Automated Irrigation System: Hydroponics Grow System for Restaurants and Individuals

An Investigation of Detroit's Food Desert Problem

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis Related Assignments.

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Introduction

With increasing awareness of healthy food consumption and climate change, more and more people are turning to healthier dietary options, eating healthy and sustainably For the first article: (Zhang et al., 2023). Hydroponics has been on the rise along with healthy consumption, which is a method to grow plants without soil, consumes less water, and increases plant growth rates (Rajaseger et al., 2023). For these reasons, there has been a surge in individual plant growers and the use of hydroponics, which leads to argue that small scale hydroponics is a viable idea with consumers willing to invest.

In accordance with the trend of healthy consumption, I will propose an automatic irrigation system that will allow individuals or restaurants to grow their own vegetables and microgreens without prerequisite knowledge of growing plants using hydroponics. The system will automatically supply water and light for the plants to grow, which will be a unique preset value for different plants. It will also keep track of humidity, temperature, ph-level, tds-level, water level of the water reservoir for the user to check through a LCD screen. For this technical project to be a viable product on the market, it is critical to understand the social demand behind the trend of healthy consumption. To understand how the recent trends may affect the success of this technical project, I will draw on the STS framework of actor network theory to analyze the problem of Detroit's food desert and the government's failure to properly address this issue. More specifically, I will analyze the network of different actors that were involved to provide a solution to Detroit's food desert solution, which will draw out the reasoning behind the failure to solve Detroit's food desert problem and how small scale hydroponics for individuals and smaller businesses such as restaurants offer a more viable solution to Detroit's food desert problem. Because the challenge of growing plants without any prerequisite knowledge or land to grow the

plants is sociotechnical in nature, it requires attending to both its technical and social aspects to accomplish successfully. In what follows, I set out two related research proposals: a technical project proposal for developing an automated hydroponics grow system for restaurants and individuals, and an STS project proposal for examining these social factors in this case.

Technical Project Proposal

As people become more aware of the need to consume healthy food such as vegetables, there has been a rising trend in consuming vegetables (Economic Research Service [ERS], 2023). With this rise in trend, people have also been growing more preference to restaurants that supply homegrown vegetables, which add to the positive image that the food they provide is healthier, with no worries about agricultural pesticides, or the product going bad over the process of delivery (BookNet Canada, 2019). However, not every restaurant can afford an outdoor space to grow their own vegetables, and has some restrictions when it comes to growing plants indoors, let alone supplying the appropriate soil for the plants (ERS, 2010). The invention of LED lights for plant growth, nutrition packets, and a temperature controlled environment has been extremely beneficial in growing vegetables even for beginners. However, the traditional way of growing plants through soil has its problems. It requires the soil to be changed and monitored to maintain a healthy nutrition level, consumes a lot of water, and needs to be monitored constantly to ensure that the plant grows healthy. Traditional way of growing plants at home or at a restaurant not only has these restrictions, but also requires the users to have some prerequisite knowledge about the specific plants that they plan to grow, along with making sure that they pay attention to plant's needs whether it be sunlight, water, or change in soil. Hydroponics system gets rid of the need for soil, uses less water, and plants take in nutrients more effectively than in soil, making it easier and more efficient for people to grow plants in a hydroponic environment. While there are

small hydroponic plant grow systems out there in the market, they are very costly and still demand the user to have some knowledge of the plant in which they intend to grow.

My capstone project, which is an automated irrigation system, will have an automated watering and lighting system with presets which allow the user to simply put a batch of plant seeds in the cube and let it grow, making it easier for people to grow plants at home or at restaurants without having to constantly check on the plant. It will have a small LCD screen which will show temperature, humidity, ph-level of the water reservoir, and nutrient level of the water for the users to monitor at their need. Along with the statistics shown on the screen, the LCD screen will allow for the user to customize the preset time for the time and amount of light and water to supply to the plants. It will be very user friendly towards the beginners, as different preset options will be given for the user to choose based on their choice of plant, which will have the optimal humidity level and lighting options for each plant in the database. All of these said features will be inside a cubic container which allows the user to leave the grow system anywhere they wish and just let the plant grow.

In order for this product to work, a thorough understanding of the microcontroller system and power consumption is needed. With the microcontroller, I must be able to take in data from the sensors to the microcontroller and display the data on the LCD screen along with making the microcontroller be able to take input from the user through the LCD screen to change presets. With power consumption, thorough knowledge of each component in the technical design is needed, making sure that the power supply I use can supply all components of the technical project. As far as proving the viability of the design, a tray of microgreen seeds will be placed in the cube to test that the automated system does in fact supply the right amount of water, nutrients, and light to the plants, which will yield a result in 2 weeks. If the microgreens do grow

successfully without having to be constantly monitored and taken care of, it will prove that the technical design does in fact work as an automated system.

STS Project Proposal

Despite technological advances and widespread access to modern conveniences like cars, delivery services, and grocery stores, food insecurity remains a persistent issue in certain areas of the United States. Many communities still lack sufficient access to fresh, healthy food options, a condition that significantly increases the risk of diet-related diseases over time. Detroit's food desert is a stark example of this imbalance, illustrating the systemic failure to ensure equitable access to nutritious food and the long-term health implications for those affected (Gallagher, 2010).

To tackle the problem of food imbalance and food insecurity in the Detroit area, the state of Michigan and the city of Detroit have made efforts to involve various community organizations and initiatives. One immediate solution they have provided is food resources, which provides meals for children under 18 and for seniors at different locations (City of Detroit, n.d.). To solve the issue of food deserts, they have also started a new program called "Keep Growing Detroit", providing resources, education, and community-building opportunities to help residents grow their own food, and aiming to grow fruits and vegetables within the city limits for availability to the Detroit citizens (Keep Growing Detroit, n.d.). With this approach, they aim to immediately provide healthy food to locals while also taking initiative for further sustainability in the future by integrating urban farming land into areas of Detroit for people to learn, grow, and access healthy food in the future (Keep Growing Detroit, n.d.).

Despite these efforts made by the city of Detroit and the state of Michigan, the problem of Detroit food imbalance and food insecurity have not been fully alleviated. Vacant lots and

community gardens that have been used to serve as the urban farmland for locals of Detroit have been put up for dispute in land ownership, causing the farmland to be demolished and leaving the people who invested time and money into growing a garden to take the financial loss (Planet Detroit, 2022). Another systematic problem found was that the Detroit urban service location was based in Ann Arbor, which is considerably far from Detroit, which made it even more challenging for farmers in Detroit to access by public transportation (Bridge Detroit, 2023).

While these initiatives provide relief, they do not fully alleviate the food imbalance and food insecurity problems in Detroit. As previously mentioned, communal gardens and educating individual farmers have more issues with money, land dispute, and accessibility to the locally participating farmers. Current approaches help citizens to work as a community to solve this issue, but are not free from the complications mentioned.

In order to support my claim, I will draw on the science, technology, and society (STS) framework of actor network theory (ANT). This idea, first proposed by Michel Callon, Bruno Latour, John Law, actor network theory draws on different human and non-human elements as actors to map a network, which achieves a certain goal (Callon, 1999). ANT claims that a network can be defined and built by network builders (actors in a network) which can be human or non-human elements, in order to achieve a common goal (Callon, 1999). A key concept in ANT is to understand that actors may be friendly towards the goal or may also be antagonistic, which defines them as rogue actors. I will analyze the initiatives taken to solve the problem of Detroit food desert primarily by taking a deeper look into the rogue actors in the network, which will be able to provide insight into how the initiatives did not successfully alleviate its problems.

The evidence that I will primarily draw on to analyze the problems of Detroit's food desert will rely on the report "Examining the Impact of Food Deserts on Public Health in

Detroit" which also provides charts and figures that more clearly conveys the statistical problems deeply embedded in the Detroit area. Along with the report, other news medias, journals, the city of Detroit's website will be used to further support my argument.

Conclusion

Proposed technical design will offer consumers a more user-friendly and cost efficient plant growing system compared to both the conventional way of growing plants and hydroponic systems that are already out in the market. Making the technical system fully automated allows the user to save as much time as possible while growing the plants would be easier. Furthermore, with actor network theory, the failure to solve the problem of Detroit's food desert can be explained, identifying rogue actors within the network that caused the initiatives to not be able to fully alleviate the problem. With the end goal of solving the problem of food imbalance and food insecurity, different actors build on the network of Detroit's food desert. Technical and STS project proposals work together to offer good reasoning and solutions for restaurants and individuals to move towards an automated hydroponics grow system, especially in areas where food imbalance and food insecurity are big issues such as Detroit, which is just one of the places that is experiencing these problems.

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