Soil Water level Controller for Different Crops in Field using PLC

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Abstract:

In a country like India, the agriculture plays an important role in the economy and development of the country. Agriculture is one of the fields where water is required in tremendous quantity. Indian agriculture is dependent on the monsoons which is not a reliable source of water. Moreover, wastage of water is major problem in agriculture. Every time excess of water is given to the fields. Therefore there is a need for an automatic system in the country which can provide water to the farms as per the crop species cultivated in the farm .Different crops have different water requirements. For eg. Water requirement of rice is 1000mm to 1500mm where as that of wheat is 250mm to 400mm. Hence, the objective of this project is to design and fabricate an ' Soil Water Level Controller for Different Crops in a Field using PLC.' The system will be provided with a Bluetooth interfacing for selecting the field and crop species in it. The sensors provided will sense the condition of the soil i.e., moisture present. Microcontroller will make decision on the basis of these signals and will pass the decision to PLC. PLC will be responsible for irrigating the selected field and with the desired water values of the selected crop in that corresponding field. The water values will be function of moisture level present, crop species, growth period of the crop and area of the field.

Key Words:

Automatic Irrigation, Water Requirement, Soil Water Sensor, Soil Moisture, PLC based System, Crop Type, Crop's Growth Period, Field area.

1. INTRODUCTION

In India, Agriculture plays an important role in the development of the country's economy as 60% population is involved in agriculture of various crops. Since scorching summers threatens our planet every year, our farmers are unable to cultivate our traditional crops at their suitable seasons. On other hand farmers are wasting water abundantly without proper management. This leads to the scarcity of water at the time of requirement. And also the article published in "cronicas de los tienpos " in April 2002 which shows the human life will be in 2070 due to scarcity of water .This article and the present day situation motivated us to do this innovative project. Dipping irrigation practicing in some part of our country inspired us to do this advanced project. At present farmers are doing the irrigation manually, but in our project it is designed to irrigate automatically.

The water level required by each crop varies tremendously. The improper maintenance of water in agriculture leads to water scarcity. . The farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of the land. Even if the farm land has a water-pump, manual intervention by farmers is required to turn the pump on/off whenever needed.

The objective of this project is to design and fabricate an 'Automatic Soil Water Level Controller for Different Crops.' The micro-controller based Automatic Soil Water Level Controller serve the following purposes:

1) As there is no un-planned usage of water, a lot of water is saved from being wasted.
2) The irrigation is done only when there is not enough moisture in the soil and the microcontroller decides when should the pump be turned on/off, saves a lot time for the farmers. This also gives much needed rest to the farmers, as they don't have to go and turn the pump on/off manually.
3) The project gives the direct option to the farmers to select their crop field and fulfill the water requirement accordingly.
4) The system has the further scope of automatically providing fertilizers and pesticides by mixing them it along with the water.

Moreover there are some crops which can be planted throughout the year whereas some are planted in specific period of the year. The crops which are planted throughout the year are temperature dependent. Different amount of water is required in different season. Hence a temperature sensor is provided to determine the water requirement at different season and fulfill the requirement. In this project we are considering two dry crops i.e. RICE and WHEAT and one wet crop i.e TOMATO.

2. METHEDOLOGY

The main theme is to control the water management for an irrigation system by automatic method does not require any man power. The important parameters are soil moisture sensor, it Sense the soil moisture level. The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil.

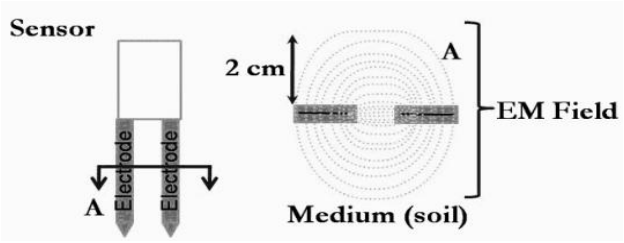


Fig 1: Soil hygrometer detector

Bluetooth interface is used to select the crop species. Microcontroller takes decision based on the selected crop specie's parameters, temperature and soil sensors value. PLC now monitors and controls water pumping of the selected crop species as per the pre defined values by controlling pumps on and off. Until water in the field becomes equal to the threshold value the pump remains ON. The threshold value depends on – Crop species, Growth stage, Soil water level, Temperature, Field area.

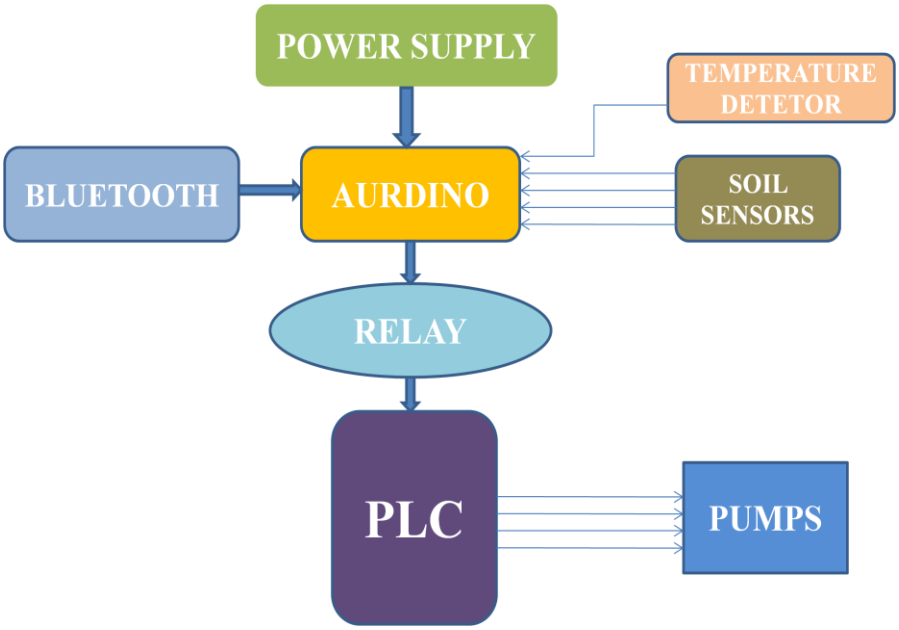


Fig 2. Block Diagram of overall system

- **Module for selection of field and crop :**

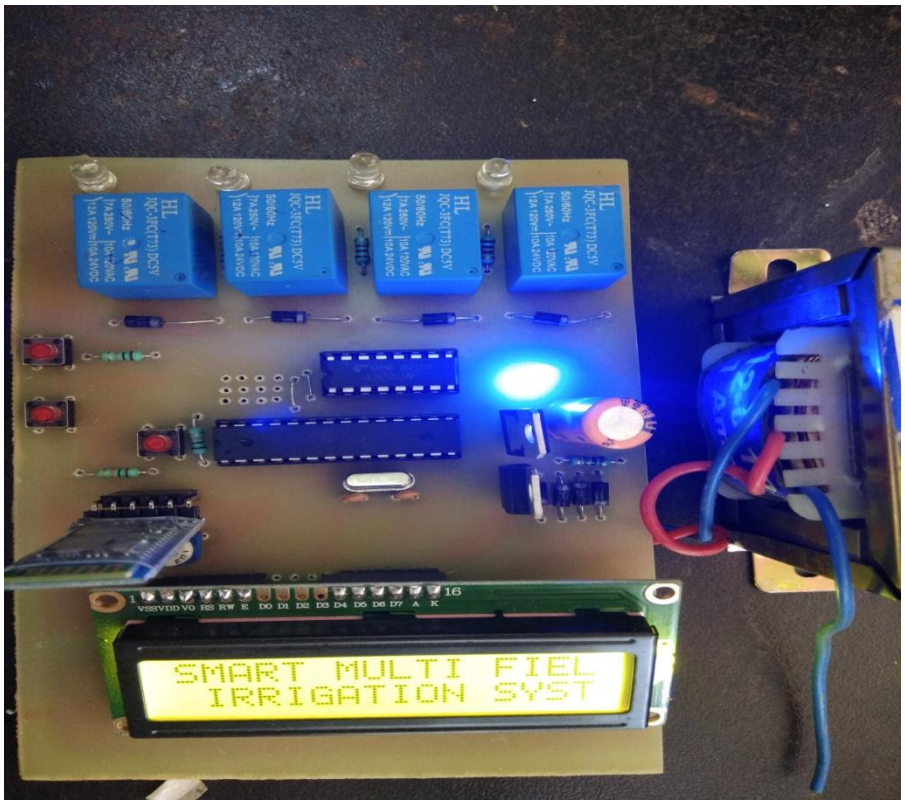


Fig 3. Bluetooth Module Circuitry

- **Selection of crops using Bluetooth is done as**

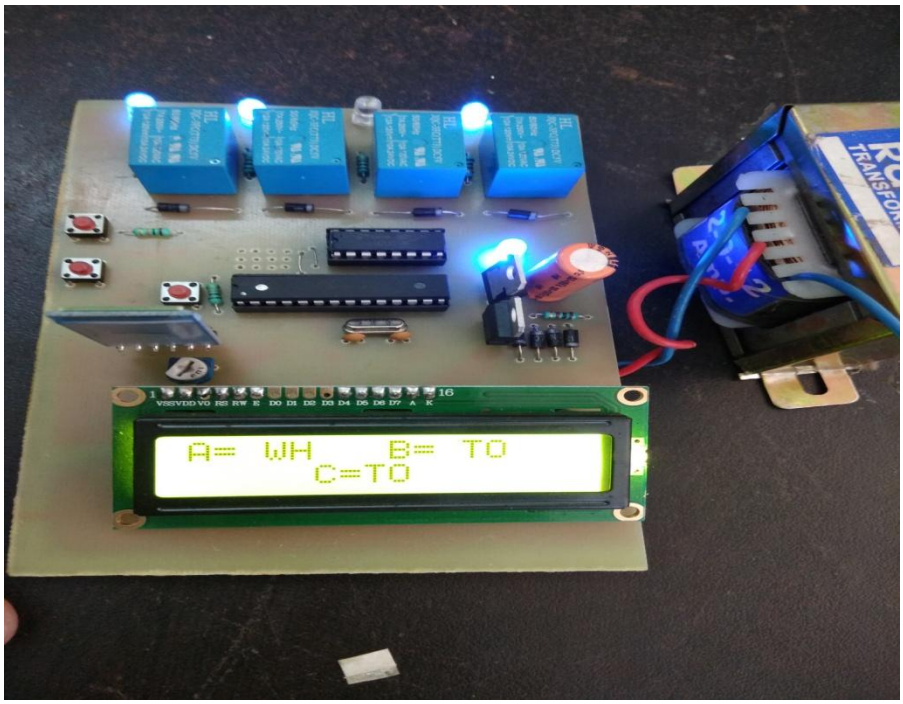


Fig 4. Selection of crops in Bluetooth Module Circuitry

- **Water requirement of different drops –**

Table 1. Water requirement of different crops

Crop	Water Requirement (mm)
Rice	900-2500
Wheat	450-650
Sorghum	450-650
Maize	500-800
Sugarcane	1500-2500
Groundnut	500-700
Cotton	700-1300
Soybean	450-700
Tobacco	400-600
Tomato	600-800
Potato	500-700
Onion	350-550
Chilies	500
Sunflower	350-500
Bean	300-500
Cabbage	380-500

Pea	350-500
Banana	1200-2200
Pineapple	700-1000
Ragi	400-450
Grape	500-1200

- **The amount of water consumed by tomato during different months (wet harvesting crop)**

Table 2: Water Consumed by Tomato During Different Months

	Feb	March	April	May	June
Crop water need (mm/month)	69	123	180	234	180
Temperature (℃)	27	35	40	45	40

- **The amount of water consumed during growing stages of wheat in mm/day (dry harvesting crop)**

Table 3: Water consumed during growing stages of wheat in mm/day

Growth Stages	Average
Emergence	1.44
3 Leaves	1.81
Tiller	5.33
Stem Elongation	5.29
Heading	5.81
Flowering	7.61
Milk Soft Dough	8.42
Hard Dough	6.03

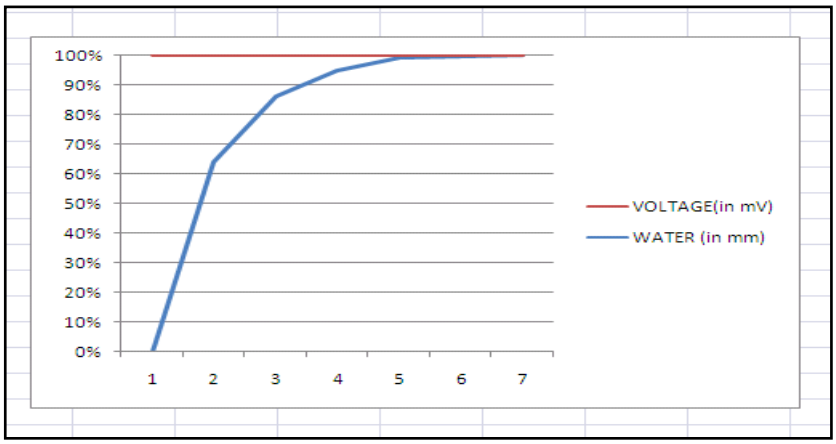
3. FINDINGS AND ANALYSIS

Table 4: Calibrated values of water level in terms of corresponding voltage

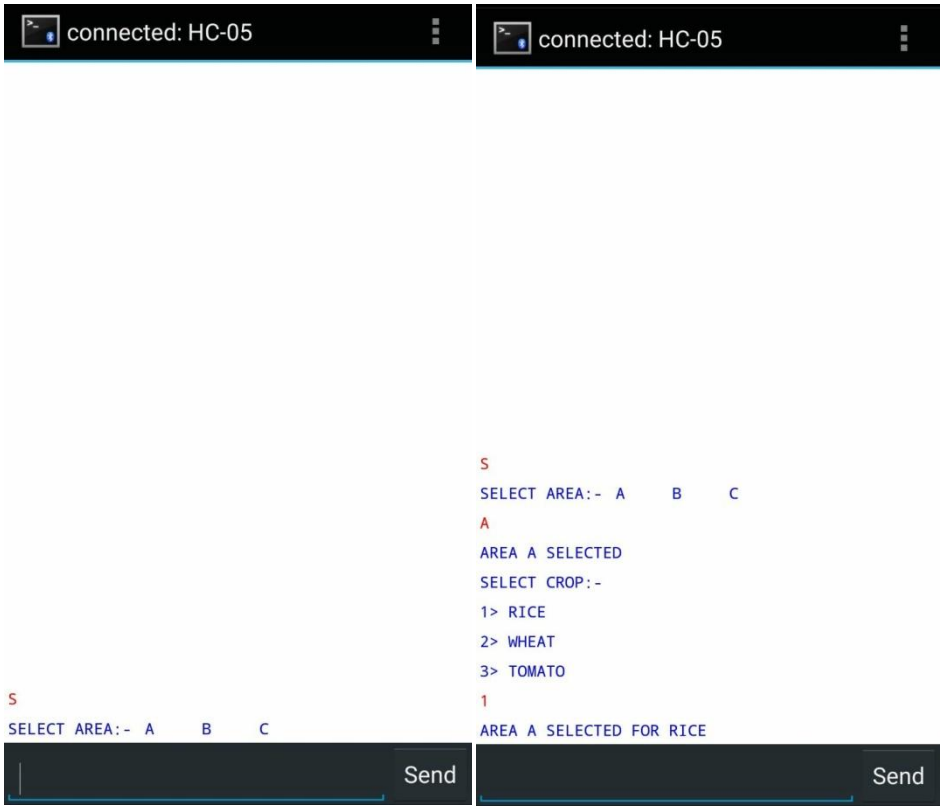
SOIL WATER LEVEL (in mm)	CORROSPONDING VOLTAGE (in mV)
00	36
50	28
100	16
150	8
200	2
250	1
300	0.3

These values are considered and a graph is plotted between the soil water level and corresponding voltage which is as shown in the following figure.

Table 5: Graph between obtained value of voltage for corresponding values of water.



- Selection of fields and it's corresponding crop species.



4. CONCLUSION

The project is designed to develop an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of irrigation is important. The advantage of using this method is to reduce human intervention and still ensure proper irrigation. There are some crops which can be planted throughout the year whereas some are planted in specific period of the year. The crops which are planted throughout the year are temperature dependent. Different amount of water is required in different season. Hence a temperature sensor is required to determine the water requirement at different season and fulfill the requirement.All this is taken care of in this project.

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