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TAWC

TEXAS ALLIANCE FOR WATER CONSERVATION

TEXAS TECH UNIVERSITY
Agricultural Sciences & Natural Resources
Davis College™

TEXAS WATER DEVELOPMENT BOARD

Front Cover and Inside Front Cover Photos by Mukesh Melah

Back Cover Photo by Alondra Cruz

In this issue:

The Texas Alliance for Water Conservation strives to conserve water and soil for future generations in collaboration with producers to identify agricultural production practices and technologies that, when integrated across farms and landscapes, will reduce the depletion of ground water while maintaining or improving agricultural production and economic opportunities.

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Autonomous Pivot

by Samantha Borgstedt

TAWC utilizes several technologies on our field sites. One of the newer technologies in Autonomous Pivot (AP), which continuously keeps track of each field's soil moisture. Information from numerous sensors is consistently collected and fed AP algorithms, along with web data, to achieve high accuracy and real-time water balance, irrigation recommendations, and alerts.

Various sensors provide information on the level of moisture in the soil: applied irrigation amounts are measured automatically by tracking the pivot's movement, pressure sensors validate irrigation applications, a rain bucket counts the amount of in-field rainfall, and AI image processing provides accurate growth-stages along with weather information to estimate the evapotranspiration (ET).

All data is collected and given to AP algorithm, and is used to regularly update soil moisture estimations. The ground-penetrating radar (GPR) provides an independent monitoring of the level of moisture, in addition standard calculations and algorithms.

Water balance (WB) is an estimation of soil water content per slice (1/8th of the field). It is given as a percentage, where 0% represents permanent wilting point and 100% represents field capacity. Algorithm estimates the amount of water in the soil using rain, irrigation, images, GPR, pressure, web data such as soil type and weather, and customer data such as root depth and crop type. Using the root depth and soil type, AP calculates the size of the water bank, in other words, the amount of plant available water the soil holds at field capacity.

Water balance is ultimately calculated as the ratio of the amount of water in the soil, and the size of the water bank. The AP app shows a graph of the hourly or daily WB along with daily rain, irrigation, and ET crop.

Maximum Allowed Depletion (MAD) is a lower boundary threshold for WB and acts as a trigger for irrigation recommendations. Recommendations are given so that no slice's WB will fall below the MAD. AP provides a field-specific MAD which is dependent on the crop, growth stage, soil type, and irrigation strategy. As a first step towards autonomous irrigation, irrigation prescriptions may be downloaded from the app to be uploaded directly to AgSense/FieldNet/FieldWise.

The ground-penetrating-radar (GPR) is a dedicated sensor for estimating the soil-moisture. It is positioned in front of the irrigation area and covers a local area of 10 square feet. In this way it measures the moisture level in the driest point in the field. Proprietary algorithms analyze the reflected signal from the soil, remove noise, and provide a supplementary estimation for soil moisture.

MAD WB 3 At Autonomous Pivot AI is an agronomist's partner, informing AP system and farmers of things that are difficult to determine by the human eye. From supplying some of the core information of our system, such as crop growth/development, to the detection of anomalies, our AI works in tandem with algorithms and agronomists to provide farmers with a general overview of the field's status and offer recommendations to maximize crop health and yield.

Autonomous Pivot AI currently operates in three capacities: providing daily updates on the

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growth stages of crops, detecting anomalies and problems in fields, and providing an approximation for crop coverage to calculate an accurate crop coefficient. In all cases, AI models are neural networks trained on hundreds of thousands of images from hundreds of fields across the mid and western United States. The models learn patterns and commonalities between images in each growth stage, anomaly type, or coverage group. Then they predict this information for every new image.

All of AP's algorithms for calculating moisture level, recommending irrigation, and detecting anomalies depend on the crop's growth stage. Some stages are difficult to detect from photos, for example, when they are not taken at the ideal angle. This is where the AI comes in. AI distinguishes between V4 and V5, which in these cases, is difficult to determine by the human eye. These predictions are based on the many images that the model has already learned at V4 and V5. Our model therefore provides growth stages that are stable and accurately calibrated. Growth Stages Another crucial factor for our systems is calculating the correct evapotranspiration rate, the amount of moisture that is transferred from the soil to the atmosphere directly or through the plant. This hinges on using an appropriate K , or crop-coefficient, a major component of which is crop coverage. Therefore, AP developed a model to detect this coverage level.

With this information, our algorithms can effectively provide K , evapotranspiration rate, and hence, determine current moisture levels and recommended irrigation in real time.

After receiving the growth stage, images are fed to an anomaly detector, a model that identifies abnormalities. Like the growth stage model, the anomaly model is trained on thousands of images. It learns what a normal crop looks like and is trained to identify patterns that are typical of abnormal images, based on a range of abnormalities from water stress to hail damage, disease to pest damage.

Models are trained in different growth stage groups, as abnormalities can look different in various stages of development. The model gives the probability that an image is an anomaly. If the probability lies above a threshold, an alert is sent to AP agronomist about the problem area in the field and is then sent to the farmer as a notification on their phone.

How do farmers use all this data?

Autonomous Pivot accumulates thousands of real time field data points, combines it with known field and crop information and standard irrigation plan, and using a proprietary artificial intelligence engine delivers optimized irrigation scheduling and record keeping. Custom irrigation plans are provided to help each farmer ensure on-time irrigation application. Additionally, AP provides mid-year and year end summary reports for all of systems to help the grower summarize irrigation, pest, weed, plant health, and weather data for the growing season. The annual subscription allows farmers to use Autonomous Pivot without major capital expenditures.

Save the Date

AUGUST 7-9, 2024

WWW.TAWWA.ORG/EVENT/AWSS2024

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Texas Water Devlopment Board (TWDB)

TWDB Visit with TAWC

The TAWC was proud to host the Texas Water Development board member George Peyton and his staff on April 10th for a visit to the farm of Lloyd and Angela Arthur. The Arthur family have been cooperating producers with the TAWC for several years and have implemented various technologies and conservation management practices on their fields. Their farms use pivot and drip irrigation. Lloyd gave an informative presentation detailing the moisture readings the irrigation technologies on his currently have relayed to his phone and computer. He also explained the expenses associated with irrigation, and the massive expenses associated with drought years. We appreciate the TWDB and Arthur family's dedication to agriculture and the TAWC project.

Texas Water Development Board has been a supporter of the Texas Alliance for Water Conservation since 2005.

Providing over $10 Million to help promote and demonstrate water conservation

TWDB Agricultural Water Conservation Grants Program

The Agricultural Water Conservation Grants Program offers grants for projects that support agricultural irrigation conservation strategies in alignment with the state water plan and demonstrate agricultural water conservation best management practices. Projects that receive grants must adhere to the Texas Administrative Code Title 31 Section 367. Each year, applications are solicited to address specific topics, based on current issue areas in Texas agricultural water conservation. Some examples of previously awarded grants include the following water saving approaches:

- Irrigation systems improvements
- Demonstrations and technology transfer
- Equipment cost share

The Agricultural Water Conservation Grants Program has funded hundreds of projects since its inception in 1985 that has saved thousands of acre-feet of water.

What can be funded?

A conservation program:

- an agricultural water conservation technical assistance program;
- a research, demonstration, technology transfer, or educational program relating to agricultural water use and conservation; and
- a water conservation program administered by a state agency or political subdivision to provide loans to persons for conservation projects.

A conservation project:

- improves the efficiency of water delivery to and application on existing irrigation systems;
- prepares irrigated land for conversion to dry land conditions;
- prepares dry land for more efficient use of natural precipitation;
- purchases and installs on public or private property devices designed to indicate the amount of water withdrawn for irrigation purposes; or
- prepares and maintains land to be used for brush control activities in areas of the state where those activities, in the TWDB's judgment, would be most effective.

How To Apply

For those qualified entities interested in applying, the Texas Water Development Board annually publishes a Request for Applications (RFA) on their site (https://www.twdb.texas.gov/financial/programs/AWCG/index.asp) and on the Texas Register (https://www.sos.state.tx.us/texreg/index.shtml).

The Agricultural Water Conservation Fund's governing rules and guidelines are outlined in Title 31, Texas Administrative Code, Chapter 367, and application instructions are available upon request.


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