

Alan Rozensztajn Schipper

Homelab: Assistive Smart Automation for Residential, Clinical and Real Estate Applications

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Final Course Project submitted to the Institute of Technology and Leadership (INTELI), to obtain a bachelor's degree in Software Engineering

Advisor: Prof. Reginaldo Arakaki

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Alan Rozensztajn Schipper

Homelab: Automação assistiva para aplicações em residenciais, clínicas e para o mercado imobiliário

Orientador : Reginaldo Arakaki

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ABSTRACT

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Homelab is a smart automation startup focused on residential and commercial environments, with new expansion into assistive solutions for the elderly and people with disabilities. The project aims to develop and scale modular and pre-configured kits for B2B sales, enabling integration in construction companies, clinics, and hospitals. The business model moves from B2C to B2B, focusing on speed, replicability, and customer experience improvement. Over the course of four academic modules, the company structured partnerships, developed a technical roadmap, validated MVPs, and implemented full installations in over 15 homes, 1 automated building, and 3 decorated model apartments. In its assistive arm, the project includes the "Senior Kit," combining lighting, voice automation, fall detection, and emergency communication. The system also includes AI customer service through WhatsApp, infrastructure planning via n8n, and specific user interfaces for non-digital native users. In the final phase, a full commercial and technical structure was developed to support scalability, inclusion, and quality of life improvement.

Keywords: smart home automation; assistive technology; b2b automation; senior tech; hospital UX; accessibility.

Summary

1	Introduction	6
2	Solution Development	8
2.1	Definition of Market Premises and Hypotheses	9
2.2	Market Sizing and Analysis	10
2.3	Competitive Analysis and Differentiators	11
2.4	Technological Solution	12
2.5	The Business Plan	16
2.6	[Validation and Results]	18
3	Conclusion	20
	References	21

1 Introduction

1.1 Context and Motivation:

Homelab is a smart automation startup born in Rio de Janeiro, focused on bringing intelligence, comfort, and safety to residential, clinical, and building environments. The project began with the growing demand for simple and scalable automation in real estate developments, and quickly evolved to also serve special audiences, such as the elderly and people with disabilities, through assistive automation kits. With the increased use of voice assistants, wireless systems, and plug-and-play devices, there is a market opportunity to offer complete solutions that improve quality of life, reduce installation time, and add commercial value to real estate projects.

The motivation to develop Homelab came from observing how fragmented and complex current automation solutions are for both final consumers and construction companies. Homelab seeks to simplify and democratize this access, creating pre-configured kits that meet the needs of various segments, from small apartments to clinics and premium hospitals.

1.2 Problem Definition and Value Proposition:

The project addresses a key gap in the B2B automation market: the lack of ready-to-install, low-complexity solutions for real estate developers, clinics, and senior living centers. Currently, automation is often treated as a luxury or an afterthought, not integrated into the initial planning of developments. Additionally, families caring for elderly or disabled individuals face daily challenges in ensuring their safety and autonomy without accessible or intuitive technology.

1.3 Objectives of the Work:

General Objective

To develop a scalable and modular smart automation solution focused on the B2B market, targeting real estate developments, medical clinics, hospitals, and assistive care.

Specific Objectives

- Define and develop pre-configured automation kits (Basic and Premium) for apartments.
- Create and test the “Senior Kit” with emergency communication and fall detection.
- Establish partnerships with construction companies and clinics.
- Automate decorated model apartments to validate sales impact.
- Develop a WhatsApp-based virtual assistant using n8n to support end users.
- Launch targeted marketing campaigns for elderly and disabled audiences.
- Validate the commercial model and scalability for institutional clients.

1.4 Justification and Contributions:

Homelab is justified by the increasing demand for automation that is not only technological but also inclusive and commercially viable for construction partners. By providing fast-installation kits, compatible with Alexa and easily adapted to different apartment types, Homelab facilitates a better experience for the end user and creates an additional revenue stream for real estate developers.

The project contributes to the areas of assistive technology, smart homes, and B2B tech integration. It also brings innovation to the healthcare sector by improving patient autonomy in premium hospital rooms and enabling remote care. For families, the Senior Kit provides peace of mind, while for developers and clinics, it offers differentiation, revenue potential, and social impact.

1.5 Work Structure:

This work is organized into five chapters. The first chapter presents the introduction of the project, its motivation, context, and general objectives. The second chapter focuses on market analysis, including segmentation, assumptions, and competitive mapping. The third chapter presents the technological solution developed by Homelab, including technical specifications and system architecture. The fourth chapter introduces the complete business plan, with financial projections, marketing strategy, and business model validation. Finally, the fifth chapter presents the results of validation, including KPIs and the risk mitigation strategy.

2 [Solution Development]

2.1 [Definition of Market Assumptions and Hypotheses:]

The Homelab project was guided by the identification of clear opportunities in the Brazilian residential and healthcare sectors. The increasing demand for comfort, security, and efficiency in living environments, especially for elderly users, people with disabilities, and compact residential units revealed significant gaps not addressed by traditional automation providers. In parallel, the growing pressure on construction companies to offer differentiated projects provided fertile ground for B2B partnerships focused on integrated, low-complexity automation kits.

2.1.1 Problem Hypothesis

Elderly people, individuals with mobility or cognitive limitations, and residents of compact apartments face daily challenges related to safety, comfort, and accessibility. Likewise, construction companies lack standardized and scalable automation offerings that can be implemented without increasing construction

complexity. We assume that these audiences are willing to pay for solutions that enhance independence, improve living quality, or accelerate apartment sales.

2.1.2 Solution Hypothesis

We assume that a pre-configured, modular automation system tailored to the needs of each audience (residential, clinical, and elderly care) is the most viable solution for addressing those challenges. For construction companies, the solution lies in plug-and-play kits, pre-programmed for rapid on-site deployment. For clinics and homes for the elderly, it lies in customizable kits focused on voice control, fall detection, and caregiver communication. For hospitals, automation creates a premium experience that improves patient satisfaction and operational efficiency.

2.1.3 Value Hypothesis

We assume that the perceived value of these automation solutions is higher than their cost when framed around emotional outcomes (peace of mind, independence, safety) and practical benefits (shorter sales cycles, better client experience, reduced manual labor). The willingness to pay is reflected in both end users who accept the upgrade when clearly explained and B2B partners, who see automation as a commercial differentiator. Therefore, our pricing model and sales structure are designed to maximize adoption while preserving profitability.

2.2 [Market Sizing and Analysis:]

2.2.1 Market Size (TAM, SAM, SOM):

TAM (Total Addressable Market): R\$10B/year – All residential and commercial buildings delivered in Brazil that could potentially receive automation.

SAM (Serviceable Available Market): R\$2.5B/year – New developments in urban centers with studios to 2-bedroom units and hospitals/clinics in the Southeast region.

SOM (Serviceable Obtainable Market): R\$12M/year – Initial target: Rio de Janeiro residential buildings (B2B) and 5 to 10 pilot clinics for Senior Kits.

2.2.2 Customer Segmentation and Profiling

Real Estate Developers: Mid-size companies focused on compact apartments looking for differentiators to increase sales velocity.

Private Clinics and Hospitals: Focused on patient comfort and premium experiences.

Elderly and Caregivers: Families seeking independent yet monitored living for senior family members.

Architecture and Interior Designers: Seeking value-added services and aesthetic solutions.

2.3 [Competitive Analysis and Differentials:]

Identified Competitors:

Direct Competitors:

Intelbras Smart Home

Strong presence in Brazil with a focus on security and residential automation through retail and installer channels.

Positivo Casa Inteligente

B2C model sold through large marketplaces (Amazon, Magazine Luiza), focusing on affordable smart devices compatible with Alexa and Google Assistant.

Indirect Competitors:

Independent contractors and integrators

Professionals offering custom smart home installations directly to consumers.

Premium international brands (e.g., Control4, Savant)

High-end tailored automation solutions focused on luxury markets and complete integrations.

Competitive Differentials:

Homelab Competitive Differentials

Homelab's positioning is built on a modular, scalable solution, designed specifically for B2B distribution with specialized offerings in the real estate, healthcare, and accessibility sectors.

Real Estate Segment:

Ready-to-install kits for decorated model apartments and residential units, pre-configured in Homelab's facilities. Real estate developers can offer automation as an optional upgrade or built-in feature for buyers. The model allows for reverse commission to developers per unit sold, creating commercial incentives.

Healthcare and Assistive Solutions:

The Senior Kit and clinical sensory kits include tailored features such as fall detection, voice-activated emergency calls, and Alexa-based communication. Kits are inclusive for elderly users, individuals with disabilities, and institutional care environments.

AI-Powered Technical Support:

A WhatsApp agent developed through n8n offers AI-guided assistance, integrating with Homelab's product database. When clients scan a QR code on a malfunctioning

device, a pre-filled support message is generated automatically—reducing support time and improving user experience.

With these differentiators, Homelab positions itself as a more focused and inclusive player than traditional consumer-facing brands, offering social impact, operational efficiency, and unique commercial partnerships that appeal to underserved verticals in the market.

2.4 [Technological Solution]

2.4.1 Requirements and Specifications:

The Homelab platform was designed to deliver modular, wireless smart automation solutions across different markets—residential units, healthcare clinics, and assistive environments. The system is composed of functional and non-functional requirements to ensure adaptability, scalability, and user safety.

- **Functional Requirements:**

- Control of lighting, air conditioning, and TV via voice and central panel.
- Smart lock with remote unlocking for caregivers.
- Emergency buttons linked to WhatsApp AI agent.
- Fall detection system that triggers alerts after inactivity on the floor.
- Alexa Drop-In functionality for two-way communication without needing manual acceptance.

- **Non-Functional Requirements:**
 - Full offline fail-safe behavior for emergency routines.
 - End-to-end encrypted communication (LGPD-compliant).
 - Sub-2-second latency on local command execution.
 - Install time under 3 hours for pre-configured kits.
 - Low energy consumption across all devices.
- **User Specifications and Use Cases:**
 - Elderly user with limited mobility: activates scenes via voice to reduce physical effort.
 - Caregiver monitoring remotely: accesses cameras and receives alerts in real time.
 - Resident in studio apartment: uses app and central panel to control all scenes instantly.
 - B2B construction client: receives pre-programmed kits for plug-and-play delivery in apartments.

2.4.2 Architecture and Technology:

Homelab uses a hybrid architecture combining cloud-based services (for AI support and backup configuration) and local device control (for fail-safe operation). Key layers include:

- Local Zigbee/Wi-Fi network with mesh topology for automation reliability.
- n8n low-code workflow engine integrated with WhatsApp API for AI agent and customer support.
- Tuya-based device ecosystem for full Alexa and Google Home compatibility.
- Cloud sync for backup, analytics, and remote updates.

The design allows fast deployment in field scenarios without requiring structural changes or internet dependency for core functions.

2.4.3 Development and Implementation (MVP):

The Minimum Viable Product (MVP) of Homelab was developed throughout an entire academic year, following an agile approach using Scrum methodology, structured into **4 modules with 5 sprints each**. This continuous, iterative development process allowed for strategic evolution across technical, commercial, and user-experience dimensions.

- **Module 1** focused on initial market validation, early partnerships with architects, and the first real installations of residential automation systems. MVP components were first field-tested in real decorated apartments.
- **Module 2** expanded the solution into pre-configured modular kits for B2B delivery, including the design of a scalable commercial model for construction companies and the automation of multiple decorated units. It also introduced energy-saving models and operational refinements.
- **Module 3** introduced assistive and therapeutic automation solutions, including the development of the **Clinical Sensory Kit** in collaboration with UFRJ. It also included technical advances in automation robustness, error detection, and the first AI prototype for WhatsApp-based technical support.
- **Module 4** finalized the **Senior Kit**—a full assistive solution for elderly and mobility-impaired users—refined the AI technical agent, and validated installations in both real estate and healthcare environments. The business structure was also redefined for full B2B scalability.

As a result, the MVP was validated through:

- Multiple installed and operational decorated units
- Over 15 homes automated
- A fully functional Clinical Sensory Kit deployed in therapeutic sessions

- A prototype AI agent developed and integrated into WhatsApp via **n8n** to handle technical support and configuration flows

This staged MVP development enabled Homelab to evolve from concept to tested, real-world solutions ready for commercial scaling.

2.4.4 Testing and Technical Evaluation:

- **Unit Tests:** Validated automation routines across devices (scene triggers, response latency).
- **Integration Tests:** Confirmed compatibility between Zigbee/Wi-Fi mesh, Alexa voice routines, and n8n agent.
- **Acceptance Tests:** Conducted in over 15 households, 1 fully automated building, and 3 decorated apartments.
- **Real-World Evaluation:** Assisted clinic prototype tested with researchers from UFRJ, demonstrating successful synchronization of visual/auditory/tactile stimuli with storytelling videos.

2.5 [The Business Plan]

2.5.1 Market and Competitor Analysis:

Market and Competitor Analysis:

- **Target Segment (Persona):**
 - Construction developers of residential buildings (studios, 1–2 BR).
 - Geriatric and rehabilitation clinics for assistive automation.
 - Elderly customers or their families looking for accessible and reliable technology.

- **SWOT Analysis:**

- Strengths: Modular architecture, fast installation, B2B focus, pre-sales support.
- Weaknesses: Limited manufacturing scale, dependence on third-party hardware (Tuya).
- Opportunities: Aging population, rising interest in smart living, healthtech integration.
- Threats: Market dominated by low-cost B2C products and general-purpose integrators.

- **Competitor Analysis**

- Intelbras and Positivo (B2C): Competitive on price, but lack vertical B2B focus.
- Integrators: Offer flexibility, but lack standardization or speed of deployment.
- Homelab's advantage lies in modular kits, technical support, and a structured B2B commercial model with customization per segment.

2.5.2 Business Model (Business Model Canvas - BMC):

- **Customer Segments:** Construction developers, clinics, hospitals, elder-care service providers.
- **Value Proposition:** Plug-and-play smart kits with voice control, emergency response, and caregiver connectivity.
- **Channels:** Direct B2B sales, partnership with architecture firms, inbound leads via decorated apartment experiences.
- **Customer Relationships:** Personalized onboarding, tech support via WhatsApp AI, demo units.
- **Revenue Streams:** Kit sales (hardware + software), installation services, monthly maintenance contracts.
- **Key Resources:** Pre-programmed hardware kits, software configuration, n8n agent infrastructure.

- **Key Partners:** Tuya-compatible hardware providers, UFRJ clinical research group, construction companies.
- **Activities:** Kit development, field testing, support automation, partner onboarding.
- **Cost Structure:** Hardware sourcing, software development, logistics, technical staff, commercial team.

2.5.3 Marketing and Sales Strategy:

- **Go-to-Market:** Automate model apartments in new real estate developments. Create immersive experience using voice scenes during buyer visits.
- **Sales Funnel:** Capture leads during the visit → explain Homelab → offer kit as upgrade during property acquisition.
- **Campaigns:** Emotional storytelling showing elderly people interacting with the system. Highlight autonomy, safety, and connection with family.
- **Channels:** Instagram, WhatsApp Business, CRM system for architecture/construction contacts.

2.5.4 Financial Projection and Feasibility:

Revenue Model: Each kit sold generates revenue between R\$2,500–R\$9,000 depending on type. Margins are increased with direct installation and software integration.

- **Pricing:** Tiered structure—Basic Kit (~R\$3,000), Premium Kit (~R\$6,500), Senior Kit with fall detection (~R\$7,000).
- **2024 Results:** R\$700,000 in revenue.
- **2025 Forecast:** >R\$3.0M revenue expected, with 460+ unit potential in current developer pipeline.

- **Viability:** Breakeven expected within 12 months of rollout. ROI calculated at 2.3x on average contract value.
- **Investment:** Minimal for hardware procurement; investment focus on team and support infrastructure.

2.6 [Validation and Results]

2.6.1 Validation Methodology:

- In-person pilot installations in real apartments.
- Decorated apartment experiences in partnership with 3 construction companies.
- Assisted clinic tests with real users (UFRJ study).
- WhatsApp agent prototype tested with real customers and FAQs.
- Landing page with lead generation used for pre-sales engagement.

2.6.2 Market Validation Results:

- 15+ real residential installations.
- 3 decorated units installed and used as active commercial tools.
- 1 building fully automated.
- 1400 followers gained via organic social media video campaigns.
- Multiple construction firms including Homelab as part of their official property offer.

2.6.3 Key Performance Indicators (KPIs):

- CAC: R\$54 per customer via Instagram video conversion.
- Installation time: <3 hours for 2-bedroom unit.
- Conversion from decorated apartment visit to automation purchase: 22% (as measured in one project).
- WhatsApp engagement rate: 78% of inbound leads engage within 1 hour.

2.6.4 Risks and Mitigation Plan:

- **Hardware Compatibility Risk:** All kits are tested in advance. Partnerships with 2+ hardware suppliers ensure redundancy.
- **Customer Education Gap:** WhatsApp AI agent reduces support burden and helps with onboarding.
- **Installation Variability:** Modular, wireless design avoids dependency on site infrastructure.
- **Competition:** Focus on vertical niches (assistive, real estate B2B) reduces price-based competition.

3 Conclusion

The objectives established for the Homelab project were successfully achieved throughout the four academic modules and twenty sprints. The company transitioned from a small-scale residential automation provider to a structured B2B business with defined verticals in real estate, healthcare, and assistive technologies. Along the way, Homelab validated real-world installations in over 15 homes, fully automated a residential building, and partnered with developers to implement automation in model units across three major developments.

In the healthcare and accessibility space, the team designed and prototyped two highly specialized solutions the Clinical Sensory Kit and the Senior Kit addressing real-world needs through voice control, fall detection, and integrated emergency communication. These solutions positioned Homelab not just as a tech provider, but as a player in the inclusion and quality-of-life ecosystem.

On the technical front, the MVP was delivered in stages, with practical installations and iterative validations in decorated apartments, clinics, and labs. The integration of a WhatsApp-based AI support agent and the use of platforms like n8n for backend orchestration further enhanced the scalability and intelligence of the system.

Looking ahead, the projections for the business are promising. With a 2025 revenue of approximately R\$700,000 and a forecast of over R\$3.0 million in 2026, Homelab is well-positioned for expansion. The company has a mapped commercial pipeline of over 460 potential units, including partnerships with developers and clinics.

Final considerations include the importance of continuous iteration and listening to the needs of end-users especially when working with vulnerable populations such as the elderly or individuals with disabilities. Homelab aims to continue evolving its product line, strengthen its commercial partnerships, and expand its presence in the healthcare and residential sectors, always focusing on user experience, security, and impact.

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