

IoT Sensor Systems for Improving Production and Quality in Vineyards (test site at 5525 Dry Ridge Road, Cincinnati)

Mohsen Rezayat, Ph.D.
Founder, President
OMID USA
Mohsen.Rezayat@omid-usa.org



Our Support Team

2

Dr. Mohamed Rezayat, Principal Investigator, is the Chief Solutions Architect at SIEMENS with over 30 years of industrial experience. He has a Ph.D. in Engineering Mechanics from University of Kentucky with over 80 technical publications and many patents. Artificial Intelligence (AI) is a major area of research for Dr. Rezayat at Siemens. He is also the founder and president of poverty-alleviation 501(c)(3) OMID USA organization. OMID USA has become photovoltaic technology and AI for the last 13 years to address many problems faced by farmers in third world and developing countries. See <https://www.omid-usa.org> for more details.

► **Dr. David Weiskittel**, MD, has a medical degree from The Ohio State University and has been a family physician for 33 years. Dr. Weiskittel has had hands-on experience testing, propagating and growing American Heritage grapes for the past 15 years. He established a vineyard at Dr. Ridge Estates (now Vinovoltacs) in 2014 and has grown other crops such as potato, tomato, lettuce, etc. He has also worked with Dr. Rezayat on the board of OMID for the last three years.

► **Dr. Je-Hweong Bahk** is an assistant professor jointly at the Dept. of Mechanical and Material Engineering and the Dept. of Electrical Engineering and Computer Science, University of Cincinnati (UC). He has recently co-developed a graduate course on smart sensor for engineering students and Industry 4.0.

Sensor System to Reduce Impact of Climate Change in Vineyards

How a warming climate disrupts wine chemistry



Sugar

Berries ripen faster at warmer temperatures, building up more sugars, which raises alcohol content in wine.

Acid

Acidity, which adds freshness and zest to wine, declines in warmer climates.

Secondary compounds

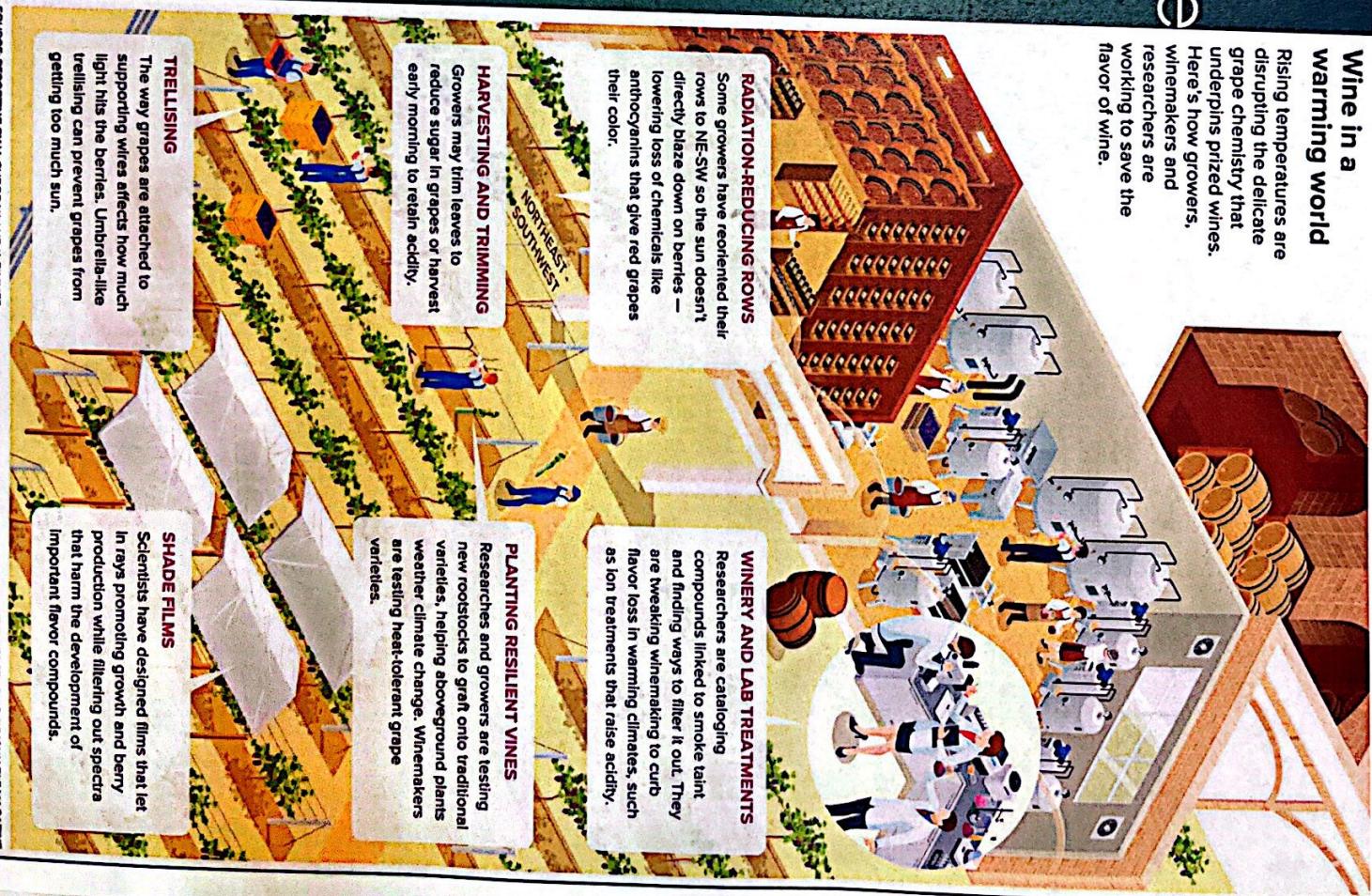
Pigments called anthocyanins break down under heat. Tannins, important for wine mouthfeel, may not develop enough if grapes are harvested early to curb rising sugars.

SOURCE: REPORTING BY U. CHROBAK AND K. ZIMMER

KNOWABLE MAGAZINE

Wine in a warming world

Rising temperatures are disrupting the delicate grape chemistry that underpins prized wines. Here's how growers, winemakers and researchers are working to save the flavor of wine.



SOURCE: REPORTING BY U. CHROBAK AND K. ZIMMER

BY INFOGRAPHIC / KNOWABLE MAGAZINE

Another Example of What a Sensor System Can do: Avoid Late-Season Frost Damage

- ▶ In 2021, late-season frost damage cost France's vineyards and fruit orchards an estimated 2 billion euros; such events are expected to happen with more regularity due to climate change.
- ▶ Growers need a jump-start to begin protecting their grapes and orchards against late-season frost.
- ▶ Possible solution: Place sensors in risky areas of vineyards and orchards to record information including temperature, humidity and topography, and then combine this information with weather prediction models and machine learning to provide growers with detailed 48-hour forecasts about the exact time late-season frost is expected **on their land**.
- ▶ With such ample warning time, growers can use frost candles to warm up the air from below or use large fans on tall platforms to mix the warmer air from above and reduce frost damage.
- ▶ At a cost of 10 euros per frost candle and need for 300 candles per acre, this most-effective defense against late-season frost could get very costly for multi-acre vineyards and orchards.

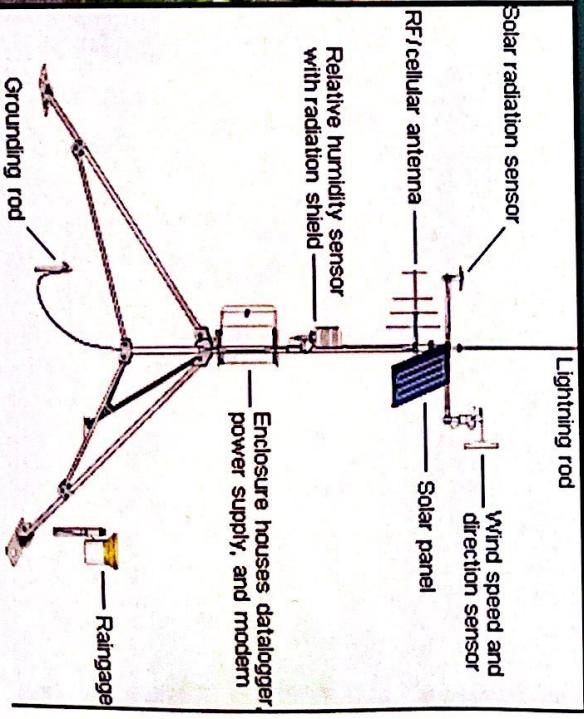
Proposed Adding IoT Sensors to Vineyards/Orchards

5

The project funds should be spent on instrumenting the entire vineyard with multiple sensors such as those shown above. Drones can collect data from possibly the vineyard.

The sensors can provide long-term behavior of vines, yield and predict quality of grapes during specific weather events during growing seasons, followed by publication to apply to other crops.

Sensors can measure/predict plant disease and vigor, soil moisture, irrigation scheduling, integrated pest management, heat/chill monitoring, frost occurrence, pesticide/fertilizer application, and more.



Tasks to be Done

6

- 1) Develop a sensor system for a vineyard at 5525 Dry Ridge Road (on West side of Cincinnati) including various climate sensors with wireless communication.
 - 2) Explore AI-based systems such as Nvidia's ForeCastNet for possible integration.
 - 3) Develop a software program (e.g LabVIEW or a phone app) that collects sensing data from the sensor system and displays the graphs real-time.
 - 4) Determine how a canopy of solar panels can power the entire sensor system.
 - 5) Field-test the developed system at the vineyard since grapevines are most affected by climate change and thus can benefit greatly from an early-warning system.
 - 6) Discuss how the results of this project can help underserved communities of farmers, which are the primary stakeholders for non-profit OMID USA.
- Please note that all design efforts for IoT Sensor system in the vineyard must be completed in compliance with relevant engineering standards and codes.