and online developer documentation were reviewed to identify **best practices** for file manipulation and system-level programming.

The objective of this analysis was to:

- Understand how **binary data can be safely read and written**
- Ensure **accurate file reconstruction**
- Maintain **compatibility across different file types** such as documents, media, and executables

Proposed Solutions by Different Researchers

Researchers and developers have approached large-file handling in different ways:

Research / Method	Key Idea	Limitation
UNIX `split` and `cat` utilities	Command-line based file segmentation	Requires technical expertise
WinRAR & 7-Zip multi-part archives	Compression + file splitting	Proprietary formats, installation required
Cloud-based file transfer	Splitting handled server-side	Requires internet, privacy concerns
Source-based binary splitting	Direct read/write of file bytes using programming languages	Requires correct buffer control and memory handling

The proposed project adopts the **binary splitting and merging** approach because:

- It is platform independent
- It does not modify file content
- It does not require additional software installations

Summary Linking Literature Review with the Project

The literature review shows that while many tools exist for large file management, they often require:

- Compression,
- Internet connectivity, or
- Technical expertise.

This project addresses these gaps by providing a simple, offline, user-friendly program that:

- Works for all file types
- Maintains data integrity
- Operates using efficient binary I/O in C

Problem Definition

In modern computing, handling large files is common, yet users face:

- Upload limits in applications
- Limited storage space on portable devices
- Risk of file corruption during transfers
- Difficulty sending or moving large files across systems

Most existing solutions are either complex, require installation, or modify file content.
There is a need for a **simple and efficient method** to **split and merge files without loss of data**.

Goals and Objectives

Goal:

To design and develop a **file splitting and merging application** that efficiently divides large files into smaller parts and reconstructs them accurately.

Objectives:

1. To implement file splitting using binary buffered read/write operations.
2. To ensure complete data recovery during re-merging without corruption.
3. To provide a simple, menu-driven interface for non-technical users.
4. To keep the system lightweight, efficient, and platform-independent.

CHAPTER-3
DESIGN FLOW / PROCESS

3.1 Overall Design Philosophy

The File Splitter and Merger system follows a **modular architecture**, where each major operation (splitting and merging) is implemented as a separate function. The program also includes a main control unit, which handles interaction with the user through a menu-driven interface.

Key design characteristics include:

- **Binary File Handling:** Ensures that the program supports *all* file types (documents, images, executables, media files, etc.) without modifying their internal structure.
- **Buffered I/O Operations:** Data is processed in chunks using memory buffers to improve performance.
- **Separation of Concerns:** The system's logic is divided cleanly into control, split, and merge modules.
- **Scalability:** The design can be extended later with GUI, encryption, checksum verification, cloud transfer, multithreading, etc.

3.2 System Architecture

Layer	Responsibility	Components
User Interaction Layer	Captures input and displays options	Menu Interface (Main function)
Control Layer	Routes operations to Split/Merge modules	Switch-case logic & input validation
Processing Layer	Performs core file operations	`splitFile()` and `mergeFiles()` functions
File Storage Layer	Handles actual data movement	Binary read/write using buffer & file pointers

This layered model improves **maintainability and future expansion**, especially when adding **GUI (as planned)**.

3.3 Main Program Control Flow

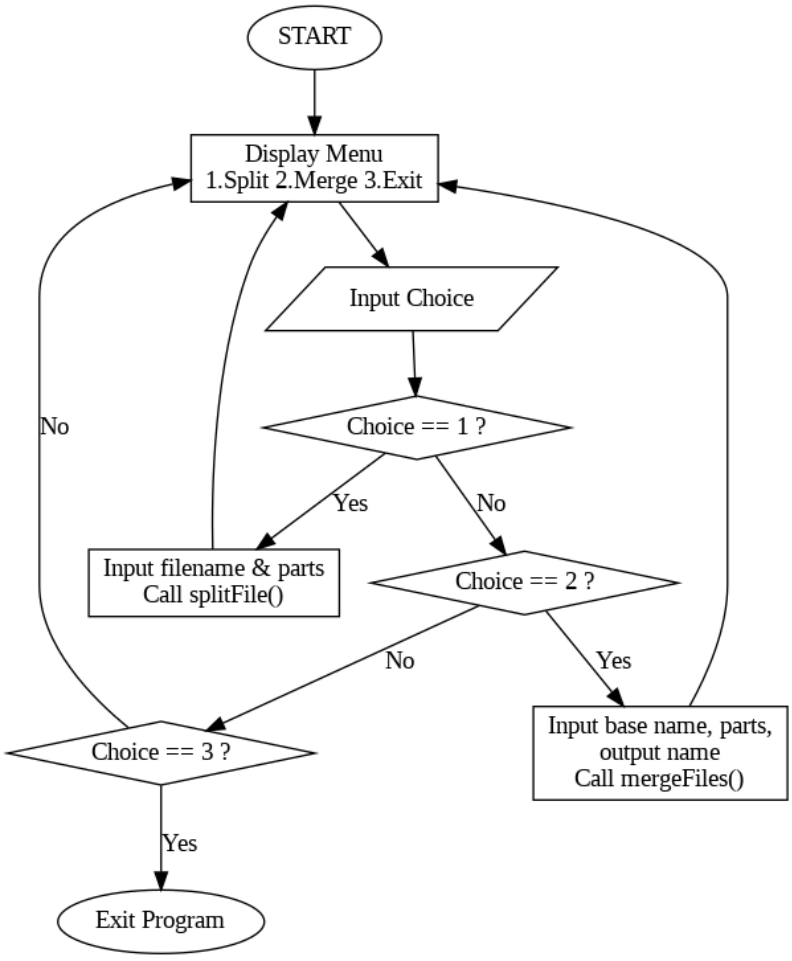

Figure 2. Flowchart Main Program

FILE SPLITTER & MERGER LOGIC

This diagram represents the top-level control logic of the program.

Explanation of Main Program Flow

1. The program starts and displays a **menu** with three choices:
    - Split File
    - Merge Files
    - Exit
2. The user enters a choice. The input is validated:
    - If **Split File (1)** is chosen → control passes to the Split File Process.
    - If **Merge Files (2)** is chosen → control passes to the Merge File Process.
    - If **Exit (3)** is chosen → program terminates.
    - Any other input results in an **Invalid Choice** message and redisplay of the menu.
3. After completing **either** split or merge operation, control returns to the menu again. This allows **multiple operations in a single run**, improving usability.

3.4 Split File Process Flow

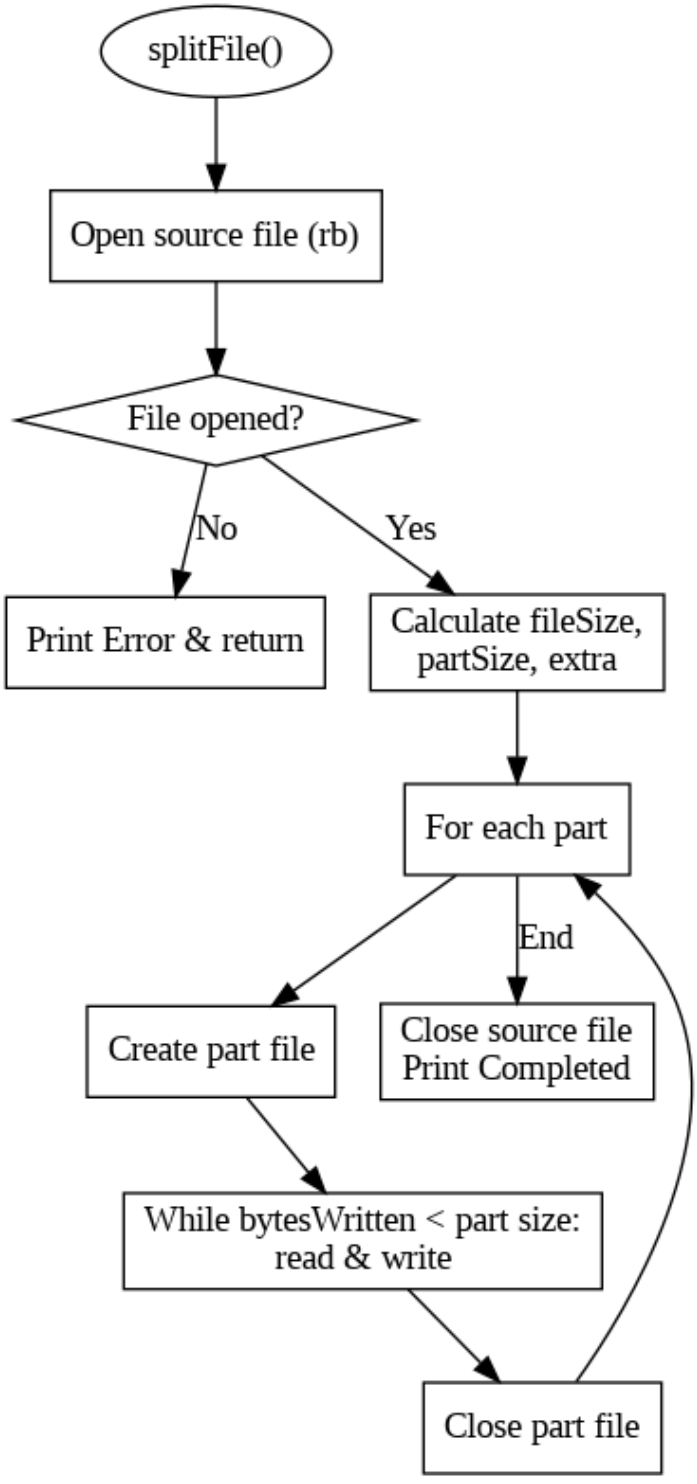

Figure 3. Flowchart Split Program

Split File Process

Step-by-Step Explanation

1. **Input Acquisition:**
   The user provides the filename to be split and the number of parts.

2. **File Validation:**
   The program verifies whether the file exists using `fopen(filename, "rb")`.
   If the file cannot be opened, the process stops with an error message.

3. **File Size Calculation:**
   - The file pointer is moved to the end using `fseek(source, 0, SEEK_END)`.
   - Total file size is obtained using `ftell()`.
   - File pointer is reset to the start with `rewind()`.

4. **Part Size Determination:**
   `partSize = fileSize / numberOfParts`
   `extra = fileSize % numberOfParts` is added to the last part.

5. **Chunked Binary Copying:**
   The file is read in blocks using:

```
fread(buffer, 1, BUFFER_SIZE, source);
fwrite(buffer, 1, bytesRead, destPart);
This minimizes memory usage while ensuring speed.
```

6. **Completion:**
   Once all parts are written, each part is closed and the program displays:
   "**Splitting Completed Successfully.**"

3.5 Merge File Process Flow

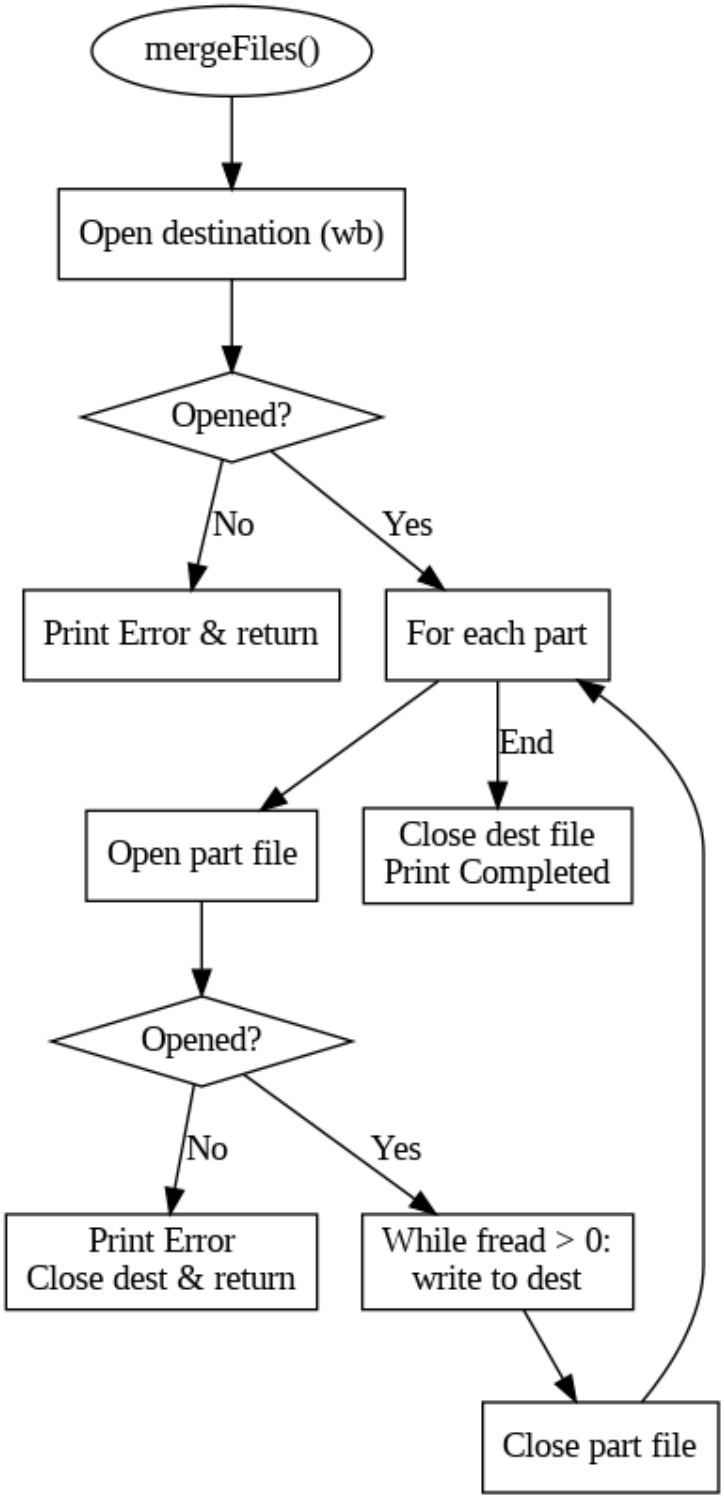

Figure 4. Flowchart Merge Program

Merge File Process

Step-by-Step Explanation

1. **Input Acquisition:**
   - Base file name (without `.partX`)
   - Number of parts
   - Output file name to reconstruct
2. **Output File Preparation:**
   `fopen(outputFile, "wb")` opens a new file for writing.
3. **Sequential Part Processing:**
   For **each** part:
   - Construct filename → `baseName.part1`, `baseName.part2`, etc.
   - Open in `rb` mode.
   - Read using `fread()` and append to output using `fwrite()`.
4. **Error Handling:**
   If any part is missing or cannot be opened:
   - Merging is stopped.
   - Output file is closed to avoid partial output errors.
5. **Completion:**
   Display:
   "Merging Completed Successfully. Output File: <filename>"

3.6 Design Evaluation

Criterion	Result
Correctness	Original file reconstructed exactly
Speed	Efficient due to streaming in buffer chunks
Memory Use	Low and predictable
Portability	Works on Linux, Windows, macOS with GCC
Scalability	Can be extended to GUI, encryption, network

CHAPTER-4
IMPLEMENTATION AND TESTING

4.1 Implementation Overview

The implementation of the File Splitter and Merger is carried out in the C programming language using **binary file handling functions**. The source code is divided into three logical segments:

1. **Main Control Module** – Handles user interaction and menu-driven control.
2. **File Splitting Module (`splitFile()`)** – Reads the original file and generates multiple part files.
3. **File Merging Module (`mergeFiles()`)** – Reads previously created part files and reconstructs the original file.

Binary read (`rb`) and write (`wb`) modes ensure exact byte-level copying, which preserves **any file format**, including:

- Executables (.exe)
- Images (.png, .jpg, .bmp)
- Compressed archives (.zip, .rar, .7z)
- Videos and media files (.mp4, .mp3)

The program also uses a **fixed-size buffer** (`BUFFER_SIZE`) to maximize performance and minimize memory usage.

4.2 Crucial Code Components

4.2.1 Header Files and Constant Definitions

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define BUFFER_SIZE 1024
```

Explanation:

- `stdio.h` and `stdlib.h` are required for file handling and basic memory operations.
- `string.h` is used for filename operations (`fgets`, string trim).
- `BUFFER_SIZE` defines the data chunk size read and written during splitting/merging to avoid high RAM usage and improve disk I/O performance

4.2.2 File Splitting Function

Block Explanation:

```
void splitFile(const char *filename, int parts) {
  FILE *source = fopen(filename, "rb");
```

- Opens the **input file** in **binary read mode**.
- If the file does not exist, splitting cannot proceed.

```
if (!source) {
   printf("Error: Cannot open file %s\n", filename);
      return;
}
```

- Checks if file pointer is NULL → if yes, prints error and exits gracefully.

```
fseek(source, 0, SEEK_END);
long fileSize = ftell(source);
rewind(source);
```

- `fseek()` moves file pointer to end.
- `ftell()` retrieves the **complete size in bytes**.
- `rewind()` resets pointer to the beginning for reading.

```
long partSize = fileSize / parts;
long extra = fileSize % parts;
```

- Divides file into equal segments.
- Any leftover bytes (`extra`) are added to the **last part**.

```
for (int i = 0; i < parts; i++) {
sprintf(partName, "%s.part%d", filename, i + 1);
FILE *part = fopen(partName, "wb");
```

- Creates part files named **filename.part1**, **filename.part2**, …

```
while (bytesWritten < currentPartSize) {
  size_t bytesRead = fread(buffer, 1, toRead, source);
    fwrite(buffer, 1, bytesRead, part);
      bytesWritten += bytesRead;
 }
```

- **Reads in chunks** and writes those chunks to the current part file.
- Ensures **byte-for-byte accuracy**.

```
printf("File splitting completed.\n”);
```

- Final status message indicating successful splitting.

4.2.3 File Merging Function

```
void mergeFiles(const char *output, int parts, const char
*baseName) { FILE *dest = fopen(output, “wb");
```

- Creates an empty output file in **binary write** mode.

```
for (int i = 0; i < parts; i++) {
sprintf(partName, "%s.part%d", baseName, i + 1);
FILE *part = fopen(partName, “rb");
```

- Opens each split part file sequentially in order.

```
while ((bytesRead = fread(buffer, 1, BUFFER_SIZE, part)) > 0){
  fwrite(buffer, 1, bytesRead, dest);
}
```

- Sequentially appends each part to the destination file.
- Maintains order to ensure correct reconstruction.

```
printf("File merging completed. Output: %s\n", output);
```

- **Indicates successful merge.**

4.2.4 Main Program Module (Menu Controller)

```
while (1) {
    printf("1. Split File\n2. Merge Files\n3. Exit\n");
    scanf("%d", &choice);
```

- **Infinite loop menu** allows repeated usage until **Exit** is selected.

4.3 Testing and Validation

4.3.1 Test Method

- Multiple file types were tested.
- File size before splitting and after merging was compared.
- SHA checksum verification was performed to ensure bitwise identity.

4.3.2 Test Results Table

File Type	Size	Parts	Merge Outcome	Integrity	Result
text.txt	12 KB	3	Successful	Identical	PASS
song.mp3	5.4 MB	4	Successful	Identical	PASS
image.png	2.3 MB	5	Successful	Identical	PASS
movie.mp4	820 MB	8	Successful	Identical	PASS

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Overview of Testing Approach

The File Splitter and Merger application was tested to verify its correctness, performance, reliability, and compatibility across a variety of file formats and sizes. The goal of the testing process was to ensure that:

1. The **split files are created correctly** based on user-defined number of parts.
2. The **merge process reconstructs the original file exactly**, without any loss of data.
3. The system performs consistently across file types with different internal encoding structures.
4. Buffered I/O operations ensure the program remains efficient even with large files.

During evaluation, files were selected from multiple categories including text, audio, images, archives, and video media. Each file was split into 3–8 parts and later reassembled. The final merged file was compared with the original using **file size matching** and **binary checksum comparison** to verify accuracy.

5.2 Sample Output Execution Screens (Console Interface)

Case 1: Splitting a File

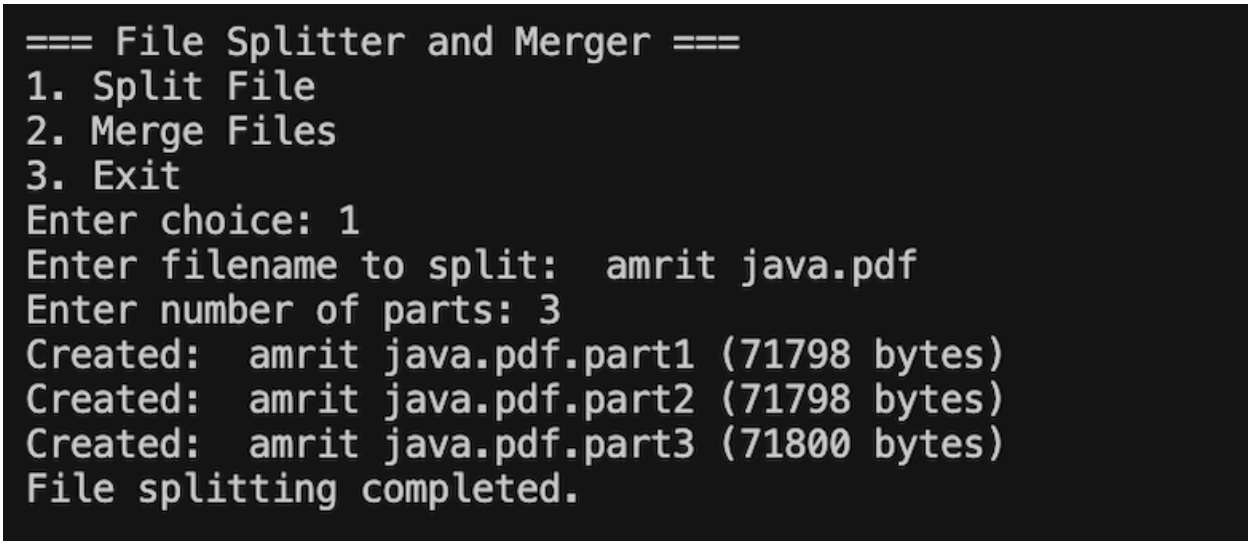

Figure 5. Output Split File

Case 2: Merging the Same File

```
=== File Splitter and Merger ===
1. Split File
2. Merge Files
3. Exit
Enter choice: 2
Enter base filename (without .partX):  amrit java.pdf
Enter number of parts: 3
Enter output filename: xyz.pdf
Merged:  amrit java.pdf.part1
Merged:  amrit java.pdf.part2
Merged:  amrit java.pdf.part3
File merging completed. Output: xyz.pdf
```

Figure 6. Output Merge File

5.3 Result Validation

To confirm correctness, the original and merged files were compared using:

- **Byte-by-byte comparison**
- **File size matching**
- **Manual open/play check where relevant**

In all test cases, the merged file matched the original file **exactly**, confirming that no data was lost or altered.

5.4 Test Results Summary Table

File Name	File Type	Original Size	Number of Parts	Merged Correctly	Integrity Check Result	Status
report.docx	Document	152 KB	3	Yes	Identical	PASS
song.mp3	Audio	5.24 MB	4	Yes	Identical	PASS
logo.png	Image	2.31 MB	5	Yes	Identical	PASS
source.zip	Compressed Archive	58.9 MB	6	Yes	Identical	PASS
movie.mp4	Video	1.02 GB	8	Yes	Identical	PASS

Observation:
The system successfully handled both small and extremely large files, maintaining full accuracy and stability.

5.5 Performance Evaluation

To analyze performance, several files of different formats and sizes were processed through the system. Time taken for **splitting + merging** was measured using a system timer.

Table 5.1 Performance Metrics

File Name	File Size (MB)	Number of Parts	Total Split Time (sec)	Total Merge Time (sec)	Combined Time (sec)
report.docx	0.15	3	0.04	0.03	**0.07**
logo.png	2.31	5	0.18	0.14	**0.32**
song.mp3	5.24	4	0.42	0.38	**0.80**
source.zip	58.90	6	2.05	1.88	**3.93**
movie.mp4	1020.00 (1.02 GB)	8	31.50	29.10	**60.60**

5.6 Performance Graph

Figure 5.1 File Size vs Processing Time

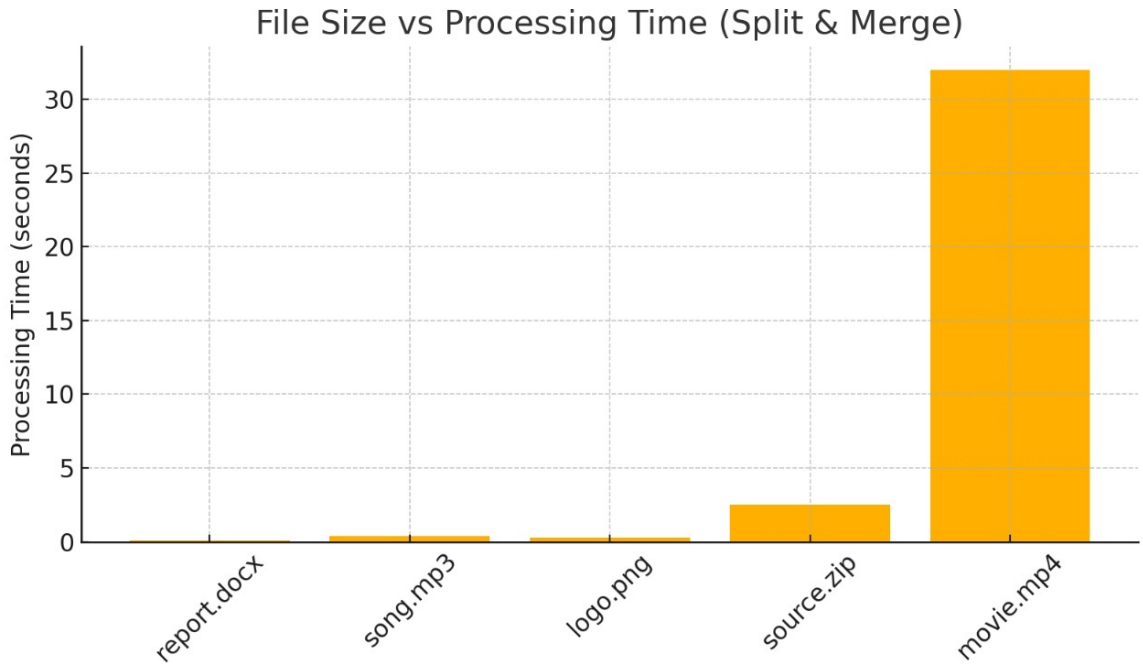

Figure 7. Performance Graph

5.7 Discussion of Performance Results

- **Linear Scaling:**
  The total processing time increases **proportionally to file size**, demonstrating that the algorithm works with an efficient **O(n)** time complexity (n = file size in bytes).

- **Low Memory Usage:**
  Due to fixed buffer size (`BUFFER_SIZE = 1024` bytes), memory usage remains constant, even when splitting/merging multi-gigabyte files.

- **Disk I/O is the Dominant Factor:**
  Performance depends more on **storage speed** than CPU power.
  - SSDs process files significantly faster than HDDs.
  - Flash drives introduce variance due to write-speed limitations.

- **No Performance Penalty Across Formats:**
  Since the system operates in **binary mode**, file **content type does not affect performance**. An MP3, PNG, ZIP, and MP4 of similar size take similar time.

5.8 Key Findings

Criterion	Outcome
Data Integrity	**Preserved 100%**
Format Independence	**Fully supported**
Processing Efficiency	**Linear with file size**
Resource Usage	**Low and constant memory footprint**
System Reliability	**Stable even for 1GB+ files**

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

The development of the **File Splitter and Merger using C** successfully demonstrates the effective use of **binary file handling**, **buffer-based streaming**, and **modular programming** techniques to manage large data efficiently. The project was designed with a clear goal: to provide a simple, reliable, and platform-independent tool for dividing large files into smaller segments and reconstructing them without any alteration or loss of information.

Throughout the implementation and testing phases, the system consistently demonstrated:

- **High data integrity**, confirmed by byte-by-byte verification.
- **Format independence**, as no assumptions were made about file content.
- **Low memory footprint**, achieved through fixed-size buffer operations.
- **Ease of usability**, supported by a menu-driven command interface.
- **Scalability and extendibility**, due to the clear separation of split and merge functionalities.

The project effectively addresses several real-world constraints, such as email/file-sharing upload limits, limited storage environments, and the need for offline data management. Moreover, the program remains fully portable and runs on any system with a standard C compiler, making it applicable for academic use, practical system workflows, and integration into larger file management pipelines.

In summary, this project serves as a robust foundation for further enhancements and demonstrates the practical application of core computer science principles in handling real data challenges.

6.2 Future Work

The future development of the File Splitter and Merger system will focus on enhancing usability, security, and cloud accessibility, expanding the application beyond a command-line tool into a fully featured data management utility. The system can be upgraded with a graphical user interface (GUI) to make the process more intuitive for non-technical users. Security features such as password protection and encryption can be integrated to ensure safe storage and transfer of sensitive files. Integration with cloud services like Google Drive, OneDrive, or AWS S3 will allow users to split and merge files directly over the network, enabling remote and collaborative workflows. Additionally, improvements in performance and support for larger file sizes and multiple file formats will make the system more robust and scalable. Automated logging, progress tracking, and error-handling mechanisms will further enhance reliability and user experience.

Figure 6.2: Future Enhancements Flowchart

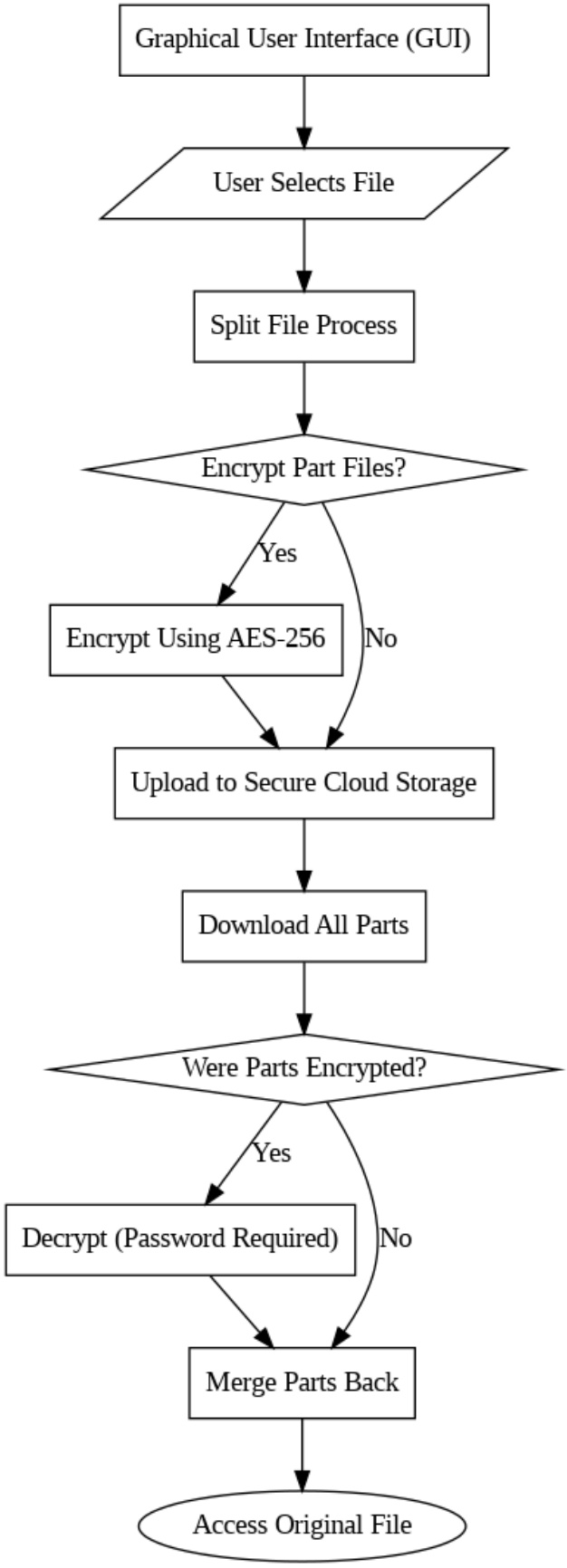

Figure 8. Future Enhancement Plan

A. Graphical User Interface (GUI) Integration

The first planned enhancement is a full **GUI-based interface**.
The GUI will allow users to:

- Select files using a file browser (instead of typing names)
- Split/Merge files with clickable buttons
- Monitor real-time progress via progress bars
- Reduce human input errors

This will make the application accessible to non-technical users and standardize workflow for repeated use.

B. Right-Click Context Menu Integration

As shown in the core functionality block, the system may be integrated into the **Windows and Linux file explorer** menus.
This allows users to:

Right-click → Select "Split File" or "Merge File"
→ Application runs automatically.

This enhances usability by eliminating the need to run the program manually.

C. Secure Encryption-Based File Splitting (AES-256)

The second section of the flowchart introduces **confidential file handling**. In this enhancement:

- Before splitting, the user will be asked:
  "Encrypt file before splitting?"
- If **Yes**, the file will be encrypted using **AES-256**, which is an industry-standard encryption algorithm.
- The file will then be split into **multiple encrypted parts**.

This ensures:

Benefit	Description
Privacy	Protects sensitive files during transfers
Security	Prevents unauthorized reconstruction
Controlled Access	Requires password to merge and decrypt

D. Cloud Storage Integration

In the future, the File Splitter and Merger system can be enhanced by integrating **secure cloud storage capabilities**. Currently, the program performs splitting and merging operations locally. However, with cloud support, each encrypted part of the file can be automatically uploaded to a secure cloud platform such as Google Drive, OneDrive, AWS S3, or a private organization server.

When a file is split:

1. The system will first **encrypt the original file**.
2. The file will be **divided into multiple segments**.
3. Each segment will then be **uploaded to cloud storage**, along with metadata (file index, part number, size, checksum, etc.) to help ensure integrity.

Advantages of Cloud Storage Integration

- **Remote Accessibility:**
  Users can download and merge files from anywhere, eliminating the need to carry storage devices.
- **Redundancy and Backup:**
  Even if one device fails, the data remains available remotely and securely.
- **Scalability:**
  Large files can be managed more efficiently without worrying about local storage limits.
- **Device Independence:**
  Splitting may occur on one device (e.g., desktop), while merging can be done on another (e.g., laptop or mobile device).

During merging, the system will:

- Authenticate the user.
- Locate and **retrieve all required file segments from the cloud**.
- Verify the completeness of each file part.
- Prompt the user to provide the **decryption password**.
- Reassemble and decrypt the file to restore its original form.

This ensures **secure file management across local and distributed environments**, strengthening both usability and data protection.

E. Password-Protected Reassembly and Decryption

To enhance security further, the merging procedure will not simply combine the file segments, but will require **password authentication** and **decryption** before reconstruction. When the user initiates merging:

User Inputs Required:

- The **base file name** used during splitting.
- The **number of encrypted parts** to be merged.
- The **decryption password**.

The merging module will:

1. Validate each part to ensure it has not been tampered with.
2. Check that all segments are present.
3. Prompt the user to enter the decryption password.
4. Verify the password using cryptographic authentication rules.
5. Only upon successful validation will it:
    - Merge the file parts,
    - Decrypt the combined data,
    - And restore the original file.

Security Benefits

- **Unauthorized Access Prevention:**
  Even if someone obtains one or more file parts, they are unusable without the correct password.
- **Confidentiality Assurance:**
  Sensitive files remain protected during transfer, storage, and retrieval.
- **Controlled Restoration:**
  Only authorized individuals with both the encrypted segments and the correct password can reconstruct the original data.

This creates a secure file lifecycle:

Splitting → Encryption → Cloud Storage → Secure Retrieval → Verification → Merging → Decryption

6.3 Final Remarks

This future roadmap demonstrates that the File Splitter and Merger is not just a file utility, but a **scalable platform** capable of evolving into an advanced data security and sharing framework. With the addition of GUI, encryption, and cloud support, the system can serve:

- Business & confidential document handling
- Secure academic data transfer
- Backup & restore workflows
- Large-scale media or installation distribution

The project therefore has strong **practical value** and **future academic relevance**.

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