Monitoring and Control of SMART Irrigation system.

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Abstract

The U.S. Department of Agriculture has identified water management improvements as a primary agricultural policy objective. Water savings of 20-30% through improved water use efficiency in landscape and turf industries could offset the ever-increasing water demand. Evaluating water use through monitoring devices is a necessary component of any SMART irrigation system. Over the last 5 years, the Center for Irrigation Technology has been involved in testing a number of soil moisture sensors and climatologically based Evapotranspiration (ET) controllers in an effort to evaluate their accuracy, reliability and repeatability under different soil types, salinity and temperature conditions. Additionally, some of these devices were installed in the field for continuous monitoring of soil moisture/tension and were linked to a web based portal that allowed access from PC/PDA/Cell phone. Our results to date indicate that these technologies can be very efficient in monitoring and controlling water usage and thereby improving water use efficiency.

Introduction

The development of Smart Water Application Technologies™ or SWAT™ was initiated by water purveyors who wanted to improve residential irrigation water scheduling. SWAT™ is a national initiative designed to achieve exceptional landscape water use efficiency through the use of irrigation technology. SWAT™ identifies, researches, and promotes technological innovations and related management practices that advance the principles of efficient water use.

It is estimated that typical residential landscapes apply 30 to 40% more water than is required by the plants. It has been noted that much of the over-irrigation occurs during the fall season when plant/water demand is dropping off and the corresponding irrigation run times are not reduced accordingly. The widespread adoption of "smart" controllers and soil moisture sensors should conserve a significant portion of the excess water applied. Most in-ground irrigation systems are operated by a controller which requires frequent input from the operator (homeowner) to adjust irrigation run times during the year. A first step in ensuring that irrigation run times are optimized is to ensure that the soil water holding capacity is not exceeded, thereby reducing water losses via leaching and run off. In order to achieve this, it is important to have some kind of kind of devices/technology like soil moisture sensors or Evapotranspiration (ET) based controller.

Over the past couple of years, the Center for Irrigation Technology (CIT) has been working closely with water purveyors statewide and the Irrigation Association (IA) as part of SWAT™ in an effort to establish a testing protocol standard to verify the accuracy of commercially available soil moisture sensors and ET controllers. The next step would consist of having the ability to continuously monitor and control these controllers- preferably with remote access too.

Historically farmers have had to physically inspect crop conditions to determine if an action is needed to be taken, that is, "When to irrigate and how long to irrigate?" With the new and advanced controllers this physical inspection can be eliminated as the controller will make the intelligent decisions with respect to irrigation. But as we all know automation in an agricultural setup is much more different from an industry floor. Agricultural fields are susceptible to weather and other natural disturbances.

The objectives of this proposed study is:

a) Achieve real time data acquisition from the field (this data can be moisture data, plant stress, temperature etc.)
b) Based on changing field schedule/conditions, be able to remotely monitor and control switch, pumps or similar devices.
c) Collect the data in a portal such that the end user (farmer/irrigator) can access the data from any part of the world.
d) Based on the incoming real-time data from the field, provide recommendations to the farmer.
e) Send alerts to the farmer (email/text message to cell-phone), in case something goes wrong in the field. Example, send alert to the farmer if the line pressure drops all of a sudden due to a line break in the field or if the sensor signal fails due to line break.

Summary and Future work

So far we have been able to finish and test the beta version of the web portal. Data was remotely collected, stored, processed, tabulated and presented in a graphic dashboard format in our web portal from four remote locations (Idaho, Fresno (CA), Riverside (CA) & Chile). These data included soil moisture data, soil temperature data and electronic flowmeter readings.

We are currently testing the control components, recommendation module and the efficiency of a crop model that has been incorporated into our control module, the crop model is supposed to control the soil moisture thresholds automatically throughout the growing season for the particular crop. We are currently running our tests on a 0.8 acre plot, which has been divided into 12 beds of 400 feet length. A relatively smaller field allows us to better quantify inputs like water usage, fertilizer treatment and manpower inputs. At the end of the growing season this fall, we will take all the inputs into account and look at the yields to do a return on investment. Of the 12 beds, 6 are being irrigated manually using traditional farmers practice and the other 6 beds are being managed by the SMART controller for irrigation, the results of water usage from these tests beds will help us quantify water use efficiency.