PROJECT REPORT

CL1002 Programming Fundamentals

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Abstract

The car rental management system is a console-based program developed in C language to store, process and display records of cars and customers which are renting cars. It allows the user to enter Brand, Model, and rent per day of car and the customer details. The system computes the rent for customers who book cars for finite number of days and displays the invoice in a formatted manner. This project applies fundamental programming concepts such as decision structures (if ... else, switch ... case...), loops (Counter and semantic loops), arrays to store records while the program is running, use of functions to promote modular programming and files to store the records after the program is terminated. It demonstrated how simple data handling can replace manual calculations and reduce errors in managing the rental records.

1. Introduction

Managing rental records manually is time-consuming and error prone. Companies often need a simple digital solution to calculate results quickly and accurately without duplication of data. This project provides a basic computerized system where users can enter details for multiple cars and customers and instantly generate connections between them by customers renting cars. It also validates the data entered so there's no chance of duplicate rent of same car. It strengthens understanding of variables, conditionals, loops, file handling, arrays and modular programming techniques.

2. Objectives

- Add new cars into the system

- Display all cars

- Register customers

- Rent a car to a customer

- Return a car and calculate total rent

- Search for a car or customer using their ID

- Keep data stored in text files

- Show revenue collected from rentals

3. System Design

System Overview
Flow of the program:

- ✓ Start
- ✓ Load data from files
- ✓ Show menu
- ✓ Perform selected operation
- ✓ Update data
- ✓ Save and exit

Algorithm

1. Start the program

2. Load car, customer, and rental data from text files

3. Show the main menu

4. Based on user choice, perform the required task

5. Validate input (car availability, customer ID, etc.)

6. Update the data in memory

7. Write updated records back to files

8. Keep repeating the menu until the user selects Exit

Input & Output

1. Input:
   - Car details (ID, Brand, Company)
   - Customer information (Customer ID, Name, Address, Phone Number)
   - Number of days for rental
2. Output:
   - Car list
   - Customer List
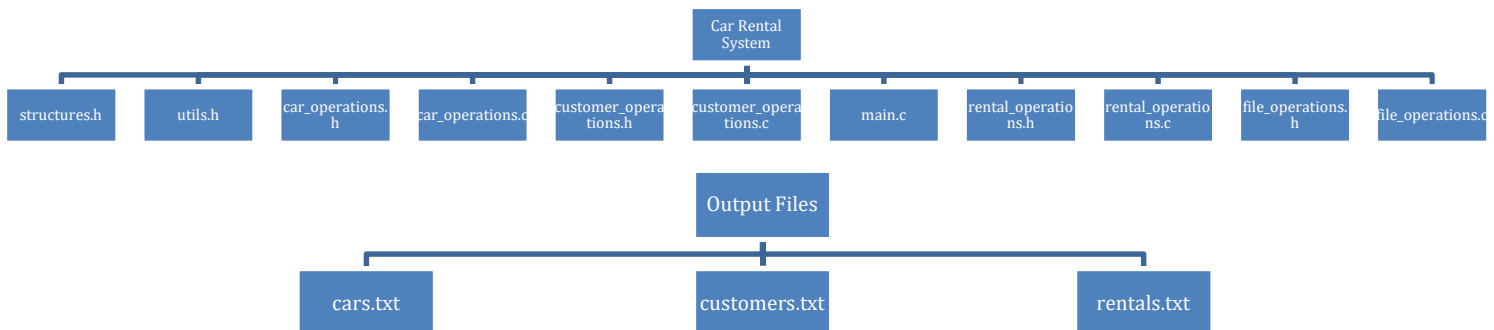   - Rent Calculations
   - Revenue report

4. Implementation

- Tools Used:
- Language Used: C
- Compiler Used: GCC
- IDE Used: VS-Code and Dev C++

Key Features

- Adding and displaying cars
- Customer Registration
- Unique customer ID system
- Multiple simultaneous rentals per customer
- Renting and Returning Cars
- Preventing double renting of Same Car
- Bill Calculation
- Revenue Tracking
- Today's actual earnings (from returned cars)
- Expected earnings (from active rentals)
- Saving all Data to files
- Sorted car list by ID before saving
- Modular structure using .c and .h files.
- Simple recursive functions for searching
- Three separate data files for organization

Project Breakdown:

```
                              Car Rental
                                System
  ┌──────┬──────┬────────┬────────┬────────┬──────┬────────┬────────┬────────┬────────┐
structures.h  utils.h  car_operations.  car_operations.c  customer_opera  customer_opera  main.c  rental_operatio  rental_operatio  file_operations.  file_operations.c
                           h                              tions.h          tions.c              ns.h            ns.c            h

                                      Output Files
                        ┌──────────────┬──────────────┐
                     cars.txt      customers.txt    rentals.txt
```

The Core Programming concepts used:

1. **Structures:** Car, Customer, Rental data structures
2. **Arrays:** Static global arrays for data storage
3. **File Handling:** Save/load data persistence
4. **Recursion:** Search, sort, and calculation functions
5. **Functions:** Modular programming approach
6. **Loops:** while, do-while, for loops
7. **Conditional Statements:** if-else, switch-case

8. Preprocessor Directives: #define, #include

The main menu:
1. Add New Car

2. Display All Cars

3. Register New Customer

4. Rent a Car

5. Return a Car

6. Search Car by ID

7. Display All Customers

8. Revenue Report

9. Exit

Enter Number:

Code Snippet:

1. For Searching Car for checking availibility of car in the file:

```
2.  int searchCar(int car_id)
3.  {
4.      int i = 0;
5.      while(i < car_count)
6.      {
7.          if(cars[i].id == car_id)
8.              return i;
9.          i++;
10.     }
11.     return -1;
12. }
```

13. Finding the customer id through indirect recursion:
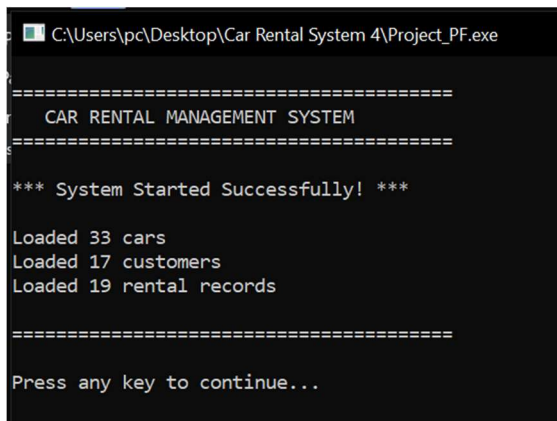
```
int findCustomer(int cid, int index)
{
    if(index >= customer_count)
        return -1;
    if(customers[index].id == cid)
        return index;
    return findCustomer(cid, index + 1);
}
int findCustomerById(int customer_id) {
    return findCustomer(customer_id, 0);
}
```

3. The commonly used features to clear buffer and pause screen for whole program:

```c
static inline void clearBuffer()
{
    int c;
    while ((c = getchar()) != '\n' && c != EOF);
}
static inline void pauseScreen()
{
    printf("\nPress any key to continue...");
    getch();
}
```
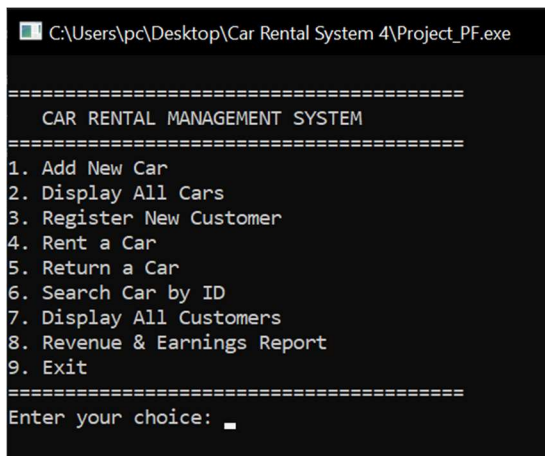
Sample Output

1. Program Starts

2. Main Menu

3. Case 2: Display Cars

```
ID    Brand           Model          Rent/Day       Status
-----------------------------------------------------------------
1     Toyota          Corolla        Rs. 8000.00    Available
2     Honda           Civic          Rs. 9500.00    Available
3     Suzuki          Alto           Rs. 5000.00    Available
4     Toyota          Fortuner       Rs. 15000.00   Available
5     Honda           City           Rs. 7500.00    RENTED
6     Suzuki          Cultus         Rs. 4500.00    Available
7     Toyota          Yaris          Rs. 7000.00    Available
8     Honda           BR-V           Rs. 12000.00   Available
9     Suzuki          Swift          Rs. 6000.00    Available
10    Toyota          Hilux          Rs. 18000.00   RENTED
11    Honda           Accord         Rs. 11000.00   Available
12    Suzuki          Wagon-R        Rs. 5500.00    Available
13    Hyundai         Tucson         Rs. 13000.00   Available
14    KIA             Sportage       Rs. 14000.00   RENTED
15    Changan         Alsvin         Rs. 6500.00    Available
16    MG              HS             Rs. 16000.00   Available
17    Toyota          Prado          Rs. 25000.00   Available
18    Honda           Vezel          Rs. 10000.00   Available
19    Suzuki          Bolan          Rs. 3500.00    Available
20    Hyundai         Elantra        Rs. 9000.00    Available
21    KIA             Picanto        Rs. 5500.00    Available
22    Toyota          Camry          Rs. 12500.00   Available
23    Honda           Civic-RS       Rs. 11500.00   Available
24    Changan         Karvaan        Rs. 4000.00    Available
25    MG              ZS             Rs. 13500.00   Available
26    Suzuki          Mehran         Rs. 3000.00    Available
27    Toyota          Land-Cruiser   Rs. 30000.00   Available
28    KIA             Sorento        Rs. 17000.00   Available
29    Hyundai         Sonata         Rs. 10500.00   Available
30    Changan         Oshan          Rs. 14500.00   Available
31    Tesla           A5             Rs. 6000.00    Available
123   toyota          corolla        Rs. 23.00      Available
124   toyotA          JOE            Rs. 1234.00    Available
-----------------------------------------------------------------

Press any key to continue...
```

4. Case 7: Customer View

```
=======================================
       ALL CUSTOMERS (SUMMARY)
=======================================

Total Customers: 17

ID      Name            Phone           Rentals  Status
----------------------------------------------------------------
101     Ahmed Hassan    03001234567     3        Active (2)
102     Fatima Ali      03112345678     2        Active (1)
103     Hassan Ahmed    03223456789     2        Regular
104     Ayesha Malik    03334567890     1        Regular
105     Bilal Hussain   03445678901     1        Regular
106     Zainab Tariq    03556789012     2        Regular
107     Usman Raza      03667890123     1        Regular
108     Sana Iqbal      03778901234     0        New
109     Kamran Shah     03889012345     1        Regular
110     Maryam Noor     03990123456     0        New
111     Asad Hameed     03001122334     1        Regular
112     Hira Saeed      03112233445     0        New
113     Faisal Jamil    03223344556     2        Regular
114     Rabia Yousuf    03334455667     1        Regular
115     Imran Siddiq    03445566778     0        New
20      Sarim           03361251259     1        Regular
123456  nigger          098765432       1        Regular
----------------------------------------------------------------

Options:
  Enter Customer ID to view details
  Enter 0 to go back

Your choice:
```

5.   101: Detailed View Customer

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

========================================
       CUSTOMER DETAILED VIEW
========================================

--- CUSTOMER INFORMATION ---
ID      : 101
Name    : Ahmed Hassan
Phone   : 03001234567
Address : Block A Gulshan Karachi

--- RENTAL STATISTICS ---
Total Rentals     : 3
Completed         : 1
Active/Ongoing    : 2
Total Spent       : Rs. 105000.00
Pending Payment   : Rs. 132000.00

--- ACTIVE RENTALS ---
Rental ID  Car                   Days      Amount
----------------------------------------------------
2          Toyota Hilux          5         Rs. 90000.00
3          KIA Sportage          3         Rs. 42000.00
----------------------------------------------------

--- RENTAL HISTORY (Last 1) ---
Rental ID  Car                   Days      Paid
----------------------------------------------------
1          Toyota Fortuner       7         Rs. 105000.00
----------------------------------------------------

========================================

Press any key to continue...
```

6.   Search Car

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

========================================
            SEARCH CAR
========================================

Enter Car ID to search: 1

========================================
            CAR DETAILS
========================================
Car ID          : 1
Brand           : Toyota
Model           : Corolla
Rent per Day    : Rs. 8000.00
Status          : AVAILABLE
========================================

Press any key to continue...
```

7. Rent a Car

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

====================================
         RENT A CAR
====================================

Enter Customer ID: 101

--- Customer Details ---
Name     : Ahmed Hassan
Phone    : 03001234567
Address : Block A Gulshan Karachi
Previous Rentals: 3
-----------------------

Enter Car ID to rent: 20

--- Selected Car Details ---
Brand: Hyundai
Model: Elantra
Rent per Day: Rs. 9000.00
---------------------------

Enter Number of Days: 5

====================================
  Car Rented Successfully!
====================================
Rental ID: 20
Customer: Ahmed Hassan (ID: 101)
Car: Hyundai Elantra (ID: 20)
Days: 5
Estimated Cost: Rs. 45000.00
====================================

This customer can rent more cars using same ID: 101

Press any key to continue..._
```

8. Return a Car

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

==========================================
            RETURN A CAR
==========================================

Enter Car ID to return: 20


==========================================
           RENTAL BILL INVOICE
==========================================
Rental ID        : 20
------------------------------------------
Customer ID      : 101
Customer Name    : Ahmed Hassan
Phone Number     : 03001234567
Address          : Block A Gulshan Karachi
------------------------------------------
Car ID           : 20
Car              : Hyundai Elantra
------------------------------------------
Days Rented      : 5 days
Rent per Day     : Rs. 9000.00
------------------------------------------
TOTAL AMOUNT     : Rs. 45000.00
==========================================

*** Car returned successfully! ***
*** Payment of Rs. 45000.00 received! ***

Press any key to continue...
```

9. Revenue Report

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

==================================
       REVENUE & EARNINGS REPORT
==================================

--- TODAY'S EARNINGS ---
Total Returns Today    : 17
Cash Received Today    : Rs. 828282.00

--- ESTIMATED EARNINGS ---
Active Rentals         : 3
Expected Revenue       : Rs. 162000.00

--- TOTAL SUMMARY ---
Total Revenue (Today)  : Rs. 828282.00
Pending Revenue        : Rs. 162000.00
Combined Total         : Rs. 990282.00
==================================

--- RETURNED CARS TODAY ---
Rent.ID  Customer           Car              Amount
--------------------------------------------------
1        Ahmed Hassan       Toyota Fortuner  Rs. 105000.00
4        Fatima Ali         Toyota Corolla   Rs. 48000.00
6        Hassan Ahmed       Honda Civic      Rs. 47500.00
7        Hassan Ahmed       Honda BR-V       Rs. 24000.00
8        Ayesha Malik       Changan Alsvin   Rs. 52000.00
9        Bilal Hussain      Toyota Camry     Rs. 37500.00
10       Zainab Tariq       Suzuki Alto      Rs. 35000.00
11       Zainab Tariq       Honda Vezel      Rs. 40000.00
12       Usman Raza         Toyota Yaris     Rs. 70000.00
13       Kamran Shah        Hyundai Elantra  Rs. 36000.00
14       Asad Hameed        Suzuki Wagon-R   Rs. 22000.00
15       Faisal Jamil       Suzuki Swift     Rs. 18000.00
16       Faisal Jamil       Honda Civic-RS   Rs. 57500.00
17       Rabia Yousuf       Suzuki Cultus    Rs. 9000.00
18       Sarim              Tesla A5         Rs. 30000.00
19       nigger             toyotA JOE       Rs. 151782.00
20       Ahmed Hassan       Hyundai Elantra  Rs. 45000.00
--------------------------------------------------
```
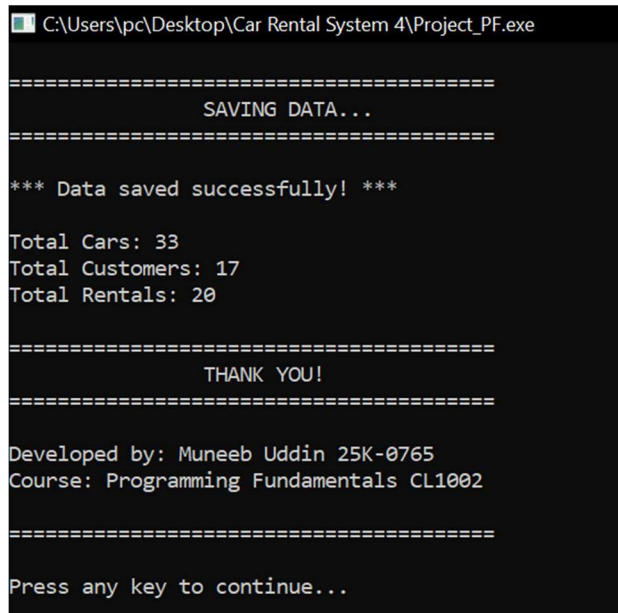
10. Program Exit

```
C:\Users\pc\Desktop\Car Rental System 4\Project_PF.exe

======================================
              SAVING DATA...
======================================

*** Data saved successfully! ***

Total Cars: 33
Total Customers: 17
Total Rentals: 20


======================================
               THANK YOU!
======================================

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Course: Programming Fundamentals CL1002


======================================

Press any key to continue...
```

5. Testing & Results

Test	What I Did	What Should Happen	What Actually Happened	Result
1	Added car with ID 5	Car gets added	Car got added	Pass
2	Tried adding ID 5 again	Error message	Showed error	Pass
3	Rented an available car	Rental works	Rental worked	Pass
4	Tried renting same car	Error message	Showed error	Pass
5	Returned a car	Bill shows up	Bill displayed correctly	Pass
6	Registered new customer	Customer saved	Customer got saved	Pass
7	Same customer rents 3 cars	All tracked separately	All 3 tracked	Pass
8	Checked revenue report	Correct totals	Numbers were right	Pass
9	Closed and opened program	Data still there	Data loaded fine	Pass
10	Searched for fake car ID	Not found message	Showed not found	Pass

The program performed successfully for all test cases. It handled both high and low marks efficiently, produced accurate totals and grades, and validated all inputs. Execution speed was near-instant, and the program required minimal system resources.

Problems I Faced During Programming

Problem 1: Input Buffer Issue

After using scanf, when I used another scanf right after, it would skip asking for input. This was super annoying.

How I fixed it: Made a function called clearBuffer() that removes leftover characters after scanf.

Problem 2: Double Renting

Initially, I could rent the same car to two people. This was a big bug.

How I fixed it: Added a check - before renting, system looks at is_rented status. If it's 1, show error.

Problem 3: Spaces in Names

When I saved names with spaces to file, loading them back was messed up. Like "Ahmed Hassan" would only load "Ahmed".

How I fixed it: Replace spaces with underscores when saving (Ahmed_Hassan), then replace back to spaces when loading.

Problem 4: Finding Customers

At first, tracking which customer rented which car was confusing.

How I fixed it: Made a third file called rentals.txt that connects customers to cars using their IDs.

6. Conclusion, Limitations & References

Conclusion

What I Achieved:

The system does what it's supposed to do - manage car rentals without manual work. It's not perfect but it works reliably. I'm pretty happy with how it turned out considering this is my first real project.

What I Learned:

Honestly, I learned a lot:

1. How to split a big problem into small pieces

2. Why saving data in files is important

3. How to debug when things go wrong (spent hours on this)

4. Why checking user input matters

5. How real programs are structured with multiple files

6. The file handling part was the hardest. I had to redo it like 3 times before it worked properly.

Limitations:

- Only handles 50 cars and 50 customers (I used fixed arrays)

- No proper interface, just text on black screen

- Doesn't track dates, so you can't tell when car was rented

- No late fees if someone returns car late

- Can't search by car brand or model, only ID

- No password, anyone can use it

Future Enhancements
- Dynamic memory allocation (after First Semester)
- Date/time tracking
- Late fee calculation
- Customer loyalty points
- Advanced search filters (After 3rd Semester)
- Database integration (After 5th semester)

References

- Let Us C by Yashavant P. Kanetkar
- https://www.programiz.com/c-programming
- https://www.geeksforgeeks.org/c-programming-language/
- https://stackoverflow.com
- Youtube Channel: Apna College
- Teacher's Support.
- My Classmates such as Sarim, Zohair, Usman etc helps me a lot too.