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--T L E M C E N--

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Présenté par :
Boumedien Meriem
Khorsi Sarra Hadile

Thème

Etude technico économique des robots désinfectant

Soutenu publiquement, le 04/07/2024, devant le jury composé de :

M. GHOUTI Abdellaoui	MCA	ESSA-Tlemcen	Président
M. BENNEKROUF Mohammed	MCA	ESSA-Tlemcen	Examinateur 1
Mme KHEDIM Amel	MCA	ESM-Tlemcen	Examinateur 2
M. MAGNAFI Hicham	MCA	ESSA-Tlemcen	Encadrant
M. BEMMOUSSAT Chems Eddine	MCB	Univ-Ain Temouchent	Encadrant
Mme GHERBI Sabah	MCA	Univ-Ain Temouchent	Co-encadrant
Mme OUHOUD Amina	MCB	ESSA-Tlemcen	Co-encadrant

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بسم الله الرحمن الرحيم

Summary

Our startup's business model revolves around providing an innovative UV-based line-following robot for disinfection needs in various industries. Through market analysis and customer relationship management, we tailor our marketing strategies to target specific sectors where hygiene and safety are paramount. Financially, we ensure cost-effectiveness in production and distribution, maximizing revenue potential. We utilize statistical data on disinfection rates to validate our product's efficacy, enhancing trust and credibility. Our sales strategy focuses on building partnerships and offering flexible pricing models to meet diverse client needs.

Keyword: Line-following robot, UV disinfection, Market analysis, Sales strategy, Disinfection statistics.

Résumé

Le modèle commercial de notre startup repose sur la fourniture d'un robot suiveur de ligne innovant à base de UV pour répondre aux besoins de désinfection dans divers secteurs. Grâce à une analyse de marché et à la gestion des relations client, nous adaptons nos stratégies marketing pour cibler des secteurs spécifiques où l'hygiène et la sécurité sont primordiales. Sur le plan financier, nous veillons à la rentabilité de la production et de la distribution, maximisant ainsi le potentiel de revenu. Nous utilisons des données statistiques sur les taux de désinfection pour valider l'efficacité de notre produit, renforçant ainsi la confiance et la crédibilité. Notre stratégie de vente met l'accent sur la création de partenariats et l'offre de modèles de tarification flexibles pour répondre aux besoins diversifiés des clients.

Mot clé : Robot suiveur de ligne, Désinfection UV, Analyse de marché, Stratégie de vente, Statistiques de désinfection.

ملخص

يدور نموذج عمل شركتنا الناشئة حول توفير روبوت يتبع الخط المبتكر بناءً على التقنية الفوق بنفسجية لتلبية احتياجات التطهير في مختلف الصناعات. من خلال تحليل السوق وإدارة العلاقات مع العملاء، نقوم بتخصيص استراتيجيات التسويق لاستهداف القطاعات المحددة حيث تكون النظافة والسلامة من الأهمية القصوى. ماليًا، نضمن فعالية التكلفة في الإنتاج والتوزيع، مما يزيد من الإيرادات المحتملة. نستخدم البيانات الإحصائية حول معدلات التطهير لتأكيد فعالية منتجنا، مما يعزز الثقة والمصداقية. تركز استراتيجية مبيعاتنا على بناء شراكات وتقديم نماذج تسعير مرنة لتلبية احتياجات العملاء المتنوعة.

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Dedication

*First and foremost, I thank **Allah** Almighty for His continuous presence in my life. He has been my support, listening to my prayers and granting my supplications. His mercy and blessings have guided and strengthened me throughout this journey.*

*I dedicate this work wholeheartedly to **my beloved father**, my hero, whose love and sacrifices have inspired me to persevere. To **my mother**, whose tenderness and encouragement have always comforted me. To my sister **Hadjer**, her husband **Hamza**, and their children **Assil** and **Iyad**, for their unwavering love and support. To my brother **Abdelkader**, his wife **Amina**, and their son **Tidjani**, who have always believed in me. To my sister **Nesrine** and my cousin **Habiba**, for their warm presence and words of encouragement.*

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With all my gratitude and love, I dedicate this work to you

Meriem

Dedication

First and foremost, I would like to thank **God,** who has always guided and blessed me, allowing me to reach this day and succeed in my studies.

I wish to commend **Myself** for the efforts, courage, and discipline demonstrated throughout my educational journey.

I dedicate this work to:To my heart, the flower of my life, to the courageous woman who has always been by my side to advise and encourage me to give my best, the one who brought me into this world and has always dreamed of my success. Through you, I have learned the beauty of compassion, the power of resilience, and grace in adversity. Thank you, **Mom.**

To my crown, the first love of my life, who has given meaning to my existence, encouraged and supported me, the man proud of me, who has sacrificed for me. Through your kind eyes, I have learned the value of hard work, perseverance, and selfless sacrifice. Thank you, **Dad.**

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accomplishments. May your path be illuminated by the same positive energy you brought to our work together.

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To **my dear family** *and* **friends** *and all those who have accompanied me on my journey.*

Sarra Hadile

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List of Figures

List of table

List of abbreviations

UV	Ultraviolet
USD	United States Dollar
DA	Algerian Dinars
CAGR	Compound Annual Growth Rate
IOT	Internet of Things
MS	Microsoft
BI	Business intelligence
SWOT	Strengths, Weaknesses, Opportunities and Threats.
PESTEL	Political, Economic, Social, Technological, Legal, and Environment
ASF	Available stable funding

Information Card

1. Management Team:

Supervisors and their specialties	
Dr. BEMMOUSSAT Chemseddine	Telecommunications
Dr. MEGNAFI Hichem	Telecommunications
Dr. GHERBI Sabah	Corporate governance
Dr. OUHOUD Amina	Industrial Engineering

2. Project Team:

First and last Name	Boumedien Meriem Khorsi Sarra Hadile
Specialization	Industrial Engineering option Industrial Management and Logistics.
Title of our Project	HYGIENITECH
Our phone number	213-774071135 213-666854894
Our email address	meriem.bmdn@gmail.com sarah.khorsi2001@gmail.com
Our city or municipality of activity	Tlemcen Higher School of Applied Sciences Tlemcen

3. Our startup

HYGIENITECH is an innovative startup specializing in the design and manufacturing of disinfectant robots using ultraviolet (UV) technology. Founded on principles of advanced technology and ecological solutions, HYGIENITECH is committed to offering automated disinfection products that meet the growing needs for cleanliness and safety in various environments.

3.1. Our Mission

Our mission is to revolutionize the disinfection industry with intelligent and efficient robots designed to provide optimal disinfection in the most demanding environments.

3.2. Future Vision

HYGIENITECH aspires to become the global leader in robotic disinfection. We are committed to continuous innovation and to offering solutions that make living and working spaces safer and healthier for everyone.

3.3. Meaning of the Name "HYGIENITECH"

- **HYGIEN**: This prefix is derived from the word "hygiene," which is at the core of our mission. It represents our commitment to cleanliness, health, and infection prevention.
- **TECH**: This suffix refers to technology, the other pillar of our company. It highlights our use of the latest technological innovations to create advanced disinfection solutions.

3.4. Our Slogan: "Where Safety Meets Innovation"

Our slogan **"Where Safety Meets Innovation"** perfectly embodies our mission and core values. Here's a brief explanation of this slogan :

- **Safety**: Safety is our absolute priority. Our UV disinfectant robots are designed to offer optimal disinfection, ensuring a clean and safe environment for everyone.
- **Innovation**: Innovation is the driving force that pushes us to constantly innovate. We use the most advanced technologies to develop disinfection solutions that are both effective and environmentally friendly.

3.5. Our Logo

Figure.1 Our logo

We chose a logo with blue and black colors, accompanied by white lettering, for our startup with a specific intention. Blue symbolizes trust, stability, and reliability, values that we aim to convey to our clients and partners. Black suggests professionalism, elegance, and sophistication, reflecting our commitment to excellence and quality. The white lettering provides sharp contrast and readability, emphasizing our transparency and accessibility. Together, these elements embody the dynamic and modern identity of our startup, poised to stand out in a competitive market while inspiring confidence and credibility.

General introduction

The development of innovative solutions to address contemporary challenges is essential in today's competitive business environment. Our startup project, a UV-based line-following robot designed for environments requiring strict and frequent disinfection, is no exception. Our project was created within the framework of **1275**, emphasizing the need for effective disinfection methods grows, so too does the importance of crafting a robust business model to support and sustain our technological innovation. This thesis explores the various aspects of our business model using the Business Model Canvas framework, examining key elements such as market analysis, financial planning, and strategic partnerships.

Disinfection is crucial in preventing the spread of infectious diseases, but it presents several market challenges. Traditional methods, such as chemical or heat-based approaches, may be ineffective against resilient pathogens and pose environmental and safety concerns. In this context, our UV-based line-following robot offers a promising solution. However, for this innovation to succeed commercially, a comprehensive business strategy is needed to navigate market demands, competitive landscapes, and financial viability.

The aim of this thesis is to develop a detailed business model for our startup project. We will provide a thorough analysis of the market, including customer segmentation, competitive landscape, and marketing strategies. We will also delve into production processes, procurement strategies, and partnership opportunities. Financial planning, including costs, revenues, and profitability, will be meticulously outlined to ensure the sustainability of our venture.

The thesis is divided into five chapters, starting with the Project Overview and Innovative Aspects, which introduces the concept of our UV-based line-following robot, detailing the core values and objectives that drive our innovation. This chapter explores the unique value proposition of our product and how it differentiates from existing solutions. The next chapter, Strategic Market Analysis, analyzes the target market for our robot, including customer segments and needs. A competitive landscape analysis identifies key competitors and market opportunities, followed by a comprehensive marketing strategy. The Production Plan and Organization chapter covers the technical and operational aspects of bringing our product to market, discussing the production process, procurement strategies for sourcing materials, and labor and workforce management. Additionally, partnership strategies that can enhance our business operations are explored. The Financial Plan chapter presents a detailed financial plan, including cost structures, revenue models, and financial projections. It examines the initial investment requirements, operational costs, and potential revenue streams to ensure our startup's financial health. The final chapter, Experimental Prototype, provides an overview of the experimental prototype of our UV-based line-following robot. It outlines the design steps and processes undertaken to develop the prototype, highlighting the practical application of theoretical concepts. The thesis concludes with a general conclusion summarizing our findings and outlining future steps for the development and commercialization of our UV-based line-following robot.

By integrating technical innovation with strategic business planning, we aim to contribute to the advancement of effective and sustainable disinfection solutions in various critical environments.

First Axis: Project Overview and Innovative Aspects

Introduction

This chapter presents the idea of our startup project: a UV-based line-following robot for environments requiring strict disinfection. We will discuss the values that drive us, such as innovation and sustainability, and define the main objectives of the project. By highlighting the innovative aspects and advantages of our robot, we lay the foundation for the more detailed analyses to come.

I.1 Project Idea (Proposed Solution)

The project involves the design and development of a UV-based disinfecting robot
As shown on **Figure I.1**, specifically tailored to meet the disinfection needs across various sectors, particularly hospitals and other medical environments. The idea originated from the increasing demand for rapid and effective disinfection solutions to combat the spread of infectious diseases, particularly in the context of the COVID-19 pandemic.

The robot will be engineered to utilize UV-C [1]rays to effectively eliminate viruses, bacteria, and other pathogens present on surfaces. Equipped with advanced sensors and intelligent software, the robot will be designed to follow a predefined path, such as a designated line on the floor, to ensure thorough disinfection.

The disinfection process will occur automatically, enabling swift and efficient disinfection without requiring direct human intervention. The team responsible for the development and manufacturing of the robot will comprise engineers specialized in robotics and UV technology, working closely with public health experts to ensure its effectiveness.

The disinfecting robot can be deployed in various settings, including hospitals, clinics, medical practices, laboratories, and other healthcare facilities where regular disinfection is crucial to ensure the safety of patients, staff, and the public.

[1] UV-C: stands for Ultraviolet C, which is a type of ultraviolet light.

Figure I.2 Our Prototype

I.2 The proposed values

In the context of the UV-based line-following disinfectant robot, the proposed values can be as follows:

- **Technological innovation:** Offering an innovative disinfection solution that integrates UV technology to ensure effective surface disinfection.
- **Health safety**: Ensuring a safe environment by eliminating pathogens and contaminants on surfaces through UV disinfection.
- **Efficiency and performance**: Ensuring quick and effective surface disinfection by autonomously following predefined lines, providing a practical and efficient solution.
- **Adaptability:** Allowing the robot to adapt to different environments and surfaces, thus offering a versatile solution for a variety of applications.
- **Environmental sustainability:** Designing the robot with durable and environmentally friendly materials, thereby contributing to sustainability and corporate social responsibility.
- **Accessibility:** Making UV disinfection technology accessible to a wide range of users, including in the healthcare, hospitality, and transportation sectors.
- **Reliability:** Guaranteeing the reliability and accuracy of the robot in its disinfection operations, thus providing a reliable solution to ensure public safety and health.
- **Ease of use:** Designing the robot with a user-friendly and intuitive interface, making it easy for non-technical staff to use.
- **Regulatory compliance:** Ensuring compliance with applicable disinfection and safety standards and regulations, thus ensuring the legitimacy and reliability of the product in the market.

I.3 Teamwork

BOUMEDIEN Meriem: Engineering student specializing in Industrial Engineering, option Industrial and Logistics Management in Higher School of Applied Sciences, Tlemcen.

KHORSI Sarra Hadile: Engineering student specializing in Industrial Engineering, option Industrial and Logistics Management in Higher School of Applied Sciences, Tlemcen.

The two students worked together on the design of the robot, the construction of the structure, the wiring and software part, the supply of materials, testing and video assembly, chapter writing, and the creation of the business model on Canva. Therefore, the work was divided and carried out with a well-balanced team effort.

I.4 Project Objectives

The commercial objectives of our startup project, which is a UV-based line-following disinfectant robot, are as follows:

- **Short term (1 year):** Our goal is to establish a presence in the local market by targeting hospitals, schools, and businesses. We aim to capture at least 5% of this local market within the first year.
- **Medium term (3 years):** In the medium term, our objective is to expand our reach regionally by entering neighboring markets and developing partnerships with distributors and healthcare service providers. We anticipate achieving a market share of at least 10% in our extended geographical region.
- **Long term (5 years and beyond):** In the long term, we aspire to become a national or even international leader in the field of robotic disinfection. We aim to secure a market share of 15% or more in our home country and to expand our presence in international markets, with a particular focus on regions where demand for advanced disinfection solutions is rapidly growing.

I.5 Project Implementation Schedule

The project implementation schedule is a crucial stage that requires meticulous planning and effective coordination of every process. To ensure the success of our venture, we have developed a detailed implementation schedule encompassing all stages of production. It all begins with product planning and design, where ideas take shape and transform into tangible concepts. Next, we proceed with the purchase of raw materials and components, followed by their reception and inspection to ensure quality. Assembling and constructing the robot's chassis and fabricating its support and carcass are essential steps that follow. Simultaneously, precision is applied in powering and assembling the electronic components, followed by programming, and developing control algorithms. Rigorous testing is then conducted to verify the proper functioning of the robot before uploading the program and installing the UV lamps. Finally, the process concludes with careful packaging of the product and preparation for shipment before distribution and delivery to the customer. Each step is seamlessly integrated into our planning, ensuring efficient execution and a quality product.

I.6 Nature of innovations

Let's now delve into the nature of innovations within our project.

I.6.1 Market uncertainty versus technological uncertainty

Our project may face technological uncertainty as it utilizes a relatively new technology, UV, for disinfection. However, market uncertainty may be moderate as there is growing demand for effective disinfection solutions in various sectors.

I.6.2 Incremental innovations

Our project could involve incremental innovations as it builds upon existing technologies and methods (such as UV technology) to develop an enhanced product addressing specific market needs, such as autonomous disinfection.

I.6.3 Market innovations

We could also incorporate market innovations by identifying and addressing specific market needs, such as the increasing demand for autonomous and effective disinfection solutions amid current health concerns.

I.6.4 Radical innovations

While our project may be considered an innovation, it may not be deemed a radical innovation overall. However, in the specific context of robotic disinfection, our product could represent a significant innovation.

I.6.5 Technological innovations

Our project certainly involves technological innovations, leveraging advancements in UV technology, robotics, and sensors to create a novel product capable of autonomously disinfecting indoor environments.

I.7 Areas of innovation

Overall, innovation in our UV-based line-following disinfectant robot project could include the following areas:

1. New processes: We could innovate by developing more efficient manufacturing and disinfection processes, which would increase profitability by reducing production costs and speeding up operations.

2. New features: We could innovate by integrating new features into our disinfectant robot, such as advanced sensors to detect high-risk contamination areas or intelligent algorithms to optimize the disinfection path.

3. New customers: We could target new customer segments, such as schools, hospitals, or businesses, by adapting our product to meet their specific disinfection needs.

4. New offerings: We could offer innovative product offerings by developing accessories or complementary solutions to our disinfectant robot, such as automatic charging stations or disinfection management software.

5. New models: We could consider modifying our business model by offering options to lease our disinfectant robots rather than selling them, or by providing subscription services for maintenance and software updates, creating a new source of revenue and value for our customers.

I.6 Conclusion

In conclusion, the introduction sets the stage for our UV-C-based line-following robot project, emphasizing innovation, health safety, and efficiency. We also discussed the nature of innovation of our robot, highlighting its value proposition. With a clear understanding of our objectives and values, we embark on the next chapter, Strategic Market Analysis, where we delve into market dynamics, competition, and customer needs to devise effective marketing strategies and ensure the success of our venture.

Second Axis: Strategic Market Analysis

Introduction

In this chapter, we conduct an in-depth analysis of the global disinfection robot market to strategize the introduction and positioning of our UV-C-based line-following robot. We explore the market's rapid growth, substantial potential, and investments, focusing on key industries prioritizing hygiene and infection control, such as healthcare and hospitality. We then shift to the Algerian market, examining the local disinfection technology landscape and identifying competitors. Using these insights, we develop a comprehensive marketing strategy tailored to Algeria, including plans for enhancing visibility, optimizing pricing, establishing efficient distribution channels, and engaging customers effectively. Our goal is to make our UV-C line-following robot a leading solution in Algeria's quest for superior hygiene and infection control.

II.1 Disinfection Robot Market Analysis

The disinfection robot market size is estimated to be USD 1.12 billion (approximately 150.78 billion DA) in 2024 and is expected to reach USD 3.36 billion (approximately 452.35 billion DA) by 2029, with a growth rate of 24.60% during the forecast period (2024-2029). The rapid increase in healthcare and sanitation expenditures due to the COVID-19 pandemic, along with significant investments in disinfection robots, has driven the demand and growth in the market. (Intelligence, 2024)

Table II.1 Disinfectant Robot Market (Intelligence, 2024)

Study period	2019-2029
Market Size (2024)	USD 1.12 billion
Market Size (2029)	USD 3.36 billion
CAGR (2024 - 2029)	24.60%
Fastest Growing Market	North America
Larget Market	Asia-Pacific

Figure II.1 Market Size in USD Billion (Intelligence, 2024)

II.2 Market Growth and Investments in Disinfection Robots

Asia-Pacific Expected to Hold the Largest Market Share. The Asia-Pacific region is rapidly becoming one of the most significant areas for the production and utilization of disinfection robots. This growth is facilitated by the region's increasing share in the global robotics industry. Countries such as Australia, South Korea, Japan, India, China, and Singapore are heavily investing in the disinfection robot market across the value chain. South Korea, Japan, India, and China are global manufacturing hubs for robots, while Hong Kong, India, and Singapore are emerging as major centers for robotics startups. Southeast Asia is seeing significant investment due to the modernization of its healthcare facilities and economic support. (Intelligence, 2024)

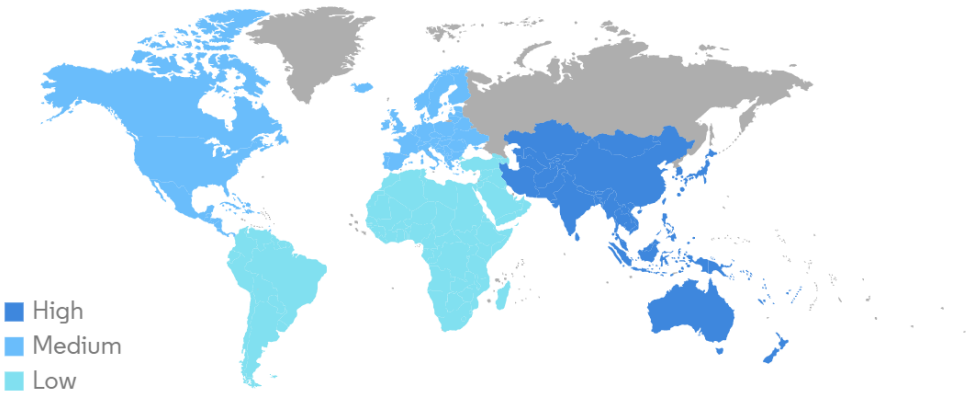

Figure II.2 Disinfectant Robot Market – Growth Rate by Region (2022-2027)
(Intelligence, 2024)

As seen in **Figure II.2**, Algeria is among the countries with the lowest utilization of disinfection robots. This represents a significant opportunity for us to introduce and establish our UV-based line-following robots in the Algerian market. With increasing global emphasis on hygiene and infection control, there is a clear potential to capitalize on the growing demand for advanced disinfection solutions. By addressing this gap, we can not only contribute to improving public health in Algeria but also position our product as a leading solution in a market with substantial growth potential. This strategic move could provide us with a competitive advantage and enable us to capture a significant share of the emerging market.

II.3 Market Leaders in Disinfection Robots

The competitive rivalry among the leading players in the disinfection robot market is intense. By introducing new products, offering items with exclusive technology, and entering agreements with end-users, industry suppliers are increasing their overall market share. In January 2022, Blue Ocean Robotics announced the expansion of its mobile robot solutions globally with an investment of 43.55 million USD to meet the growing demand for service robots that can assist businesses and institutions. (Intelligence, 2024)

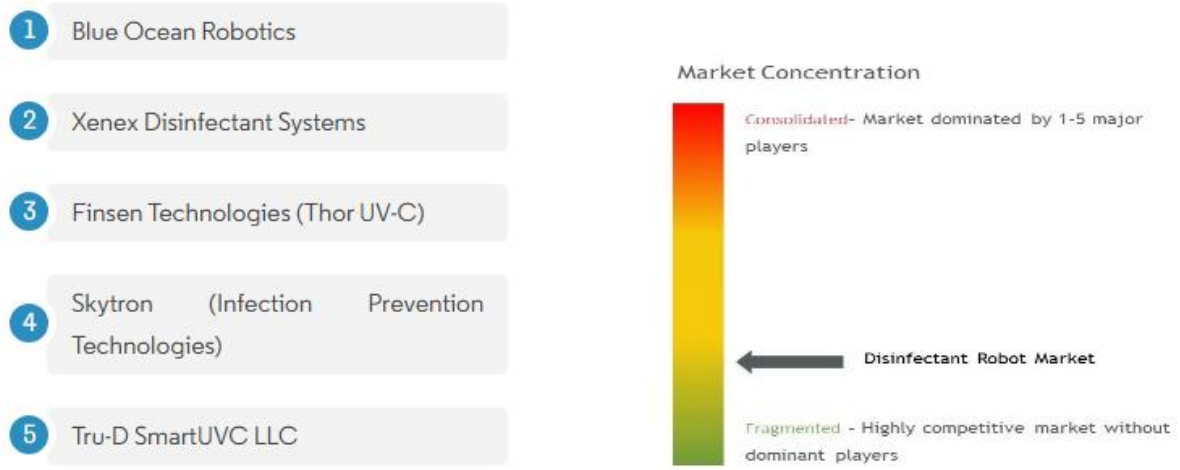

Figure II.3 Market Leaders in Disinfection Robots (Intelligence, 2024)

II.4 The market segment

As we transition into the next segment of our analysis, let's delve deeper into the strategies aimed at satisfying clients for our UV-C disinfection robot.

II.4.1 Market potential

The market potential for UV disinfection robots is extensive, encompassing a wide range of industries and sectors. Demand is particularly high in high-infection-risk environments like hospitals, nursing homes, and care facilities. This market is driven by the growing awareness of the importance of effective disinfection for infection control and disease prevention.

II.4.2 Target Market Segment

Our UV disinfection robot targets a broad market segment encompassing various industries and facilities prioritizing hygiene and infection control. These include:

- Healthcare: Hospitals, clinics, medical offices.
- Food Industry: Factories, restaurants, kitchens
- Laboratories: Research laboratories and medical facilities
- Environment: Public spaces, public transportation, offices
- Hospitality: Hotels and lodging places
- Pharmaceutical Industry
- Agriculture
- Sensitive Areas: Cleanrooms and research zones
- Residential: Homes

These diverse sectors all share a need for automated and effective disinfection solutions to maintain cleanliness and minimize the risk of contamination.

II.4.3 Securing Key Clients

To secure contracts across this diverse market segment, we'll employ a multifaceted approach. We'll build relationships with key decision-makers in each target sector, from hospital administrators and school principals to hotel managers and agricultural business owners. By understanding their specific needs and challenges, we can tailor presentations highlighting the unique benefits of our UV disinfection robot. Offering pilot programs and demonstrations will further showcase its effectiveness. Additionally, flexible payment terms and financing options will enhance accessibility for a wider range of potential clients. We're confident that our robot's versatility, safety, and efficiency will make it a valuable solution across various industries.

II.5 Competitive Landscape Analysis

In evaluating the competitive landscape, we have identified both direct and indirect competitors in the disinfection technology sector within Algeria. While there are no local manufacturers of UV-based disinfection robots like ours, notable players such as UVD ROBOT operate as distributors of imported European-made disinfection robots. UVCtech, on the other hand, serves as a distributor of UV disinfection products and traditional chemical disinfectants in Algeria.

UVCtech, with its imported European robots, holds a significant position in the market by offering high-tech autonomous disinfection solutions. However, a key weakness lies in the relatively high pricing of these imported robots, which may limit widespread adoption among Algerian customers. In contrast, our locally manufactured robot addresses this challenge by offering a competitively priced alternative without compromising on quality or technology.

Analyzing UVCtech's strengths and weaknesses, we observe that their distribution network and access to advanced European technology provide a competitive advantage. Nonetheless, the pricing barrier remains a notable weakness. Our robot, produced domestically at a reasonable cost, emerges as a superior solution for the Algerian market, combining affordability with advanced disinfection capabilities. This strategic positioning allows us to capitalize on the demand for effective and accessible disinfection solutions in Algeria, outperforming competitors like UVCtech in terms of local market relevance and customer value proposition.

II.5.1. Strategic Analysis

We conducted a strategic analysis, including SWOT[2] and PESTEL[3] frameworks, to thoroughly examine the landscape of our project.

Table II.1 SWOT Analysis of UVCtech.

SWOT	
Strengths ▪ Access to Advanced Technology: UVCtech distributes high-tech, autonomous European-made UV disinfection robots, ensuring cutting-edge solutions. ▪ Established Distribution Network: Well-developed channels for distributing both UV disinfection products and traditional chemical disinfectants in Algeria. ▪ Reputation: Being associated with European technology enhances brand credibility and trust among consumers.	**Weakness** ▪ High Pricing: The cost of imported European robots is relatively high, which can limit widespread adoption among cost-sensitive Algerian customers. ▪ Dependence on Imports: Reliance on imported products may lead to supply chain disruptions and longer lead times. ▪ Limited Local Customization: Imported products may not fully address local needs and preferences compared to locally manufactured solutions.
Opportunities ▪ Growing Market Demand: Increasing awareness and need for effective disinfection solutions post-COVID-19. ▪ Partnerships and Collaborations: Opportunities to partner with local healthcare institutions and businesses to expand market reach. ▪ Technological Advancements: Potential to integrate more advanced features and functionalities into their offerings to stay competitive.	**Threats** ▪ Local Competition: Emergence of local manufacturers offering competitively priced alternatives, such as our locally manufactured UV disinfection robot. ▪ Economic Instability: Economic fluctuations in Algeria could impact purchasing power and investment in advanced technology. ▪ Regulatory Changes: New regulations or changes in import policies could affect the cost and availability of imported products.

[2] SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. A "SWOT analysis" involves carefully assessing these four factors in order to make clear and effective plans.
[3] PESTEL is a framework used to analyze and monitor the macro-environmental factors that may have a profound impact on an organization's performance.

Table II.2 SWOT Analysis of our Project.

SWOT	
Strengths	**Weakness**
▪ Localized Production: Manufacturing the robot in Algeria can significantly reduce costs associated with import taxes and logistics. This also allows for quicker response times to market needs and potential customizations. ▪ Growing Demand: There is an increasing global and local demand for effective disinfection solutions, especially post-COVID-19, which can drive market adoption. ▪ Advanced Technology: Incorporating UV-C disinfection technology ensures high efficacy in killing bacteria and viruses, making the product highly effective in healthcare and other sensitive environments. ▪ Market Potential: Algeria is currently one of the lowest users of disinfection robots, presenting a substantial opportunity for market penetration and growth.	▪ Technological Barriers: Ensuring the product meets international standards and certifications can be challenging and resource-intensive.
Opportunities	**Threats**
▪ Government Support: Potential for government grants and subsidies for healthcare improvements, including advanced disinfection technologies. ▪ Healthcare Sector Growth: Expanding healthcare infrastructure in Algeria can drive demand for	▪ Competition: High competition from established international players with advanced technology and established market presence. ▪ Economic Factors: Economic instability and fluctuations in Algeria could impact the purchasing power

advanced disinfection solutions. ▪ Export Potential: Opportunities to export the product to neighboring countries and regions with similar market gaps and needs. ▪ Technological Advancements: Continuous improvements and innovations in UV-C technology and robotics can enhance product offerings and efficiency.	of potential customers. ▪ Regulatory Challenges: Navigating complex regulatory environments and obtaining necessary certifications can delay market entry and expansion. ▪ Technological Obsolescence: Rapid technological advancements could make the current model obsolete, necessitating continuous investment in research and development.

Table II.3 PESTEL Analysis of our Project.

Political	**Economic**	**Social**
▪ Government support through subsidies and grants. ▪ Strict health regulations. ▪ Political stability	▪ Economic growth affecting purchasing power. ▪ Local manufacturing reducing costs.	▪ Increasing public awareness about hygiene. ▪ Focus on healthcare improvements. ▪ Cultural acceptance
Technological	**Environmental**	**Legal**
▪ Innovation in UV-C and IoT[4] integration. ▪ Need for robust technological infrastructure	▪ Sustainability trends. ▪ Regulatory compliance. ▪ Availability of raw materials	▪ Intellectual property protection. ▪ Product liability issues. ▪ Navigating trade policies

Nb: All these three tables (SWOT and PESTEL) have been meticulously created by students.

II.6 Marketing Strategy

A comprehensive marketing strategy is crucial for introducing your UV disinfection robot to the Algerian market and capturing a significant share. This strategy should encompass various aspects, including visibility, pricing, distribution, and customer engagement.

A comprehensive marketing strategy is crucial for introducing your UV disinfection robot to the Algerian market and capturing a significant share. This strategy should encompass various aspects, including visibility, pricing, distribution, and customer engagement.

[4] The term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.

II.6.1 Visibility Strategies

- **Online Presence:** We will establish a strong online presence by creating a user-friendly website that showcases our robot's features, benefits, and testimonials.
- **Social Media Engagement:** Leveraging on social media platforms like Facebook, Instagram, and LinkedIn to connect with potential customers and share informative content, engage with followers, and run targeted ads to increase brand awareness and drive traffic to our website.
- **Public Relations and Media Outreach:** Issue press releases, pitch stories to local media outlets, and participate in industry events to generate positive media coverage and enhance brand credibility.

II.6.2 Pricing Strategy

- **Competitive Pricing:** Employ a competitive pricing strategy that balances affordability with profitability.
- **Flexible Payment Options:** Offer flexible payment options, such as installment plans or rental agreements, to make our robot accessible to a wider range of customers, particularly businesses with budget constraints.
- **Early Adopter Discounts:** Provide introductory discounts or special offers to early adopters to incentivize early purchases and generate positive word-of-mouth.

II.6.3 Distribution Strategy

- **Direct Sales:** Establish a direct sales team to personally engage with potential customers, particularly large businesses and healthcare facilities. This approach allows for customized sales presentations and relationship building.
- **E-commerce Platform:** Utilize an e-commerce platform to sell our robot directly to consumers and small businesses.the platform is user-friendly, secure, and offers multiple payment options.
- **Partnerships with Distributors:** Partner with established distributors in the cleaning and sanitation industry to expand our reach and leverage their expertise in sales and logistics.

II.6.4 Free Trials and Demonstrations

Offer free trials or demonstrations of our robot to allow potential customers to experience its effectiveness firsthand. This can be particularly effective for larger clients.

By implementing a comprehensive marketing strategy that combines effective visibility, competitive pricing, strategic distribution, and proactive customer engagement, We can

successfully introduce our UV disinfection robot to the Algerian market, establish a strong brand presence, and achieve sustainable growth.

II.7 Conclusion

In conclusion, the thorough examination of our target market segment, its potential, and the strategies outlined to secure key clients underscores the robust foundation upon which our UV disinfection robot project stands. As we proceed to analyze the competitive landscape and develop our marketing strategy, we remain confident in our ability to meet market demands effectively and establish a strong foothold in the Algerian market. Moving forward, we will now delve into the intricacies of our Production and Organization Plan in the next chapter.

Third Axis: Production and Organization plan

Introduction

The production and organization plan for our UV disinfection robot project is a pivotal aspect of ensuring quality, efficiency, and success in delivering our innovative product to the market. In this chapter, we will delve into the intricacies of our production process, procurement strategy, labor and workforce management, and partnership strategy. By meticulously outlining each stage of production, from material selection to assembly and testing, we aim to uphold the highest standards of quality and safety. Additionally, our procurement strategy prioritizes sourcing high-quality components while maintaining cost-effectiveness and sustainability. Moreover, we'll explore our approach to labor and workforce management, emphasizing skills assessment, training, and workplace safety. Finally, our partnership strategy focuses on strategic collaborations and community engagement to foster innovation, expand market reach, and promote environmental sustainability. Through these concerted efforts, we are poised to meet market demands effectively and establish a strong presence in the UV disinfection industry.

III.1 Production Process

Our UV disinfection robot undergoes a meticulous production process to ensure the highest quality and standards. Each stage is carefully monitored and controlled to deliver a product that meets the expectations of our valued customers.

1) **Product Planning and Design:** The initial phase involves detailed planning and designing of the robot to meet specific requirements and industry standards.
2) **Procurement of Raw Materials and Components**: We source high-quality components and materials from reputable suppliers to ensure the durability, performance, and safety of our robots.
3) **Receiving and Inspecting Raw Materials:** All materials and components undergo thorough inspection upon arrival to ensure they meet our stringent quality criteria.
4) **Assembly and Construction of the Robot Chassis:** Skilled technicians assemble the robot's chassis with precision and care, following strict quality control procedures.
5) **Fabrication of the Robot’s Frame and Casing:** The support structures and casing are fabricated to provide a robust and protective housing for the robot’s components.

6) **Power Supply and Assembly of Electronic Components:** The power supply system and electronic components are meticulously assembled and integrated into the robot.
7) **Programming and Development of Control Algorithms:** We develop and program the control algorithms that ensure the robot operates effectively and efficiently.
8) **Testing and Verification:** Each robot undergoes rigorous testing to verify its functionality, safety features, and compliance with industry standards.
9) **Uploading the Program and Installing UV Lamps:** The control software is uploaded, and UV lamps are installed to enable the robot's disinfection capabilities.
10) **Packaging and Preparation for Shipment:** Robots are securely packaged with protective materials, clearly labeled with product details, handling instructions, and compliance certifications. An advanced tracking system monitors each package's journey, providing customers with real-time updates for transparency and reliability.
11) **Distribution and Delivery to the Customer:** The final products are distributed and delivered to customers, ensuring timely and efficient service.

This structured approach ensures that our UV disinfection robots are of the highest quality and meet the needs of our customers.

III.2 Labor and Workforce Management

Our team comprises a diverse group of skilled professionals who are integral to the production of our UV disinfection robots. Below are the key roles and their responsibilities:

III.2.1. Roles and Responsibilities

- **Project Manager 1** : Oversees the entire project, ensuring timely and within-budget completion. Manages resources and coordinates between departments.
- **Project Manager 2** : Supports Project Manager 1 with quality control and compliance, assisting in decision-making and problem-solving.
- **Procurement Specialist** : Handles purchasing of materials and components, ensuring quality and negotiating prices.
- **Receiving Worker** : Inspects and verifies incoming materials and components.
- **Instrumentation Technician** : Manages instrumentation and ensures all equipment is correctly calibrated.
- **Electro-Mechanical Engineer 1** : Integrates electrical and mechanical components for seamless operation.
- **Electro-Mechanical Engineer 2** : Assists in the integration of electrical and mechanical components and provides technical support.
- **Packaging Workers** : Handle final packaging and labeling.

- **Customer Service and Marketing Specialist** : Manages customer inquiries and marketing activities.

III.2.2. Strategies for Ensuring Production Success

To ensure the success of our UV disinfection robot production, we will carefully apply the following strategies:

III.2.2.1. Human Resource Planning

- **Skills Assessment**: Identify specific skills and expertise required for each role in the production process.
- **Recruitment and Training**: Implement a comprehensive recruitment strategy to attract qualified candidates and provide necessary training.
- **Employee Development**: Offer continuous training and development opportunities to enhance employee skills and productivity.

III.2.2.2. Workplace Safety

- **Safety Protocols**: Implement strict safety protocols and provide regular safety training to all employees.
- **Ergonomic Workstations**: Design ergonomic workstations to minimize employee fatigue and prevent workplace injuries.
- **Emergency Procedures**: Establish clear emergency procedures and conduct regular safety drills to ensure employee preparedness.

By implementing these strategies, we aim to maintain a highly skilled and motivated workforce, ensuring the highest quality in our production processes while prioritizing the safety and well-being of our employees. All the details of our plan have been meticulously crafted and managed using MS Project[5], as outlined below:

[5] MS Project is project management software product, developed and sold by Microsoft. It is designed to assist a project manager in developing a schedule, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads

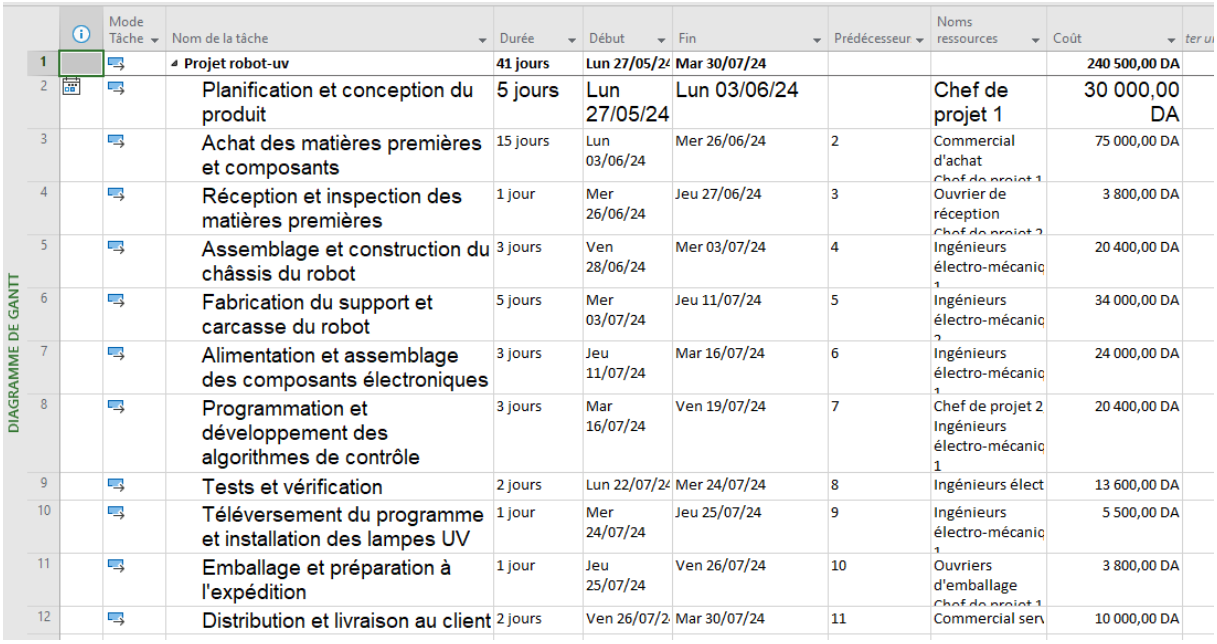

DIAGRAMME DE GANTT

	Mode Tâche	Nom de la tâche	Durée	Début	Fin	Prédécesseur	Noms ressources	Coût
1		**Projet robot-uv**	**41 jours**	**Lun 27/05/24**	**Mar 30/07/24**			**240 500,00 DA**
2		Planification et conception du produit	5 jours	Lun 27/05/24	Lun 03/06/24		Chef de projet 1	30 000,00 DA
3		Achat des matières premières et composants	15 jours	Lun 03/06/24	Mer 26/06/24	2	Commercial d'achat	75 000,00 DA
4		Réception et inspection des matières premières	1 jour	Mer 26/06/24	Jeu 27/06/24	3	Ouvrier de réception	3 800,00 DA
5		Assemblage et construction du châssis du robot	3 jours	Ven 28/06/24	Mer 03/07/24	4	Ingénieurs électro-mécanic	20 400,00 DA
6		Fabrication du support et carcasse du robot	5 jours	Mer 03/07/24	Jeu 11/07/24	5	Ingénieurs électro-mécanic	34 000,00 DA
7		Alimentation et assemblage des composants électroniques	3 jours	Jeu 11/07/24	Mar 16/07/24	6	Ingénieurs électro-mécanic	24 000,00 DA
8		Programmation et développement des algorithmes de contrôle	3 jours	Mar 16/07/24	Ven 19/07/24	7	Chef de projet 2 Ingénieurs électro-mécanic	20 400,00 DA
9		Tests et vérification	2 jours	Lun 22/07/24	Mer 24/07/24	8	Ingénieurs élect	13 600,00 DA
10		Téléversement du programme et installation des lampes UV	1 jour	Mer 24/07/24	Jeu 25/07/24	9	Ingénieurs électro-mécanic	5 500,00 DA
11		Emballage et préparation à l'expédition	1 jour	Jeu 25/07/24	Ven 26/07/24	10	Ouvriers d'emballage	3 800,00 DA
12		Distribution et livraison au client	2 jours	Ven 26/07/2	Mar 30/07/24	11	Commercial serv	10 000,00 DA

Figure III.1 A visual representation of the production stages in MS Project software.

This table appears to represent a project plan outlining the various stages necessary for the design and delivery of a product, likely a robot, spanning several weeks. Below is a detailed description of the different steps, details, and remarks:

1. Product Planning and Design (5 days)

- Dates: From Monday, May 27, 2024, to Monday, June 3, 2024.
- Responsible: Project Manager 1, Project Manager 2.
- Cost: 30,000.00 DA.

Remark: This initial phase involves defining the product specifications and planning its design. It requires collaboration between the project managers.

2. Purchase of Raw Materials and Components (15 days)

- Dates: From Monday, June 3, 2024, to Wednesday, June 26, 2024.
- Responsible: Purchasing Commercial, Project Manager 1.
- Cost: 75,000.00 DA.

Remark: During this period, the raw materials and components necessary for product fabrication will be purchased. Close coordination between the commercial department and project managers is essential.

3. Reception and Inspection of Raw Materials (1 day)

- Dates: Wednesday, June 26, 2024, to Thursday, June 27, 2024.
- Responsible: Reception Worker, Project Manager 2.
- Cost: 3,800.00 DA.

Remark: This step involves the receipt of purchased raw materials and their inspection to ensure quality and compliance.

4. Assembly and Construction of Robot Chassis (3 days)

- Dates: From Friday, June 28, 2024, to Wednesday, July 3, 2024.

-Responsible: Electro-Mechanical Engineers 1, Instrumentation Technician, Project Manager1.

- Cost: 20,400.00 DA.

Remark: Experts in engineering are tasked with assembling and constructing the robot chassis according to specifications.

5. Manufacturing of Robot Support and Frame (5 days)

- Dates: From Wednesday, July 3, 2024, to Thursday, July 11, 2024.

-Responsible: Electro-Mechanical Engineers 2, Instrumentation Technician, Project Manager2.

- Cost: 34,000.00 DA.

Remark: This step involves manufacturing supports and the frame of the robot, requiring the expertise of electro-mechanical engineers and technicians.

6. Powering and Assembly of Electronic Components (3 days)

- Dates: From Thursday, July 11, 2024, to Tuesday, July 16, 2024.

- Responsible: Electro-Mechanical Engineers 1, Electro-Mechanical Engineers 2, Project Manager 1.

- Cost: 24,000.00 DA.

Remark: This phase involves powering and assembling the electronic components of the robot.

7. Programming and Development of Control Algorithms (3 days)

- Dates: From Tuesday, July 16, 2024, to Friday, July 19, 2024.

-Responsible: Project Manager 2, Electro-Mechanical Engineers 1, Instrumentation Technician.

- Cost: 20,400.00 DA.

Remark: Experts work on programming and developing algorithms necessary for controlling the robot.

8. Testing and Verification (2 days)

- Dates: From Monday, July 22, 2024, to Wednesday, July 24, 2024.

- Responsible: Electro-Mechanical Engineers 2, Instrumentation Technician, Project Manager 1.

- Cost: 13,600.00 DA.

Remark: This stage involves thorough testing to verify the proper functioning of the robot.

9. Program Upload and UV Lamp Installation (1 day)

- Dates: From Wednesday, July 24, 2024, to Thursday, July 25, 2024.
- Responsible: Electro-Mechanical Engineers 1, Project Manager 2.
- Cost: 5,500.00 DA.

Remark: The final program is uploaded into the robot, and UV lamps are installed as needed.

10. Packaging and Preparation for Shipment (1 day)

- Dates: From Thursday, July 25, 2024, to Friday, July 26, 2024.
- Responsible: Packaging Workers, Project Manager 1.
- Cost: 3,800.00 DA.

Remark: The product is appropriately packaged and prepared for shipment to the customer.

11. Distribution and Delivery to Customer (2 days)

- Dates: From Friday, July 26, 2024, to Tuesday, July 30, 2024.
- Responsible: Customer Service and Marketing Commercial, Project Manager 2.
- Cost: 10,000.00 DA.

Remark: The product is distributed and delivered to the customer, marking the end of the project.

This table as shown on **Figure III.1** illustrates a detailed plan, indicating the tasks to be completed, the individuals responsible, the start and end dates of each task, and the associated costs.

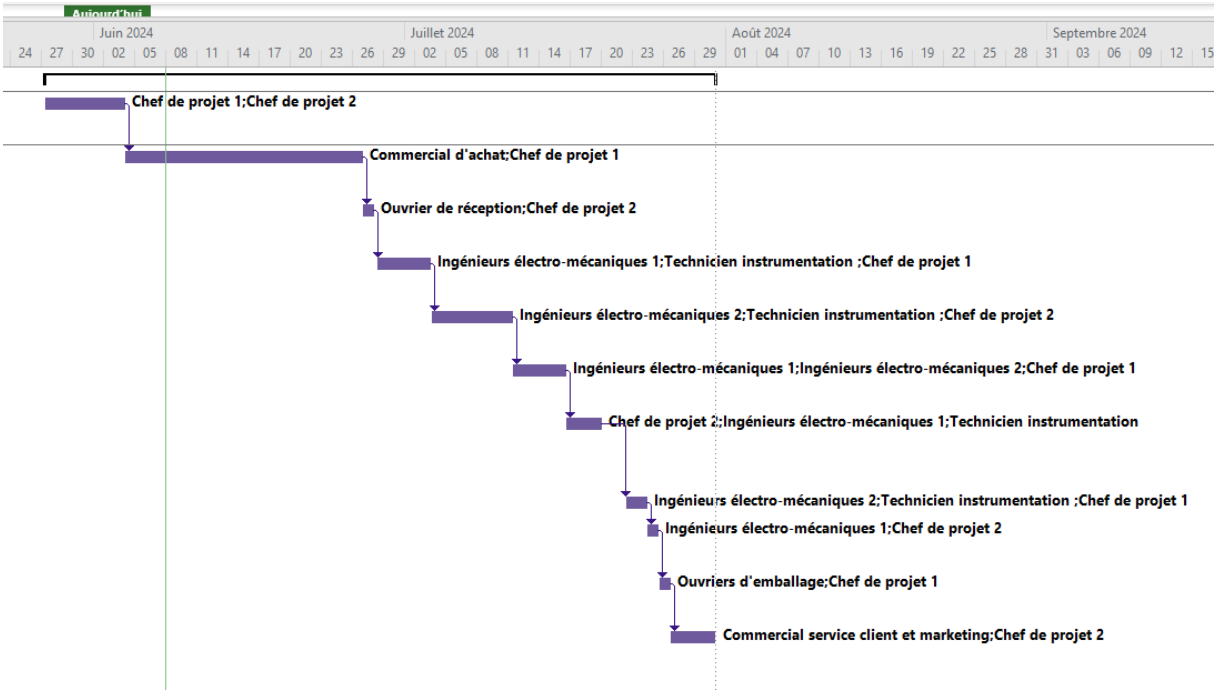

Figure III.2 A visual representation of the Gantt chart in MS Project software

As shown on **Figure III.2** the Gantt chart generated from MS Project provides a detailed visual representation of the planning for the realization of the robot. Each step of the project is clearly defined and presented in chronological order, allowing for instant understanding of the task sequence. Horizontal bars represent the duration of each task, with clear start and end points along the timeline axis. Dependencies between tasks are also highlighted, showing the logical links between different activities. Key project milestones, such as raw material delivery, chassis assembly, programming, and testing, are clearly identified, making it easy to track project progress and identify potential delays or critical activities. By using this Gantt chart, the project team can effectively plan resources, manage deadlines, and ensure that the project progresses smoothly towards completion.

III.3 Procurement Strategy

Navigating the intricate web of suppliers and materials is essential for our UV disinfection robot project, highlighting the significance of our procurement strategy.

III.3.1 Supplier Selection

- **Quality Standards:** We prioritize suppliers who adhere to stringent quality standards and can provide consistent supply of materials.
- **Cost-Effectiveness:** We negotiate competitive pricing while ensuring that quality is not compromised.
- **Sustainability:** We consider suppliers with environmentally friendly practices and a commitment to social responsibility.

III.3.2 Inventory Management

- **Optimized Inventory Levels:** We maintain optimal inventory levels to minimize storage costs and prevent stock outs.
- **Just-in-Time (JIT) Inventory:** We implement JIT principles to reduce inventory carrying costs and improve efficiency.
- **Inventory Tracking:** We utilize advanced inventory management systems to track stock levels, reorder points, and expiration dates.

III.4 Partnership Strategy

Our partnership strategy is integral to the growth and success of our UV disinfection robot project, fostering collaborations that enhance innovation, distribution, and community engagement.

III.4.1 Strategic Collaborations

- **Research and Development:** We collaborate with research institutions and universities to advance UV disinfection technology and develop innovative product features.
- **Distribution and Sales:** We partner with established distributors and sales channels to expand our market reach and increase customer access to our robots.
- **After-Sales Support:** We collaborate with service providers to offer comprehensive after-sales support and maintenance services.

III.4.2 Community Engagement

- **Industry Associations:** We actively participate in industry associations and forums to stay updated on industry trends and collaborate with peers.
- **Local Communities:** We engage with local communities to promote awareness about the importance of disinfection and the benefits of our robots.
- **Environmental Initiatives:** We support initiatives focused on environmental sustainability and the responsible use of UV technology.

III.4.3 Strategic Financial Partnerships

We rely on several partners to provide the necessary funds for investment and the launch of our project as a promising startup. Among them, **ASF** plays a key role by providing crucial financial support, while banks offer structured and reliable financing solutions. Additionally, we collaborate with passionate and visionary investors who share our ambition to make a significant impact in the market. Together, these financial partners enhance our ability to realize our vision and achieve our strategic goals successfully.

III.5 Conclusion

In conclusion, our production and organization plan outlines a meticulous approach to ensuring quality, efficiency, and innovation in delivering our UV disinfection robot to the market. By focusing on each aspect of production, from procurement to labor management and strategic partnerships, we aim to uphold the highest standards while fostering growth and community engagement. As we move forward, we will delve into the financial aspects of our

project in the next chapter, highlighting our commitment to transparency and sustainability in all facets of our endeavor.

Fourth Axis: Financial Plan

Introduction

In this chapter, we delve into the financial plan for our startup project, which develops a UV-based line-following robot. Following an in-depth market study, we analyze various sales and rental options for our product, evaluating their potential impact on our business model. We also detail the costs associated with the production, marketing, and distribution of our robot, taking into account operational expenses and initial investments. Subsequently, we present a comprehensive financial analysis that includes revenue projections, profitability calculations, and key financial indicators such as the return on investment (ROI) and the break-even point. This chapter aims to provide a clear and precise view of the economic viability of our project, highlighting the essential financial aspects for strategic decision-making and the success of our startup.

IV.1 Market Sales Analysis and Statistics

In this section, we present a comprehensive market sales analysis, focusing on identifying our potential customers, primarily hospitals and private clinics. To achieve this, we conducted a detailed market study and used Excel to calculate the number of public hospitals and private clinics across the 48 wilayas (provinces) of Algeria. This allowed us to estimate the number of robots required and to determine the maximum and minimum potential sales nationwide. Additionally, we utilized Power BI to create visualizations, including graphs and charts, to effectively present our findings. Following this, we will provide a detailed explanation of our Excel calculations and the Power BI visualizations separately, offering a thorough understanding of our market analysis process and results.

IV.1.1 Detailed Excel Calculations

We structured our analysis using an Excel spreadsheet as shown on **Figure IV.1** to organize the data of the 48 wilayas of Algeria. The columns include the following information: the wilaya number, the wilaya name, the number of public hospitals, the number of private clinics, the total area to be disinfected, the total available budget, the number of robots needed, as well as the minimum and maximum sales.

For each wilaya, the total area to be disinfected was calculated using the formula:

Total Disinfection Area = (Number of Hospitals × Average Area per Hospital) + (Number of Private Clinics × Average Area per Private Clinic)

The values used for the average areas are 15,000 m² for a hospital and 3,000 m² for a private clinic.

The total budget available for each wilaya was calculated with the formula:

Total Available Budget = (Average Budget per Hospital × Number of Hospitals) + (Average Budget per Private Clinic × Number of Private Clinics)

The average budgets used are 750,000 DZD for a hospital and 200,000 DZD for a private clinic.

Next, the number of robots needed was determined by the formula:

Number of Robots Needed = Total Disinfection Area / Area Covered by One Robot

The area covered by one robot is 2,000 m².

To estimate the minimum and maximum sales, we used the following formulas:

Minimum Sales = Number of Robots Needed × Minimum Demand Factor

Maximum Sales = Number of Robots Needed × Maximum Demand Factor

The minimum and maximum demand factors are respectively 0.5 and 0.8.

Data Interpretation:

Algiers Wilaya: With 29 hospitals and 70 private clinics, Algiers requires 323 robots to cover a total area of 645,000 m². The minimum and maximum sales are 161 and 258 robots respectively.

Tizi Ouzou Wilaya: Tizi Ouzou, with 17 hospitals and 20 private clinics, requires 158 robots for an area of 315,000 m². The minimum sales are 79 robots and the maximum sales are 126 robots.

Constantine Wilaya: With 10 hospitals and 50 private clinics, Constantine needs 150 robots to disinfect 300,000 m². The minimum and maximum sales are 75 and 120 robots respectively.

Other wilayas follow similar trends, with variations depending on the number of hospitals, clinics, and the disinfection area.

			$S_{moyen\ hôpital}$	15000	$B_{moyen\ hôpital}$	750000	$S_{couverture\ robot}$	2000	
			$S_{moyen\ clinique}$	3000	$B_{moyen\ clinique}$	200000	Facteur de demande minimale		0,5
							Facteur de demande maximale		0,8
	Wilaya	Nombre d'hopitaux	Nombre de clinique privee	Superficie totale à désinfect	Budget total disponible (DZD	Robots nécessaires	Ventes minimales	Ventes maximal	Région
1	Adrar	11	4	177000	9050000	89	44	71	Sud-Ouest
2	Chlef	9	4	147000	7550000	74	37	59	Centre
3	Laghouat	7	9	132000	7050000	66	33	53	Centre
4	Oum el Bouaghi	10	8	174000	9100000	87	44	70	Est
5	Batna	13	13	234000	12350000	117	59	94	Est
6	Béjaïa	10	20	210000	11500000	105	53	84	Centre
7	Biskra	8	7	141000	7400000	71	35	56	Est
8	Béchar	7	3	114000	5850000	57	29	46	Sud-Ouest
9	Blida	8	20	180000	10000000	90	45	72	Centre
10	Bouira	7	10	135000	7250000	68	34	54	Centre
11	Tamanrasset	2	0	30000	1500000	15	8	12	Sud
12	Tébessa	8	5	135000	7000000	68	34	54	Est
13	Tlemcen	7	10	135000	7250000	68	34	54	Ouest
14	Tiaret	10	11	183000	9700000	92	46	73	Ouest
15	Tizi Ouzou	17	20	315000	16750000	158	79	126	Centre
16	Alger	29	70	645000	35750000	323	161	258	Centre
17	Djelfa	9	2	141000	7150000	71	35	56	Centre
18	Jijel	4	5	75000	4000000	38	19	30	Est
19	Sétif	11	6	183000	9450000	92	46	73	Est
20	Saïda	2	20	90000	5500000	45	23	36	Ouest
21	Skikda	7	2	111000	5650000	56	28	44	Est
22	Sidi Bel Abbès	7	6	123000	6450000	62	31	49	Ouest
23	Annaba	9	8	159000	8350000	80	40	64	Est
24	Guelma	5	18	129000	7350000	65	32	52	Est
25	Constantine	10	50	300000	17500000	150	75	120	Est
26	Médéa	6	7	111000	5900000	56	28	44	Centre
27	Mostaganem	8	15	165000	9000000	83	41	66	Ouest
28	M'Sila	8	7	141000	7400000	71	35	56	Centre
29	Mascara	9	7	156000	8150000	78	39	62	Ouest
30	Ouargla	9	10	165000	8750000	83	41	66	Sud
31	Oran	16	44	372000	20800000	186	93	149	Ouest
32	El Bayadh	4	6	78000	4200000	39	20	31	Sud-Ouest
33	Illizi	2	5	45000	2500000	23	11	18	Sud
34	Bordj Bou Arreridj	6	23	159000	9100000	80	40	64	Est
35	Boumerdès	4	7	81000	4400000	41	20	32	Centre
36	El Tarf	4	15	105000	6000000	53	26	42	Est
37	Tindouf	1	3	24000	1350000	12	6	10	Sud-Ouest
38	Tissemsilt	3	10	75000	4250000	38	19	30	Centre
39	El Oued	5	6	93000	4950000	47	23	37	Sud
40	Khenchela	5	13	114000	6350000	57	29	46	Est
41	Souk Ahras	3	3	54000	2850000	27	14	22	Est
42	Tipaza	6	6	108000	5700000	54	27	43	Centre
43	Mila	6	7	111000	5900000	56	28	44	Est
44	Aïn Defla	4	5	75000	4000000	38	19	30	Centre
45	Naâma	3	12	81000	4650000	41	20	32	Sud-Ouest
46	Aïn Témouchent	6	10	120000	6500000	60	30	48	Ouest
47	Ghardaïa	5	6	93000	4950000	47	23	37	Sud
48	Relizane	7	4	117000	6050000	59	29	47	Ouest

Figure IV.1 A visual representation of the sales analysis in Excel.

IV.1.2 Power BI Visualizations of Sales Statistics

To showcase sales statistics on Power BI[6], various visualization tools are used, including maps, pie charts, clustered column charts, cards, slicers, stacked bar charts, and line charts. As shown in the screenshot, these tools allow us to better analyze calculations, sales, target regions, potential markets, and the maximum and minimum sales rates for the next five years. This provides a strategic vision for our project.

[6] Power BI is an interactive data visualization software product developed by Microsoft with a primary focus on business intelligence. It is part of the Microsoft Power Platform.

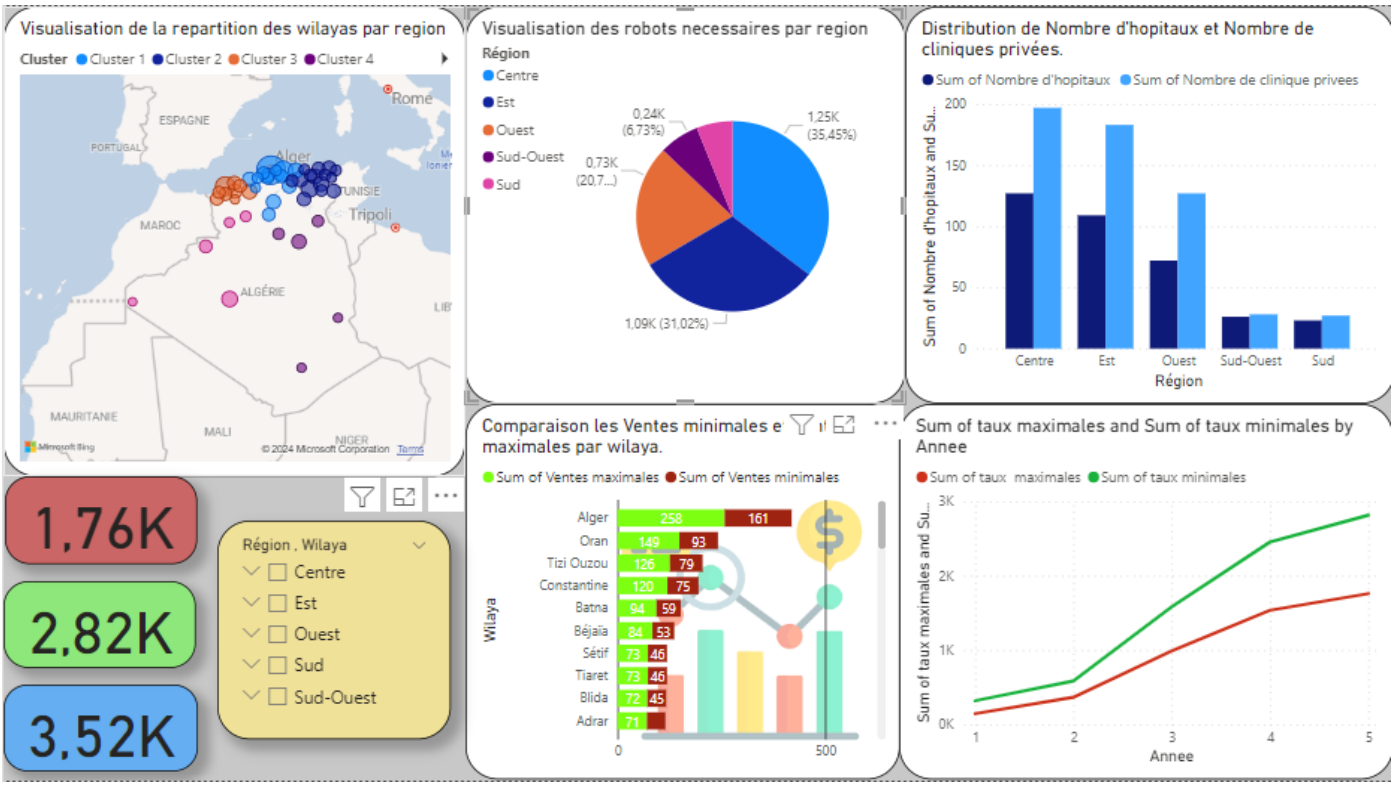

Figure IV.2 A visual representation of the sales statistics in the Power BI dashboard.

Here is a detailed explanation and commentary on each visualization tool used in the dashboard:

1. **Map (Visualisation de la répartition des wilayas par région) :**
   - This map displays the distribution of wilayas (provinces) by region, divided into clusters (Cluster 1, Cluster 2, Cluster 3, Cluster 4).
   - It helps in understanding the geographical spread and grouping of different wilayas, aiding in regional analysis.
2. **Pie Chart (Visualisation des robots nécessaires par région) :**
   - The pie chart shows the proportion of robots required by region.
   - The regions are divided into Centre, Est, Ouest, Sud-Ouest, and Sud.
   - This visualization helps in identifying the demand for robots across different regions, with the Centre region having the highest demand (35.45%).
3. **Clustered Column Chart (Distribution de Nombre d'hopitaux et Nombre de cliniques privées) :**
   - This chart displays the number of hospitals and private clinics by region.
   - The regions compared are Centre, Est, Ouest, Sud-Ouest, and Sud.
   - It highlights the healthcare infrastructure distribution, showing that the Est region has the highest number of both hospitals and private clinics.
4. **Cards :**
   - Three cards show key performance indicators (KPIs):
     - 1.76K, 2.82K, and 3.52K.
   - These could represent different metrics like sales figures, number of units sold, or other relevant data points, providing a quick snapshot of important statistics.

5. **Slicer :**
    - A slicer is used to filter data by Region and Wilaya.
    - This interactive tool allows users to dynamically filter the visualizations based on specific regions or wilayas, making the analysis more focused and customized.
6. **Stacked Bar Chart (Comparaison les Ventes minimales et maximales par wilaya):**
    - This chart compares the minimum and maximum sales by wilaya.
    - It provides a detailed comparison of sales performance across different wilayas, with Algiers showing the highest sales range.
7. **Line Chart (Sum of taux maximales and Sum of taux minimales by Année)**:
    - The line chart shows the trend of maximum and minimum sales rates over a period of five years.
    - It indicates a positive growth trend in sales rates, with both maximum and minimum rates increasing over time.

IV.2 Rental Market Analysis and Statistics

For this section, we conducted a similar analysis for the rental market, focusing on five specific wilayas: Oran, Tlemcen, Aïn Témouchent, Sidi Bel Abbès, and Mostaganem. Our study particularly targeted private nurseries, which require regular disinfection, making them significant potential clients for our robot disinfection rental service.

We used Excel to organize and analyze the data, calculating the minimum and maximum annual revenues. The columns include the names of the wilayas, the number of private nurseries, and the potential revenues based on different demand scenarios.

For visualizing the results, we used Power BI to better understand trends and optimize our rental strategy. The visualizations include graphs and charts to clearly and intuitively present the results of our analysis.

IV.2.1 Detailed Excel Calculations

The provided data offers a detailed overview of the daycare situation in the western region, allowing for an in-depth analysis of opportunities within this specific geographical area. Each row in the table represents a wilaya in the western region, providing information such as the number of daycares, the minimum and maximum rental duration for the robots (expressed in months), the number of robots required, the rental price for a single use, and the minimum and maximum annual revenues generated by renting these robots. These data enable a precise assessment of the potential demand for disinfection services in the western region, as well as financial projections for the robot rental business. Additionally, the table also provides totals for the overall number of daycares in the western region and the total number of disinfections required per year, offering a comprehensive view of the scale of the business and its potential impact on public health and the regional economy as shown on **Figure IV.3**.
Here's the translated phrase with the formula:

To calculate the minimum and maximum revenues, we used the following formula: Revenu annuel minimum/maximum=nombre minimale/maximale de location×Nombre de desinfections par an×Prix de location.

	Wilaya	Région	Nombre de creche	min de location (mois)	max de location(mois)	Robots nécessaires	Prix de location (1fois)	Revenu min annuel	Revenu max annuel	Pays
13	Tlemcen	Ouest	4	2	4	1	20000	160000	320000	Algerie
22	Sidi Bel Abbès	Ouest	7	2	5	1	20000	160000	400000	Algerie
27	Mostaganem	Ouest	6	2	4	1	20000	160000	320000	Algerie
31	Oran	Ouest	15	4	10	1	20000	320000	800000	Algerie
46	Aïn Témouchent	Ouest	3	1	3	1	20000	80000	240000	Algerie
Total			35					880000	2080000	
				le nombre de desinfection pendant 1 an		4				

Figure IV.3 Excel data on UV robot rental.

Data interpretation:

- The western region, represented by the wilayas of Tlemcen, Sidi Bel Abbès, Mostaganem, Oran, and Aïn Témouchent, is home to a total of 35 daycare centers.
- The annual revenues generated by the rental of these UV robots vary depending on the rental duration and the number of daycare centers in each wilaya.
- The minimum annual revenue for the entire western region is estimated at 880,000 DA, while the maximum annual revenue is estimated at 2,080,000 DA.

IV.2.2 Power BI Visualizations of rental Statistics

In our analysis, we utilized Power BI to visualize the rental statistics of our disinfection robot As shown on **Figure IV.4**. We created a donut chart to display the total rental figures, focusing on the western region, specifically the wilayas of Tlemcen, Sidi Bel Abbès, Mostaganem, Oran, and Aïn Témouchent. This visualization provided a clear comparison of rental activity across these areas. Additionally, we employed a grouped bar chart to showcase the maximum income generated per wilaya, highlighting the financial performance in each region. To further analyze income distribution, we developed a grouped histogram that illustrated both the maximum and minimum income values for each wilaya. These visualizations collectively offer valuable insights into our rental operations, enabling us to identify key revenue sources and potential areas for growth.

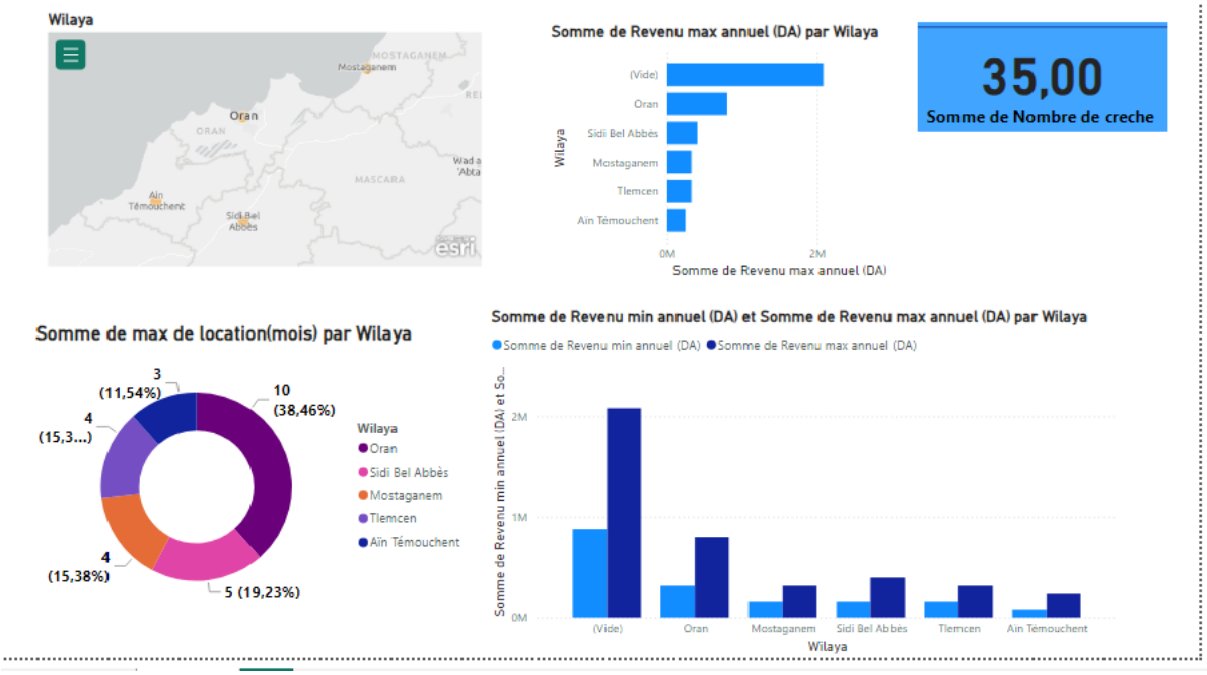

Figure IV.4 A visual representation of the rental statistics in the Power BI dashboard.

IV.3 Production equipment and materials

In this section, we present the essential equipment and tools required for the production of the UV line-following robot in our workshop, which will be staffed by 9 human resources. Each piece of equipment has been carefully selected to ensure efficient and safe production. The table Table **IV.1 and Table IV.2** below lists the necessary equipment, their quantities, unit costs, total costs, and suppliers. This setup will allow us to maintain a high standard of quality and productivity in our manufacturing process.

Table IV.1 Components and materials needed for the production of the UV line-following robot.

Component	Quantity	Unit Cost (DA)	Total Cost (DA)	Supplier
Aluminum	10 kg	300 DA/kg	3,000 DA	Métal Industriel DZ
Infrared sensors	2	5,000 DA	10,000 DA	CapteurTech
Distance sensors	1	10,000 DA	10,000 DA	Distance Solutions
Microcontrollers	1	15,000 DA	15,000 DA	MicroChip DZ
PCB boards	2	2,000 DA	4,000 DA	PCB Algérie
Resistors, capacitors, etc.	20	100 DA/each	2,000 DA	ElectroComposants DZ
UV-C lamps (Philips)	4	20,000 DA	80,000 DA	UV Solutions
Lithium-Ion batteries	3	10,000 DA	30,000 DA	PowerBattery DZ
Chargers	1	5,000 DA	5,000 DA	ChargeTech
Screws and nuts	50	50 DA/each	2,500 DA	Fixations DZ

Adhesives	1	1,000 DA/tube	1,000 DA	AdhésifPro
Paint and finishes	1	2,000 DA	2,000 DA	Peinture DZ
Soldering wire	5 m	500 DA/m	2,500 DA	SoudureTech
Electrical wires	10 m	100 DA/m	1,000 DA	Câbles Algérie
Connectors	10	200 DA/each	2,000 DA	ConnectPro

Table IV.2 Equipment and tools required for the production workshop for 9 human resources.

Equipment	**Quantity**	**Unit Cost (DA)**	**Total Cost (DA)**	**Supplier**
Soldering iron	5	3,000 DA	15,000 DA	Outillage DZ
Cutting machine	1	15,000 DA	15,000 DA	DécoupeTech
Testing equipment	1	10,000 DA	10,000 DA	TestEquip DZ
Pliers and screwdrivers	10	200 DA	2,000 DA	Outillage Express
Multimeter	3	5,000 DA	15,000 DA	Électronique DZ
Workbench	3	20,000 DA	60,000 DA	Atelier Pro
Safety glasses	10	500 DA	5,000 DA	Sécurité Plus
Work gloves	10	300 DA	3,000 DA	Protection DZ

IV.4 Financial Analysis

In this section, we will conduct a detailed financial analysis of our UV-based line-following robot project. This includes examining initial investment costs, production costs, market demand, fixed and variable costs, and ultimately calculating the annual revenues and net profit. The following information provides a comprehensive overview of the financial aspects of the project:

IV.4.1 Initial Investment

- **Production equipment costs**: 125,000 DA
- **Software and hardware development**: 0 DA
- **Initial marketing and startup costs**: 100,000 DA
- **Total initial investment**: 225,000 DA

For the initial investment, all costs are mentioned according to the tables in the previous section.

IV.4.2 Selling Price Per Unit

After considering the market and the cost of production, we propose a selling price of **500,000 DA** per unit. This price is competitive and ensures a good margin while remaining affordable for our target customers.

IV.4.3 Production Costs Per Unit

- **Materials**: 10,000 DA
- **Electronic components** : 41,000 DA

- **UV-C lamps**: 80,000 DA
- **Direct labor**: 240,500 DA
- **Total production costs per unit**: 371,500 DA

IV.4.4 Market Demand

- **Estimated annual sales** : 1750 units

IV.4.5 Annual Fixed Costs

Salaries for administrative and technical staff:
(90,000 DA+60,000 DA+24,000 DA+39,000 DA+75,000 DA+75,000 DA+24,000 DA+60,000 DA+90,000 DA) ×12=6,444,000 DA

- **Other fixed costs (electricity, insurance, etc.)**: 10,000 DA
- **Total fixed costs** : 6,454,000 DA

IV.4.6 Annual Variable Costs

- **Marketing and advertising**: 50,000 DA
- **Maintenance and repairs**: 20,000 DA
- **Other variable costs**: 10,000 DA
- **Total variable costs**: 80,000 DA

IV.4.7 Discount Rate

Discount rate: 6%

IV.4.8 Revenue and Cost Calculations

Annual Revenues

To calculate the annual revenues:
Annual Revenues=Selling Price Per Unit×Estimated Annual Sales

Annual Production Costs

To calculate the annual production costs:
Annual Production Costs=Production Costs Per Unit×Estimated Annual Sales

Annual Gross Margin

To calculate the annual gross margin:
Annual Gross Margin=Annual Revenues−Annual Production Costs

Net Annual Profit Before Taxes

To calculate the net annual profit before taxes:
Net Annual Profit=Annual Gross Margin−Total Fixed Costs−Total Variable Costs

Annual growth rate (%)

To calculate the Annual growth rate (%)
Annual growth rate = ((final value −initial value)/initial value) ×100

We have calculated our revenue projections for years 1 to 5 using two different Excel spreadsheets, each based on carefully studied data. The first spreadsheet represents figures in an optimistic scenario, while the second reflects a pessimistic scenario. These projections are based on thorough market analysis, demand forecasts, and historical performance, enabling strategic planning and proactive risk management. Specific details for each scenario are presented in the following tables:

Table IV.3 Revenue in the optimistic scenario for the business

Year	1	2	3	4	5
Estimated annual sales	600	1000	1085	1343	1445
Maximum annual rental revenue	2080000	2080000	2080000	2080000	2080000
annual sales revenue	300000000	500000000	542500000	671500000	722500000
total annual revenue	302080000	502080000	544580000	673580000	724580000
Annual Production Costs	222900000	371500000	403077500	498924500	536817500
Annual Gross Margin	79180000	130580000	141502500	174655500	187762500
Net Annual Profit Before Taxes	72 646 000	124 046 000	134 968 500	168 121 500	181 228 500
Annual growth rate (%)	0%	70,75	8,81	24,56	7,80

Table IV.4 Revenue in the pessimistic scenario for the Business

Year	1	2	3	4	5
Estimated annual sales	400	650	830	950	1200
Maximum annual rental revenue	2080000	2080000	2080000	2080000	2080000
annual sales revenue	200000000	325000000	415000000	475000000	600000000
total annual revenue	202080000	327080000	417080000	477080000	602080000
Annual Production Costs	148600000	241475000	308345000	352925000	445800000
Annual Gross Margin	53480000	85605000	108735000	124155000	156280000
Net Annual Profit Before Taxes	53 480 000	85 605 000	108 735 000	124 155 000	156 280 000
Annual growth rate (%)	0%	60,07	27,02	14,18	25,87

The average growth rate of our startup over a period of 5 years is a key indicator for evaluating its performance. Here is an interpretation of the growth rates we mentioned:

Optimistic case: 39.47%

Pessimistic case: 39.03%

Interpretation:

- Exceptional Growth: 39.47%and 39.03% are both very high average annual growth rates. These rates suggest that our startup has nearly quadrupled in size each year on average over 5 years, which is remarkable.
- Growth Robustness: The small difference between the optimistic and pessimistic cases (39.47% vs 39.03%) indicates robustness and stability in our startup's growth. Even in the most pessimistic scenario, the growth remains extremely strong.
- Market Comparison: For a new startup, a growth rate of 39% is exceptional. Generally, startups in a rapid growth phase can aim for growth rates of 20-30%. Our startup significantly exceeds this norm, placing it in a high-performance category.
- Startup Valuation: Such a high growth rate is very attractive to investors and can significantly increase our company's valuation. It indicates strong demand for our products or services, good management, and a solid competitive position in the market.

NB: It is important to note that our estimation of sales costs does not consider the inflationary trends in Algeria during the projected revenue years. Additionally, we have not considered potential changes in pricing relative to our competitors in the future, nor the integration of new technologies to enhance our product. These factors could significantly impact our sales costs and should be considered in our future analyses for more accurate and adaptable market planning.
The Excel data presented in this figure was created by students.

IV.5. Conclusion

This chapter explored cost management, highlighting types of costs, cost estimation techniques, and cost control methods. Note that our sales cost estimations do not consider Algeria's inflation, competitor pricing changes, or new technologies, which are crucial for future analyses. In the next paragraph, we will provide an overview of our prototype.

Fifth axis: Experimental prototype

Introduction

This chapter provides an overview of the design and development process of our UV-based disinfection robot prototype. From initial conceptualization to rigorous testing and deployment, we showcase our dedication, ingenuity, and pursuit of excellence in creating a pioneering solution to address pressing public health challenges. Through this project, we aim to contribute to the advancement of robotics engineering and the promotion of public health and safety.

X.1 Overview

Our project focuses on the creation of an automatic and autonomous robot equipped with advanced UV technology for comprehensive disinfection of large spaces. We chose UV technology due to its proven effectiveness in eliminating up to 99.99% of viruses, bacteria, and other pathogens, making it a powerful tool to improve public health and safety.

In addition to its disinfection capabilities, our robot integrates a line-following feature, enabling precise navigation and coverage of designated areas. By incorporating a line-following mechanism into the base design, our robot can autonomously traverse predefined paths, ensuring thorough disinfection of targeted spaces with minimal human intervention.

X.2 Design Steps of Our Robot

We followed a series of detailed steps that ensured both the hardware and software components worked harmoniously.

1. **Programming and Development of Control Algorithms**

We developed control algorithms to enable our robot to autonomously navigate designated lines. These algorithms were essential for ensuring efficient and precise movement during the disinfection process.

2. **Fabrication of the Robot Support and Frame**

Apart from the chassis, we fabricated additional support and frame components to house electronic parts and ensure stability during operation.

3. **Power Supply and Assembly of Electronic Components**

We assembled electronic components, including UV lamps, power supply units, sensors, and control boards, to create a functional robot capable of disinfection.

4. **Program Upload and Installation of UV Lamps**

Once the hardware components were assembled, we uploaded control programs and installed UV lamps to complete the robot's functionality.

5. **Assembly and Construction of the Robot Chassis**

We fabricated the carcass structure of our robot using 3D printing via SolidWorks 2020. Various components such as the rear, front, sides, top, and UV lamp holder were meticulously designed and printed to ensure structural integrity and functionality.

6. **Testing and Verification**

We conducted rigorous testing to ensure that our robot met performance and safety standards. This phase involved simulated disinfection scenarios and real-world tests to validate the effectiveness of our solution.

NB: The detailed functionalities of our UV-based line-following disinfection robot prototype are comprehensively presented in a separate engineering thesis. This complementary thesis delves into the intricate design and operational aspects of the prototype, covering the implementation of UV-C technology for effective disinfection, the integration of line-following mechanisms for autonomous navigation, and additional features that enhance its efficiency and safety. Through rigorous testing and analysis, this engineering thesis provides valuable insights into the technical performance and capabilities of the prototype, serving as a crucial reference for understanding the practical application and potential improvements of the disinfection robot.

X.4 Conclusion

In this chapter, we provided an overview of our UV-based disinfection robot project, highlighting its purpose and key features. We detailed the design steps, from programming control algorithms and fabricating the robot's frame to assembling electronic components and conducting rigorous testing. Additionally, we outlined our strategic roadmap, which sets clear milestones for the further development, commercialization, and expansion of our robot. This comprehensive approach underscores our commitment to innovation and excellence in advancing public health and robotics engineering.

General Conclusion

In conclusion, this thesis has thoroughly investigated the development of a UV-based line-following disinfection robot as a startup initiative, underscoring its potential to meet growing disinfection needs across various sectors by focusing on innovation, health safety, and efficiency.

The critical insights from this research include recognizing the substantial market opportunity for UV disinfection robots, particularly in the wake of the COVID-19 pandemic. The project aims to initially establish a local market presence before expanding regionally and internationally. The robot's use of UV-C technology for disinfection and line-following for autonomous operation represents significant technical innovation, with prospects for future enhancements in functionality. A strategic market analysis indicates rapid growth in the disinfection robot market, particularly in the Asia-Pacific region, and identifies Algeria as a promising target due to its limited use of such technology. The competitive advantage of locally manufacturing the robot, which ensures affordability against expensive imports, is highlighted. The marketing strategy emphasizes an online presence, social media engagement, competitive pricing, strategic distribution channels, and free trials as crucial elements for success. A clear production and organization plan ensures quality and efficiency, prioritizing high-quality components and cost-effectiveness in procurement.

By adeptly managing the production process, market dynamics, and competition, this UV disinfection robot project is positioned to become a leading solution in the field of hygiene and infection control. The project not only showcases technological ingenuity but also aligns with global health priorities, emphasizing the importance of effective disinfection solutions in public health. As the demand for reliable and efficient disinfection methods increases, the innovation encapsulated in this project holds the potential to revolutionize sanitation practices across various environments, from healthcare facilities to public spaces and private enterprises.

Furthermore, the project's strategic approach to market entry and expansion, starting from a local base and scaling up to international markets, ensures that it can adapt to diverse market conditions and demands. The focus on affordability and local production not only addresses economic feasibility but also supports local economies and reduces dependence on foreign imports. This localized approach enhances the robot's competitive edge and positions it as a viable alternative in regions with limited access to advanced disinfection technologies.

In summary, the UV-based line-following disinfection robot represents a convergence of technological advancement and entrepreneurial vision. Its development responds to an urgent global need for improved disinfection methods, offering a practical, innovative, and scalable solution. By integrating cutting-edge UV-C technology with autonomous navigation, the project sets a new standard in the field, paving the way for future innovations and applications. As it progresses from concept to market-ready product, this initiative exemplifies how targeted innovation and strategic planning can address critical health challenges while creating new business opportunities in the emerging market of disinfection robotics

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Summary

Our startup's business model revolves around providing an innovative UV-based line-following robot for disinfection needs in various industries. Through market analysis and customer relationship management, we tailor our marketing strategies to target specific sectors where hygiene and safety are paramount. Financially, we ensure cost-effectiveness in production and distribution, maximizing revenue potential. We utilize statistical data on disinfection rates to validate our product's efficacy, enhancing trust and credibility. Our sales strategy focuses on building partnerships and offering flexible pricing models to meet diverse client needs.

Keyword: Line-following robot, UV disinfection, Market analysis, Sales strategy, Disinfection statistics.

Résumé

Le modèle commercial de notre startup repose sur la fourniture d'un robot suiveur de ligne innovant à base de UV pour répondre aux besoins de désinfection dans divers secteurs. Grâce à une analyse de marché et à la gestion des relations client, nous adaptons nos stratégies marketing pour cibler des secteurs spécifiques où l'hygiène et la sécurité sont primordiales. Sur le plan financier, nous veillons à la rentabilité de la production et de la distribution, maximisant ainsi le potentiel de revenu. Nous utilisons des données statistiques sur les taux de désinfection pour valider l'efficacité de notre produit, renforçant ainsi la confiance et la crédibilité. Notre stratégie de vente met l'accent sur la création de partenariats et l'offre de modèles de tarification flexibles pour répondre aux besoins diversifiés des clients.

Mot clé : Robot suiveur de ligne, Désinfection UV, Analyse de marché, Stratégie de vente, Statistiques de désinfection.

ملخص

يدور نموذج عمل شركتنا الناشئة حول توفير روبوت يتبع الخط المبتكر بناءً على التقنية الفوق بنفسجية لتلبية احتياجات التطهير في مختلف الصناعات. من خلال تحليل السوق وإدارة العلاقات مع العملاء، نقوم بتخصيص استراتيجيات التسويق لاستهداف القطاعات المحددة حيث تكون النظافة والسلامة من الأهمية القصوى. ماليًا، نضمن فعالية التكلفة في الإنتاج والتوزيع، مما يزيد من الإيرادات المحتملة. نستخدم البيانات الإحصائية حول معدلات التطهير لتأكيد فعالية منتجنا، مما يعزز الثقة والمصداقية. تركز استراتيجية مبيعاتنا على بناء شراكات وتقديم نماذج تسعير مرنة لتلبية احتياجات العملاء المتنوعة.

الكلمات المفتاحية: روبوت متابع للخط ,تطهير بالأشعة فوق البنفسجية-ج, تحليل السوق، استراتيجية المبيعات، إحصائيات التطهير.