

Smart Door Mate Security System

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Abstract- Women Visitors arrive unannounced. Sometimes welcome, sometimes not. We built a doormat that watches. Raspberry Pi 4B+ waits quietly. Pressure sensor under mat feels weight, sends signal, system wakes. Telegram fires to owner: "Someone at door." Servo rotates camera, captures face, transmits image. Remote eyes where none existed. No subscription, no cloud lock-in, no monthly fees. Telegram free, Pi owned, code open. Cost under ₹5,000, works on any door, alerts any phone. Continuous monitoring eliminated—mat sleeps, Pi dozes, power sips. Only presence triggers, only relevance notifies. Smart because selective, not because complex.

Keywords – Raspberry Pi, IoT, Smart Home Security, Telegram API, Servo Motor, OpenCV, Automation.

I. INTRODUCTION

We lock doors, install cameras, yet still miss arrivals. Life distracts—meeting, shower, deep sleep. Traditional security demands eyes, demands presence, fails when attention wanders.

Doorbells require visitor cooperation. Press me, they must choose. Many don't: delivery rushes away, intruder avoids notice, friend assumes you're out. Passive waiting loses information.

We wanted active knowing. Step on mat, detection automatic, no visitor choice involved. Pressure sensor indifferent to intention—catches deliberate arrivals, catches sneaky ones, catches all weight-bearing presences.

Raspberry Pi judges, responds, notifies. Telegram message beats running to door. Image confirms: expected package, unexpected stranger, neighbor's cat. Owner decides action informed, not guessed.

IoT without cloud dependency, automation without subscription, security without monthly drain. Present when owner absent, watching when human attention impossible.

II. LITERATURE SURVEY

Security at doors evolved slowly, then suddenly.

- **Traditional surveillance:** Cameras record, hard drives fill, nobody watches. After break-in, footage reviewed—evidence, not prevention. Reactive by design, useless for real-time response.
- **Video doorbells:** WiFi-connected, motion-triggered, app-notified. Better, but flawed. PIR sensors see heat—passing car, wandering cat, sun-warmed brick. False alarms train

users to ignore. Visitor must press button; avoidance possible, silence achievable.

- **IoT and embedded systems:** Raspberry Pi local processing, OpenCV image analysis, Telegram API messaging. No dedicated app to build, maintain, update. Cloud communication without cloud lock-in. Modular, replaceable, understandable. We follow this path—pressure trigger instead of PIR, mat instead of button, certainty instead of choice.

III. PLATFORM TECHNOLOGY USED

- **Raspberry Pi 4B+ – the overqualified doorman:** We bought muscle for a simple job. Quad-core 1.5GHz, 4GB RAM—ridiculous for door watching. But camera drivers work, Python runs smooth, WiFi stays stable. Future-proofing: maybe face recognition later, maybe multiple mats, maybe cloud storage. For now, mostly idle, waiting. Headless, no screen, no keyboard—black box under table, forgotten until needed. Boots, runs, reports. That's all.
- **OpenCV – the lazy photographer:** Single Python import, one function call. No filters, no enhancement, no AI detection. See person, snap picture, send. 640x480 because full HD wastes bandwidth, takes longer, adds nothing. Color slightly wrong, exposure sometimes off—doesn't matter. Face visible, clothing identifiable, enough for decision: open door or don't.
- **Telegram Bot API – the free messenger:** No app building, no Play Store approval, no server renting. Fifteen lines of Python, bot token, chat ID.
- **Message fires:** "Someone at door." Image attaches, sends, delivers in 2 seconds. Already on user's phone, already familiar, already trusted. Telegram sees our images; we see their convenience. Trade accepted.
- **MG995 servo – the mechanical owl:** Metal gears, PWM whisper, 180 degree sweep. Rests center, snaps left or right

on command. Camera bolted directly, shaky but functional. Manual calibration: twist screw, aim, test, repeat. Not precision engineering—good enough engineering. Rotates, stops, holds. Every time.

IV. PROBLEM STATEMENT

Life moves fast. Door doesn't care.

Homeowners away—office, travel, grocery run. Delivery arrives, leaves, note stuck. Visitor waits, leaves, opportunity missed. Intruder tests, finds empty, enters. Traditional security watches, doesn't speak; records, doesn't alert.

Doorbells demand cooperation. Press me, visitor must choose. Many don't—hurried delivery, shy neighbor, testing thief. Silent arrivals stay silent. CCTV fills hard drives, nobody reviews until after.

Smart doorbells slightly better. Motion triggers, phone buzzes. PIR sees heat, not intention—car passes, alarm screams; cat walks, alarm screams. Users mute, ignore, miss real threat. Still requires visitor press for certainty; avoidance possible.

We wanted unavoidable detection. Step on mat, presence known—willing or unwilling, aware or unaware. No button, no choice, no silence. Image captured, owner notified, evidence preserved. Cost under ₹5,000, no subscription, no visitor compliance required.

V. AIM AND OBJECTIVES

Build a doormat that snitches—sees, tells, shows proof.

- **Feel the step:** Pressure sensor under mat, weight detected, signal sent. No visitor choice, no button press, no avoidance. Presence equals detection, period.
- **Shout to phone:** Telegram fires instantly. "Someone there." Owner knows, wherever, whatever doing. Alert actionable, not after-the-fact.
- **Look around:** Servo rotates camera, covers angle, catches face. Static camera misses; moving camera watches. Cheap mechanical solution, not multiple cameras.
- **Capture proof:** USB camera snaps, image saved, evidence locked. Not video—bandwidth, storage, processing. Single frame, clear moment, sufficient identification.
- **Send remotely:** Image travels to owner's pocket. Remote monitoring means informed decision: neighbor, threat, package. Open door or call police, but decide knowing.

VI. DIAGRAM

A) Block Diagram

The block diagram maps the data flow from the primary input (Pressure Sensor/Doormat Switch) to the Raspberry Pi. The Pi then simultaneously triggers the MG995 Servo Motor to align

the USB Camera and interfaces with the Wi-Fi router to push the data via the Telegram API to the user's smartphone.

B) Flow Chart

The software flow chart begins with system initialization and enters a standby loop. Upon sensor trigger, it sequentially executes the Telegram alert, servo rotation, image capture, image transmission, and finally resets the system to standby mode.

c) Circuit Diagram

The circuit diagram illustrates the GPIO connections on the Raspberry Pi 4B+, detailing the 5V and GND routing to the MG995 servo motor, the digital input connection from the pressure switch, and the USB interface for the camera module.

VII. COMPONENTS / MATERIALS

- **Pi 4B+ – the bored brain:** Bought muscle for simple job. Quad-core sits mostly idle, waiting. Camera drivers work, Python stable, WiFi doesn't drop. Future-proofing we probably won't use. Hidden under table, dust gathers, still boots.
- **Pressure-based doormat switch – the snitch:** Two metal plates, foam separator, weight squishes, circuit closes. No fancy load cell, no calibration, on/off only. Visitor steps, Pi wakes. Can't avoid, can't silence, can't not trigger.
- **USB camera module – the cheap eye:** ₹800 plug-and-play, auto-focus struggles, colors slightly wrong. Doesn't matter. Face visible at 3 meters, clothing identifiable, timestamp embedded. Sufficient for "friend or threat" decision.
- **MG995 servo motor – the mechanical owl:** Metal gears grind quietly, PWM commands angle. Rests center, snaps left or right. Camera bolted shakily, jitters slightly, settles. Coverage over precision—sees door left, door right, enough.
- **5V 3A adapter – the juice:** Pi wants 2.5A, servo wants surge, 3A provides margin. Standard USB-C, grocery store replacement. No proprietary brick, no hunt when lost.
- **Raspberry Pi OS – the stripped foundation:** Lite version, no desktop, no bloat. Boots to command line, script auto-runs, loops forever. Memory free, CPU yawning, power sipping.
- **Python, OpenCV, Telegram API – the lazy code:** Import, snap, send. Fifteen lines total. No app building, no server renting, no certificate hell. Telegram hosts, we borrow. Free, slightly sketchy, completely functional.

VIII. WORKING

- **System initialization – the morning stretch:** Pi boots, camera wakes grumpy, servo hums to center, sensor waits. WiFi connects, Telegram handshake, bot online. Thirty

seconds from dark to vigilant. Then nothing—pure waiting.

- **Standby monitoring – the sleep:** CPU idles, camera off, servo rests. Pressure sensor alone watches, sips microamps. Mat feels nothing, system dreams. Power conserved, attention sharpened, patience infinite.
- **Visitor detection – the step:** Weight compresses foam, plates kiss, GPIO pinjumps HIGH. Interrupt fires, Pi wakes, script runs. No delay, no polling, instant response. Cat too light, wind irrelevant—human weight threshold tuned experimentally.
- **Alert notification – the shout:** "Visitor detected at your door." Telegram fires, HTTPS travels, phone buzzes. Owner glances, knows, decides. Two seconds, sometimes three. Network dependent, usually sufficient.
- **Camera alignment – the look:** Servo snaps to 45 degrees, preset angle, face height assumption. Mechanical, imprecise, mostly correct. Whirrs, settles, holds. Camera sees door center, catches something, sufficient.
- **Image capture – the proof:** OpenCV grabs frame, saves to RAM, compresses slightly. Face blurry? Lighting bad? Doesn't matter—clothing, posture, context visible. Evidence, not art. Transmits immediately, cloud backup automatic.
- **System reset – the return:** Servo whirrs home, camera sleeps, sensor resumes watch. Loop closed, waiting restored. Ready for next footfall, next alert, next decision.

IX. RESULTS

- Detection accuracy: PIR sensors cried wolf—wind, cat, sun-warmed brick. Pressure mat silent until real weight, real presence. Zero false positives in testing, zero missed humans. Threshold tuned: cat ignored, child detected, adult certain.
- Mechanical response: Servo moved in 200 milliseconds, camera steady in 500. Human perception: instant. Whir audible, visitor notices, sometimes looks—better image result.
- Notification latency: Telegram reliable, 2-3 seconds consistent. Text arrives first, image follows, both before visitor leaves. WiFi strong in tests; weak signal would lag, not implemented fallback. Good enough for home, office, covered porch.

X. ADVANTAGES & APPLICATIONS

Advantages

- Resource efficiency: CCTV records empty hours, fills hard drives, wastes electricity. We sleep until stepped on, wake only for relevance. Power sips, storage minimal, attention focused.
- Unavoidable detection: Doorbells demand press; visitors avoid. Motion sensors see everything; we see only weight.

Step on mat, trigger guaranteed. No choice, no silence, no evasion.

- Cheap and simple: ₹5,000 total, grocery store parts, no drilling, no wiring walls. USB camera, servo, Pi, mat. Install in afternoon, secure by evening.

Applications

- Residential: Apartments, houses, elderly alone. Know daughter arrived, stranger loitering, delivery dropped. Peace for worried children, independence for aging parents.
- Commercial: Small office, back room, restricted door. Visual log automatic, timestamped, cloud-stored. No receptionist memory, no dispute later.
- Delivery verification: Package thrown, stolen, or actually placed? Image proves, timestamp confirms. Argue with Amazon armed with evidence.

Future Scope

- Facial recognition: Haar Cascades run on Pi, barely. Known faces—family, regular delivery—silent log. Unknown faces—loud alert, immediate attention. Training data: twenty images sufficient, false positives acceptable, false negatives dangerous. Deep learning would need Coral USB, more cost, more power. Maybe later.
- Two-way audio and smart locks: Speaker, microphone, "Who's there?" from bed. Voice distorts, delay annoys, still better than silence. Smart lock—relay clicks, door opens, remote trust. Risk: hacked, spoofed, teenager sharing code. Trade convenience for security, individual choice.
- Environmental adaptability: IR LED ring, night becomes day, visitor visible 24 hours. Solar panel, battery, off-grid installation. Rural gate, construction site, farm shed. Sun charges, dark works, no electrician needed. Cost doubles, flexibility triples.

XI. CONCLUSION

Door security stayed dumb too long. We made it slightly smarter.

Raspberry Pi watches mat, feels step, shouts phone, shows face. Synergistic sounds fancy; reality is cheap parts talking to each other. Pressure sensor certain, servo shaky, Telegram free. Works anyway.

Traditional doorbells demand visitor cooperation. CCTV demands owner attention. We demand nothing—step happens, alert fires, image arrives. Proactive because automatic, efficient because selective, convenient because already on your phone.

Not perfect. Facial recognition missing, night vision absent, two-way audio future dream. But functional today, affordable today, secure enough today. Peace of mind through knowing, not through hoping.

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