 **SIMATS SCHOOL OF ENGINEERING**

**SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES**

**CHENNAI-602105**

# **Building a Modular Hospital Management System with C++**

# **A CAPSTONE PROJECT REPORT**

*Submitted in the partial fulfilment for the award of the degree of*

**BACHELOR OF ENGINEERING**

**IN**

**COMPUTER SCIENCE**

**Submitted By**

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**DECLARATION**

# We, **C.Venkata Kamali**, **A.Mani Bhumika** students of **Bachelor of Engineering in computer science**, Department of Computer Science and Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, hereby declare that the work presented in this Capstone Project Work entitled **Building a Modular Hospital Management System with C++**is the outcome of our own Bonafide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics.

(C. Venkata Kamali 192211325)

(A. Mani Bhumika 192211494)

Date:

Place:

**CERTIFICATE**

# This is to certify that the project entitled “**Building a Modular Hospital Management System with C++**” submitted by C. Venkata Kamali, A. Mani Bhumika has been carried out under my supervision. The project has been submitted as per the requirements in the current semester of B. Tech Information Technology.

Teacher-in-charge

MR.YUVARAJ S

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**ABSTRACT:**

The Hospital Management System (HMS) developed in C++ is a robust and efficient software application designed to streamline and automate hospital administrative and operational tasks. The system encompasses functionalities such as patient record management, doctor scheduling, appointment booking, billing, and report generation. Leveraging object-oriented programming principles and efficient data handling techniques, the system ensures scalability, reliability, and ease of use. By minimizing manual errors and optimizing resource utilization, the HMS significantly enhances the overall efficiency of healthcare operations. This project not only addresses current challenges in hospital management but also lays the groundwork for future enhancements, such as integration with external healthcare systems, web and mobile interfaces, and predictive analytics powered by artificial intelligence. The HMS stands as a testament to how modern programming techniques can transform traditional hospital workflows into a more streamlined, accurate, and patient-centered process.

The project emphasizes efficiency, accuracy, and user accessibility while reducing the burden of manual processes. Developed with a focus on modular design, the system ensures adaptability for various hospital scales and use cases. Its future scope includes the addition of cloud-based storage, integration with laboratory systems, and AI-powered analytics for enhanced healthcare services. This HMS serves as a step forward in using technology to address the growing demands of modern healthcare management.

The system employs object-oriented design principles and file management techniques to ensure reliability, efficiency, and data security. With the increasing demand for digital transformation in healthcare, the HMS provides a streamlined workflow that reduces redundancy and enhances the overall quality of services. Future advancements, such as the incorporation of AI and mobile-friendly designs, can further elevate its usability and functionality. This project highlights the intersection of technology and healthcare in driving operational excellence.

**INTRODUCTION:**

The healthcare industry has witnessed significant growth in recent years, with an increasing demand for efficient and reliable management systems. Hospitals, being critical institutions, must handle extensive operations involving patient care, administrative tasks, and resource management. A Hospital Management System (HMS) developed in C++ is a software solution designed to address these needs by integrating various hospital operations into a single cohesive platform. The HMS enables the storage, retrieval, and management of patient records, doctor schedules, appointment bookings, billing, and other administrative processes with precision and efficiency.

C++ is an ideal choice for developing such systems due to its performance, object-oriented features, and extensive library support. This programming language allows developers to create modular, reusable, and maintainable code, which is essential for a complex system like HMS. The HMS incorporates essential modules such as patient registration, where patients' medical histories and personal details are stored securely, and doctor management, which includes scheduling, availability tracking, and specialization data. Appointment booking and billing are streamlined to reduce wait times and errors, thereby enhancing patient satisfaction and administrative efficiency.

The system employs object-oriented programming principles, ensuring modularity, scalability, and maintainability. By integrating these features, the hotel booking system in C++ delivers a comprehensive solution to enhance operational efficiency and customer satisfaction.

### **Key Features of Hospital Management System**

The Hospital Management System (HMS) is designed to optimize hospital operations and enhance the overall patient care experience. Below are the key features of the system:

1. **Patient Management:**
   * Efficient registration of patients with detailed medical and personal information.
2. **Doctor Management:**
   * Database of doctors with their specializations, schedules, and availability.
3. **Appointment Scheduling:**
   * Automated scheduling of appointments to avoid overlaps and ensure efficient time management.
4. **Billing and Payment Processing:**
   * Accurate calculation of patient bills, including consultation fees, treatments, tests, and medicines.

**OBJECTIVES:**

1. **Streamline Hospital Operations:**
   * Automate routine tasks like patient registration, appointment scheduling, and billing to improve operational efficiency.
2. **Enhance Patient Care:**
   * Provide a seamless experience for patients by reducing wait times and improving access to medical records and services.
3. **Improve Data Management:**
   * Enable secure storage, easy retrieval, and efficient management of patient records, doctor schedules, and hospital resources.
4. **Facilitate Communication:**
   * Enhance coordination among different departments, such as patient care, pharmacy, and billing, by integrating workflows.
5. **Optimize Resource Utilization:**
   * Ensure efficient use of hospital resources like beds, medical equipment, and staff availability.
6. **Ensure Security and Privacy:**
   * Protect sensitive patient and hospital data with encryption and role-based access control.
7. **Scalability and Adaptability:**
   * Design a modular system that can accommodate the growth of the hospital and adapt to future requirements.

**CASE DESCRIPTION:**

The Hospital Management System (HMS) in C++ is designed to address the operational challenges faced by a medium-sized hospital with multiple departments, including general medicine, surgery, pediatrics, and emergency services. The hospital struggles with managing patient data manually, scheduling doctors efficiently, and ensuring seamless coordination between departments. These inefficiencies often lead to delays, errors, and an overall decline in the quality of patient care. The proposed HMS provides an integrated software solution to automate and streamline these processes. It allows for efficient patient registration by securely storing personal details, medical histories, and insurance information, making it easily accessible for future reference. The system maintains detailed schedules for doctors, ensuring patients are allocated to the appropriate specialists based on their needs and the doctors’ availability.

**METHODS:**

* **Object-Oriented Programming (OOP):** Utilizes classes and objects to model patients, doctors, and appointments for modular design.
* **File Handling for Data Storage:** Stores patient records, schedules, and billing information in text or binary files.
* **Database Integration:** Implements databases like MySQL for efficient management of large-scale data.
* **Scheduling Algorithms:** Ensures conflict-free doctor appointments and resource allocation.
* **User Input Validation:** Verifies user-provided data to maintain accuracy and prevent errors.

**MODULES OF HOSPITAL MANAGEMENT SYSTEM :**

1. Patient Management

2. Staff Scheduling

3. Inventory Management

4. Billing System

5. Appointment Scheduling

6. Emergency Services Tracking

7. Report Generation

**CODE:**

#include <iostream>

#include <vector>

#include <string>

using namespace std;

// Structure to store patient details

struct Patient {

int id;

string name;

int age;

string disease;

string admissionDate;

};

// Structure to store staff details

struct Staff {

int id;

string name;

string role;

string schedule;

};

// Structure for inventory items

struct InventoryItem {

string name;

int quantity;

};

// Structure for appointments

struct Appointment {

int patientId;

string doctorName;

string date;

string time;

};

class HospitalManagementSystem {

private:

vector<Patient> patients;

vector<Staff> staffList;

vector<InventoryItem> inventory;

vector<Appointment> appointments;

double totalBilling;

public:

HospitalManagementSystem() : totalBilling(0.0) {}

// 1. Patient Management

void addPatient() {

Patient p; // Correctly declare p as a Patient object

cout << "Enter Patient ID: ";

cin >> p.id;

cin.ignore();

cout << "Enter Name: ";

getline(cin, p.name);

cout << "Enter Age: ";

cin >> p.age;

cin.ignore();

cout << "Enter Disease: ";

getline(cin, p.disease);

cout << "Enter Admission Date (dd/mm/yyyy): ";

cin >> p.admissionDate;

patients.push\_back(p);

cout << "Patient added successfully.\n";

}

void listPatients() {

cout << "\n--- Patient List ---\n";

for (const Patient& p : patients) { // Ensure p is a Patient object

cout << "ID: " << p.id << ", Name: " << p.name << ", Age: " << p.age

<< ", Disease: " << p.disease << ", Admission Date: " << p.admissionDate << "\n";

}

}

// 2. Staff Scheduling

void addStaff() {

Staff s; // Correctly declare s as a Staff object

cout << "Enter Staff ID: ";

cin >> s.id;

cin.ignore();

cout << "Enter Name: ";

getline(cin, s.name);

cout << "Enter Role: ";

getline(cin, s.role);

cout << "Enter Schedule (e.g., Morning/Evening): ";

getline(cin, s.schedule);

staffList.push\_back(s);

cout << "Staff added successfully.\n";

}

void listStaff() {

cout << "\n--- Staff List ---\n";

for (const Staff& s : staffList) { // Ensure s is a Staff object

cout << "ID: " << s.id << ", Name: " << s.name << ", Role: " << s.role

<< ", Schedule: " << s.schedule << "\n";

}

}

// 3. Inventory Management

void addInventoryItem() {

InventoryItem item; // Correctly declare item as an InventoryItem object

cout << "Enter Item Name: ";

cin >> item.name;

cout << "Enter Quantity: ";

cin >> item.quantity;

inventory.push\_back(item);

cout << "Inventory item added successfully.\n";

}

void listInventory() {

cout << "\n--- Inventory List ---\n";

for (const InventoryItem& item : inventory) {

cout << "Item: " << item.name << ", Quantity: " << item.quantity << "\n";

}

}

// 4. Billing System

void generateBill() {

int patientId;

double billAmount;

cout << "Enter Patient ID: ";

cin >> patientId;

cout << "Enter Bill Amount: ";

cin >> billAmount;

totalBilling += billAmount;

cout << "Bill generated successfully for Patient ID: " << patientId << "\n";

}

void showTotalBilling() {

cout << "Total Billing: $" << totalBilling << "\n";

}

// 5. Appointment Scheduling

void scheduleAppointment() {

Appointment appt; // Correctly declare appt as an Appointment object

cout << "Enter Patient ID: ";

cin >> appt.patientId;

cin.ignore();

cout << "Enter Doctor's Name: ";

getline(cin, appt.doctorName);

cout << "Enter Appointment Date (dd/mm/yyyy): ";

cin >> appt.date;

cout << "Enter Appointment Time (hh:mm): ";

cin >> appt.time;

appointments.push\_back(appt);

cout << "Appointment scheduled successfully.\n";

}

void listAppointments() {

cout << "\n--- Appointments ---\n";

for (const Appointment& appt : appointments) {

cout << "Patient ID: " << appt.patientId << ", Doctor: " << appt.doctorName

<< ", Date: " << appt.date << ", Time: " << appt.time << "\n";

}

}

// 6. Emergency Services Tracking

void emergencyService() {

cout << "\n--- Emergency Services ---\n";

cout << "Ambulance service available 24/7. Dial 911 for emergencies.\n";

}

// 7. Report Generation

void generateReport() {

cout << "\n--- Hospital Report ---\n";

cout << "Total Patients: " << patients.size() << "\n";

cout << "Total Staff: " << staffList.size() << "\n";

cout << "Total Inventory Items: " << inventory.size() << "\n";

cout << "Total Billing: $" << totalBilling << "\n";

}

};

int main () {

HospitalManagementSystem hms;

int choice;

do {

cout << "\n--- Hospital Management System ---\n";

cout << "1. Add Patient\n2. List Patients\n3. Add Staff\n4. List Staff\n";

cout << "5. Add Inventory Item\n6. List Inventory\n7. Generate Bill\n";

cout << "8. Show Total Billing\n9. Schedule Appointment\n10. List Appointments\n";

cout << "11. Emergency Services\n12. Generate Report\n13. Exit\n";

cout << "Enter your choice: ";

cin >> choice;

switch (choice) {

case 1: hms.addPatient(); break;

case 2: hms.listPatients(); break;

case 3: hms.addStaff(); break;

case 4: hms.listStaff(); break;

case 5: hms.addInventoryItem(); break;

case 6: hms.listInventory(); break;

case 7: hms.generateBill(); break;

case 8: hms.showTotalBilling(); break;

case 9: hms.scheduleAppointment(); break;

case 10: hms.listAppointments(); break;

case 11: hms.emergencyService(); break;

case 12: hms.generateReport(); break;

case 13: cout << "Exiting...\n"; break;

default: cout << "Invalid choice! Try again.\n";

}

} while (choice!= 13);

return 0;

}

**EXPLANATION :**

1. **Data Structures**:
   * **Patient Structure**: Stores patient details (id, name, age, disease, admissionDate).
   * **Staff Structure**: Stores staff details (id, name, role, schedule).
   * **InventoryItem Structure**: Stores inventory item details (name, quantity).
   * **Appointment Structure**: Stores appointment details (patientId, doctorName, date, time).
2. **Hospital Management System Class**:
   * Manages hospital operations such as patient management, staff management, inventory management, billing, and appointment scheduling.
   * Contains private members:
     + patients: A vector to store patient details.
     + staffList: A vector for staff details.
     + inventory: A vector for managing inventory items.
     + appointments: A vector for scheduling appointments.
     + totalBilling: A double to keep track of total billing.
3. **Methods**:
   * **addPatient()**:
     + Collects patient details and adds them to the patients vector.
   * **listPatients()**:
     + Displays all registered patients.
   * **addStaff()**:
     + Collects staff details and adds them to the staffList vector.
   * **listStaff()**:
     + Displays all staff members.
   * **addInventoryItem()**:
     + Adds a new inventory item to the inventory vector.
   * **listInventory()**:
     + Displays all inventory items.
   * **generateBill()**:
     + Takes a patient ID and bill amount, updating the totalBilling.
   * **showTotalBilling()**:
     + Displays the cumulative billing amount.
   * **scheduleAppointment()**:
     + Collects appointment details and adds them to the appointments vector.
   * **listAppointments()**:
     + Displays all scheduled appointments.
   * **emergencyService()**:
     + Provides information about emergency services available 24/7.
   * **generateReport()**:
     + Generates a report showing the number of patients, staff, inventory items, and total billing.

**4.Main Functionality**.

* + Users can perform various actions such as adding patients, staff, inventory items, generating bills, scheduling appointments, and viewing reports.
  + Data structures are updated dynamically based on user input.

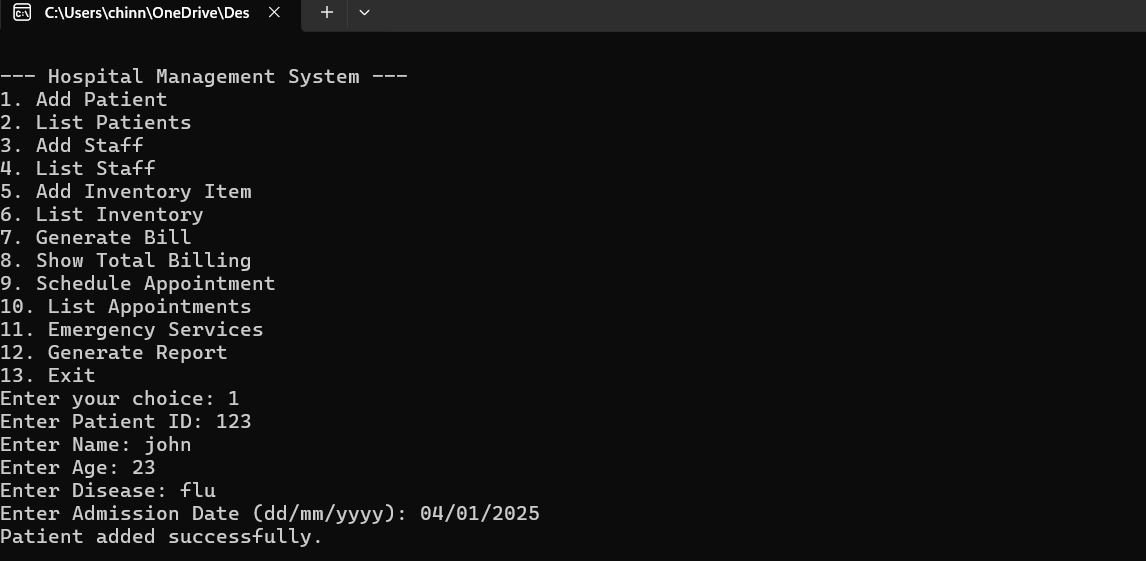
**5.Input Handling and Validation**:

* + Input is handled using cin.ignore() to clear the input buffer and getline() for reading strings with spaces.
  + Invalid choices are handled using a default case, prompting the user to try again.

**6.Design Considerations**:

* + The use of object-oriented programming principles ensures encapsulation of data.
  + Vectors provide a dynamic way to manage data efficiently.
  + The modular design allows for easy extension and future upgrades.

**RESULT:**



**DISCUSSION:**

A Hospital Management System (HMS) implemented in C++ provides a robust solution for managing various hospital operations efficiently. Using object-oriented design principles, the system organizes different components such as patients, staff, inventory, billing, and appointments into distinct classes and structures. This approach ensures modularity, scalability, and better code reusability. C++ offers efficient data management through the use of vectors and structures, allowing seamless storage and manipulation of large amounts of information.

One of the key features of the HMS is patient management, where each patient’s information, including personal details, medical history, and admission dates, is securely stored and easily accessible. Additionally, staff scheduling ensures that doctors, nurses, and other medical professionals are allocated appropriately, minimizing conflicts and optimizing resources. The inventory management system allows the hospital to keep track of medical supplies and equipment, ensuring that necessary resources are always available.

**FUTURE SCOPE:**

The future scope of a Hospital Management System (HMS) implemented in C++ is promising, as it focuses on enhancing healthcare delivery through the integration of advanced technologies and improved functionalities. One of the key areas for future development is the incorporation of Artificial Intelligence (AI). AI can revolutionize the system by offering predictive analytics, early diagnosis, and optimized treatment plans, which can significantly improve patient outcomes. Furthermore, AI-driven insights can assist in resource allocation, reducing inefficiencies in hospital operations.

Another area of growth is the adoption of cloud-based solutions. Cloud technology allows hospitals to access critical data from anywhere, ensuring seamless collaboration between various departments and enhancing data security. Additionally, cloud solutions provide scalability, making it easier for hospitals to handle increasing patient numbers and larger datasets.

The inclusion of mobile and web interfaces will offer greater flexibility and accessibility for patients and healthcare providers. Patients will be able to book appointments, view medical records, and communicate with healthcare professionals remotely, improving convenience and reducing physical hospital visits. This is especially beneficial for rural areas or regions with limited access to healthcare facilities.

**CONCLUSION:**

The Hospital Management System (HMS) implemented in C++ offers a robust and efficient solution for managing various aspects of hospital operations. From patient management and staff scheduling to inventory control and billing, the system ensures seamless coordination and improved healthcare delivery. By leveraging object-oriented programming principles and utilizing data structures like vectors and structures, the system provides a scalable and flexible framework that can adapt to the evolving needs of modern healthcare.

Future advancements such as Artificial Intelligence, cloud integration, mobile interfaces, and IoT can further enhance the capabilities of the HMS, making it more intelligent, accessible, and secure. As healthcare institutions continue to embrace digital transformation, the HMS serves as a critical tool for optimizing hospital operations and providing quality patient care.

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