Raspberry Pi

Customer story

Vineyard Kikushima: Affordable environmental monitoring in a Japanese vineyard with Raspberry Pi 3B+

For Vineyard Kikushima, the Raspberry Pi ecosystem provided support and information to increase healthy grape yield with a targeted, minimalist pesticide regime based on temperature and humidity monitoring.

Raspberry Pi solution	Raspberry Pi 3+
Size of business	Small to medium/SME
Industry	Agriculture

Kunio Kikushima's first career was as an employee of one of Japan's "big name" electronics manufacturers. In 2015 he changed careers and began running a vineyard, which he enjoyed, and which supported his modest lifestyle. However, he was also keen on producing "great wine", and with wine tourism taking off in the Katsunuma region north of Tokyo where he lives, he sensed an opportunity.

As a newcomer to Raspberry Pi, Kikushima was reassured by the wealth of relevant information available

One route to making a name for himself and his wine would have been to invest and expand, but Kikushima was far more interested in quality than in competing with established wine brands. Responsible production methods were also important to him, and he was keen to keep the use of pesticides and other chemicals to a minimum.

Back in 2020 when the project began, he told Raspberry Pi's MagPi Magazine of his aim "for eco-friendly wine without any agricultural chemicals where possible". Vineyard Kikushima began with viticulture and vinification from Kunio Kikushima's base in Koshu city, Yamanashi Prefecture, and a small vineyard in Katsunuma.

The challenge

The Katsunuma region is hot and suffers high humidity, which can attract lots of unwanted insects that then attack the grapevines or spread diseases. In order to make a success of his budding wine business, Kikushima needed help fending off the threat of pests but without damaging the taste or quality of his wine.

More specifically, he needed a precise means of applying agricultural chemicals and pesticides, using them only when weather conditions were ideal, thus maximising their effectiveness. A further challenge was that of relaying information from the field to Kikushima's office, for which solar power and wireless connectivity would be needed. "I wanted to check the timing of high humidity [by] collecting temperature and humidity data automatically measured at regular intervals," he explains. "I want to check those data in real-time over the network, as the fields are scattered and far away from my office."

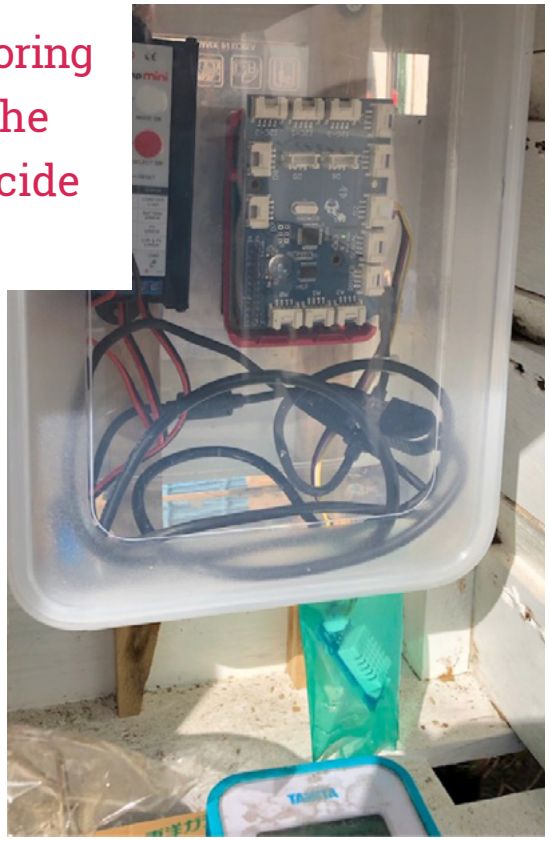
A tech solution seemed obvious, but Kikushima doesn't have much experience with programming and developing.

Sensor data is sent to Kikushima's cloud-based dashboard wirelessly and via 3G at hourly intervals. Here it can be displayed as graphs for further analysis in the AmbiData.io IoT visualisation platform. It's also displayed on Twitter in real time so it can easily be monitored and accessed from any location.

When Kikushima embarked on the vineyard-monitoring project he hadn't yet acquired any programming skills. He learned as much as he needed to assemble everything by watching and imitating other Raspberry Pi users, deploying the system in one field initially before adding sensors to cover his other three fields of vines. He is confident that a similar temperature and humidity measurement setup could be applied to other agricultural scenarios.

Kikushima was keen to use solar power for what he calls his "Hinno" IoT system — the Japanese term suggesting that this is a simple peasant's approach to viniculture — because it could also be used to power electric fences to keep animals off his crops. As a farmer of modest means, keeping costs to a minimum was an important factor.

Since Kikushima began monitoring his crop using Raspberry Pi, he has been able to deploy pesticide at the optimum time



The solution

Kikushima found support from the Japanese Raspberry Pi Users Group when he explained the issues he was facing in effectively monitoring his vine crops. They proposed an IoT setup involving Raspberry Pi temperature and moisture monitoring that would inform Kikushima of the optimal time to apply pesticides to protect his vines. It would also allow him to keep a watchful eye on atmospheric conditions from his office.

With their help, Kikushima developed a system using $35 Raspberry Pi 3B+ computers to aggregate data from air temperature and humidity sensors in the field. The system is powered by a solar panel and battery working with a charge/dischargesystemcontroller,providingasustainableand low-cost power source.

Why Raspberry Pi?

Once Kikushima had figured out a technical setup that would do what he needed, it was clear that Raspberry Pi could be used to great effect at his vineyard. He was attracted by the "ultra low cost" of Raspberry Pi and its easy availability, and as a newcomer to using Raspberry Pi he was reassured by the wealth of information relating to how to achieve temperature monitoring and humidity testing. He was impressed at being able to simply search for how to achieve something using Raspberry Pi, and with Linux's ease of use. Kikushima was able to set up both a trial version of his IoT setup and a live field version providing real-world results.

The results

Kikushima started with a trial phase consisting of a field test, plus a setup reserved for system development. The total cost was ¥30,000–¥40,000 (about £225–£300, or $275–$370) including the solar power equipment. Adding 3G dongles to the system, the total cost will be ¥50,000–¥60,000 (about £375–£450, or $460–$550).

Kikushima says the setup process — in which he put together a prototype involving sensors hanging off the side of a box — was completed "with ease". Happily, he was able to save money even during the trial phase: right from the start, the remote reporting process eliminated the need to physically visit the vineyards to gather data in person.

He soon reported that he'd "enjoyed the process of setting up the trial and [was] pleased with how it has gone so far, so much so that we intend to roll out the system to our three other vineyards". He also added new functionality, such as setting alerts if temperature or humidity exceeded a certain threshold, and calculating accumulated temperatures to better inform pest and disease prevention.

In the two years since Kikushima Vineyard led the way in introducing an IoT monitoring system, many more small vineyards have arrived, and Kunio Kikushima is sure the system helps their viticulture.

Since Kikushima began monitoring his crop using Raspberry Pi, he has been able to deploy pesticide at the optimum time. This has helped to reduce the number of diseases that afflict the grapes, thus increasing the yield of healthy grapes.

Crucially, of course, this means Kikushima has been able to achieve his goal of making great wine: "I could make delicious wine with Raspberry Pi."