

A Novel Method for Water irrigation System for paddy fields using ANN

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Abstract

Water is an essential resource in the earth. It is also essential for irrigation, so irrigation technique is essential for agriculture. To irrigate large area of lands is a tedious process. In our country farmers are not following proper irrigation techniques. Currently, most of the irrigation scheduling systems and their corresponding automated tools are in fixed rate. Variable rate irrigation is very essential not only for the improvement of irrigation system but also to save water resource for future purpose. Most of the irrigation controllers are ON/OFF Model. These controllers cannot give optimal results for varying time delays and system parameters. Artificial Neural Network (ANN) based intelligent control system is used for effective irrigation scheduling in paddy fields. The input parameters like air, temperature, soil moisture, radiations and humidity are modeled. Using appropriate method, ecological conditions, Evapotranspiration, various growing stages of crops are considered and based on that the amount of water required for irrigation is estimated. Using this existing ANN based intelligent control system, the water saving procedure in paddy field can be achieved. This model will lead to avoid flood in paddy field during the rainy seasons and save that water for future purposes.

Key words Artificial Neural Network, Automated hardware, Irrigation scheduling, Evapotranspiration, water saving.

1.Introduction

In our country farmers have to face many difficulties because of the poor irrigation system. During flood situation, excessive waters will be staged in paddy field producing great loss and pain to farmers. So, proper Irrigation mechanism is an essential component of paddy production. Poor irrigation methods and crop management are rapidly depleting the country's water table. Most small hold farmers cannot afford new wells or lawns and they are looking for alternative methods to reduce their water consumption. So proper irrigation mechanism not only leads to high crop production but also pave a way for water saving techniques. Automation of irrigation system has the potential to provide maximum water usage efficiency by monitoring soil moistures. The control unit based on Artificial Neural Network is the pivotal block of entire irrigation system. Using this control unit certain factors like temperature, kind of the soil and crops, air humidity, radiation in the ground were estimated and this will help to control the flow of water to acquire optimized results.



2. Motivation of the work

In our country agriculture is said to be "the gambling of the monsoon", so irrigation is essential for agriculture. Our country is getting the benefits of rainfall during four months **from June to October**. So it is essential to provide irrigation for cultivation of crops during the rest of the eight months. So irrigation technique is necessary for cultivation of crops in less rainfall areas. India is an agricultural and populous country. In our country most of the people depend on agriculture in order to increase the level of agricultural products. So, extensive irrigation is necessary.

3. Background of the work

This paper is an attempt to use the ANN based controller for controlling the irrigation activity.

3.1. Artificial Neural Network

A neural network is a processing device, either an algorithm, or an actual hardware. Information that flows through the network affects the structure of the ANN because a neural network is sensitive based on their input and output.

3.2 Controllers

A controller is an integral part of an irrigation system. It is an essential tool to supply water in the necessary quantity at right time. It is used to sustain the agricultural production and achieve high level of efficiency in water and energy. Two types of controllers are used in irrigation system. [1, 2, 3]

- 1) Open loop controller
- 2) Closed loop controller

Open loop controller

It takes the input and computes output. It does not support any feedback system to determine whether it had achieved desired result.

Closed loop controller

This type of controller supports feedback from the controlled system. By using this type we can identify whether right amount of water is supplied for irrigation system or not. This paper is proposing closed loop controller. This controller receives feedback from different sensors placed in the paddy fields. This controller unit determines how much water to be supplied to the field and also directs the valves for collecting excess amount of water from the fields, based on the data received from the sensors and predefined parameters. These are the input parameters which control the irrigation system such as Soil humidity, Radiation, Wind speed, Air humidity, temperature.

3.3. Architecture of ANN based Irrigation Controller

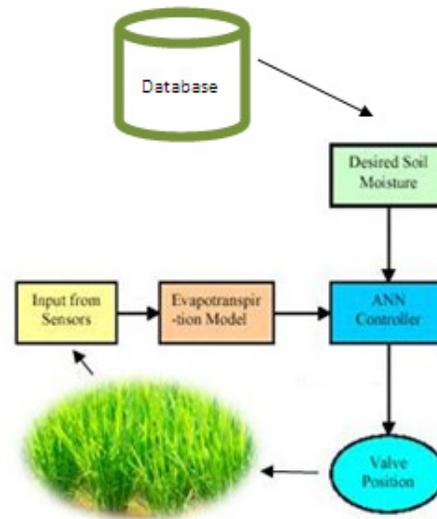


Figure 1: Irrigation control system block diagram

Pseudo code
Step 1 Collect the details from field using sensors.
Step 2 Calculate the water requirement using Evapotranspiration model.
Step 3 Compare the output of the Evapotranspiration model with required soil moisture with the help of Ann controller.
Step 4 Control the valves position

It is seen from above that control system consists of four interconnected stages.[3,4,5]

Input from Sensors In this stage different parameters like temperature, air humidity, soil moisture, wind speed and radiation are collected. Then these parameters are passed to next stage as input.

Evapotranspiration Model This block converts four input parameters into actual soil moisture

Required Soil Moisture This block provides information about the amount of water required for proper growth of plants.

ANN Controller This stage compares the required soil moisture with actual soil moisture and decision is made dynamically.

3.4. Working details of the Irrigation Control System

For getting information about paddy field wireless sensors should be fixed in various places of the paddy field. The sensors [8] will collect the information such as temperature, air humidity, soil moisture, wind speed and radiation, and store this information in the database.

During the second phase this paper uses the Evapotranspiration (ET) [1, 2, 4, 6, and 7]

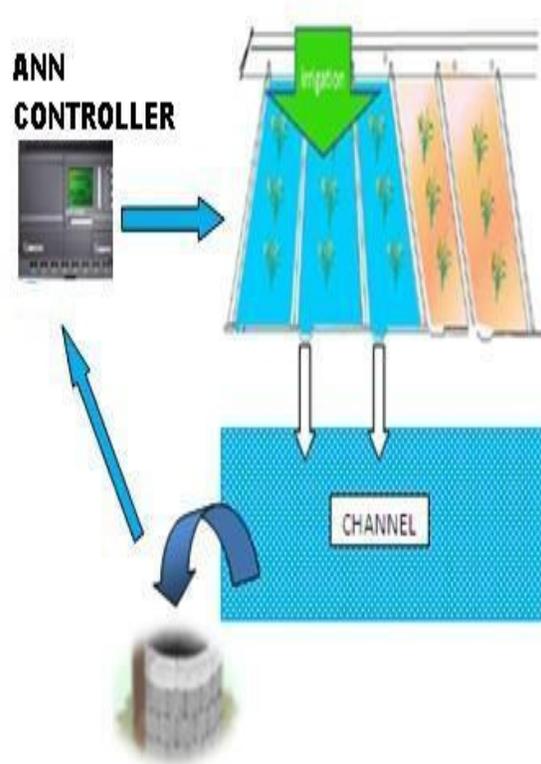


Figure2: Functional Diagram for Irrigation Control System

Evapotranspiration (ET) is a term used to describe the sum of evaporation and plant transpiration from the Earth's land surface to atmosphere. The Evapotranspiration process is composed of two separate processes: **transpiration** (T) and **evaporation** (E). Transpiration is the water transpired or "lost" to the atmosphere from small openings on the leaf surfaces, called stomata. Evaporation is the water evaporated or "lost" from the wet soil and plant surface.

The Penman-Monteith equation has been shown to be the most reliable in most environments and has been accepted as the standard Evapotranspiration calculation method.

$$E_{to} = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2(e_s - e_a)}{\Delta + \gamma(1+0.34u_2)} \quad (a)$$

$$\Delta = \frac{4098e_o(T)}{(T+273.3)^2} \quad (b)$$

$$e^o(T) = 0.6108 \exp\left(\frac{17.27T}{T+273.3}\right) \quad (c)$$

$$\gamma = \frac{C_p P}{\epsilon \lambda} \cdot 10^{-3} = 0.001628 \cdot P/\lambda \quad (d)$$

This equation is expressed as combined function of Radiation, maximum and minimum temperature, vapor pressure, and wind speed.

E_{to} = Reference Evapotranspiration [mm day⁻¹],

R_n = Net radiation at the crop surface [MJ m⁻² day⁻¹],

G = Soil heat flux density [MJ m⁻² day⁻¹],

T = Mean daily air temperature at 2 m height [°C],

U_2 = Wind speed at 2 m height [m s⁻¹],

e_s = Saturation vapor pressure [kPa],

e_a = Actual vapor pressure [kPa],

$e_s - e_a = e^o(T)$ = Saturation vapor pressure deficit [kPa],

D = Slope vapor pressure curve [kPa °C⁻¹],

g = Psychrometric constant [kPa °C⁻¹].

P = Atmospheric pressure [kPa],

z = Elevation above sea level [m],

$e^o(T)$ = Saturation vapour pressure at the air temperature T [kPa],

Instead of using manual calculation there is lots of software's available for calculating Evapotranspiration

techniques. In the second phase we identify the water loss and water requirement of the paddy field.

During rainy season excess amount of water will be staged inside the fields. This may damage the paddy crop. So we have to drain the water from the field. Here we can use the closed loop ANN controller that is the controller that accepts feedback.

ANN controller [1] compares the required soil moisture to the calculated water level which was estimated by Evapotranspiration. Based on this method ANN controller controls the valve position. If excess amount of water staged in the field, then the controller will open the valves automatically and collect the excess water. The collected excess water flows through separate channel and is saved in a well or irrigating lawns.

4. Conclusions and Future work

Water is one of nature's most important gifts to mankind, because of the increase in population food requirement for human being is also increasing. Over the past few decade usage of water for irrigation has increased hysterically. Water is polluted due to wastage and contaminants in the industries. Saving water is more important. This ultimate aim can be achieved by using the exiting ANN control system .It will provide a way to save flood water in the fields for future irrigation purpose.

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