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Research and Business Innovation Project

Team Members:

Alexandra Aldana Leonardo Torres Melisa González Omar Marin
Angélica López Renata Chávez Alfredo Cuamatzi Samantha Hernández

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Supervisor: Andrés Mercado

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1 Executive Summary

SmartCrops is revolutionising urban agriculture in the United Kingdom by providing a groundbreaking solution for homegrown produce. Our intelligent greenhouse is designed specifically for urban consumers, enabling them to cultivate tomatoes inside their homes, regardless of space constraints, climate challenges, or gardening experience. This innovative product leverages advanced automation technology to optimise plant growth, eliminating the need for constant monitoring. A user-friendly mobile app allows seamless oversight and management of the growing process, ensuring a sustainable and accessible way for anyone to produce their own organic tomatoes at home.

2 Problem Statement & background

Tomatos need the right amount of sunlight, a healthy substrate, a warm temperature, correct watering, and fertilisation to grow optimally. The challenge, however, is that the UK's climate is becoming increasingly unpredictable due to climate change.

The proposed solution aims to grow food without being limited by agro-climatic conditions. We shifted focus to growing widely consumed tomatoes in Britain, where approximately 500,000 tonnes are consumed annually [2]. A study revealed that 58.4% of UK shoppers prefer pesticide and chemical-free products [1], supporting the idea that people seek natural food options when possible.

3 Market Analysis

3.0.1 Target market

This greenhouse targets UK families interested in gardening, harvesting, sustainability, children's education, and healthy living. This product would provide well-being for families by growing their products while also caring for the environment by reducing their ecological footprint.

3.0.2 Competitor analysis

The SWOT analysis for the Harvst H-Series Indoor Grow System 1 highlights its strengths in versatile, year-round growing and compact, automated design. However, it faces challenges due to its high cost and limited capacity. Opportunities include tapping into the growing indoor gardening market and enhancing technological features. On the other hand, the SWOT analysis for Smart Garden 27 3 emphasises its strengths in space-efficient, year-round gardening with ease of use and aesthetic appeal. However, its high cost and reliance on proprietary plant pods are potential weaknesses. Opportunities lie in the growing interest in home gardening and sustainability, while competition and economic downturns constitute potential threats for both companies.

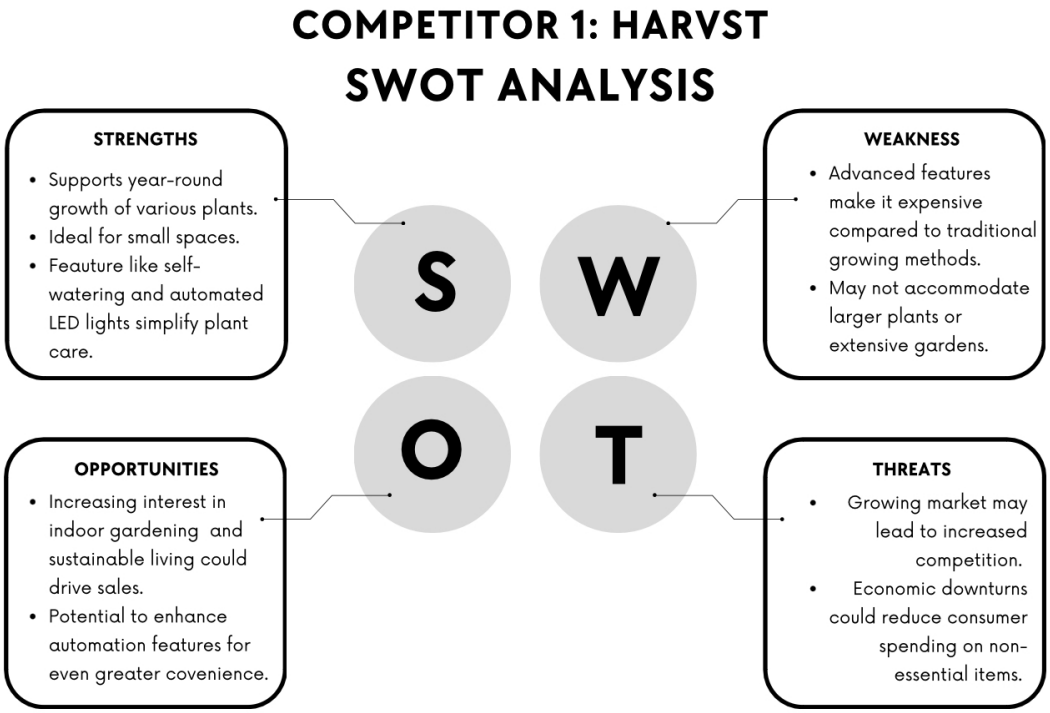

Figure 1: "harvst" SWOT ANALYSIS

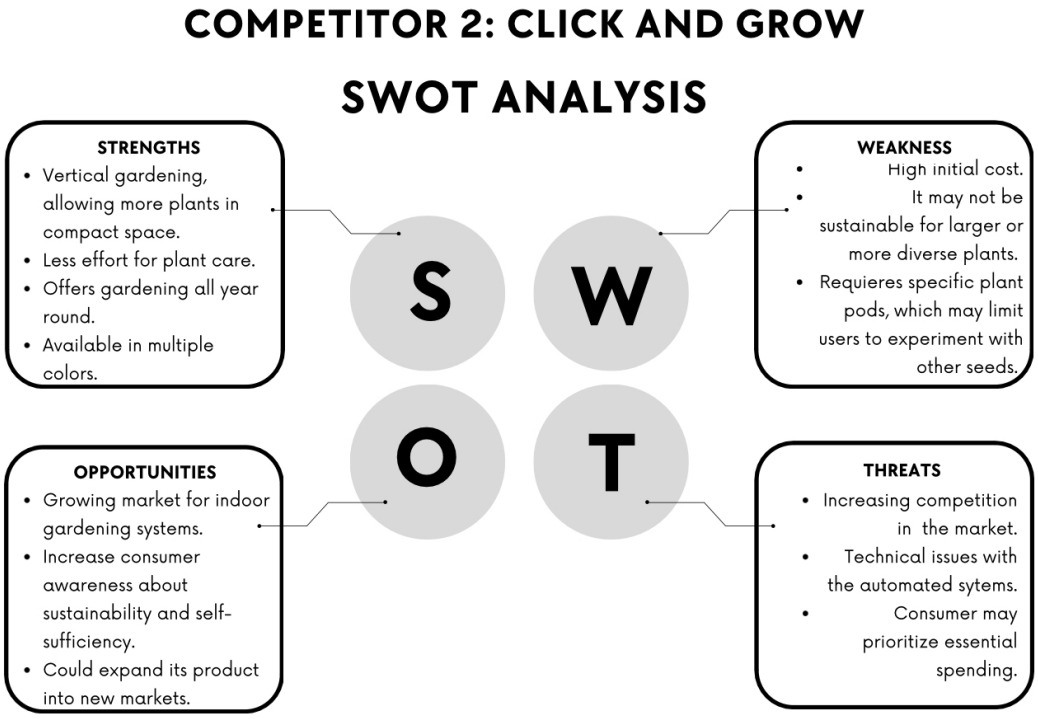

Figure 2: "Click and Grow" SWOT ANALYSIS

SmartCrops excels with its advanced technology, sustainability, and versatility, offering more opportunities for innovation compared to competitors [4].

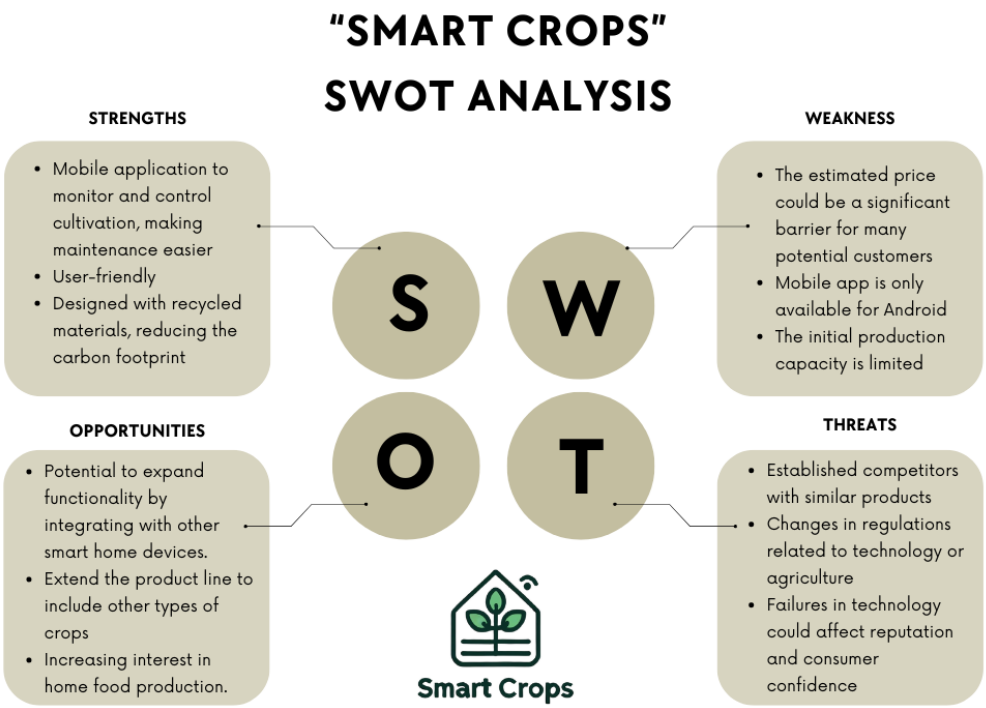

Figure 3: "Smart Crops" SWOT ANALYSIS

4 Objectives

4.1 General

The general objective is to establish itself as a leading provider of innovative, sustainable, and technologically advanced solutions for urban agriculture by developing and marketing intelligent greenhouses that enable consumers, particularly in urban environments, to easily grow their own organic products.

4.2 Specifics

- Develop a smart greenhouse with automated irrigation, nutrient delivery, and an environmental condition management system.
- Implement a mobile application that uses artificial intelligence to monitor and predict the needs of plants, allowing for timely interventions.
- Reduce the carbon footprint associated with traditional crop cultivation and exportation by promoting local production within urban settings.

5 Idea specification / Idea Concept

SmartCrops is a greenhouse with an innovative technological proposal that includes the use of artificial intelligence and a mobile application for managing and monitoring tomato cultivation. The mobile app enables real-time monitoring of environmental conditions, plant disease detection, and visual tracking of crop development. The greenhouse also has an electronic system for collecting crop data with low power consumption and multiple transmission methods for sharing information with users.

6 Preferred Solution

6.1 Manufacturing Specification

6.1.1 Product Description

The aesthetics of our smart greenhouse are based on honeycombs, from which we draw inspiration for the hexagonal prism main structure and the proposal of working with modules that allows the expansion of the greenhouse as much as the customer wants.

Figure 4: Product prototype

Table 1: Features

Height	7.874 inch
Radius	11.811 inch
Materials	Stainless aluminum, Polycarbonate, Cedar wood, Plastic (All recycled)
Color options	Beige
	Black
Software	Mobile application
Power Supply	220Vac±15%, 50-60 Hz

6.1.2 Development Process

The mobile application was initially developed for Android platform, with future plans to expand to iOS. The development process included integrating sensor data via HTTP protocol, designing an intuitive user interface, and implementing an AI algorithm based on GoogleNet, which allows for early disease detection in tomato plants. User testing was conducted to ensure functionality and ease of use, and features of the application were adjusted based on feedback received.

Considering sustainability as one of the project's main priorities, the chosen materials of the product are recycled, and it should maintain the internal and external conditions that the greenhouse must produce, and therefore endure, being the most important ones:

- Keep the exact humidity and pressure levels as precise as possible.
- Light and portable allow users to allocate the greenhouse in their chosen location.
- Being durable enough to function uninterruptedly for a minimum period of 5 years gives it the correct maintenance.

Given these requirements, the materials chosen for these features were Aluminum and Nickel alloy, Polycarbonate panels, Cedarwood, and injected plastic pieces.

6.2 Electronic Design

The greenhouse will have an electronic system to capture environmental data and take real-time photographs of the crops. The data will be sent via Wifi using the HTTP protocol. Electronic components will be sourced from competitive internet suppliers. The electronic board will be designed

using EasyEda software and manufactured by JLCPCB. Finally, the board will be integrated into the structure, tested, and undergo quality control.

6.3 Mobile Software Implementation

It is a mobile app for controlling and monitoring tomatos cultivation in an intelligent greenhouse. Real-time data readings from different sensors, viewing plant growth stages through the live feed of cameras, and detection using artificial intelligence are some features on offer.

6.3.1 Sensor Data Integration

It allows for integrated sensor data, including temperature, humidity and pressure, among other sensors. This data will be sent to the app using the HTTP protocol. This information will appear on the app, allowing users to control and monitor conditions at their greenhouse.

6.3.2 Camera integration and plant monitoring

A camera installed in the greenhouse will enable users to monitor their tomato plants' growth visually. The app will categorise the growth into four phases, from initial planting to full maturity. Users can view these stages live or access historical images for comparison.

6.3.3 AI-Powered disease detection

The application uses an AI algorithm, specifically GoogleNet, to detect plant diseases from images. When an anomaly is detected, the user is notified to adjust greenhouse conditions accordingly.

6.3.4 User Interface and User Experience (UI/UX)

The app's user interface is designed to be intuitive and user-friendly, focusing on simplicity and ease of navigation. Accessibility features are incorporated to ensure the app is usable by a wide range of users, regardless of their technical expertise.

6.3.5 Community forum and social interaction

The app includes a community forum where users can share photos, ask questions, and engage in discussions related to tomato cultivation. This forum functions similarly to a social network, with features like posting, commenting, and liking posts.

6.3.6 Platform availability and future development

Currently, the application is being developed for Android, and plans to release an iOS version soon. Future updates may include additional features, such as support for other types of crops or integration with other smart home devices.

7 Financial Analysis

This analysis aims to establish a strategic investment for the solid establishment of operations and to promote sustained growth in the competitive gardening and agriculture market. With an estimated annual production of 960 units, the sale cost for each greenhouse would be £1,487.49. Adding a 0.31 profit margin, the estimated selling price of the greenhouse would be £1,950.

Table 2: Fixed Costs

Fixed Costs	£876,020.00
Unit Variable Cost	£574.97
Unit Selling Price	£1,950.00
Break-even Point	638
Break-even Revenue	£1,242,698.40

7.1 ROI

Based on the production and sale of 960 units per year with the estimated costs and prices, the company's ROI would be approximately 0.31. This means the company earns a net profit of 31 per cent for every pound invested.

$$\text{ROI} = \frac{\text{net profit}}{\text{investment cost}} \times 100 = \frac{£442,677.27}{£1,427,991.20} \times 100 = 31 \tag{1}$$

7.2 Marketing techniques

Based on this analysis, an annual marketing budget of £12,000 is allocated with the following objectives:

- Increase Brand Visibility and Recognition
- Generate and Convert Leads
- Customer Retention

The following strategies will cover these objectives:

- Digital Marketing and Social Media Advertising (£4,500)
- Content Strategy and SEO (£3,000)

- Local and Specialized Media Advertising (£2,000)
- Participation in Trade Shows and Events (£1,500)
- Email Marketing and Newsletters (£1,000)
- Collaboration and Sponsorships with Organizations (£1,000)

8 Risk Analysis

identifying and assessing the main challenges that could affect the company's performance and growth. By understanding these risks, the company develop effective strategies to mitigate their impact.

- Lack of Market Knowledge: This leads to a lack of experience and understanding of the market.
- Low Brand Visibility and Recognition: No brand presence or recognition exists.
- Product Immaturity: Possible functionality or stability issues that haven't been fully resolved.
- High-Cost Structure: Costs are too high for expected revenue during the first few years.

9 Conclusion

SmartCrops is poised to revolutionize urban agriculture with its innovative intelligent greenhouse technology, comprehensive marketing strategy, and promising financial outlook. It aims to establish itself as a leading provider of sustainable and technologically advanced solutions for urban farming. With its focus on promoting sustainable living practices and reducing the carbon footprint associated with traditional agriculture, SmartCrops anticipates significant market penetration and envisions expanding its product line to include a diverse range of vegetables and herbs.

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Approved by
Andrés A. Mercado V.

A Appendix

Table 3: Cost Breakdown

Sensor or component	**Registration**	**Unit**	**GBP**
Atmospheric humidity sensor	DHT11	1	£0.38
Soil humidity sensor	FC-28	1	£0.32
Microcontroller	SIM7600G-H R2	1	£17.00
Light intensity sensor	BH1750	1	£0.52
Fan	24V	1	£1.76
Barometric pressure sensor	BMP180	1	£0.24
Water pump	5L/min	1	£5.05
Infrared CO2 Sensor	MH-Z19B	1	£8.81
PH Sensor	PH-4502C	1	£6.08
LED lamps	LED UV 3mm	1	£0.90
PCB	PCBWay	1	£57.01
Peltier cell	TEC1-12706	1	£1.10
Power supply	12V	2	£2.63
Camara	ESP32CAM	1	£2.77
DC-DC Buck Converter	-	2	£1.41
Total final			**£109.00**
Soil + nutrient solution	-	1	£10.00
			£10.00

Table 4: Fixed Costs

Concept	**Annual Cost (£)**
Salaries	£855,000.00
Office	£7,200.00
Nutrient Analysis	£500.00
Marketing	£12,000.00
Application	£1,320.00
Fixed Costs	**£876,020.00**

Table 5: Variable Costs

Concept	**Cost per Unit (£)**	**Total Cost per 80 Units (£)**
Software	£109	£8720
Manufacture	£455.97	£36477.6
Plant Growth	£10	£800
Variable Costs	**£574.97**	**£45997.6**