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INTERNSHIP REPORT

Electroteca

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Abstract

The project titled "Electroteca" presents a hybrid lending platform that broadens hands-on access to measurement devices, development boards, tools, and components across education and innovation settings.

This report is organized into the following chapters: Introduction, Domain Analysis, Problem Description and Motivation, Market Research, Solution Concept, System Design and Implementation, and Conclusions with Bibliography and Appendices.

Electroteca proposes a policy-driven lending model that combines institutional management where universities publish and govern their own inventories with verified peer contributions, where individuals can list devices and earn credits when those devices are borrowed. The platform comprises a secure web application with catalog and search, reservations, check-out and check-in, reminders and messaging and essential safety controls such as user verification, condition logging, and calibration records. Roles and permissions for borrower, staff, contributor, and administrator are defined alongside a compact data model for items, loans, incidents, and credits.

Evaluation focuses on the completeness and clarity of the lending workflow and policies. The result is a practical blueprint that increases visibility of available equipment, raises utilization of existing resources, and lowers the threshold for project-based learning and rapid prototyping.

Keywords: laboratory equipment loan, peer-to-peer platform, resource sharing, credit-based system, collaborative innovation, sustainable utilization.

Introduction

Access to advanced scientific instruments remains a significant barrier for many researchers, particularly in smaller institutions or regions with limited funding. High costs restrict innovation, reduce reproducibility, and contribute to inequities in scientific capacity. Addressing these challenges requires rethinking how resources are shared, accessed, and maintained.

The open science movement has already transformed the way knowledge is produced and disseminated, beginning with open-access publishing and later expanding to data, code, and research workflows. However, hardware and electronics central to the production of scientific data have long remained outside this framework. The emergence of open-source hardware, and in particular open electronics platforms such as Arduino and Raspberry Pi, has started to close this gap by providing low-cost, modular, and customizable alternatives to commercial instruments. Open electronics, originally popularized by hobbyists and makers, are increasingly applied in academic and industrial research. Their modularity, sensor compatibility, and scalability make them well suited for experimental customization, rapid prototyping, and cost-effective replication of setups. Beyond affordability, these platforms support transparency and reproducibility, while fostering collaboration within and across institutions. They also create opportunities for education and citizen science, enabling wider engagement with technological innovation.

By leveraging such tools, researchers can overcome funding barriers, institutions can reduce reliance on proprietary equipment, and the scientific community can move toward more equitable and innovative practices. This report examines how a rental platform for electronic equipment could extend these benefits by broadening access, supporting education, and fostering collaboration.

1. Domain Analysis

1.1 From Open Science to Open Hardware: Access Gaps and Opportunities

Open science started with open-access publications and has now expanded to liberate access to data, program code, and even lab notebooks. However, so far one domain, which is at the very core of scientific data production, has been missing in the open science movement: hardware, electronics, and instruments. Proprietary instruments support high-profile research, such as microfluidic instruments for transcriptomics or autonomous underwater vehicles to monitor marine environments, yet high costs limit their access only to well-funded labs. Most researchers globally do not have access to the funding required to buy state-of-the-art proprietary instruments, limiting both reproducibility and innovation potential [1].

Free and open-source hardware has the potential to close this divide: in many instances, it can match high-end performance of proprietary instrumentation while facilitating the sharing of free-of-cost design blueprints to re-build, modify, or advance instruments, and fostering collaboration with other scientists and a worldwide community of "makers," civic scientists, and hobbyist inventors. With millions of hobbyist makers and DIYers around the globe, and more than 37 million Raspberry Pi microcomputers sold alone [2] the popularity of open electronics has continued to rise and is beginning to establish in diverse scientific domains. Figure 1.1 presents the distribution of subject areas associated with Arduino and Raspberry Pi related publications indexed in the Web of Science (WoS), indicating a predominant focus on engineering and computer science.

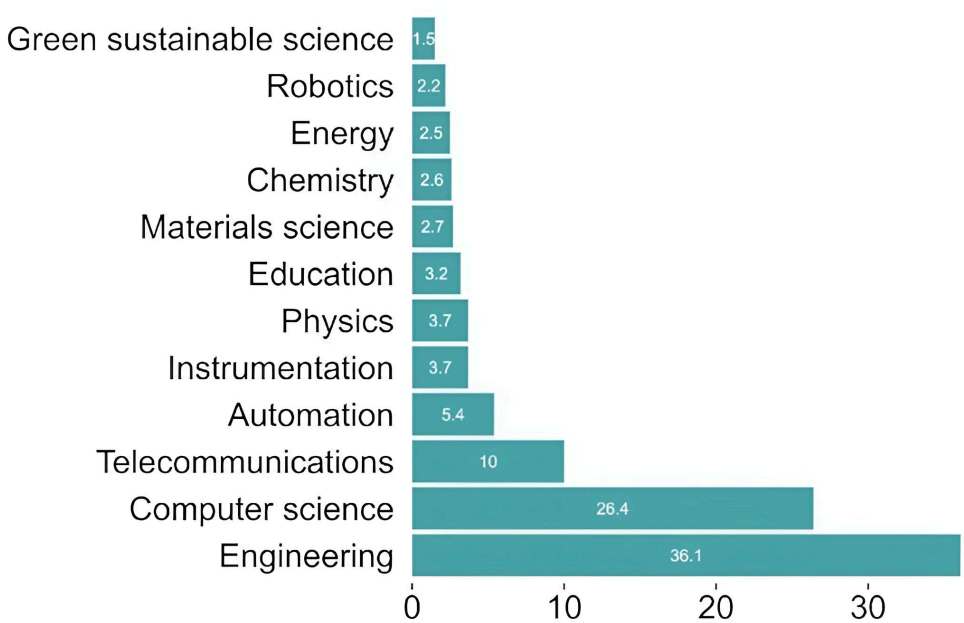

Figure 1.1 – *Distribution of dominant subject areas for Arduino and Raspberry Pi publications in the Web of Science (WoS) database.*

Despite their increasing uptake in science, open-electronics applications are far from being widespread. Poor awareness, inadequate documentation, and insufficient electronic literacy outside the engineering and computer sciences have contributed to its fragmented and uneven use across scientific subjects.

To reach broad-scale uptake of open electronics, important barriers need to be overcome by increasing access to detailed information, improving educational and research support, and by presenting a clear case for how open electronics can benefit researchers, institutions, and the scientific community alike. This will help to accelerate hardware innovation, democratize hardware access, lower research costs, and enable highly customizable solutions for experimental science [3].

Some of the driving forces behind the rise of open electronics are the aim to make computing and electronics accessible to anyone, such as in STEM education, and to introduce students to electronics and programming basics as well as solving practical problems and practicing the scientific method. A persistent challenge in engineering and technical education is bridging the gap between theory and practice. While students often acquire solid conceptual knowledge, opportunities to apply this understanding experimentally are limited. Employers increasingly expect graduates to demonstrate not only theoretical proficiency but also the ability to design, build, and test solutions in real-world contexts. Hands-on engagement with instruments, electronic components, and laboratory equipment therefore becomes an essential part of professional preparation.

However, access to these resources remains inconsistent. Universities and training centers frequently operate under strict budget constraints, which limits their ability to maintain broad inventories of equipment. Even when high-value devices are purchased, they are often reserved for specific courses or research projects and remain idle outside of those uses. In some cases, sophisticated instruments are underutilized entirely, while the lack of continuous operation contributes to equipment degradation over time. This results in wasted investment and lost opportunities for learning [4].

The issue extends beyond academia. Startups, makers, and independent inventors increasingly require specialized instruments to develop prototypes and validate ideas. Yet for these groups, purchasing expensive devices outright is not financially feasible. What they need is short-term access to equipment that can support rapid experimentation and proof-of-concept development. In this way, the challenges of students and innovators converge: both communities benefit from flexible, affordable pathways to advanced tools.

1.2 Benefits of Open Electronics for Scientific Research

In addition to their diverse application potential, open electronics can provide a broad range of significant benefits at the different levels of academia and resolve important practical, financial, and structural issues.

1.2.1 Benefits to Individual Researchers

Wide applicability, from simple to complex

Unlike most commercial scientific instruments, which confine customers and applications to product lines, open electronics are highly flexible and adaptable and can be implemented in a broad range of applications [5]. Users can start simple and expand their devices with increasing programming and electronics skills, like starting with only logging lab temperature, then displaying it live on an LCD screen, controlling heaters to regulate temperature to, finally, a complete stand-alone system with multiple sensors, warning messages, and interactive graphical user interfaces (GUIs). Users can also easily repurpose open electronics by reusing components from previous setups for new or more complex builds.

Broad Sensor and Actuator Application Potential

A major strength of open electronics is the wide range of sensors and actuators available that can approach reference-grade accuracy of reference equipment. Open electronics can also be used in applications with a small footprint both in the lab and under harsh conditions in the field [6], [7]. Micro-controllers and single-board computers also enable multiple sensors and actuators to be connected simultaneously, providing a sensing and reactive capacity that, in many instances, can rival proprietary solutions for specific tasks while having significantly lower individual hardware unit needs, costs, and power consumption.

Lab Automation

Repetitive tasks, such as control and recording of experimental parameters, mixing reagents, animal feeding, and monitoring of experimental trials, are amongst the most time-consuming factors in research labs. Open electronics can benefit researchers by automating such tasks, including by using robotics for pipetting [8] or RFID-based animal feeding stations [9]. Task automation also helps reduce human error and experimental variability and increases resilience to unforeseen circumstances.

Customization

Most instruments, such as HD cameras, plate readers, microscopes, and PCR machines, are closed entities, constrained to the functions set by the manufacturer and operating software, and can thus become redundant if research needs change. The poor ability to modify or expand functionalities also confines the scope and implementation of new research ideas. Open electronics can solve this as researchers can not only develop or retrofit existing setups and devices, exchange, or program new operations, but also link and expand the features of existing laboratory instruments.

Sensors
Environment (temperature, humidity, barometric pressure, soil moisture, particulate matter, light intensity, smoke, dust, radiation)
Movement (distance, acceleration, seismic, GPS, break-beam, motion)
Gas (CO, CO_2, alcohol, H_2, TVOCs, ozone, H_2S, CH_4, NO)
Biometrics (heart rate, muscle activity, fingerprints, weight/load, force)
Water (chlorine, pH, depth and pressure, liquid level, flow, turbidity)
Imaging (spectroscopy, visible and IR range cameras, thermal imaging, gestures)
Other (magnetism, capacitive touch, current, voltage, sound, RFID)
Actuators
Switches (mechanical, electrical, magnetic, DC and AC relays)
Movement (servos, stepper motor, gear motor, vacuum pumps, valves)
Light (LEDs, infrared, UV, laser)
Other (vibration, sound, ultrasound, Peltier heating/cooling)

Figure 1.2 – *Range of sensors and actuators in open electronics, with platform compatibility.*

Transferable Skills

Besides providing practical benefits, learning to work with open electronics and creating custom devices and applications also provides researchers with transferable skills, including knowledge of programming and electronics, technical problem solving, and creative thinking, which is paramount to scientific progress. This new skill set may spark new and cross-disciplinary ideas for research. It can further generate engineering- or programming-related skills, which improve researchers' employability outside academia or lead to unexpected business opportunities.

The best way to get started with open electronics is to dive right in and start building simple systems and applications. Hobby electronics starter kits provide great value and come with a large range of sensors, actuators, LEDs, breadboard, cables, and resistors that can be used to start tinkering. These are widely available online and can be used with both microcontrollers and single board computers. For beginners especially, Arduino and Raspberry Pi are recommended as they are the most popular and have by far the most documentation and support available. As first learning resources, a wide range of tutorials are available online that are geared towards hobbyists and teach fundamental electronic skills such as wiring, powering, and soldering when needed.

Figure 1.3 represents the potential steps for incorporating open electronics into one's research.

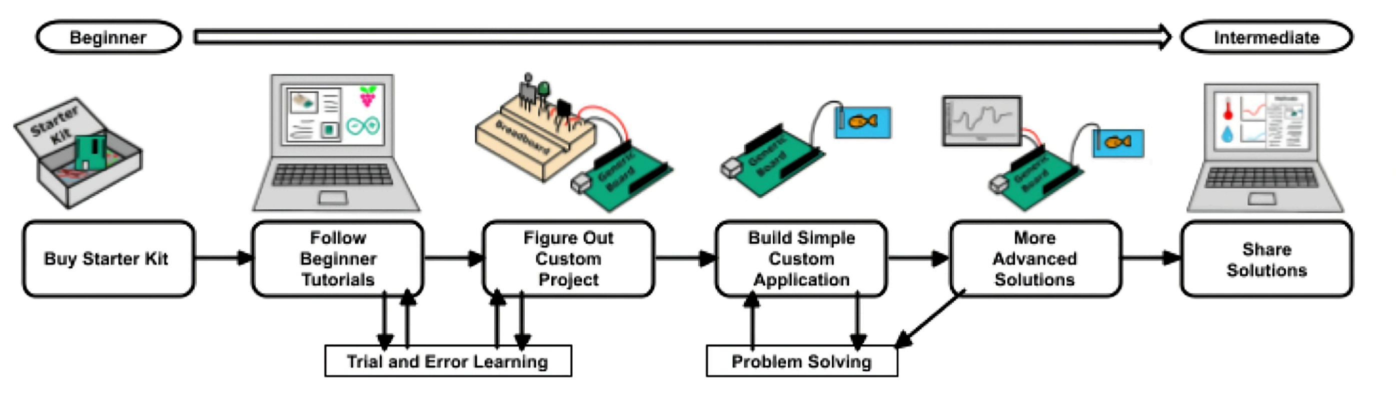

Figure 1.3 – *Workflow for Developing Open Electronic Solutions*

Figure 1.4 represents an overview of some of the key micro-controllers and single-board computers on the market rated for their price, skill level, performance, flexibility, resources and support available, and possibility to run machine learning applications.

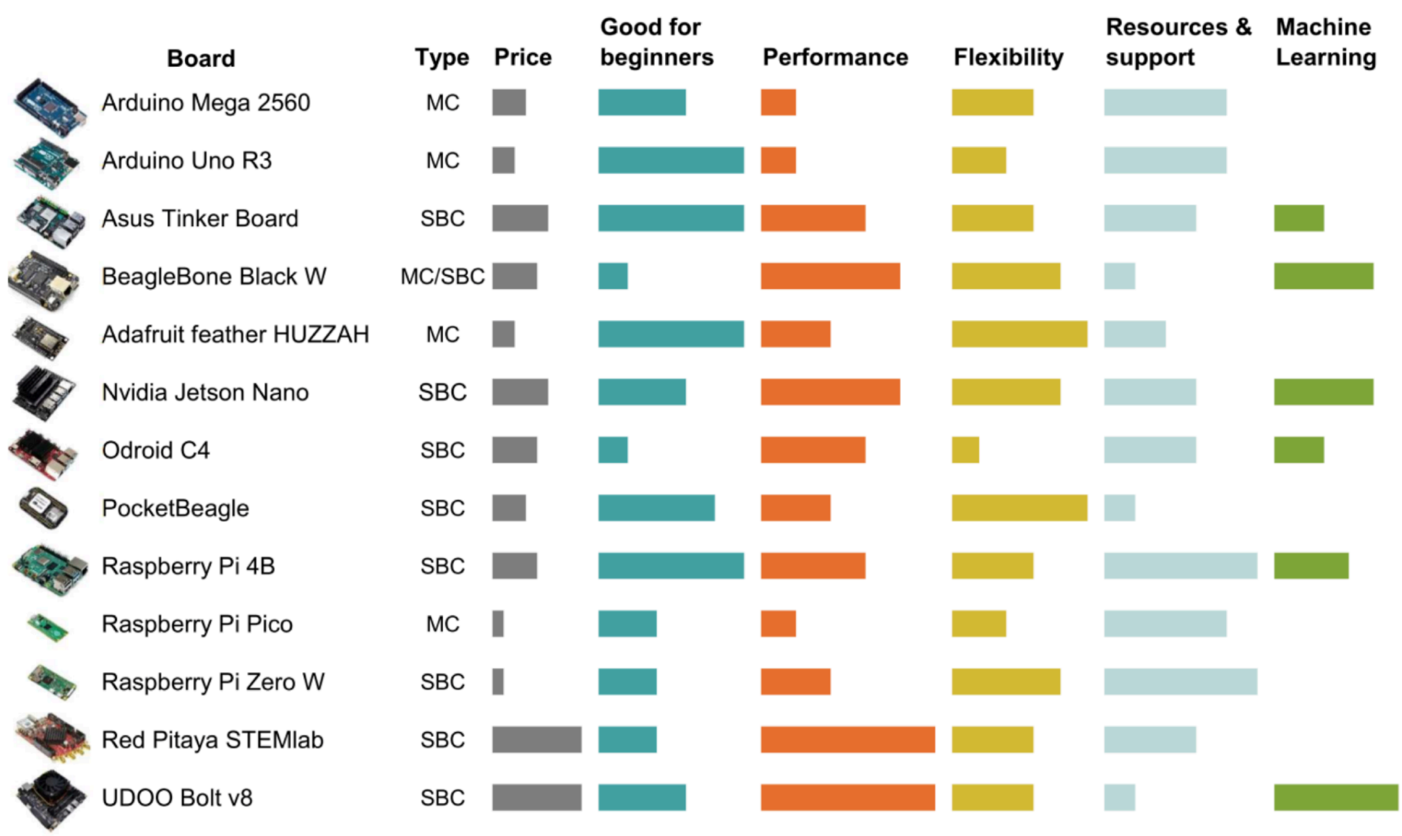

Figure 1.4 – *Comparison of Microcontroller and Single-Board Computer platforms by cost, usability, performance, flexibility, support.*

1.3 Problem Description and Motivation

In both education and innovation, access to laboratory and electronic equipment is essential for turning theory into practice, fostering creativity, and driving applied learning. Stakeholder consultations carried out with students, professors, and independent makers consistently highlighted that although institutions such as Microlab hold valuable instruments, much of this inventory remains idle, depreciating in value while providing little educational or community benefit. From a circular economy perspective, maximizing utilization is a cornerstone of sustainability, as it reduces redundant purchases, extends the lifespan of assets, and minimizes environmental impact (Geissdoerfer et al., 2017). [10].

Students repeatedly expressed that they lack consistent access to power supplies, microcontrollers, and similar tools necessary for completing course projects or independent explorations. Comparable studies have shown that inequitable access to laboratory tools significantly limits student engagement and achievement in STEM fields [11]. Professors reinforced these concerns, explaining that project-based learning initiatives cannot scale effectively because laboratory resources are insufficient to support the number of students requiring access at the same time. From the perspective of Microlab, a significant fraction of its equipment remains stored for long periods without being loaned, resulting in wasted potential and gradual deterioration. Beyond the university, hobbyists, small startups, and local innovators similarly lack affordable options to obtain short-term access to high-quality instruments for prototyping and experimentation.

One promising response has been the establishment of shared instrumentation facilities. Strom, Haugstad, and Shu (2020) show that centralized research facilities where equipment is managed, scheduled, and accessed by multiple research groups significantly improve utilization rates while also fostering collaboration across disciplines [12].

Addressing this problem requires more than simply acquiring additional devices. Institutions need greater visibility into what resources are available and must adopt flexible rental policies that reflect real user needs, short-term borrowing for routine components and longer-term access for specialized instruments. Aligning equipment access with actual usage patterns not only maximizes return on investment but also creates a more inclusive and innovation-friendly ecosystem.

1.4 Target Audience

1. **Engineering and Technology Students**

   Includes undergraduates, master's, and PhD students in fields such as electrical engineering, computer science, mechatronics, and robotics. Initiatives such as the WinterLab portable experiment system demonstrate how mobility in equipment access fosters independent inquiry and strengthens problem-driven learning (Rouble, Dobbs, & Gilbert, 2020) [16].

   Need: affordable and timely access to power supplies, microcontrollers, sensors, and other lab instruments to complete coursework, capstone projects, and extracurricular competitions.

2. **University Professors and Academic Institutions**

   Faculty members responsible for laboratory classes, research supervision, and project-based teaching, as well as administrators managing resource allocation.

   Need: scalable and cost-efficient solutions to equip students with real-world experimental opportunities without overspending on hardware.

3. **Independent Makers and Hobbyists**

   Individuals engaged in DIY electronics, robotics, IoT systems, and hardware projects, often working outside of formal institutions.

   Need: short-term access to affordable electronic parts and instruments for experimentation and creative exploration.

4. **Research Groups and Laboratories**

   Academic labs, community labs (makerspaces, fab labs), and interdisciplinary research teams.

   Need: resource-sharing systems to optimize utilization of equipment across teams and projects.

5. **Citizen Science and Community Tech Initiatives**

   Grassroots organizations, NGOs, and public engagement projects involving local communities in scientific or technical activities.

   Need: accessible tools for experiments in fields like environmental monitoring, robotics education, or STEM outreach.

6. **Employers and Industry Partners**

   Companies collaborating with universities, training centers, or hiring graduates from technical fields.

   Need: graduates with both theoretical knowledge and hands-on skills.

1.5 Solution Concept

Electroteca is a digital lending platform that provides structured, affordable, and time-limited access to electronics and laboratory equipment. Inspired by library lending systems and shared instrumentation facilities, it adapts these principles to the needs of students, educators, hobbyists, and innovators. The platform is built on a secure web-based infrastructure, ensuring reliable access and management of resources.

At its core, Electroteca combines two models of access:

- **Institutional management** – universities and organizations list equipment available for borrowing, increasing utilization of existing resources.
- **Peer-to-peer contributions** – individuals can contribute their own components or devices and, in return, earn credits redeemable for future borrowing.

This hybrid structure creates a sustainable ecosystem in which users gain affordable access to tools, while equipment owners benefit from higher utilization and community recognition. Borrowing operates through membership or subscription models, offering flexibility for short-term or project-based needs.

Accountability is maintained through incident reporting, deposits, or pledges that cover potential repairs and replacements. Looking ahead, Electroteca envisions integrating an AI-powered recommendation assistant that can suggest compatible tools or alternatives based on project requirements, thereby streamlining user choices and enhancing learning outcomes.

To make the mechanics of Electroteca concrete, Figure 1.5 models the platform as a UML sequence. It shows the two supply channels of institutional listing and peer-to-peer contributions and the borrower's happy path from search and reservation through pickup, return, and settlement. The settlement step distinguishes institutional items from contributed items, issuing credits to contributors when their devices are borrowed.

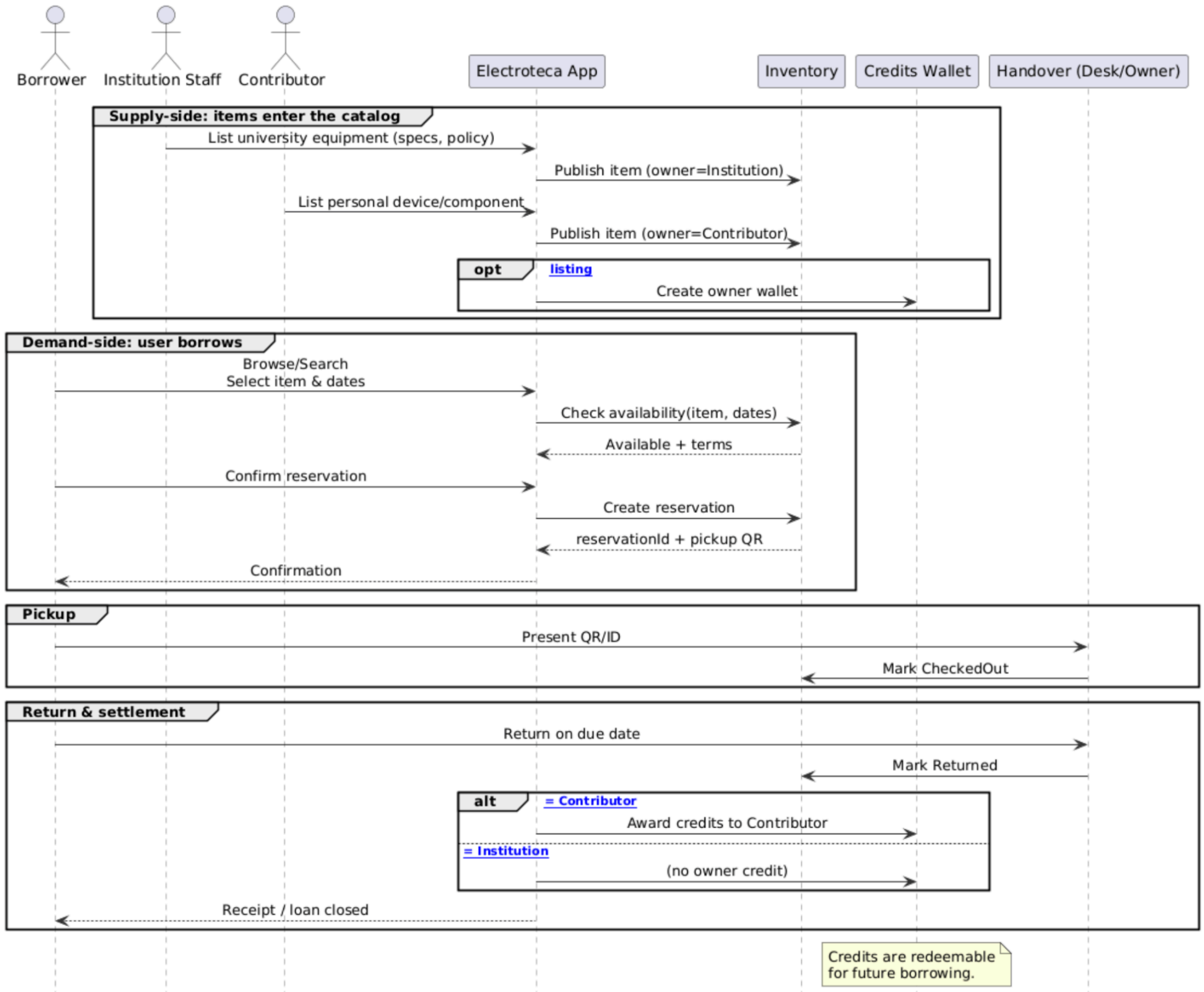

Figure 1.5 – *Electroteca: user borrowing sequence and credit-issuing model.*

Actors: Borrower, Institution Staff, Contributor.

Services: Electroteca App, Inventory/Catalog, Credits Wallet, Handover (desk/owner).

Phases: supply-side cataloging → demand-side reservation → pickup → return & settlement (credits awarded only for peer-to-peer items).

1.6 Market Research

Market research provides insights into current trends, growth potential, and user behaviors that shape demand for shared access to instruments and electronic components. By examining both global industry forecasts and local usage patterns in academic and innovation environments, this section highlights the economic relevance of equipment lending and identifies opportunities for adoption in education, research, and startup ecosystems.

The IT equipment rental industry is growing quickly, valued between USD 25–94 billion in 2023 and projected to reach USD 202 billion by 2030. Other segments show even faster growth, with robotics rentals expanding at 19–20% CAGR (Compound Annual Growth Rate) test and measurement equipment at 4.6% CAGR, and consumer electronics rentals at 11.2% CAGR (USD 125B by 2029) [13].

In U.S. academic libraries, technology items accounted for 21% of all loans in 2021, with borrowing durations varying widely depending on the item: monitors were often borrowed for a semester, while portable solar power supplies were checked out for a day. One survey at NC State University showed 30% of students only discovered tech-lending services through word of mouth, and 16% didn't know they existed until being asked. This highlights the importance of outreach and clear communication to drive adoption of such services [14].

Current usage also shows room for growth. According to a 2022 Library Journal survey, just 13.9% of students reported borrowing equipment, compared to 61.2% who accessed digital resources and nearly half who used study spaces. This suggests the need to increase visibility and design flexible rental policies that reflect real user expectations: short-term borrowing for some items, longer-term rentals for others [15].

These growth trends align with the following target groups: Engineering students and university professors need affordable access to IT and lab equipment. Independent makers, hobbyists, and startups benefit from flexible robotics and electronics rentals to experiment without heavy costs. The underuse of tech lending on campus reflects unmet demand rather than lack of interest. At the same time, market trends toward access-over-ownership indicate favorable conditions for an electronics-lending model.

This shift aligns with global movements in the sharing economy, where digital platforms transform idle assets into shared resources. The Moldovan e-commerce market reached an estimated EUR 358.6 million in 2023, of which tangible goods represented about 63.9 percent; consumer electronics and large home appliances alone accounted for roughly 40 percent of the market value for goods, making electronics a commercially significant online category and therefore a promising target for a platform that offers instrument loaning rather than outright purchase. Figure 1.6 illustrates the distribution of online sales in Moldova in 2023, both in terms of value (EUR million, excluding VAT) and share (%) across the main product groups [17].

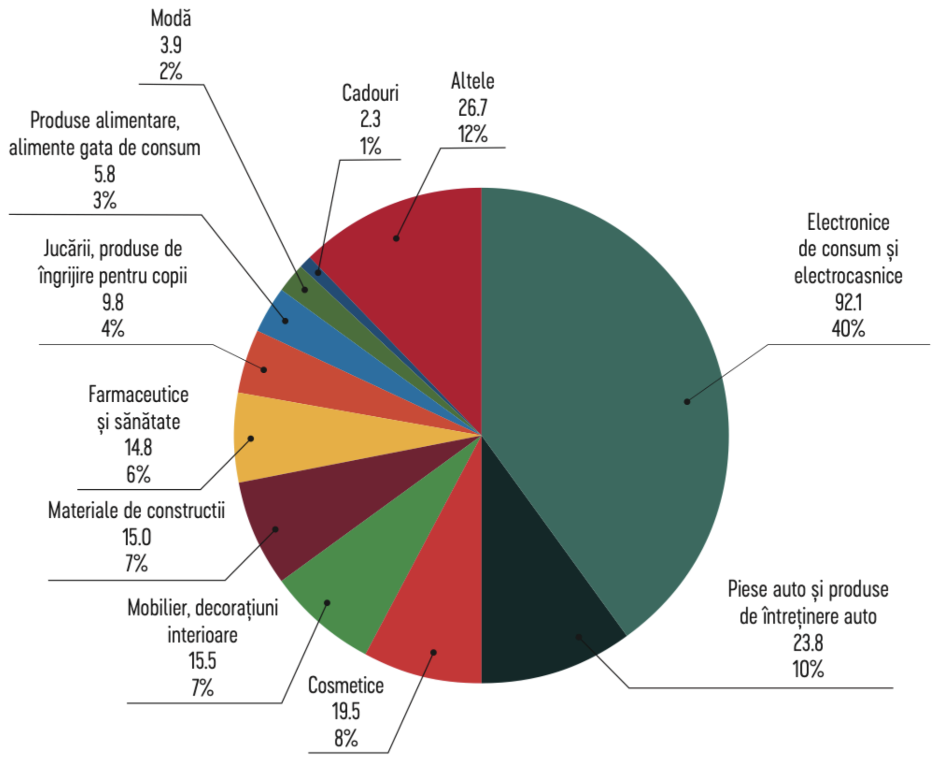

Figure 1.6 – *Value (EUR million, excluding VAT) and share (%) of the main product groups in online sales in Moldova, 2023*

Parallel insights from AMCHAM's 2024 e-commerce market study reveal that Moldovan consumers are spending heavily online. Approximately 327,000 people who make up slightly more than 20% of the adults in the country have a sufficient level of online spending. The rest of the population in Moldova is excluded from the e-commerce market. Cash on delivery continues to dominate, highlighting both a trust gap and an opportunity for loan-enabled, rental-first models that reduce upfront risk. For Electroteca, this means that financing mechanisms such as "rent-to-own," installment plans, or BNPL schemes can be strategically introduced to match consumer behaviour while expanding access to equipment. Figure 1.7 illustrates how much, on average, each resident in Moldova spent per month on e-commerce in 2023 (EUR, excluding VAT) [17].

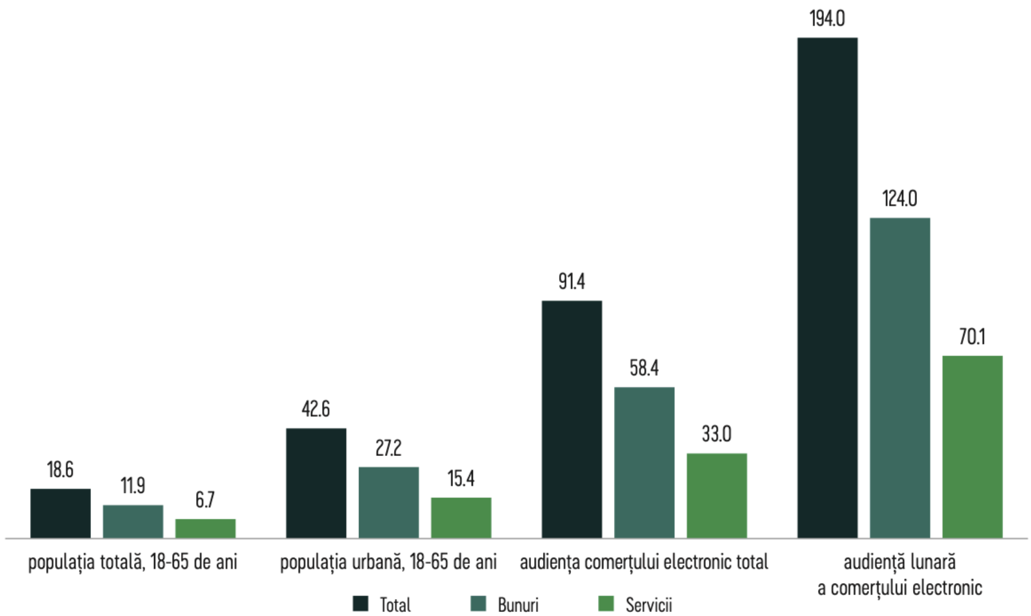

Figure 1.7 – *Average monthly per capita expenditure on e-commerce in Moldova (EUR, excluding VAT), 2023*

On the supply and financing side, official statistics show that leasing activities in Moldova remain modest and highly concentrated in vehicles, leaving equipment leasing and similar asset finance underdeveloped. The National Bureau of Statistics reported that in 2022 the total value of fixed assets provided under leasing was about 1.476 billion MDL, of which approximately 97 percent was transport (vehicles) and only a small fraction represented machines and equipment. This concentration signals a market gap: standard financial products already exist for vehicles, but not for smaller-scale technical equipment and lab instruments that Electroteca targets. From a policy and development perspective, mapping studies confirm that equipment leasing comprises roughly 8 percent of the leasing market in Moldova, while vehicle leasing dominates; leasing arrangements for equipment typically exist but are relatively niche and often more costly than bank lending. Those facts create an opening for alternative asset-finance and short-term rental models aimed at students, makers, and MSMEs that need temporary access rather than ownership. Figure 1.8 presents the structure and dynamics of leased fixed assets in Moldova, expressed in MDL, for the period 2018–2022.

	2018	2019	2020	2021	2022
Mijloace fixe acordate în leasing - total	**1583,4**	**1812,6**	**1400,3**	**1702,7**	**1476,0**
mijloace de transport	1516.7	1611.0	1303.3	1555.9	1426.0
mașini și utilaje	23.9	144.7	78,8	66,3	24.0
clădiri și construcții speciale	26.6	18,3	13,8	39.2	26.0
alte mijloace fixe	16,2	38,6	4,4	41,3	0,0

Figure 1.8 – *Leased fixed assets (MDL)*

A rental and loan-centric model fits perfectly with Electroteca's mission. By lowering immediate cash barriers, it enables students, researchers, and entrepreneurs to borrow equipment affordably while providing Microlab and partners with sustainable revenue streams. Usage and repayment histories generated on the platform can serve as alternative credit data, strengthening future financing partnerships with banks or nonbank lenders. In this way, Electroteca becomes not only a resource-sharing ecosystem but also an enabler of financial inclusion.

Electroteca is supported by institutional partnerships and practical programs. Microlab's Microclub already provides access to advanced technologies through structured internships in areas such as Autonomous Vehicles, Drone Engineering, Industrial Automation, Smart Wearables, and Smart Environment Systems. Each internship focuses on cutting-edge domains ranging from DC motor control and computer vision for traffic sign detection to drone swarm communication and humanoid robotics. These programs reflect the type of high-value equipment that, if made available via Electroteca, could transform both educational and entrepreneurial outcomes. For example, innovators could borrow ultrasonic sensors or GPS-RTK modules for prototyping, while students could access robotic arms or environmental monitoring kits for class projects.

Through these partnerships, Electroteca gains credibility, access to a pool of technical instruments, and a steady stream of motivated users. Moreover, the collaboration with Microclub ensures that the platform is not just theoretical but embedded in a living ecosystem of training, mentorship, and applied engineering challenges. Together with the favourable macro-financial conditions and the growing e-commerce adoption in Moldova, these collaborations position Electroteca as a strategic platform to bridge the gap between idle equipment and unmet demand.

1.7 User Stories

Viewing a project from the end user's perspective ensures that the software effectively addresses real needs. To better visualize our application's features from this viewpoint, it is useful to formulate user stories: concise, non-technical descriptions that emphasize what the user aims to accomplish and why, helping the development team remain aligned with customer goals. In Table 1.1, we outline the processes through a series of user stories, specifying acceptance criteria and the priority level.

Table 1.1 – *User stories*

TITLE	USER STORY	ACCEPTANCE CRITERIA		PRIORITY	DESCRIPTION
Enable equipment booking system	An engineering student wants to book electronic tools and instruments in advance so that he can plan and complete his projects without delay.	**1**	The booking system must allow users to select available equipment.	High	This feature enables students to plan their project work by reserving electronics equipment in advance. It helps reduce scheduling conflicts, improve tool availability.
		2	Users must be able to reserve time slots and dates for equipment use.		
		3	The system must show real-time availability.		
		4	Users must receive confirmation of their booking.		
Create equipment availability dashboard	A student or an external user wants to easily see which tools are available and when, so they can plan their work efficiently.	**1**	Dashboard must display real-time availability.	Medium	This feature allows users to make informed decisions about when and where to use shared equipment. It also increases transparency and reduces frustration from unavailability.
		2	Users can filter equipment by type.		
		3	Booking history and future reservations must be viewable.		
		4	Equipment status must be shown.		
Membership based temporary access to equipment	A hobbyist or a startup member wants to pay for temporary access to electronic equipment, so that he can prototype and experiment without buying expensive tools.	**1**	The system must allow users to register as temporary members.	High	This feature allows university / non-university users to pay for time-limited access to equipment. It generates revenue and increases the utility of underused lab instruments.
		2	Users must be able to view and choose from available membership plans.		
		3	Users must be able to make secure payments.		
		4	Only users with an active membership can access and book equipment.		
Report equipment issues	A user wants to be able to report equipment	**1**	The system must allow users to submit issue reports linked to specific	High	This feature improves safety, ensures

	malfunctions or missing items, so that those issues can be fixed quickly and other users are aware.		equipment.		equipment reliability, and helps administrators
		2	Reports must include details (description, photos).		
		3	Equipment with active issues must be flagged as unavailable until resolved.		
User equipment sharing	A hobbyist wants to list his personal equipment for rental, so others can benefit from tools he’s not using.	**1**	The system must allow users to register equipment with details.	Low	This feature expands resource availability and creates an additional revenue stream for the users.
		2	Listings must be reviewed/approved by admins before going live.		
		3	Equipment owners must receive notifications when their items are booked.		

1.8 Technical Requirements

Now that we have identified the processes of our application, the next step is to conduct a requirements analysis. This ensures that stakeholder needs are clearly defined and translated into technical specifications. A thorough analysis reduces risks and guarantees that the final product meets its intended goals. In Table 1.2, we outline the key requirements for our application, specifying which user story they satisfy and the structural elements that fulfill them.

Table 1.2 – *Technical requirements*

ID	Summary	Type	Satisfies	Satisfied by
SYR 1	The system shall provide the ability for engineering students to book electronics tools and instruments in advance.	Functional Requirement	Efficient resource management	Web app, Database, Server app, UI
SYR 2	The system shall allow users to view real-time availability of equipment, including filtering by type (e.g., soldering stations, 3D printers).	Functional Requirement	Provide equipment availability visibility and avoid wasted time.	Web app, Database, Server app, UI
SYR 3	The system shall allow users to reserve time slots and dates for equipment use, ensuring no conflicts in scheduling.	Functional Requirement	Avoid double-booking and guarantee that resources are allocated fairly and efficiently	Web app, Database, Server app, UI
SYR 4	The system shall provide registration, authentication, and identity verification for external users.	Functional Requirement	Support inclusivity of non-student users while maintaining security and proper payment control	Desktop app, Database, Server app, Payment System, UI
SYR 5	The system shall notify users of bookings, cancellations, or maintenance updates.	Functional Requirement	Keep users informed and minimize scheduling disruptions	Notification System, UI, Server app
SYR 6	The system shall allow users to report equipment issues (broken or malfunctioning items), and automatically update availability status.	Functional Requirement	Enable timely fault reporting while maintaining catalog accuracy, user safety, and an auditable maintenance workflow.	Web app, Database, Server app, UI, Notification System
SYR 7	The system shall provide detailed equipment usage history for students and admins.	Functional Requirement	Enable monitoring and auditing of equipment usage	Database, Web app, Server app, UI

SYR 8	The system should display a real-time availability dashboard where users can filter equipment by type	Functional requirement	View equipment availability	Web app, Database, Server app, UI
SYR 0	The system shall allow administrators to manage equipment inventory, including adding, removing, and updating items.	Functional Requirement	Maintain up-to-date inventory records	Web app, Database, Server app, UI
SYR 10	The system shall provide secure password management, including change and recovery options.	Functional Requirement	Ensure account security and user flexibility	Database, Server app, UI
SYR 11	The system shall generate reports on equipment usage, reservations, and AI suggestions for performance analysis	Functional Requirement	Support decision-making and system improvement	Database, Server app, Web app, UI

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