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Hospital Emergency Management System

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Abstract

Hospital emergency departments operate in time-critical environments where efficient patient prioritization and accurate record management are essential. Manual systems are often slow, error-prone, and unable to handle high patient volumes effectively.

This project presents a **Hospital Emergency Management System** developed in **C++** with a graphical user interface using **Dear ImGui**. The system enables hospital staff to register patients, assign medical priority levels, manage emergency queues, search patient records, and store data persistently using CSV files.

A backend module handles patient data storage, priority-based queue management, and searching functionality, while the GUI provides an intuitive interface for interaction. The system demonstrates the practical application of data structures, file handling, and GUI programming to solve real-world healthcare problems.

1 Introduction

Emergency departments require rapid decision-making and organized data handling to ensure that critical patients receive immediate care. Traditional paper-based or semi-digital systems often fail to provide efficient prioritization and fast data retrieval.

1.1 Problem Statement

Manual emergency room systems do not guarantee optimal patient prioritization, fast searching, or reliable data persistence, leading to increased waiting times and operational inefficiencies.

1.2 Objectives

- Develop an automated emergency patient management system
- Prioritize patients based on medical urgency
- Provide fast patient search functionality
- Store patient records persistently using files
- Design a user-friendly graphical interface

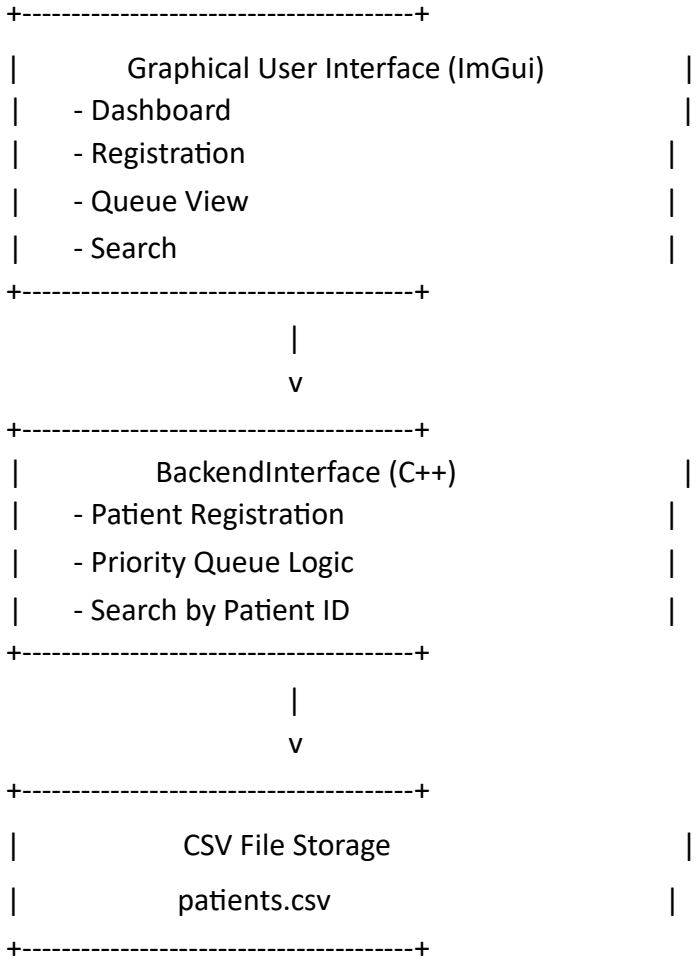
2 System Design

2.1 Overall Architecture

The system follows a modular layered architecture to ensure separation of concerns and maintainability.

- **Presentation Layer**: Dear ImGui GUI
- **Application Layer**: BackendInterface
- **Data Storage Layer**: CSV File Storage

2.2 System Architecture Diagram



2.3 Data Structure Choices and Justification

- **Vector-based Queue**: Used to maintain patient order and priority grouping.
- **Structs**: Used to represent patient records efficiently.
- **Linear Search**: Used for patient lookup due to moderate data size.

3 Code Architecture

3.1 File Structure

PatientBackend.h / .cpp -> Backend logic and CSV handling GUIManager (main.cpp) -> GUI rendering and interaction patients.csv -> Persistent data storage

3.2 Module Interaction

- GUI collects input and sends it to BackendInterface
- BackendInterface stores patient data and saves to CSV
- GUI retrieves queue and search results from backend

4 Implementation Details

4.1 Patient Data Structure

```
struct Patient { int id; string name;
    int age; string symptoms; int
    priority; string priorityLabel;
    time_t registrationTime;
};
```

4.2 Patient Registration Logic

```
newPatient.id = backend.nextPatientID++; backend.addPatient(newPatient);
```

4.3 Search Implementation

```
Patient* BackendInterface::searchPatient(int id) { for (auto& p :
    patientQueue) { if (p.id == id) return &p;
    } return nullptr;
}
```

4.4 CSV File Handling

```
outfile << p.id << "," << p.name << "," << p.age << ","
        << "\"" << p.symptoms << "\"" << ","
                    << p.priority << "," << p.priorityLabel << "\n";
```

5 Data Flow Diagram

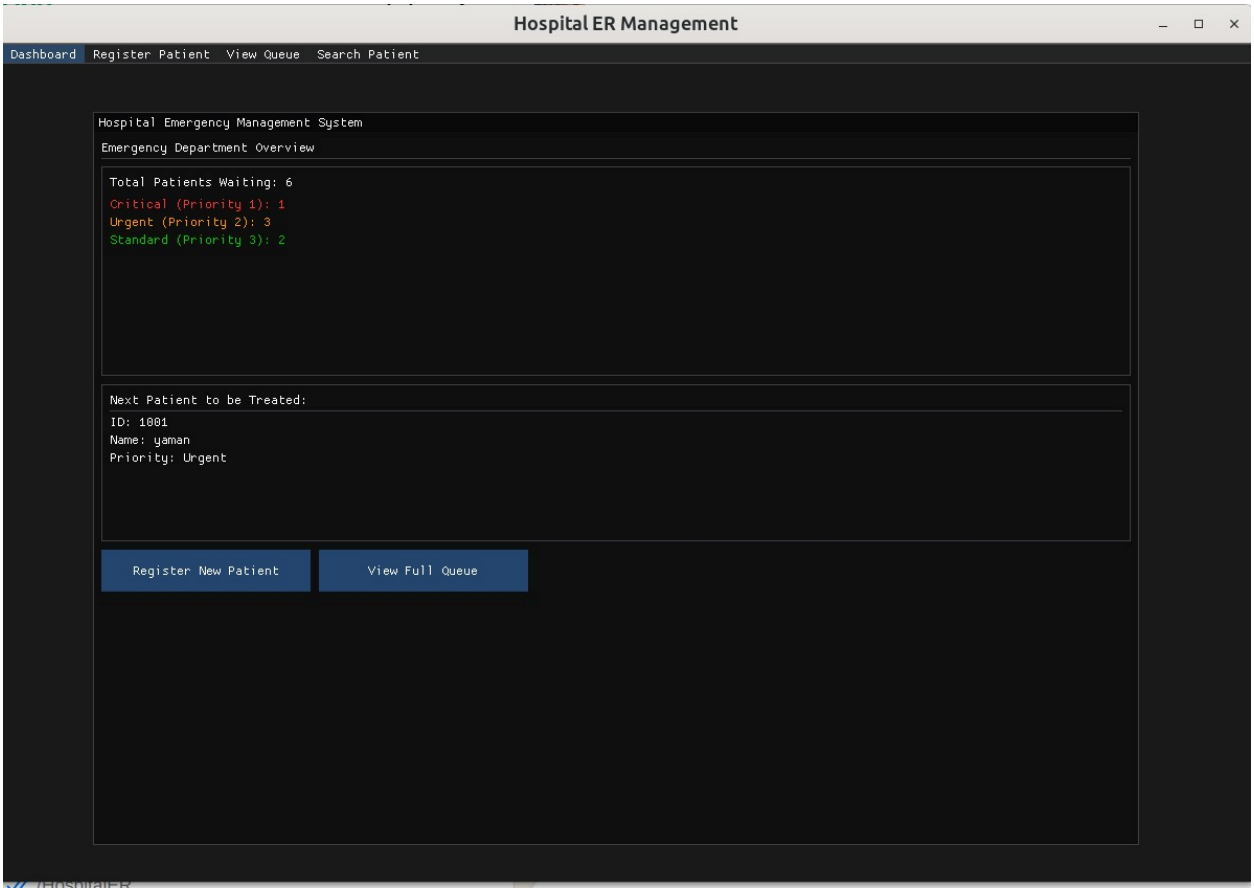
```
User Input (GUI) | v
Patient Registration
        |
        +--> BackendInterface
        |           |
        |             +--> Save to CSV
        |
        +--> Queue Display / Search
```

6 Testing and Validation

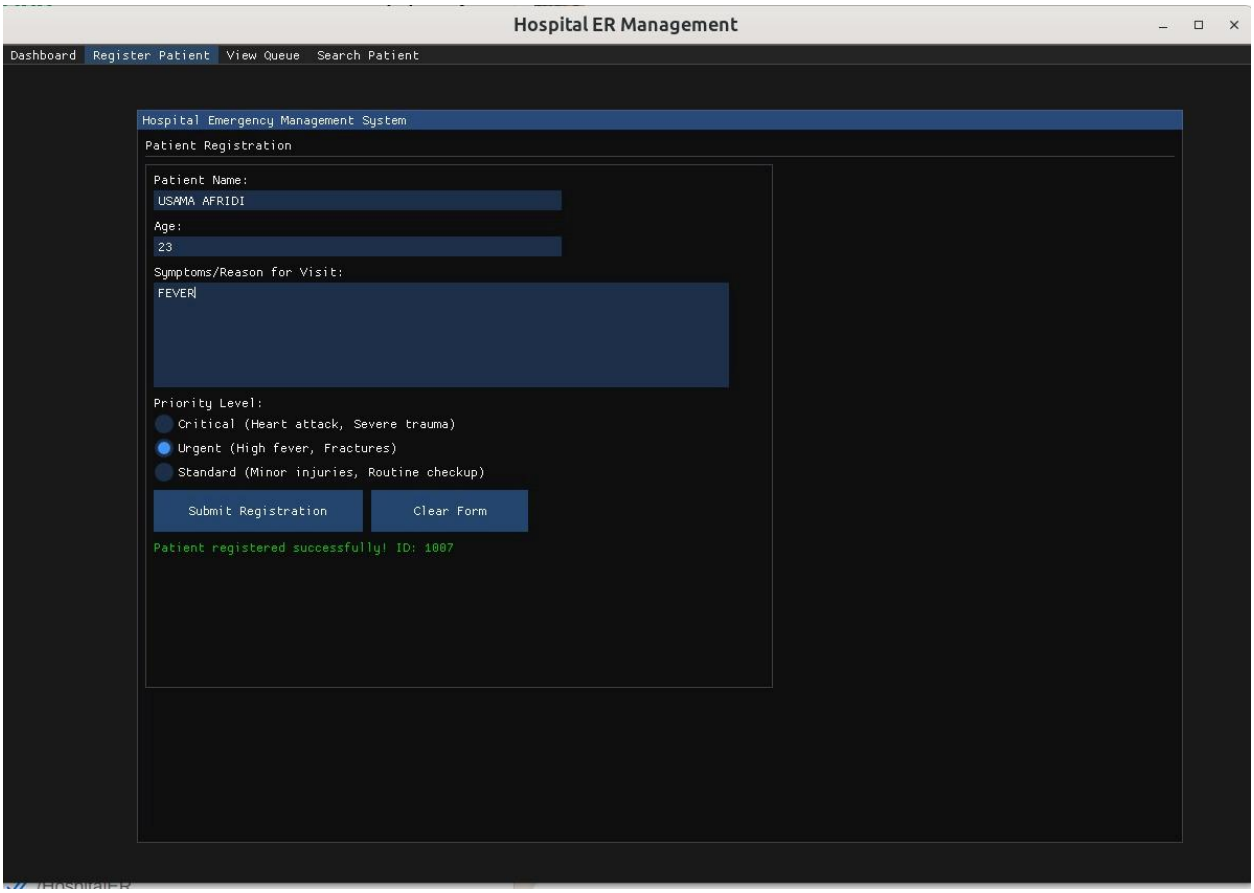
Test No.	Test Description	Result
1	Register patient with valid data	Pass
2	Register patient with empty name	Pass
3	Invalid age input	Pass
4	Priority selection validation	Pass
5	View patient queue	Pass
6	Search existing patient ID	Pass
7	Search non-existing patient	Pass
8	CSV file saving	Pass
9	Reload data from CSV	Pass
10	GUI navigation between screens	Pass

Screenshots:

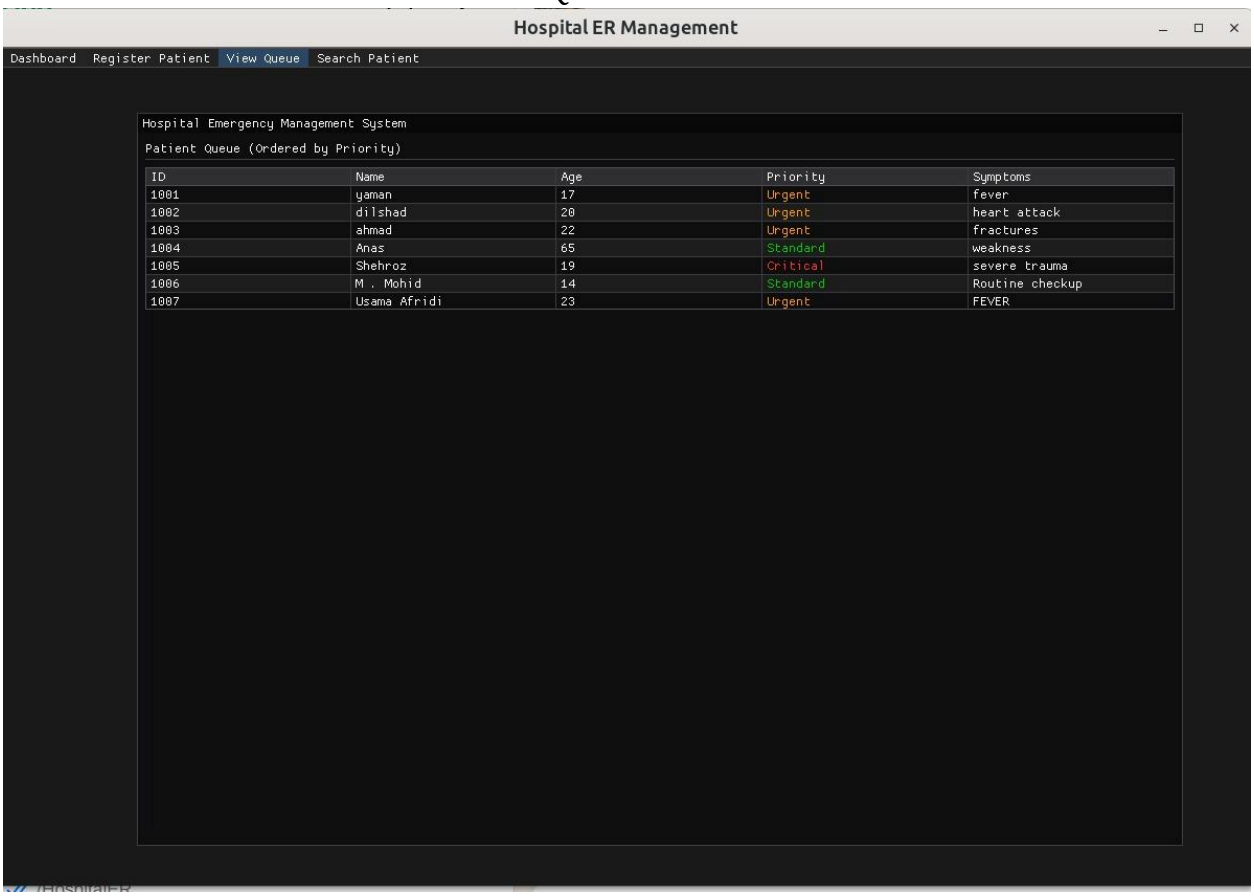
Dashboard Screen



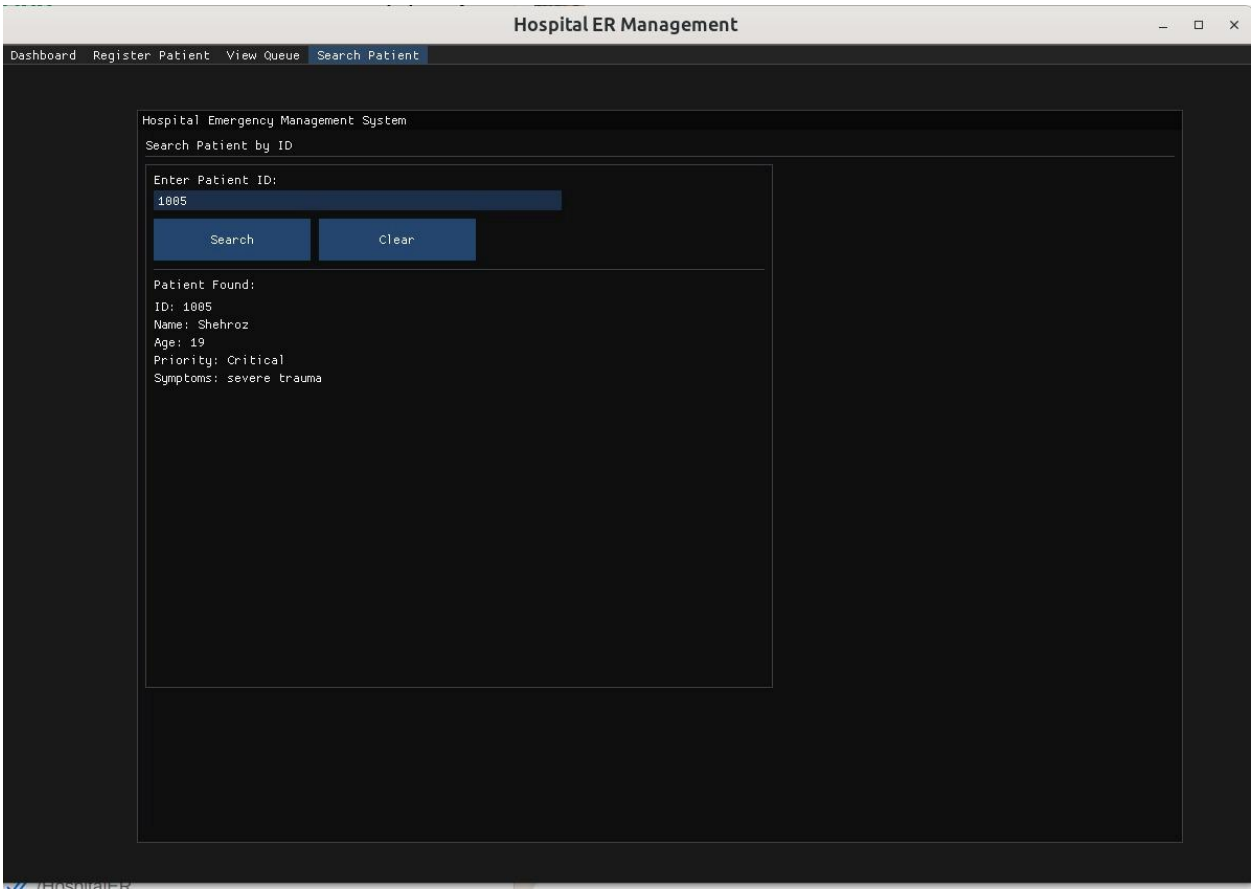
Patient insertion:



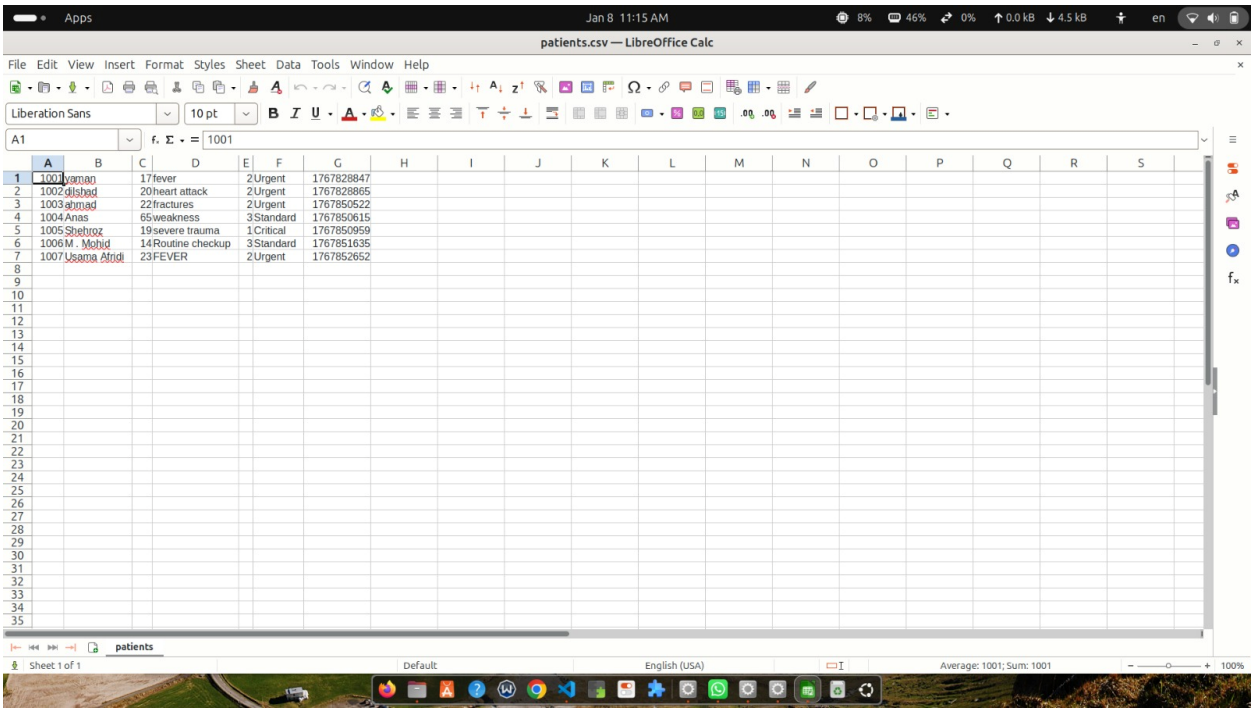
Patient Queue:



Patient search:



Csv file:


Apps
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1002 dilshad 20 heart attack 2 Urgent 1767828865
1003 ahmad 22 fractures 2 Urgent 1767850522
1004 Anas 65 weakness 3 Standard 1767850615
1005 Shehroz 19 severe trauma 1 Critical 1767850959
1006 M . Mohid 14 Routine checkup 3 Standard 1767851635
1007 Usama Afridi 23 FEVER 2 Urgent 1767852652
patients
Sheet 1 of 1
Default
English (USA)
Average: 1001; Sum: 1001
100%

7 Challenges Faced and Solutions

- GUI state management solved using screen enumeration
- CSV parsing issues fixed using string streams
- Input validation implemented to prevent crashes
- Data persistence ensured using file overwrite mode

8 AI Tools Used

- ChatGPT – Code debugging, architecture design, documentation
- Dear ImGui Documentation – GUI components
- C++ Reference – File handling and STL usage

9 Conclusion

The Hospital Emergency Management System successfully automates emergency room operations using a graphical interface and backend logic. The system improves patient prioritization, data organization, and operational efficiency. It demonstrates the practical application of programming concepts and serves as a foundation for future healthcare systems.

10 References

- https://en.cppreference.com
- https://github.com/ocornut/imgui
- https://www.geeksforgeeks.org
- ChatGPT – OpenAI