Red Team (#2)
Lam-Anh Le, Jinru Zhang, Yue Zhang, Xuehao Wang
Professor Carmel
ITEC-616

Enhancing Scotts Miracle Gro's Digital Transformation: The Case for AR integration for the *My Garden App*

How does dirt and data go hand in hand for the average garden enthusiast? As mentioned in previous milestones, Scotts Miracle Gro has leveraged a number of software technologies as it moves toward an integrated IoT ecosystem that will offer data on a user's soil levels, water, temperature, and pest control for precision watering and other guidance to achieve healthy gardens. They have collaborated with hardware partners including soil sensor companies PlantLink and Parrot and smart water controllers Blossom, Rachio, Green IQ and Lono to launch a unique personalized "Connected Yard" platform called *My Garden*. With such a promising digital platform, what other emerging technology could the company possibly need?

After further user experience research into the *My Garden* app, we have noted these findings:

- Users cannot add their own photos to track progress in a way that they want
- Less customizable than expected, the "Prep & Plant" portion only shows boilerplate instructional video based on the type of plant
- Not as intuitive--users can add a plant project to their garden but there isn't a notification system to alert users when to tend to their garden

With this in mind, it seems that a possible solution to expanding the personalization feature of the platform would be to pivot toward Augmented Reality (AR), specifically an AR-enabled, camera-equipped device with computer vision technology that recognizes a symbol, object, or image and adds relevant content so that we can see these layered visualizations as if they were real. If adopted, users can "drag and drop multiple 3D landscape objects into the scene and can move them anywhere to visualize it differently" while forecasting how the landscape will look after a couple years—all within the palm of their hands.[1]

But how is computer vision technology able to do that? Under the hood and specifically for mobile, camera-based AR systems, the three basic foundations are localization and mapping (where it is in the world), geometry (what the world looks like), and semantics (extracting meaning and understanding). Smartphones can utilize

[1] Brainvire. (2021). Case Study: An Augmented Reality App For Transforming Landscape Industry. Brainvire. Retrieved from https://www.brainvire.com/augmented-reality-app-transforming-landscape-industry/

the technique called Visual Inertial Odometry (VIO), where an object's movement is tracked over time without GPS, to track their spatial position and orientation. Essentially, the inertial system employs an accelerator and gyroscope to help the device determine its position on multi-dimensional axes and orientation (pitch, yaw, roll or the 6-degrees-of-freedom pose).

This is all combined into the broader system called Simultaneous Localization and Mapping (SLAM) that allows the smartphone to create and update a map of an unknown environment (say, a user's garden) while simultaneously keeping track of its location within the map. Coupled with this system is the use of 6D.ai to map a user's environment spatiality (3D reconstruction). This translates to the ability of the monocular RGB camera on the smartphone to possess the power of a depth sensor, which can scan the environment and capture a "dense point cloud" that later converts into a "mesh" through computational geometry. This means, as a user moves their camera smartphone around their environment, the "mesh" or a "thin invisible blanket that drapes over the scene to outline the external surface of objects" is updated in real-time to provide the most accurate spatial understanding of the user's physical world. In terms of semantics, this is achieved through a convolutional neural network (CNN) model where computers can be trained to localize, detect, classify, and segment objects. Through a series of specialized layers, the model allows for recognition of specific patterns like "edges, shapes, textures, corners or even sophisticated objects like dogs, cats, humans, cars or stop signs."[2] In our case, it would result in a wide array of plants relative to a user's location and preference.

The concepts of smart gardens are not novel. Leveraging the open-source computer tracking library ARToolkit, AR-based apps are currently being used by the landscaping industry on a large scale.[3] Researchers Okayama and Miyawaki from Ibaraki University demonstrated in their article "The 'Smart Garden' System using Augmented Reality" how smart gardens can support farmers and amateur gardeners to

1. visualize guidance of farming operations using CGS (computer generated solutions) and overlay them on a field where the operator is working
2. record the operator's positions and viewpoints during their operations.[4]

In this way, Scotts Miracle Gro will be able to entice users with an expanded, more personalized platform that provides the opportunity for them to visualize and plan

---

[2] Alex Chuang. (2019). AR's Inner Workings: A Peek Under the Hood. AR Insider. Retrieved from https://arinsider.co/2019/06/19/ars-inner-workings-a-peek-under-the-hood/

[3] (2018). Reinventing the Concepts of Gardening with Augmented Reality. Brainvire Blog. Retrieved from https://www.brainvire.com/blog/reinventing-the-concepts-of-gardening-with-augmented-reality/

[4] Tsuyoshi Okayama, Kazuya Miyawaki (2013). The "Smart Garden" System using Augmented Reality. Vol 46:4. IFAC Proceedings Volumes. Retrieved from https://www.sciencedirect.com/science/article/pii/S1474667016335613

their garden in real time. What's more, they're able to retain users with enhanced user experience as there will be the option to further customize and update their garden based on current gardening metrics such as soil and water levels. They can also view demonstrations of how specific Scotts Miracle Gro products can improve the growth and quality of their plants through this feature.

How does this fit into the bigger picture of Digital Transformation? According to Michael E. Porter and James E. Heppelmann from Harvard Business Review, the wealth of data available to us remains "trapped on two-dimension pages and screens" and limits our ability to "take advantage of the torrent of information and insights produced by billions of smart, connected products (SCPs) worldwide."[5] The aforementioned research also explains how as Japan enters an unprecedented aging society, many retirees are experiencing an abundance of leisure time to allow for more opportunities for home gardening. Additionally, their younger generations have expressed interest in overall healthier, farm-to-table gardening. For the U.S., we also see projections of an increasing aging population[6] and trends toward more urban gardening and eco-friendly, locally sourced food.

The main challenge, to date, is the gap of information and knowledge to begin gardening in the first place as there are many factors to consider including data metrics on soil, watering, weather, and climate conditions. The Scotts Miracle Gro *My Garden* app has made considerable progress to tackle that challenge. It's now up to them to consider AR enhancements to continue leading the way for personalized smart gardening.

---

[5] Michael E. Porter, James E. Heppelmann (2017). Why Every Organization Needs an Augmented Reality Strategy. Harvard Business Review. Retrieved from https://hbr.org/2017/11/why-every-organization-needs-an-augmented-reality-strategy

[6] United States Census Bureau. (2018) Press Release: Older People Projected to Outnumber Children for First Time in U.S. History. Retrieved from https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html