

PERFORMANCE OF FULLY AUTOMATED SELF PROPELLED CENTER PIVOT IRRIGATION SYSTEM

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Abstract - Agriculture sector plays a strategic role in process of economic development of a country. In India, the agriculture sector acts as the backbone of an economy. It is the basic source of the food supply of all the countries of the world whether underdeveloped, developing or even developed one. Due to over increase of population in underdeveloped and developing countries and its rapid increase, demand for food is increasing at a faster rate. Nowadays water scarcity is a major concern for agriculture. Therefore efficient water management needs to be taken into consideration during irrigation, on that account availability of water to crops at the time of requirement is an indispensable thing to get maximum production of crops to meet the food production target of the nation. In this stage, the artificial irrigation comes into the scenario. At Present in India, Drip & Sprinkler irrigation are being practiced. This paper also discusses one such modern method of irrigation called Self- propelled Center Pivot Irrigation. The Self- propelled Center Pivot Irrigation method helps to irrigate a land in a circular pattern by using its unique methodology. And this method generally applies water quite uniformly, so that equal amount of water is distributed throughout the farmland.

Keywords: Self-propelled irrigation, crop productivity, pivot pipe, sprinklers, sensors.

I. INTRODUCTION

The world population will increase during the next few years to around 8.5 billion people, with almost 50 percent increase in total population and as a consequence total demand for food will inevitably increase over the next few years as well. In many countries, climatic conditions dependent upon seasonal monsoon and our country is fully influenced by seasonal wind and rainfall. It becomes unfeasible to depend merely upon the natural resource of water like rain. As rainfall is not sufficient to meet the moisture need of crops necessary for the growth of crops and accordingly to increase productivity, irrigation practices are the important one that also stabilizes yields.

Irrigation is an indispensable practice in most agricultural systems and it is defined to be the artificial application of water to the soil for the reason of crop production. The mechanism of irrigation systems allows a flow of water to be redirected from its native place to be applied to farmlands for purpose of boosting water for growing crops and enhancing crop yields. The main irrigation method followed among country is surface irrigation. The main disadvantage by this traditional method of irrigation is that it needs more labor power compared to modern methods like a sprinkler and drip irrigation. These methods are highly beneficial to farmers as water losses are low and limited no of labor is sufficient to complete the task.



Fig1. Center pivot system

Center pivot irrigation systems were invented by the farmer Frank Zybach in 1940. He lived in Strasburg, Colorado. The method which was developed by Frank Zybach was recognized as an efficient one to improve water distribution to fields.

Center pivot irrigation system consisting of several segments of pipe in the form of overhead sprinkler irrigation with sprinkler positioned along their length which are joined together and supported by means of trusses and mounted upon wheeled towers. Then the system rotates in a circular manner and pivot point is present at the center of the circle through which water is fed. The center pivots are mostly common in size and its length is less than 1600 feet in circle radius. And for about 125 acres of land, it covers 1/4 mile radius crop circle.

These center pivots are mostly replaced with hydraulic systems and electric motor-driven systems. As they are mostly of water-powered. At present many systems are driven by an electrically powered motor which is mounted using the separate tower. The set of wheels placed at outside sets the master pace which is used for rotation purpose usually once in three days. Between two segments, the inner sets of wheels are mounted at hubs and when the bend at the joint exceeds certain threshold it is detected by means of angle sensors.

This self-propelled irrigation utilizes less amount of water and reduces labor power compared to other types of irrigation methods like furrow irrigation. Than ground-irrigation techniques, it has lower labor costs which are required by digging channels. Amount of soil tillage can also be reduced through this irrigation method. By this, it helps to reduce soil erosion and runoff water on accompanying ground irrigation.

II. PROPOSED SYSTEM

1. OVERVIEW

The overview of the system is shown in fig.2. This system is semi-automated and accesses anywhere from the world via the internet. The main components of the system are sensors and microcontrollers, center pivot irrigation system, control panel and the web application for easy access of users. First, assemble the sensors box randomly in any part of farmland and these sensors are sensing the data and send every data for a particular time limit into the control panel via the internet. In this control panel will display the current data and it also sends data into our web application. Web applications stores and retrieves data from the database and perform analysis of data, based on that decisions are made and then send it into control panels. This control panel will display the result on the webpage and then it will start the activity of the center pivot irrigation.

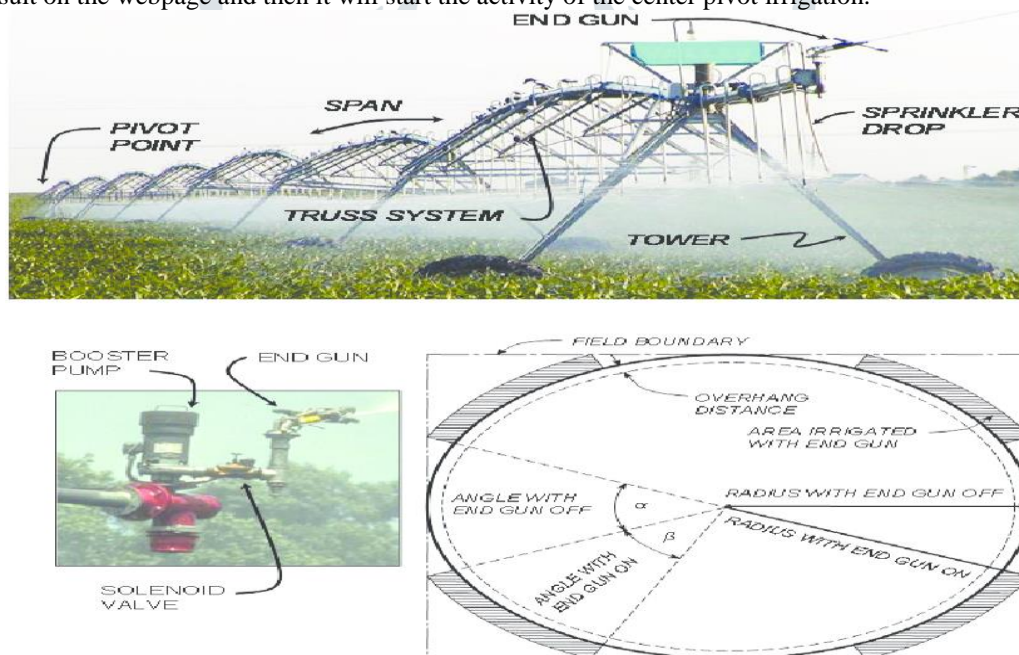


Fig 2. Overview of center pivot design

2. SYSTEM ARCHITECTURE

In this project the data's are collected from land and send it into Wemos ESP 8266 board via internet then process that information then send into other devices. These data's are stored for future references in databases.

Self-propelled Centre Pivot systems are a harbour at one end and rotate around a fixed central point. While Lateral systems are not anchored and both ends of the machine move at a constant speed up and down a paddock. This system needs an energy source to move water from the origin to the plant as well as energy to move the machine on the farm.

Key components center pivot system:

The Centre Pivot systems consist of the following components:

- The pipe and framework between two towers are called a span.
- The spans are supported by a tower that contains wheels and drives mechanisms.
- The point at which water exits the main pipes called Outlets.
- At outlets, emitters are attached either directly or on rigid or flexible droppers.
- Through emitters, water is supplied to the plants.

➤ Rigid or flexible small diameter pipes are called Droppers which allows emitters to be placed closer to the ground

The center pivot system is the precise application as it applies the water in a prescribed volume, in order to satisfy the need of crop water requirements. And for surface runoff, it reduces the opportunity or to match soil infiltration characteristics the system is designed with deep percolation.

It provides opportunities for fertigation, as the system allows some of the selected applications of small quantities of nutrients, which results in uniformity of application with less risk of nutrient losses. This self-propelled irrigation system can also be used for applying pesticides and herbicides.

This system is less landforming which is capable of working even at rolling topography and for surface drainage or rainfall-induced runoff, there is a need for some landforms. It requires only less labor power compared to surface irrigation. Depending on the system and degree of automation of the machine labor are needed to operate the system. A system provides reduced variability. The new well-designed machines are based on the efficiencies of the reported application range which would be generally about 80-95% in range on comparing to 50-90% for surface irrigation systems.

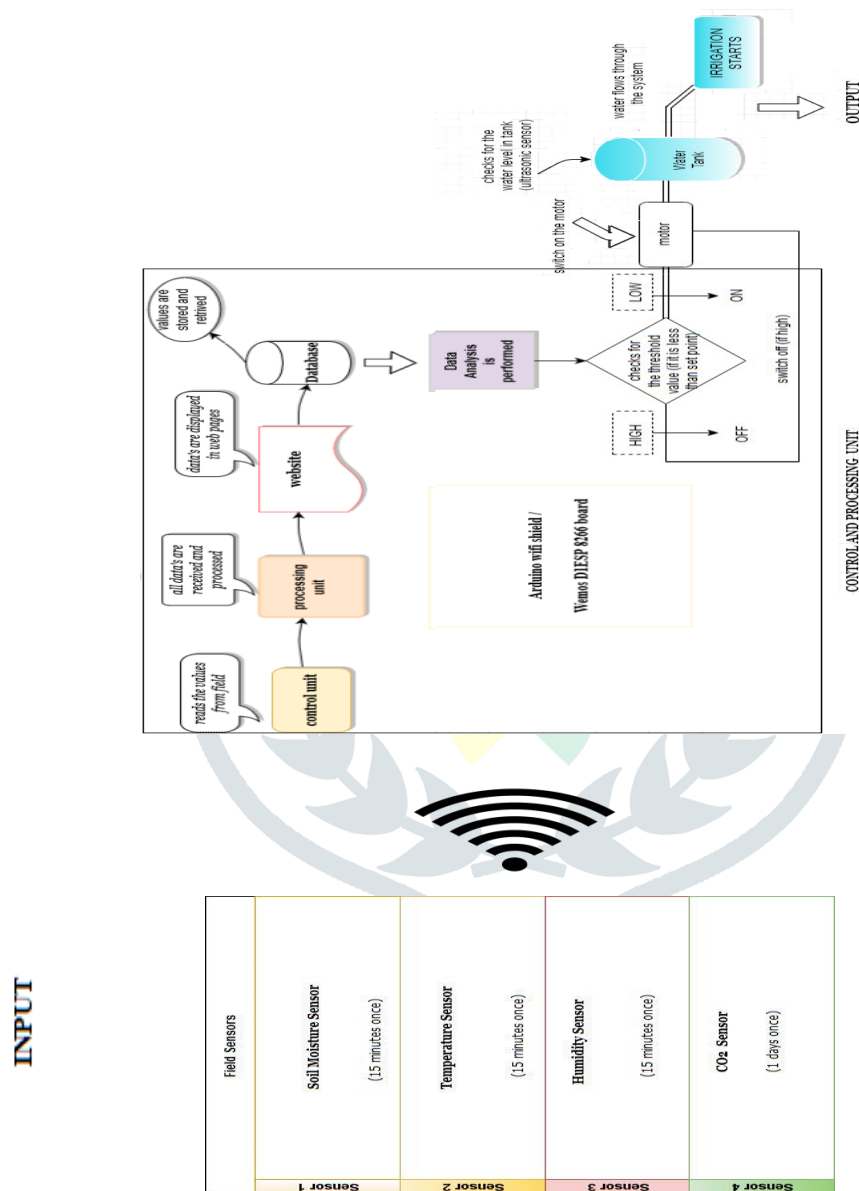


Fig 3. System architecture diagram

3. MODULES

1. Sensing/ Data Collection Module
2. System Design Module
3. Processing And Analysis Module

1. Sensing/ Data Collection Module

This module senses the value's/ data's like temperature, soil moisture, humidity, co2 level and send these values to the main control panel. The control panels sends and receives the values from web pages via OTA.

Parameter	Data sense from every time(min)
Temperature	30 min
Soil moisture	30min
Humidity	30min
Co2 level	1 day
Water level	1 day
Weather	Update from server

Table 1. Sensing data's and time difference for two activities

2. System Design Module

This module explains the system installation and working of center pivot irrigation system.

3. Processing and Analysis Module

All sensed data's are received, processed and send to the web pages via Internet. Then the database performs storing and retrieving of values from web page's. Data analysis is performed, here it checks the values for threshold limit, and if the values are checked then the acknowledgement is send to the control panel. Also it display's the current values of field sensor.

These are the modules in working system under which functionality at each stage has been discussed above. Through this center pivot irrigation method are elaborated in detail starting from sensing module to processing module. Compared to other irrigation it is more beneficial to the farmers to achieve high productivity.

III. COMPARING CENTRT PIVOT IRRIGATION Vs DRIP IRRIGATION

Parameter	Drip irrigation	Center pivot irrigation
Initial cost	Less	High
Maintenance cost	7-10 % of initial cost	1-2 % of initial cost
Management	50000 emitters/50 hectare	150 sprinklers/50 hectare
Design	Well skill and knowledge design	Simple designs
Life span	Max 10 years	20+ years
Pests	Damage the pipes	Not affect sprinklers
Resale	20-25% Of total cost	50% of initial cost
Environmental impact	Hazardous material	100% recyclable steel

Table 2. Drip irrigation and center pivot irrigation comparison

IV. ADVANTAGES

- Fully/ semi-automated
- Low power consumption
- Reduce manual work
- Access anywhere and any time
- Less water usage
- Reduces the watering time
- Reduces the water wastage
- Reliable
- Efficient
- Eco-friendly
- Versatile
- High return on investment

V. CONCLUSION

In the present paper, various aspects of a self-propelled center pivot irrigation system are discussed. This type of modern method of irrigation technique is yet to be followed in India, as it provides vast opportunities. This system is provided with many advantages like efficient water management, less labor power, and the system can operate automatically according to the availability of power, this makes the farmers relieve from their stress from irrigating a farmland frequently. Power consumption is also minimized by this system and also a large area of land is saved from being wasted in digging the trenches for irrigation purpose. One issue in this system is its cost, as it requires a high initial amount to be invested in order to develop the system but that can be solved through an innovative solution in the context and it can also be used by average Indian farmers for irrigation purpose by making it cost-efficient. This is the main reason behind designing the system and various research institutes are also involved in the process and they try to come out with the best solution to solve the problem and government must take care of farmer's subsidy to encourage them. Finally, these efforts lead towards satisfying food demands of society and to rejuvenate the economic background of the Indian farmer.

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