Microsoft

AI for Earth Grantee Profile

AdaViv

AI-enabled adaptive growing system

Summary

AdaViv is developing an adaptive and efficient indoor growing system on Azure that uses sensors, actuators, and machine learning to monitor plant growth, predict yields, detect diseases, and understand precisely how nutrients, environment and light are affecting plant growth. This system will help indoor producers attain higher yields, precise quality control, and hyper-efficient production.

Using AI to unleash the potential of urban agriculture

According to the Food and Agriculture Organization of the United Nations, almost 800 million people suffer from hunger today, yet there is already enough food being produced for everyone on the planet. While increasing food production is a major goal, we also need to explore how to better distribute the food we already grow by increasing incomes, opening up employment opportunities in the agriculture sector, securing land rights, creating resilient food systems, and strengthening markets so that people can access safe and nutritious food.

> Food production will need to increase by at least 60 percent over the next 35 years to provide food security and meet growing demands.

Looking forward, we also need to be considering how we'll sustainably feed an increasing global population while addressing the fact that 20 to 40% of global crop yields are lost each year due to pest and disease damage (FAO). By 2050, the world population is projected to reach 9.7 billion, 33 percent higher than it is today. Losses need to be reduced and food production will need to increase by at least 60 percent over the next 35 years to provide food security and meet demands.

Fostering more localized and sustainable food systems for urban areas

While it will take a collection of solutions to help solve this global challenge, there is one getting considerable attention—urban agriculture. Public interest in urban agriculture has been growing rapidly due to a desire to foster more localized and sustainable food systems (Seiferling, G.K. MacDonald, C.R. Ratti. 2018). Food demand in more developed countries has become increasingly concentrated in cities, which could highly benefit from having locally produced food—such as nutrient recycling, local climate regulation, pollination, recreational value, and social cohesion.

However, urban agriculture is currently struggling to gain real momentum due to high energy demands, inability to reduce food-related carbon emissions, and scalability limitations. To make urban agriculture a more viable option, we need to increase energy efficiency and crop production, and uncover more scalable methods for growing crops.

AdaViv is developing an adaptive and efficient growing system that uses sensors, actuators, and machine learning to monitor plant growth, predict yields, detect diseases, and understand precisely how nutrients, environment and light are affecting plant growth. This hardware-enabled, predictive analytics system will help indoor producers attain higher yields, precise quality control, and hyper-efficient production chains through improved operational efficiency, reduced labor and losses, and precisely tailored products.

While the industrial agriculture sector has been seeing the benefits of AI for some time due to the digitization of farming, indoor farming has seen less innovation to date. Although this can largely be attributed to the market opportunity of industrial agriculture, it’s also in part due to the cost and complexity of implementing the variety of sensors and other hardware to provide the predictive analytics with the data needed to be useful. Industrial agro-tech solutions are able to rely on drones to capture the data they need, but indoor farming’s physical space limitations typically require the implementation of individual sensors or costly, purpose-built machines.

Bringing big tech to small spaces

To combat costly, complex hardware implementations, AdaViv is developing a custom sensory array in a small, lightweight package that can easily move around the greenhouse to capture visible and invisible plant features. Using standard sensors all packaged into mobile housing, AdaViv expects their sensor to be able to meet the price point required while still capturing the level of data needed to feed their predictive analytics models.

Using the data gathered from the greenhouse sensory array along with environmental data—such as humidity levels and temperature readings—AdaViv’s predictive analytics models will be able to monitor plant growth, predict yields, and detect diseases. Through these insights, AdaViv plans to provide growers with precisely tailored recommendations, fundamentally changing how indoor crops are grown, inspected and maintained.

Using their AI for Earth grant, AdaViv plans to enhance the capabilities of their predictive models and enable the scale needed for general availability rollout. The team is excited to take advantage of the computer vision API, databasing, and convolutional neural network capabilities already built into Microsoft Azure, which will enable them to improve the effectiveness of their models and expand the catalog of plants the models are equipped to analyze. And because these capabilities are already developed, tested, and routinely updated, the team will be able to scale very quickly since they won't need to start from scratch.

Going forward

AdaViv is currently working on refining their core predictive analytics models for greenhouse applications of specialized crops such as medicinal cannabis, but the vision is to scale and grow the technology to other indoor crops such as tomatoes, leafy greens, berries, vine crops and flowers. The team plans to eventually expand to additional indoor farming applications (such as vertical farming and large warehouses), and to begin exploring the development of a social engagement component where farmers could share insights, engage other farmers, and ask for advice.

About AdaViv

AdaViv consists of three MIT postdoctoral researchers and one MIT Sloan MBA student. Ian Seiferling is an environmental scientist who brings expertise in image processing, urban agriculture, and plant physiology. Mohammad Vazifeh is a physicist who brings expertise in machine learning, dynamical systems, and experience in entrepreneurship. Julian Ortiz has a background in industrial engineering and economics, and brings expertise in consulting, project management, and sustainable development. Thomas Matarazzo is an engineer with expertise in sensing techniques and mathematical models of physical systems.

Resources

Websites

AdaViv company website detailing company mission, recent news, and sharing contact info.

Publications

Seiferling, G.K. MacDonald, C.R. Ratti. Urban form constrains agriculture production potential within and across cities. In submission. 2018.

Documentation

FAO, IFAD, UNICEF, WFP and WHO. 2017. *The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security.* Rome, Food and Agriculture Organization of the United Nations. http://www.fao.org/3/a-I7695e.pdf