|  |
| --- |
| VerTechX |
| Problem: |
| According to the world’s bank, 70% of the world’s water consumption goes to agriculture. But the terrifying fact is that 40% of this consumption is lost. Why? There are 3 Main causes for this water loss:   * Water evaporation happens because the water travels for long distances before it reaches traditional farms. These long distances also cause the water to arrive polluted which decreases the efficiency of traditional farms. The level of pollution may higher the running cost due to the need for filtration systems. * a large amount of water doesn’t get absorbed by the plants and goes beneath the soil and turns into Groundwater which is much harder to be used. * In traditional farms, water is not distributed correctly which causes a lack of water for the most water-demanding crops and overwhelming amounts for less water-demanding ones.   That was from a worldwide perspective, but the truth is that here in Egypt these problems are not affecting the agriculture industry enough to create a solution that only solve this problem. But there are some business problems that arises alongside with this problem which pushes us to solve them. These problems can be summrized in the following points:   1. Increasing demand for fresh produce in urban areas, but limited space for conventional farming. 2. Inefficient use of resources (land, fertilizers and insecticides) in conventional farming methods. 3. Dependence on seasonal crops and fluctuations in market prices due to inflation. 4. Climate change - Changing weather patterns and more frequent extreme weather events can have a significant impact on crop yields and profitability, making it difficult for farmers to plan and manage their operations effectively. 5. Limited availability of arable land - As urbanization continues to accelerate, there is less land available for farming, putting pressure on farmers to adopt more efficient and sustainable methods to produce food. according to the central agency for public mobilization and statistics, there is 9.3 million acres of arable and in Egypt. While the area of Egypt is about 241 million acres. 6. Dependence on pesticides and fertilizers - Conventional farming methods often rely on large amounts of pesticides and fertilizers, which can be harmful to the environment and human health.   Who are affected by these problems?   1. Landowners: Most of the Egyptian population live in the countryside and rely on the arable land the own as their main source of income. 2. Agricultural engineers: agricultural engineers are responsible of solving problems that faces landowners. The more complex these problems the harder to solve which puts a high problem on engineers especially when you know that many of them monitor large amount of arable land. 3. Peasants: Most of the peasants are not properly educated to manage the land and many landowners complain about their behavior that may lead to devastating results on the land |
| Solution: |
| Executive summary:  VerTechX is a state-of-the- art smart greenhouse that combines IoT and AI with vertical farming to maximize crop yield and Quality and minimize water and power consumption while collecting data about the crops that are needed in scientific research.  How is the solution implemented?  Say that we Have 1000 square meters of land, and we want to implement our solution in it. The first step is to create a mechanical structure that divides the land into vertical layers isolated from each other and from the surrounding environment. Then a set of sensors - Temperature, Humidity, and soil moisture -eras are distributed all over each layer. all these sensors are connected to a network of microcontrollers that collects these data and sends it to a cloud computing service that can store the data, analyze it, and then send commands to the microcontrollers which are connected to a set of actuators - pumps, piezoelectric elements and heaters -that can modify the farming environment to the state ordered by the server.  Our solution relays on 3 main aspects:   1. IoT: the system consists of a network of microcontrollers that are connected via Bluetooth Low Energy. This network allows them to communicate between each other and with the host microcontroller efficiently and with minimum power consumption. The host microcontroller is responsible for sending the data to a cloud computing service so it can be gathered, cleaned, analyzed and then the command is sent to the host microcontroller which can distribute the command to the microcontrollers network. 2. AI: We use machine learning models to monitor crops health and environment parameters so we can provide the perfect environment for the crops. For example, we have developed an AI model that can determine whether the strawberry is healthy or not based on a footage taken by a system of cameras. 3. Vertical farming: Vertical farming is a farming technique that divides the farming areas into vertical layers to maximize crop yield per squared meters. it gives you full control of every single cupped centimeter of your land. Notice that we used “cupped” not just squared because we are using the vertical dimension. By combining this technique with AI and IoT, WE maximize the efficiency of the system and crop yields.   How can this solution solve the problems mentioned in section 1?   * Water Vaporization: In our solution, Water travels in pipes so no vaporization happen which decreases water lost. * High porosity: As the system is built vertically, any water that doesn’t get absorbed by the higher plant layer won’t turn into underground water. Instead, the lower plant will be able to absorb it easily which means the second problem is solved. * Water management: as we will have full control of the system, we will be able to distribute the water all around the system as we want which will terminate the last problem. * High food demand: Our solution can double the production by a factor up to 6X. * Inefficient use of resources and dependency over fertilizers and pesticides: with IoT capabilities, our solution allows the administrator to control the amount of fertilizers and water that goes to the crops. With the isolated environment, there will be no need for pesticides and the soil will be cleaned before planting in it. * Seasonal crops and limited arable land: as the planting environment is isolated and controlled, any crop can be planted any time anywhere which increases profitability because the owner can sell the crop off season with higher price, and he can export it outside Egypt. * Lack of data: the system will be able to supply us with a tremendous amount of data which will help us to further enhance our system in the future and sell this data to research institutions.   Success Criteria:   * Increased crop yield: The success of VerTechX can be measured by an increase in crop yield over time, compared to traditional farming methods. The ability to grow crops in a multilayered system may result in a higher yield per square foot of farmland. * Reduced water consumption: VerTechX aims to reduce water consumption compared to traditional farming methods. Success can be measured by the amount of water saved per crop grown, and the efficiency of the smart irrigation system. * Improved profitability: VerTechX aims to be profitable over the long term. Success can be measured by the project's ability to generate revenue and maintain a positive cash flow, while also accounting for operational costs and potential risks. * Increased customer satisfaction: VerTechX aims to provide locally grown, fresh produce year-round. Success can be measured by customer satisfaction with the quality and availability of the produce, as well as feedback on pricing and accessibility. * Improved environmental impact: VerTechX aims to reduce the environmental impact of conventional farming methods. Success can be measured by a reduction in greenhouse gas emissions, water consumption, and land usage, as well as an increase in sustainable farming practices. * Expansion and growth: The success of VerTechX can also be measured by its ability to expand and grow over time, potentially through the creation of new farms in other locations. The ability to scale up operations and maintain profitability can indicate long-term success for the project |
| Objectives: |
| * Providing a sustainable and efficient alternative to conventional farming methods meeting the growing demand for fresh produce in urban areas. * Providing a consistent supply of produce year-round creating job opportunities in the local community. * Diversified revenue streams: By producing a range of crops year-round,   VerTechX can potentially diversify its revenue streams and reduce its reliance on a single crop or seasonal fluctuations in demand.   * Reduced food waste: With a local source of fresh produce, VerTechX can potentially reduce the amount of food waste associated with transportation and distribution, contributing to a more sustainable food system. * Education and community engagement: As a new and innovative approach to   farming, VerTechX can engage with local communities and educate consumers about sustainable food production practices, creating a sense of connection and trust between the farm and the community it serves. |
| Results |
| * Reduced input costs: One of the key benefits of the VerTechX is that it can reduce input costs associated with conventional farming (e.g., water, fertilizer), potentially leading to lower operating expenses and higher profit margins. * Diversified revenue streams: By producing a range of crops year-round, VerTechX can potentially diversify its revenue streams and reduce its reliance on a single crop or seasonal fluctuations in demand, increasing the stability and predictability of its income. * Improved market access: VerTechX's ability to produce high-quality, locally grown produce year-round may open up new markets and distribution channels, providing. additional revenue opportunities and potentially increasing profitability. * Environmental and social benefits: As a sustainable and innovative approach to farming, VerTechX may benefit from increased consumer demand for environmentally and socially responsible products, potentially leading to higher prices and increased profitability. * ROI: The return on investment for VerTechX will depend on a range of factors, including the initial investment costs, operating expenses, revenue streams, and market demand. A detailed financial analysis will be needed to accurately estimate the return on investment and determine the viability of the project. |
| Scalability: |
| Risks and issues:   1. Energy costs: The use of artificial lighting and climate control systems in a vertical farm can result in high energy costs, which may reduce profitability. 2. Market demand: The demand for locally grown produce may fluctuate based on consumer preferences and economic conditions, which could impact the profitability of the vertical farm. 3. Lack of hardware component essential for the project: As our vertical farming project depend on many hardware components so lack component is risk to project. 4. Capital investment: The initial capital investment required to build a vertical farm may be substantial. 5. Market competition: The market for locally grown produce is becoming increasingly competitive, with new entrants and established players competing for market share. 6. regulatory compliance: VerTechX may need to comply with a range of local, state, and federal regulations related to farming, food safety, and environmental protection.   Mitigation strategies:   1. use solar energy as our main source of power. 2. penetrate the market geographically from El- bahira. That’s because we have already established market connections there in the customer validation phase. 3. We have already communicated with some local hardware suppliers to get our hardware needs from them. 4. participate in incubation programs to get the capital investment that we need. We expect to get about 200 000 EGP from incubation programs to support us establish our prototype and start up. 5. collaborate with traditional greenhouses suppliers to be resellers for our products for 30% of the net revenue from product selling. 6. communicate with local agricultural associations to help us get the needed permits.   Adaptation strategies:   1. provide software updates that can frequently start and shutdown some features of the systems – like heaters for example -to decrease the power consumption. 2. Create different versions that provides different features that suites different kinds of crops. 3. Locally manufacturing some of the hardware components that doesn’t require high technology. 4. Using previously collected data to control the environment without need of hardware sensors. 5. Expanding in new markets in delta region while targeting new crops.   Market penetration strategy:  We aim to expand geographically on 3 sprints:   1. We will start with strawberry producers in El -bahira governorate for many reasons:  * According to Export agricultural council, Egypt is the 1st country in the world in terms of exporting strawberry with 0.25 billion dollars and 213 kilo ton of exports. * We have market connections with strawberry farmers in El – Behera and we have already finished customer validation with some of them. * Strawberry is one of the sensitive crops that needs special care to grow well and be exported outside Egypt.  1. Aromatic plant mass producers in El – Fayoum governorate:  * Aromatic oil producers only take pesticides – free Crops. * It’s the 3rd largest aromatic plants producer governorate with 20% of Aromatic plants production of Egypt.  1. Agricultural research institutions:  * Researchers suffer from low Quality Data. * Researchers are unable to customize the planting environment of the crops and we will allow them to do so. |
| Sustainability: |
| * 2nd goal (Zero hunger): by using VerTechX, our agricultural production can doubled up to 6 times while consuming less land, water, fertilizers and pesticides. Moreover, High Quality products provided by VerTechX will decrease food waste sense most of food waste is low Quality Crops. * 6th goal (clean water and sanitation): according to agricultural researchers, most of our agricultural drainage water consists of chemicals that was used in the farming process. with VerTechX, we aim to eliminate agricultural drainage water by using zero pesticides with minimal usage of chemical fertilizers. This will allow us to re-use this water in our land and decrease our consumption of Nile water. * 7th goal affordable and clean energy: With VerTechX, we plan to use solar power as the main source of power for our greenhouse. And by using minimal amounts of chemical fertilizers, we aim to reduce chemical fertilizers factories power consumption to its lowest levels. |
| Execution Timeline: Yahia |
|  |
| Budget: Hamama |
| |  |  |  |  | | --- | --- | --- | --- | | Item | No of items | Cost of item | Total cost of item | | Arduino Mega | 1 | 550 | 550 | | Temperature & Air Humidity Sensor(dht11) | 3 | 40 | 120 | | Soil Moisture Sensor | 3 | 55 | 120 | | TFT Display | 1 | 400 | 400 | | Water Pump | 4 | 439.88 | 1759.52 | | Piezo Electric | 3 | 120 | 360 | | Fan (Extractor) | 3 | 350 | 1050 | | Ultra violet source | 3 | 200 | 600 | | Relay Module | 12 | 58.99 | 707.88 | | Bread board | 3 | 33 | 99 | | Jumpers male to male | 75 | 1 | 75 | | Jumpers male to female | 50 | 1 | 50 | | Jumpers male to female | 25 | 1 | 25 | | PCB Single Layer 20\*30cm | 3 | 60 | 180 | | T-block 2 pin (screw terminal) | 15 | 2.25 | 33.75 | | pin header female 40 pin | 4 | 3.5 | 14 | | buck converter | 2 | 50 | 100 | | Ne555 (Timer) | 3 | 4 | 12 | | IRLZ44N (MOSFET) | 3 | 34.9 | 104.7 | | Coil ( 220 micro henry ) | 3 | 1 | 3 | | Mechanical Design | 1 | 10000 | 10000 | | Total cost for 2\*2 area(minimum area posible) | 16408.85 |  |  | |