

Designing and Testing a Human-Centered Smart Irrigation Solution, so Farmers Want to Adopt Water-Saving Technologies: A Collaborative Effort between MIT Gear Lab and MIRRA funded by USAID

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In August 2023, Georgia Van de Zande, one of MIRRA's research partners from the Massachusetts Institute of Technology, defended her Ph.D. in Mechanical Engineering. For her dissertation, Dr. Van de Zande worked with a team of engineers and researchers to design and test an energy- and water-efficient irrigation controller that has been piloted on MIRRA's Climate-Smart Farm in the Jordan Valley over the past year.



In August 2023, Georgia Van de Zande defended her PhD dissertation to an audience in Cambridge, Massachusetts, USA, as well as a virtual audience that included MIRRA members.

Dr. Van de Zande successfully defended her PhD dissertation at the Massachusetts Institute of Technology, which has partnered with MIRRA for the past 5 years.



Translating Farmer's Needs

Dr. Van de Zande's role on this team was to translate farmers' needs and preferences to the engineering team. She focused on understanding what farmers preferred in an irrigation tool in order to increase adoption. Too often, agriculture equipment is not adopted by farmers despite the technical benefits they might provide. If farmers' preferences are not considered in the design of a tool, it can lead to disadoption of otherwise beneficial technologies.



A Unique Design Approach

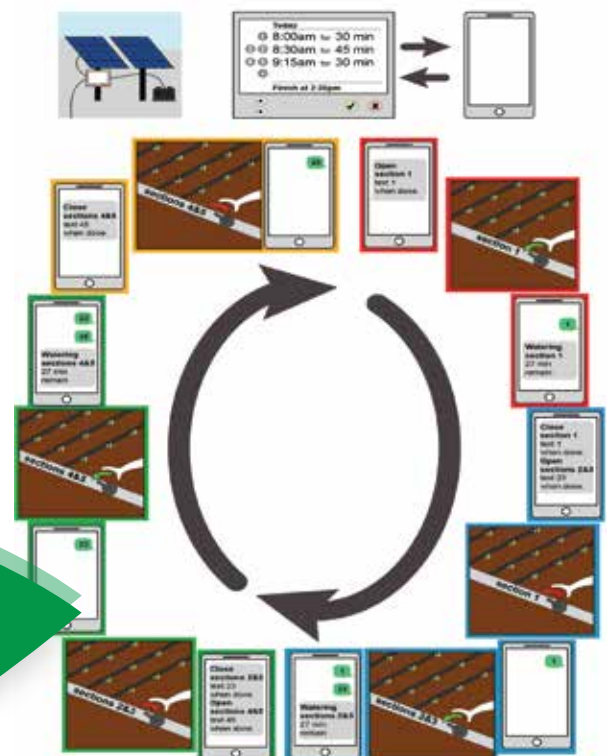


The MIT and MIRRA team using the storyboards to explain to farmers in the Jordan Valley the functionality of the proposed irrigation controller and irrigation mobile application.

Dr. Van de Zande took a unique approach to understand what farmers might value most in an energy- and water-efficient irrigation tool. Along with the MIT team and local partners like MIRRA, she first conducted a series of interviews with farmers and key irrigation market stakeholders in multiple countries to learn how farmers currently used irrigation equipment on their farms. Using this information, the MIT team developed a concept for an energy- and water-efficient irrigation controller that was detailed in last month's newsletter. Dr. Van de Zande's specific contribution to this concept was a user experience that would allow farmers to continue using familiar, inexpensive manual valves with an automatically-generated schedule. She hypothesized this would particularly help capital cost-constrained farmers gain the efficiency benefits of precision irrigation scheduling while reducing the necessary equipment as much as possible.

A Novel Interaction Method

This proposed concept included a novel way of interacting with an irrigation tool, so Dr. Van de Zande recognized that it was important to understand how farmers might react to this different user experience.



A 2-D illustration of the Irrigation Scheduling Mobile Application developed by the MIT. This illustration was used to explain to farmers the functionality of this proposed water-saving Agri-technology.

She designed a set of storyboards—2D visual representations—and an interactive prototype that could explain the irrigation tool and its user experience to farmers. The MIRRA team translated the storyboards to Arabic, and the MIT team was able to use them as a tool to facilitate several interviews with farmers. These interviews were a key source of farmer feedback to improve the tool concept before the tool was built.



The MIT and MIRRA team using the storyboards to explain to farmers in the Jordan Valley the functionality of the proposed irrigation controller and irrigation mobile application.

Farmer Field Days

In March of 2023, Dr. Van de Zande travelled to MIRRA's Climate-Smart Farm in the Jordan Valley with other researchers from the MIT team in order to finish building a working prototype of this irrigation tool. There, she also demonstrated how the prototype worked to several local Jordanian



In March 2023, Dr. Van de Zande visited the MIRRA test farm. Her team and the MIRRA team invited Jordanian farmers to see the new irrigation technology they were piloting on the farm.

farmers, gaining their crucial feedback. The prototype monitored local weather conditions, generated water-efficient schedules using an existing scheduling theory, and notified users' phones when they should manually open or close valves. After 11 weeks of use on a real farm context, study participants demonstrated successful use of the prototype on a daily basis. Irrigation events were measured on the field to show that users confirmed 93% of the scheduled events correctly using the tool's interface. Further, of the irrigation events that did occur, a majority of their durations fell within 15% of the scheduled duration. Dr. Van de Zande hopes that results from this field pilot and feedback from study participants can continue to improve the design of the proposed irrigation tool and its user experience.



Here, Dr. Van de Zande is showing a group of farmers the app she designed to link the solar irrigation system to a tool many farmers use daily--their cell phone.

MIRRA's Climate-Smart Farm – Jordan Valley

In August 2023, Dr. Van de Zande successfully defended her Ph.D. dissertation to an audience that included several members of the MIRRA team. She is thankful for having the support of MIRRA in helping realize this irrigation tool.



In addition to testing this technology in Jordan, Dr. Van de Zande have tested it in Kenya, Morocco, and Massachusetts. This photo was taken at Gaining Ground, a local farm in Massachusetts.

She believes that the MIRRA's Climate-Smart Test Farm in the Jordan Valley was an ideal site to conduct the kind of transdisciplinary research that her work entailed.

It was extremely valuable to demonstrate this tool's capabilities to local farmers, incorporate their feedback, and conduct a season-long pilot in a real farm context. Dr. Van de Zande believes that if adopted at scale, the tool she and her team developed could increase the adoption of water-efficient irrigation practices on resource-constrained farms that are not served by existing precision irrigation technology, improving food security and sustainable agriculture in countries like Jordan.



Dr. Van de Zande and her colleague, Dr. Sheline, installing sensors on MIRRA's Climate-Smart Farm.

Welcome!



Hello! My name is **Sewar Saleh**, and I'm thrilled to introduce myself as the newest intern at MIRRA for this semester. I'm eager to gain professional experience and develop my skills at MIRRA. With a background in Natural Resources Management, this is a great opportunity to apply my academic and theoretical background towards real-world projects being developed at MIRRA. I am looking forward to contributing to exciting projects and learning from MIRRA's experienced team!

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