

Reducing Food Deserts: Designing Greenhouses for Urban Farming using Microelectronics

Background

Food deserts are areas that have limited access to affordable and nutritious foods. In the United States, food deserts are identified by having a relatively large distance to the closest grocery store or farmer's markets, low mean household incomes, and limited access to public transportation (Annie E. Casey Foundation, 2021). The most recent data indicate that over 19 million people live in food deserts (Rhone, et al., 2017), which is over 6% of the population of the United States. This number is even higher in Indianapolis, as it is estimated that between 9.5% and 24% of the population of Indianapolis lives in a food desert depending on the distance to the nearest grocery store that is used (USDA, 2023). Many of those impacted by food deserts are children and elderly persons. Lack of access to fresh, healthy food can lead to poor health outcomes such as obesity, diabetes, malnutrition, and food insecurity.

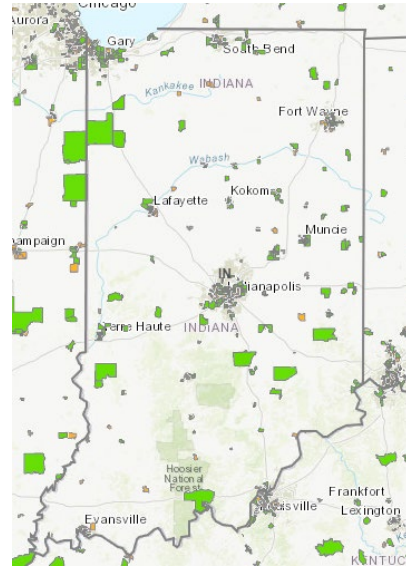


Figure 1: Food deserts in Indiana. Both green and orange indicate the size of the food desert.

One solution to this important issue is the development of urban agriculture, which includes gardens, urban farms, and vertical gardens (Schneider, 2022). Urban agriculture increases access to fresh and nutritious foods by decreasing the need for transportation to the nearest grocery store. However, the ability to maintain and harvest food from a garden is seasonal. Therefore, there is a need to develop greenhouses that are effective, help to extend the growing season, as well as inexpensive and able to fit the community's needs. i²engineering is a research laboratory at Purdue University that conducts research on interactive educational technology. They are looking for innovative ideas for affordable greenhouses that can extend the growing season for urban agriculture that incorporate microcontrollers and sensors. i²engineering would like your team to put forth design ideas that have merit to their Design Committee.



Figure 2: A community garden in Indianapolis. Image from: <https://www.indystar.com/story/news/2022/08/17/urban-farming-brings-water-to-the-food-desert/7580739001/>

Design Challenge

As a team, your job over the next few weeks is to develop a plan for a greenhouse that will allow for urban agriculture for community gardens in Indianapolis. i²engineering wants creative engineers to collect data and use their analytical skills to develop **evidence-based** proposals for new greenhouses that are affordable and extend the typical growing season allowing for food to be harvested later in the growing season. They are requesting proposals for new approaches that will be effective and will either withstand harsh winters or can be taken down during winter and easily put back up in the Spring. To succeed at this project, you must engage in **informed design**. You will work through this project in multiple steps (as separate assignments) as outlined in the assignment document. This will mean you will turn in the same document multiple times, but more completed for each submission. Follow all instructions.

Your Final Solution

Your final solution should meet the following criteria and constraints:

Desirable	<ul style="list-style-type: none"> • Solution extends the growing season. • Solution is appropriate for a community garden. • Solution is easy to set up, take down, and transport.
Effective	<ul style="list-style-type: none"> • Solution provides evidence for extending the growing season. • Solution is usable by diverse users of varying ability. • Solution itself is safe and reliable. • The solution must use microelectronic technology in the design.
Economically viable	<ul style="list-style-type: none"> • Solution may not exceed a budget of \$4,000. • Solution can be built in 3 days or fewer without using specialized tools.
Technically feasible	<ul style="list-style-type: none"> • Solution can be implemented with existing technology, materials, and infrastructure, or materials that are easily obtained within the budget. • Solution is easy and cheap to maintain. • Solution is portable with minimal effort for construction and removal. • Power requirements must be documented.
Use Microcontroller Technology	<ul style="list-style-type: none"> • Your prototype must use the Texas Instruments MSP432 P401R microcontroller* to demonstrate part of your design. Kits will be provided to your team. • More information to come regarding this.

* What is a microcontroller? [Video 1](#), [Video 2](#)

Tip: For each task that you work on it is good practice to take pictures and video that can be incorporated into your final project deliverables, such as your final report and final presentation. Pictures and video can make a strong contribution to data collection and communication with your client. Document when and where all photos and video are captured. In addition, you must document your testing, all prototypes, and every design idea.

References:

Annie E. Casey Foundation. (February, 13, 2021). Food Deserts in the United States.

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Rhone, A., Ver Ploeg, M., Dicken, C., Williams, R., & Breneman, V. (January 2017). Low-Income and Low-Supermarket-Access Census Tracts, 2010-2015, EIB-165, U.S. Department of Agriculture, Economic Research Service. Retrieved from

<https://www.ers.usda.gov/webdocs/publications/82101/eib-165.pdf?v=3395.3>

Schneider, K. (August 17, 2022). Grown in Indiana: Urban farmers uplift Indy communities, raise next generation. Indy Star. <https://www.indystar.com/story/news/2022/08/17/urban-farming-brings-water-to-the-food-desert/7580739001/>

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