**Robot Greeter — Project Charter & Requirements (v0.2)**

Status: Draft for review | Owner: Stephen Perelgut | Date: 2025-10-15

A small green robot with wheels and a camera

AI-generated content may be incorrect.

**1. Executive Summary**

Design and deploy an indoor, human‑friendly mobile robot that patrols a defined space, detects visitors, greets them, and—if consented and enrolled—addresses known individuals by name. Unknown visitors receive a privacy‑respectful greeting and can be handed off to a human operator via a companion app over Bluetooth Low Energy (BLE). The MVP emphasizes reliability, on‑device perception (for privacy and latency), simple enrollment with consent, and safe autonomous navigation.

**2. Objectives & Success Criteria**

Objectives:

* Provide a consistent, courteous greeting experience for visitors within a controlled indoor area.
* Operate safely around people and obstacles with autonomous navigation and bump recovery.
* Recognize enrolled individuals locally (opt‑in, consent‑based) and customize greetings by name.
* Enable rapid human handoff via a companion app with live view and push‑to‑talk.
* Protect privacy by default: on‑device processing, encryption at rest, and clear consent flows.

Measurable Success Criteria (MVP Demo Readiness):

* Autonomy: 60 minutes of patrol without collision; recovery from gentle bump within 1 second.
* Perception: ≥95% recall for person detection in the demo environment; ≤2 false greets/hour.
* Recognition (opt‑in): ≥95% top‑1 accuracy on an enrolled test set with ≥2 images/person.
* Latency: detection‑to‑greet < 800 ms; handoff to human < 1.5 s from button press.
* Privacy & Consent: All enrollments logged with consent; one‑click deletion verified.

**3. Scope**

In Scope (MVP):

* Indoor differential‑drive robot with depth‑assisted obstacle avoidance and bumper failsafe.
* On‑device person detection and optional face recognition (consent‑based).
* BLE companion app (Flutter) for live view (low‑FPS), push‑to‑talk, greet/handoff controls, and enrollment workflow.
* Local storage (SQLite) of consent records, embeddings, and visitor logs with export capability.
* Basic patrol within a pre‑mapped area and a ‘greeting zone’ behavior.

Out of Scope (MVP, deferred):

* Cloud‑based continuous streaming or external identity providers (e.g., SSO).
* Advanced SLAM in dynamic/large spaces; multi‑floor navigation.
* Emotion analysis or any sensitive‑attribute inference.
* Security enforcement actions beyond greeting and notification.
* Multi‑robot coordination.

**4. Stakeholders & RACI (Draft)**

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| --- | --- | --- | --- | --- |
| Role | Name/Org | Responsibility | RACI | Notes |
| Project Sponsor | Stephen Perelgut | Vision, approvals, demo success | A | Sets priorities, signs off MVP |
| Tech Lead (Robotics) | TBD | ROS 2 stack, nav, safety | R | Leads robot bring‑up |
| Perception Lead | TBD | Detection, embeddings, thresholds | R | Accuracy & latency targets |
| App Lead (Flutter) | TBD | BLE app, UI, consent/enrollment | R | Handoff & logs |
| Privacy Officer | TBD | Policy, signage, audits | C | PIPEDA alignment |
| QA/Safety | TBD | Test plans, acceptance | C/R | Runs demo‑readiness tests |

**5. User Stories (MVP)**

* As a visitor (unknown), I want to be greeted politely and offered help so I know how to proceed.
* As an enrolled visitor (known), I want to be greeted by name so the experience feels personal.
* As an operator, I want to see what the robot sees and talk through it so I can assist visitors remotely.
* As an administrator, I want an easy enrollment flow that captures consent and enables deletion.
* As a safety officer, I want the robot to slow/stop near people and recover safely from bumps.

**6. Non‑Functional Requirements**

* Reliability: 1‑hour continuous operation per patrol cycle in a typical indoor setting.
* Privacy: On‑device inference by default; encrypted storage for identities/logs; no cloud uploads without explicit approval.
* Accessibility: Clear voice; on‑device volume control; visual indicators for status; signage with QR to policy.
* Maintainability: Modular ROS 2 nodes; configuration via YAML; logs export as CSV/JSON.
* Security: BLE pairing confirmation; signed app builds; local admin PIN for sensitive actions.

**7. System Architecture (Overview)**

Compute module (Linux + ROS 2) orchestrates navigation (Nav2), perception (person detection + optional face embeddings), greeting logic, and a BLE service. Sensors include an RGB/depth camera, microphones, speakers, and bumper switches. The Flutter app connects over BLE to show a low‑latency preview, perform handoff, and run enrollment/consent. Data is stored locally with export features for audits and deletion.

**8. Hardware Requirements (Categories)**

* Compute: Raspberry Pi 5 + optional Edge TPU, or NVIDIA Jetson Orin Nano.
* Sensors: RGB/depth camera (e.g., RealSense D435), bumper switches; optional 2D lidar for robustness.
* Audio I/O: 2‑mic array; 3–5 W speaker; small class‑D amplifier.
* Mobility: Differential‑drive base with encoders; motor driver; odometry feedback.
* Power: Li‑ion pack with BMS; DC‑DC converters (5V/12V rails); emergency stop.
* Chassis: Layered plates or 3D‑printed shell; accessible e‑stop; cable management.

**9. Software Requirements (MVP)**

* OS & Frameworks: Ubuntu 22.04 LTS; ROS 2 Humble; OpenCV; Nav2; rclcpp/rclpy.
* Perception: Person detector (e.g., YOLO/MediaPipe) with tracking; embeddings for face recognition (ArcFace/FaceNet‑style).
* Speech: On‑device ASR (e.g., Whisper small/Vosk); TTS (local engine or pre‑recorded prompts).
* App: Flutter (iOS/Android/Desktop) with BLE; live view (low‑FPS MJPEG/RTSP); enroll/consent; logs view/export.
* Data: SQLite for identities/logs; AES‑encrypted columns or FS‑level encryption; nightly backup to encrypted volume (optional).

**10. Data Governance & Privacy (Draft)**

* Consent‑first enrollment; prominent signage at entry points; QR code to policy and contact.
* Purpose limitation: use images/embeddings only to personalize greetings; no secondary uses.
* Minimal retention: store embeddings and consent record; no raw training sets retained by default.
* Right to access & deletion: Admin UI supports lookup and immediate deletion; actions logged for audit.
* Security controls: encryption at rest; device‑level full‑disk encryption; admin PIN; change logging.

**11. Safety Requirements**

* Max speed limit in proximity to people; dynamic slowdown near detected humans.
* Physical e‑stop accessible and clearly marked; software watchdog for runaway states.
* Bump detection triggers immediate stop and re‑plan; path planning respects keep‑out zones.
* Battery and power protections: BMS, fusing, proper cable strain relief; safe charging procedures.

**12. Operational Scenarios (Happy Paths)**

1. Patrol and greet unknown visitor → polite message → offer handoff → operator assists via app.
2. Known visitor approaches → robot recognizes → greets by name → offers assistance menu or handoff.
3. Enrollment: operator requests consent → capture name + 2–3 images → embeddings stored locally.
4. Bump event: robot stops → announces ‘excuse me’ → re‑plans path → resumes patrol.

**13. MVP Delivery Plan (8–10 Weeks)**

Phase 0 (Week 1): Charter, safety plan, privacy policy, acceptance tests seeded.

Phase 1 (Weeks 2–4): Platform bring‑up, teleop, person detection, generic greeting, BLE app live view.

Phase 2 (Weeks 5–7): Enrollment/consent, name greeting, unknown‑visitor flow, human handoff, basic patrol.

Phase 3 (Weeks 8–10): Hardening, logs/exports, demo scripts, signage and end‑user docs.

**14. Key Risks & Mitigations (Snapshot)**

* False recognition: threshold + confirmation (‘Did I get your name right?’) + easy correction.
* Lighting variability: use depth + auto‑exposure; small IR assist in low light.
* Acoustic noise: push‑to‑talk prioritizes operator; use wake‑word only in quiet zones.
* BLE reliability: keep sessions short; Wi‑Fi fallback for setup; reconnect logic.
* Battery life: duty‑cycle compute; configurable patrol cadence; low‑power standby.

**15. Acceptance Criteria (Go/No‑Go for MVP Demo)**

* All success criteria in Section 2 met in the demo environment.
* Consent and deletion flow demonstrated for at least two individuals.
* Patrol with at least five successful greetings (mixed known/unknown) in 15 minutes.
* Emergency stop and bump recovery demonstrated visibly and reliably.

**16. Assumptions & Constraints**

* Indoor, level flooring with reasonable lighting; defined patrol area available.
* Local regulations and institutional privacy policies allow consent‑based recognition.
* Hardware availability may affect component selection; alternates permitted if spec‑equivalent.
* No dependency on external internet connectivity during demos.

**17. Deliverables (MVP)**

* Operational robot prototype with patrol, greet, and handoff features.
* Flutter companion app (test builds) with enrollment and logs.
* Documentation pack: setup guide, operator guide, privacy policy, signage PDF.
* Test reports: performance metrics, safety checks, and acceptance results.

**18. Glossary (Select)**

* BLE: Bluetooth Low Energy for short‑range, low‑power connectivity.
* Embedding: Vector representation of a face used for recognition (not a photo).
* Nav2: ROS 2 Navigation stack for mapping and path planning.
* PIPEDA: Personal Information Protection and Electronic Documents Act (Canada).

— End of v0.2 —

This document is a working draft intended for internal review and iteration.