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1. Problem Statement

Hostel management today is fragmented, paper-based, and inefficient. Students struggle with:

- **Lack of transparency** in room assignments, payment status, and complaint resolution
- **Manual, time-consuming processes** for leave requests and grievance filing
- **No centralized communication** with hostel administration
- **Attendance tracking** that's prone to proxy/cheating

Administrators face:

- **Manual workload** managing student records, payment verification, and leave approvals
- **Poor visibility** into outstanding grievances and operational issues
- **No audit trail** for attendance and leave records

Guards and staff lack:

- **Digital tools** for attendance tracking and work assignment visibility
- **Real-time information** on approved leaves

HostelPulse v1 aims to digitize and streamline core hostel operations with a mobile-first platform that connects students, administrators, guards, and staff.

2. Target Users

Primary Users

1. Students (Hostel Residents)

- Age: 18-25
- Tech-savvy, mobile-first users
- Need: Self-service access to information, quick request submission

2. Warden/Admin

- Age: 30-55
- Moderate tech comfort
- Need: Centralized dashboard for approvals, monitoring, and management

Secondary Users

3. Guards

- Age: 25-50
- Basic smartphone literacy
- Need: Simple attendance tracking interface

4. Support Staff

- Age: 25-55
- Basic smartphone literacy
- Need: View assigned tasks

User Base (Initial): Single hostel, 200-500 students

3. Core User Flows

3.1 Student Flows

A. Onboarding & Profile Access

Student signs in → Views dashboard → Sees room details (room no, block, floor, roommates) → Access profile (read-only, uploaded by warden)

B. Leave Request Submission

Student navigates to Leave Request → Fills form (name, address, hostel name, room no, year, semester, registration no, phone, parent phone, leave type, dates, place of visit, extra details) → Uploads mentor confirmation document → Submits → Receives confirmation → Waits for warden approval → Receives notification on status

C. Grievance Filing

Student selects "Room Settings/Grievance" → Chooses category (Electrical, Cleaning, Plumbing, Carpentry, Connectivity, Electronics, Food, Safety, Emergency) → Selects sub-category → Sets priority (High/Medium/Low) → Writes description → Uploads image (optional) → Submits → Receives ticket ID → Tracks status

D. Payment View

Student navigates to Payments → Views hostel fees, dues, payment history → (V1: View only)

E. Message Warden

Student opens frontdesk chat → Sends message to warden → Receives response → Ongoing chat thread

F. QR Attendance

Student opens app at designated time → Guard displays QR on their device → Student scans QR → System verifies location proximity (within 2 meters of guard) → Attendance marked → Student receives confirmation with timestamp

3.2 Warden/Admin Flows

A. Student Data Entry

Warden logs in → Navigates to Student Management → Adds new student → Enters details (name, registration no, room assignment, year, semester, phone, parent phone, address) → Uploads documents (Aadhaar, etc.) → Assigns room → Saves

B. Leave Request Approval

Warden views pending leave requests → Reviews details and uploaded document → Approves/Rejects with comments → Notification sent to student → Approved leaves visible to guards

C. Grievance Monitoring

Warden views grievance dashboard → Filters by priority/category/status → Reviews grievance → Assigns to staff (Future) OR marks as resolved → Student notified

D. Frontdesk Messages

Warden receives notification → Opens frontdesk inbox → Views student message → Replies → Ongoing conversation

E. Payment Verification (V1: Manual)

Warden receives offline payment info → Marks payment as verified in system → Student's payment status updated → (Future: Auto receipt generation and email)

3.3 Guard Flows

A. QR Attendance Generation

Guard logs in → Selects "Night Attendance" → Chooses block and year → System generates time-bound QR code (First year: 7:30PM-9:00PM, Second year: 7:30PM-10:00PM) → Guard displays QR on device → Students scan → Guard views live attendance list → Guard marks attendance period closed → System flags absent students

B. Leave Monitoring

Guard views approved leaves for the day → Checks student details (name, room no, leave dates) → (Future: Marks departure/arrival)

C. Late Entry QR (Future V1.1)

Guard generates late entry QR for specific student → Student scans → Late entry logged

3.4 Staff Flows (Minimal V1)

A. View Assigned Work

Staff logs in → Views assigned tasks/grievances → (Future: Updates status)

4. Feature List

4.1 MVP Features (V1 - Must Have)

Authentication & User Management

- Role-based login (Student, Warden, Guard, Staff)
- Basic profile view for all users
- Session management

Student Features

- Dashboard with room details (room no, block, floor, roommates)
- Read-only profile (data entered by warden)
- Leave request submission with document upload
- Grievance submission with category, priority, description, image upload
- Frontdesk messaging (chat with warden)
- Payment status view (read-only, no gateway)
- QR attendance scanning with location verification
- Notifications (leave status, grievance updates)

Warden Features

- Student data entry and management (manual input with document upload)
- Leave request review and approval/rejection
- Grievance monitoring dashboard with filters (category, priority, status)
- Manual grievance resolution (mark as resolved, add comments)
- Frontdesk messaging inbox
- Manual payment verification (mark as paid)
- Room assignment management
- View attendance reports

Guard Features

- QR code generation for attendance (block + year selection, time-bound)
- Live attendance tracking during scanning window
- View approved leaves for current/upcoming dates
- Location services enabled for proximity verification

Staff Features

- View assigned grievances/tasks (read-only)
- Submit task status updates

System Features

- Location-based attendance verification (2-meter proximity check)
- Document upload and storage (leave confirmations, student documents)
- Basic notification system (in-app)
- Attendance time windows (configurable by year: 1st year 7:30-9PM, 2nd year 7:30-10PM)

4.2 Future Features (Post-V1)

Phase 2 (V1.1)

- Payment gateway integration (online payments)
- Automated payment receipt generation and email
- Late entry QR generation by guards
- Staff task status updates (in-progress, completed)
- Room change request submission by students

- Room change assignment by warden
- Push notifications (Firebase/OneSignal)
- Email notifications

Phase 3 (V1.2+)

- Grievance assignment to specific staff members
 - Staff work completion workflow
 - Leave departure/arrival logging by guards
 - Analytics dashboard for warden (attendance trends, grievance patterns)
 - Event announcement system
 - Multi-hostel support
 - Parent portal (view student details, payments)
 - Mess menu and feedback
 - Visitor management
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5. Edge Cases & Validation Rules

5.1 Attendance System

- **Location spoofing:** Use device location + additional verification (device fingerprinting in future)
- **QR sharing:** Proximity check ensures student is within 2m of guard's device
- **QR expired:** Time-bound QR invalidates after window closes
- **Student scans multiple times:** System accepts first valid scan only per session
- **Poor network during scan:** Queue scan locally, sync when online (with timestamp validation)
- **Guard phone dies mid-session:** Guard can log in on another device, regenerate QR for same session
- **Student forgets to scan:** Marked absent, can request manual correction from warden

5.2 Leave Requests

- **Overlapping leaves:** System allows (students can extend leaves)

- **Leave without mentor confirmation upload:** Form validation requires file upload
- **Retroactive leave requests:** Allow (common use case), but flag for warden review
- **Leave cancellation:** Student can cancel pending requests; warden can revoke approved leaves

5.3 Grievances

- **Duplicate complaints:** Allow, track by unique ticket ID
- **Emergency complaints:** High priority grievances send urgent notification to warden
- **Image upload fails:** Allow submission without image, student can add later
- **Grievance re-opening:** Students can comment on resolved grievances to reopen (Future)

5.4 Payments

- **Partial payments:** Warden can record partial amount, dues updated accordingly
- **Payment disputes:** Student can message warden via frontdesk
- **Late payment fees:** Manual calculation by warden in V1

5.5 Room Management

- **Over-capacity:** System validates max occupancy per room during assignment
- **Room swap:** Requires warden approval (Future - room change request feature)
- **Mid-semester room change:** Warden can reassign, student profile updates

5.6 Messaging

- **Abusive messages:** Manual moderation by warden, option to flag (Future)
- **Message flood protection:** Rate limiting (max 10 messages per hour per student)
- **Warden offline:** Messages queue, warden sees all on next login

5.7 User Management

- **Student graduation/checkout:** Warden can deactivate account
 - **Forgotten password:** Password reset via email/phone OTP
 - **Concurrent logins:** Allow, track last active device
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6. Non-Goals (Out of Scope for V1)

✖ **Multi-hostel management** - V1 supports single hostel only
✖ **Payment gateway integration** - V1 is payment tracking only, no online payments
✖ **Automated receipt generation** - Manual process in V1
✖ **Parent portal** - Future feature
✖ **Advanced analytics** - Basic reports only in V1
✖ **Mess management** - Separate module for future
✖ **Visitor management** - Not in V1
✖ **Staff task workflow** - Staff has read-only access in V1
✖ **Room change requests** - Manual process via frontdesk messaging in V1
✖ **Event management** - Basic notifications only
✖ **Attendance biometric integration** - QR-only in V1
✖ **External system integrations** - Standalone app in V1
✖ **iOS app** - Android + Web only in V1
✖ **Offline mode** - Requires internet connection (except queued attendance scans)

7. Success Metrics

7.1 Adoption Metrics (First 3 Months)

- **80%+ student active users** (logged in at least once per week)
- **100% warden adoption** (daily active use)
- **90%+ guard adoption** (using QR attendance daily)

7.2 Operational Efficiency Metrics

- **Leave request processing time:** < 24 hours average (from submission to approval/rejection)
- **Grievance acknowledgment:** < 4 hours (warden views complaint)

- **Attendance completion:** 95%+ students marked present/absent within designated time window
- **Attendance accuracy:** < 5% proxy/cheating incidents

7.3 Engagement Metrics

- **Average student session time:** 3-5 minutes
- **Frontdesk messaging:** 70%+ messages receive warden response within 24 hours
- **Grievance submission rate:** 10-20 complaints per week (indicates trust in system)
- **Leave request completion rate:** 95%+ (students complete form and upload document)

7.4 Quality Metrics

- **App crash rate:** < 1%
- **QR scan success rate:** > 95% (on first attempt)
- **Document upload success rate:** > 90%
- **User-reported bugs:** < 5 critical bugs per month

7.5 Satisfaction Metrics (Quarterly Surveys)

- **Student satisfaction:** 4/5 average rating
- **Warden satisfaction:** Features save 5+ hours per week vs manual processes
- **Guard satisfaction:** QR system faster than manual roll call

8. Technical Considerations (High-Level)

8.1 Platform

- **Mobile:** Android app (React Native / Flutter)
- **Web:** Admin dashboard for warden (responsive web app)
- **Backend:** REST API (FastAPI/Django)

8.2 Key Technical Requirements

- **Location services:** GPS accuracy ±2 meters for attendance proximity check
- **QR generation:** Dynamic, time-bound QR codes with encryption
- **File storage:** Cloud storage for documents/images (50MB limit per file)
- **Database:** Relational DB for structured data (student records, attendance logs)
- **Authentication:** JWT-based, role-based access control (RBAC)
- **Real-time:** WebSocket for live attendance updates and messaging

8.3 Security & Privacy

- **Data encryption:** In-transit (HTTPS) and at-rest
 - **Document access:** Role-based (only warden can access student documents)
 - **Location data:** Used only during attendance, not stored long-term
 - **GDPR compliance:** Student data export/deletion on request
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9. Open Questions & Risks

Open Questions

1. **Payment gateway preference?** (Razorpay, Paytm, Stripe) - Parking for V1.1
2. **Notification infrastructure?** (Firebase Cloud Messaging vs OneSignal)
3. **Document retention policy?** How long to store student documents after graduation?
4. **Attendance correction workflow?** How do students request manual attendance correction?
5. **Multi-language support needed?** Regional language support in V1?

Risks

Risk	Impact	Mitigation
Students bypass location check (VPN, spoofing)	High	Implement device fingerprinting, random spot checks

Risk	Impact	Mitigation
Low internet connectivity in hostel	High	Offline queue for attendance scans with server-side timestamp validation
Warden overwhelmed with notifications	Medium	Implement notification batching, daily digest emails
Guards resist QR system	Medium	Training sessions, emphasize time savings vs roll call
Data privacy concerns	High	Clear privacy policy, minimal data collection, student consent
Scalability issues with QR scans	Medium	Load testing before rollout, CDN for QR image delivery

10. Launch Plan

Phase 1: Internal Testing (Week 1-2)

- Deploy to staging environment
- Test with 20 volunteer students + 1 warden + 1 guard
- Gather feedback, fix critical bugs

Phase 2: Pilot Rollout (Week 3-4)

- Deploy to single hostel block (50-100 students)
- Monitor adoption and performance
- Iterate based on feedback

Phase 3: Full Rollout (Week 5-6)

- Deploy to entire hostel
- Training sessions for wardens and guards
- 24/7 support for first week

Phase 4: Stabilization (Week 7-12)

- Monitor metrics
 - Fix bugs
 - Gather feature requests for V1.1
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11. Appendix

11.1 Grievance Categories & Sub-Categories

Electrical

- Light not working
- Fan issue
- Socket/switchboard problem
- Power outage

Cleaning

- Room cleaning required
- Corridor/washroom cleaning
- Garbage disposal issue
- Pest control needed

Plumbing

- Tap/faucet leak
- Toilet/flush issue
- Water supply problem
- Drainage blockage

Carpentry

- Furniture repair (bed, chair, table)
- Door/window issue
- Cupboard/almirah problem

Connectivity

- WiFi not working
- Slow internet speed
- Network coverage issue

Electronics

- Geyser issue
- Cooler/AC problem
- Other appliances

Food

- Meal quality complaint
- Hygiene concern
- Menu feedback

Safety

- Security concern
- Fire safety issue
- First aid needed

Emergency

- Medical emergency
- Urgent repair needed
- Safety threat

11.2 Leave Types

- Home leave
- Medical leave
- Academic (conference, workshop, exam)
- Personal emergency
- Festival/cultural event
- Other (specify)