

# SMART PARKING MANAGEMENT SYSTEM

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## DECLARATION

I hereby declare that the project titled “**Smart Parking Management System**” is an original work developed by me. This project demonstrates real-world parking automation concepts using Python, including slot allocation, time tracking, billing, and revenue management.

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### 1. EXECUTIVE SUMMARY

The **Smart Parking Management System** is a console-based simulation of a real-time parking lot system built using Python.

The system replicates real-world parking operations such as:

- Automatic slot allocation
- Vehicle entry & exit management
- Time-based billing
- Revenue tracking
- Parking availability monitoring

The project demonstrates structured programming, modular design, and real-world problem-solving using Python.

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## **2. INTRODUCTION**

Modern malls, airports, and commercial complexes require:

- Automated slot tracking
- Accurate billing
- Real-time availability
- Revenue monitoring
- Efficient vehicle management

This project simulates these functionalities using Python in a command-line interface environment.

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## **3. PROBLEM STATEMENT**

Manual parking systems face several issues:

- Time-consuming slot allocation
- Incorrect billing calculations
- Poor revenue tracking
- No real-time availability updates

The challenge was to design a system that:

- Automatically assigns available slots
- Tracks entry and exit time
- Calculates billing accurately
- Maintains daily revenue data
- Prevents invalid parking operations

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## **4. PROPOSED SOLUTION**

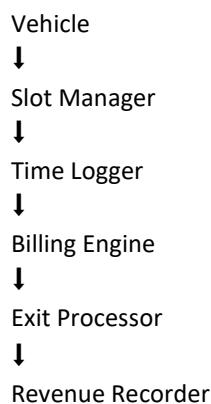
A modular parking management system that:

- Uses dictionaries to manage parking slots
- Records vehicle entry time using datetime
- Calculates charges based on parking duration
- Frees slots automatically during exit
- Maintains daily revenue records
- Validates incorrect inputs

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## **5. SYSTEM ARCHITECTURE**

### **Logical Flow Model**



## Architecture Layers

- ❖ **Presentation Layer**  
Handles CLI interaction and user input.
  - ❖ **Business Logic Layer**  
Processes slot allocation, billing, and exit operations.
  - ❖ **Time Tracking Layer**  
Records entry timestamps using Python datetime module.
  - ❖ **Storage Layer**  
Maintains slot data and revenue tracking using dictionaries.
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## 6. TECHNOLOGY STACK

### CORE STACK

- **Backend:** Python, Django (MVT Architecture)
  - **Frontend:** HTML5, CSS3, JavaScript (Bootstrap 5, FontAwesome)
  - **Data Analysis:** Pandas (Log sanitization and data cleaning)
  - **Database:** PostgreSQL / SQLite / MySQL (Optimized for rapid account state management)
  - **Reporting:** jsPDF, SheetJS, and AutoTable (High-precision PDF, Excel, and CSV generation)
  - **Interface:** Command Line Interface (CLI)
  - **Storage Mechanism:** In-memory dictionary-based storage
  - **Time Management:** Python datetime module
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### PYTHON CONCEPTS USED

- Dictionaries
  - Lists
  - Functions
  - Conditional Statements
  - Loops
  - Exception Handling
  - Date & Time Handling
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### DEVELOPMENT TOOLS

- VS Code
  - Git
  - GitHub
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## 7. FUNCTIONAL MODULES

### SLOT MANAGEMENT MODULE

- Displays available slots
- Automatically assigns first free slot
- Updates slot status

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### **VEHICLE ENTRY MODULE**

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- Accepts vehicle number
  - Records vehicle type
  - Captures entry timestamp
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### **BILLING MODULE**

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- Calculates parking duration
  - Computes charges per hour
  - Supports variable pricing logic
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### **EXIT MODULE**

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- Computes final bill
  - Displays total parked time
  - Frees parking slot
  - Updates revenue
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### **REVENUE MODULE**

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- Tracks total vehicles parked
  - Tracks total revenue generated
  - Generates daily summary report
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## **8. DATA STRUCTURE DESIGN**

### **Slot Data Format**

Slot\_Number

↓

{

```
"vehicle_number": String,  
"vehicle_type": String,  
"entry_time": datetime
```

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### **Why Dictionary-Based Design?**

- Fast slot lookup
  - Easy scalability
  - Clear mapping between slot and vehicle
  - Efficient data handling
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## **9. BILLING & PRICING LOGIC**

The billing engine calculates charges based on:

- Total hours parked
- Per-hour pricing model

Optional Premium Model:

- First 2 hours fixed rate
- Additional hours charged per hour
- Vehicle-type-based pricing (bike/car/EV/heavy vehicle)

Formula Example:

Total Charge = Hourly Rate × Total Hours Parked

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## **10. PARKING WORKFLOW**

- Step 1 ► Launch Application
- Step 2 ► Select Vehicle Entry
- Step 3 ► Enter Vehicle Details
- Step 4 ► System Assigns Slot
- Step 5 ► Entry Time Recorded
- Step 6 ► Vehicle Exit
- Step 7 ► Calculate Duration
- Step 8 ► Generate Bill
- Step 9 ► Free Slot
- Step 10 ► Update Daily Revenue

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## **11. ERROR HANDLING & VALIDATION**

- Prevents duplicate vehicle entry
- Prevents exit without entry
- Handles invalid slot numbers
- Handles incorrect menu selection
- Ensures numeric input validation
- Graceful exit system

Ensures stability and crash-free execution.

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## **12. ADVANCED FEATURES**

- Variable pricing model
  - VIP reserved slots
  - Vehicle-type-based pricing
  - PDF export of revenue report
  - Color-coded CLI interface
  - Parking analytics dashboard
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### **13. TESTING STRATEGY**

- Unit testing for billing calculations
  - Slot allocation testing
  - Edge case testing (full parking lot)
  - Invalid input testing
  - Revenue tracking validation
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### **14. PERFORMANCE & RELIABILITY**

- Fast slot allocation
  - Efficient time tracking
  - Accurate billing computation
  - Modular and scalable design
  - Low memory consumption
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### **15. FUTURE ENHANCEMENTS**

- GUI version using Tkinter
  - Database integration (MySQL/PostgreSQL)
  - Web-based deployment
  - QR-based vehicle entry
  - Online slot booking system
  - Real-time dashboard analytics
  - Cloud deployment
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### **16. CONCLUSION**

The Smart Parking Management System demonstrates:

- Practical implementation of Python concepts
- Real-world parking automation simulation
- Structured modular design
- Time-based billing logic
- Revenue tracking system

The project provides a strong foundation for building enterprise-level smart parking solutions.

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### **17. GITHUB REPOSITORY**

Click the link below:

[Smart Parking Management System](#)

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