Precision Water Level Measurement and Distribution in Irrigation System

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Abstract- *Water being one of the basic natural resource which is available in abundance and one of the resource which has been important parameter for agriculture.*

Due to improper use and management of water, lot of water is wasted every year which as a result leads to scarcity of water in non-monsoon seasons. Efficient water management is a major concern in many cropping systems in semiarid and arid areas. The main causes of wasteful and unsustainable water use are Leaky irrigation systems, Wasteful field application methods and Cultivation of thirsty crops not suited to the environment. Improper use of water may lead to depletion in ground water sources. Excessive irrigation may also lead to increase in soil salinity and wastage of water. Precise water level measurement and distribution based irrigation systems offer a solution to support irrigation management that allows farmers to increase production and use water more efficiently. This project provides potential solution for water management and was developed considering the need of water for each crops varying as per season. It has been found water requirement of each crops varies. Water requirement of crops may also vary depending upon seasons. Therefore the study of water need of crop (crop factor), varying with season (Season factor) are considered major part of study. This project describes details of the design, mechanics of irrigation, controller and interface with farmer. Water management is one of the major aspect of the project. Available water quantity is studied with level sensors. Irrigation mechanics was controlled with programmable controller which was interfaced so that it was easily operated by farmers.

I. INTRODUCTION

Irrigation is mostly used practice in agriculture systems specially in arid and semiarid regions. Efficient and precise application of available water and management are major concerns, however variation in availability of water, soil contents, climatic changes exist while taking a certain crops. Selection of proper irrigation systems can reduce impacts of these variable conditions on crops which will increase application efficiency and increase yield per acre. The development of a irrigation system where available water is used precisely and irrigation system is managed to use water efficiently will offer potential to increase yield and quality of crops.

Irrigation techniques can be classified on the basis of water source and its distribution. Some of the basic types of irrigation are

- Surface irrigation: In surface (furrow, flood, or level basin) irrigation systems, water moves across the surface of agricultural lands, in order to wet it and infiltrate into the soil [1].
- Localized irrigation: Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods [1].
- Modern irrigation techniques include: Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network:

This technique uses moisture sensor to detect the moisture of a soil this reading is transmitted by using Bluetooth transmitter present at the field station. Bluetooth patch antenna is present at the base station to receive the signal from transmitter. A GPS mapping dialog followed to display irrigation plots, receive GPS readings from the PLC, process the GPS and in-field sensor data for decision making to individual sprinklers and update plot display [2]. & Micro Controller Based Automatic Plant Irrigation System [3].

It will be easy to precisely discharge required amount of water to the crop when available quantity of water is known.

II. HIGHER LEVELSOLUTION

2.1. CONCEPTUAL LAYOUT:

Fig.1 shows the conceptual layout of system interfaced with controller in such a way to fulfill the objective.

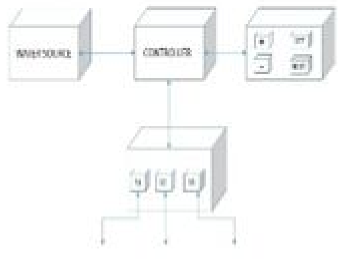

Fig.1 Conceptual system layout

System consist of water source (tank), controller, working mechanism and sub-mechanism. Once crops are selected controller has policy P1, P2, P2 and P4 for each crop categorized as C1,C2,C3 and C4 depending upon climate, time required from sowing to harvesting and water requirement which governs the sub-mechanism M1, M2, M3 and M4. For each crop policy is specified depending upon in which category they fall (C1, C2, C3 and C4).

Controller has a policy for each category of crops; it also checks the water quantity available and is programmed to irrigate each crop with necessary quantity of water.

Our method helps to irrigate the crops precisely with no wastage of water. Controller examines the available amount of water and also the crops taken. Controller has separate policies stored regarding the crops taken and amount of water required by each crop from sowing to harvesting in particular season. Controller is connected to working mechanism which has nodes M1, M2, M3 and M4 as shown in figure. Nodes are elements that are located at the field cultivated. They distribute precise amount of water at each field guided by control mechanics and each crop gets precisely irrigated.

For e.g. Consider a sugarcane crop which needs 1000ml of water per hour and a wheat crop which needs 200ml per hour in a particular season, now consider we have 6 litres of water in our storage tank. Now controller has all necessary data i.e. amount of water available and crops cultivated in a particular season and water requirement of each crop cultivated. Mechanics is a control element which performs final control action and supplies necessary amount of water to the nodes. In our case controller will feed 1000ml of water for each hour for next 5 hours to the sugarcane crop and 200ml for each hour to the wheat crop for 5 hours.

Thus we can see there is no wastage of water in this method. Water from tank directly reaches the roots of the crops with no loss. Amount of water delivered is controlled depending upon crops. This method can be used for proper management of available water and extra supply of water to the crops can be avoided which helps in uniform irrigation of crops and due to proper management of available water more land can be irrigated. Excessive irrigation is avoided. Thus increasing yield per acre.

III. LOWER LEVEL SOLUTION

Basic blocks of the block diagram include:

1. Water source(tank)
2. Controller
3. Working mechanism(solenoid valve)

1. **Water source:** Water source used is a tank with known capacity. Its water level is continuously monitored and water level is considered important factor while irrigating the crops. Water distribution is mainly dependent of type of crops, season and water quantity available.

2. **Controller:** Controller continuously monitors the water level. Data regarding to the types of crops and seasons are stored in its memory or can be fed manually by farmer. Water need is calculated considering crop factor. Controller has continuous look on water level and follows predefined algorithm.Once the water level available is noted by controller it follows the procedure to calculate the water need of crop and thus stimulates the valve. Working mechanism can be started or stopped depending upon water need of crops.

3. **Working mechanism (solenoid valve):** Working mechanism is stimulated by controller depending upon water need of crop per unit time calculated. Output flow of the valve per unit time can be calculated and compared with water need of crops per unit time, so as to set a delay to switch ON/OFF the solenoid valve. Delay can be set so as to meet water need of crops per unit time.

III. MATHEMATICAL SOLUTION

Consider a water tank of capacity W1, requirement of water by crop i.e. crop factor Cf.

Crop water requirement mainly varies depending upon their types and season of cultivation.

Water need of crops can be calculated by considering these factors and availability of water.

Water need of crop = Water supplied without considering seasonal effect * Crop factor

If ‘W’ is the water need of crop then,
W= W1 * Cf

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