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Smart Irrigation in Agriculture Sector by Using PLC

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ABSTRACT

India is a developing country. To make it a developed one, we need to boost the agriculture sector which is the backbone of India. This our paper deals with a smart irrigation system based on a programmable logic controller (PLC) to reduce the water consumption and to increase productivity. This project automatically irrigates the agricultural land so the human efforts are less bring into use. This self-monitoring system uses soil, level, temperature sensors to monitor and control the operation during the growth of crops, the requirement of water does not remain constant. It varies, depending on the climatic condition such as temperature, humidity, sunlight, etc. combination of Programmable Logic Controller (PLC) and PID controller/microcontroller/ Arduino make the system reliable.

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I. INTRODUCTION

In India, agriculture is an important sector. Many people are dependent on it. Better production of crops results in a better economy. Due to a shortage of water and the improper use of water it is difficult to get higher production of crops in agriculture. Hence management of irrigation plays an important role. Irrigation management helps to reduce water consumption and hence helps to increase crop production which results in a good economy. Irrigation is a key point in the agriculture sector. The growth of crops also depends on many weather conditions such as temperature, humidity, the moisture of soil, nutrients, etc.

Hence to minimize the wastage of water, we develop an automatic irrigation system. The problem of water scarcity is minimized. The plant growth is the main feature achieved by an automatic irrigation system.

In this paper, we develop a system that senses the above parameters by using sensors such as soil moisture sensor, temperature sensor, and water level sensor. This sensing data is fed to the programmable logic controller (PLC). The program is built-in PLC such that it compares the data with set value and accordingly to give a command to the valve to turn on or turn off.

II. METHODS AND MATERIAL

In this section we used following different types of components for controlling the system of smart irrigation. We have designed the system in such a way that it operates in two modes a) Automatic mode and
b) Manual mode. In the system input components is temperature sensor, soil moisture sensor, water level sensor, signal conditioning device, switching relay and output components are a fan, pump, etc. These components are operated manually as well as automatically by using PLC [1-3].

A. Soil Moisture Sensor:-

The Soil moisture sensors are used to measure the water content in the agriculture soil [4]. The soil moisture requires processes like drying, removing, and weighing of an agricultural soil sample. The soil moisture sensors measure the available water content indirectly by using the property of the agricultural soil, such as electrical resistance (R), dielectric constant ($\in$). The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric

conductivity (ρ). The reflecting microwave radiation is affected by the agriculture soil moisture and is used in the hydrology/water and agriculture sector. Soil moisture sensors can be used by farmers/people.

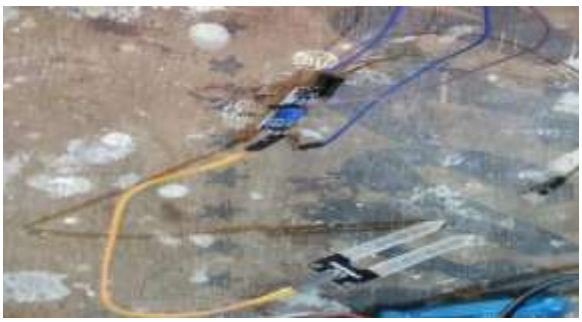

Figure 1: Soil Moisture Sensor

B. Solenoid Valve:-

This valve is electromechanically operated. The valve controlled by an electric current (I) through a solenoid. The solenoid valve we have used as because in the case of a 2-port valve the flow is switched on/off also in 3- port valve, the outflow is switched between the 2 outlet ports. Many solenoid valves can be placed put together on a manifold. Solenoid valves are the widely used to control water flow in irrigation sector by farmers/people.

Figure 2: Solenoid Valve

C. Relay

The relay is an electrical switch used for making ON/OFF to an electrical circuit, similar to a contactor. A contactor is controlled by a circuit which required low power input.

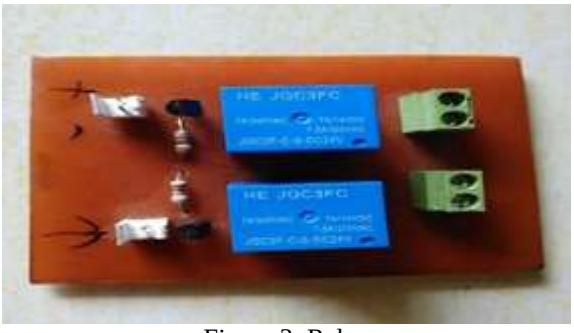

Figure 3: Relay

Contactors are available in different kinds and varieties with varying capacities and properties. Unlike a circuit breaker, a contactor is not used to interrupt a short circuit current (i). Contactors have breaking current of several Amperes to 100A and 24 V DC to many KV. Contactors are used to switch the ON/OFF pump.

D. Buzzer:-

Buzzer is an electrical device which produce a buzzing noise. Here in this project when one entire sequence of the PLC will be completed the buzzer will turn ON. Buzzer operation shows that the water and fertilizers are provided to the field as per the program done by user.

Figure 4: Buzzer

E. Pump:-

A device that moves fluids (liquids or gases), or sometimes a semi-liquid mixture, by mechanical action, is known as a pump. There are 3 types of pumps classified according to the method they use to move the fluid which are displacement, direct lift, and gravity pumps. Pumps operate typically reciprocating or rotary and consume energy to perform required mechanical work by moving the fluid and slurry. They are operated via different kinds of energy sources, including electricity, engine manual operation or wind power, come into many sizes from microscopic to macroscopic for use in medical, household applications to large industrial process pumps.

precision integrated-circuit temperature sensing devices with an output voltage linearly- proportional to the Centigrade temperature. It has many advantages over conventional linear temperature sensors. The output voltage is directly proportional (Linear) to temperature (i.e.) there will be a rise of 10mV (0.01V) for every 1°C rise in temperature. This sensor offers ±0.5°C accuracy in output. This sensor is used in few cases for the measuring the temperature for purpose of controlling.

Figure 5: Water pump

F. PLC:-

An industrial automation tool known as a programmable logic controller (PLC) or programmable controller has been improved and adapted for the control of manufacturing processes, such as assembly lines, robotic devices, or any activity that demands high- reliability control, ease of programming and process fault diagnosis. For this paper, we have used Allen Bradly PLC.

Figure 6: programmable logic controller (PLC)

Specifications

- I/O ports: 14(8 input+6 output)
- Max I/O ports : 494
- Program Capacity : 8k steps
- Communication port : Built in RS-232
- Operating Voltage : 24V
- Programming Software : RSLogix 5000

G. Temperature Sensor:-

We have used the LM35 series which are

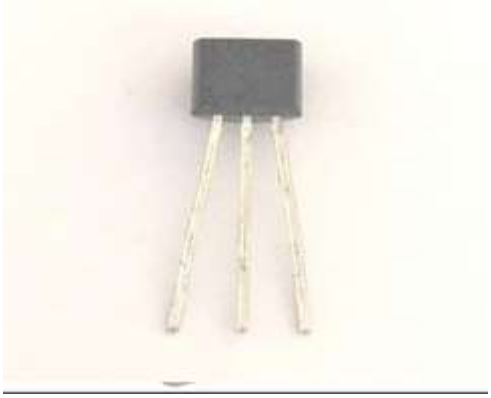

Figure 7: Temperature sensor LM35

H. Level Sensor:-

A floating switch is an input device that is used to sense the level of liquid within a tank and water reservoir. The switch may actuate a pump, an indicator, an alarm, or another device. It can be easily converted from normally open (NO) to normally close (NC) by inverting the float. The current that the switch can carry is much low (0.5A), so you just need to use a relay or contactor when it is connected to a load.

Figure 8: Floating Level Sensor

III. EQUATIONS

Irrigation water management is the art of timing and regulating irrigation water applications in a way that will satisfy the water requirement of the crops without the waste of water, soil, plant nutrients or energy. The simple and basic irrigation water management tool is the equation:-

B. Flow Chart

The flow chart of the smart irrigation in Agriculture sector by using PLC is as shown in below figure 8.

QT=DA

Where, Q= Flow rate (m3) T= Time (hrs.)

D= Depth (inch) A= Area (acers)

IV. BLOCK DIAGRAM, FLOWCHART AND CIRCUIT DIAGRAM

A. Block Diagram

The block Diagram of smart irrigation in agriculture sector by using PLC is as shown in below figure 9.

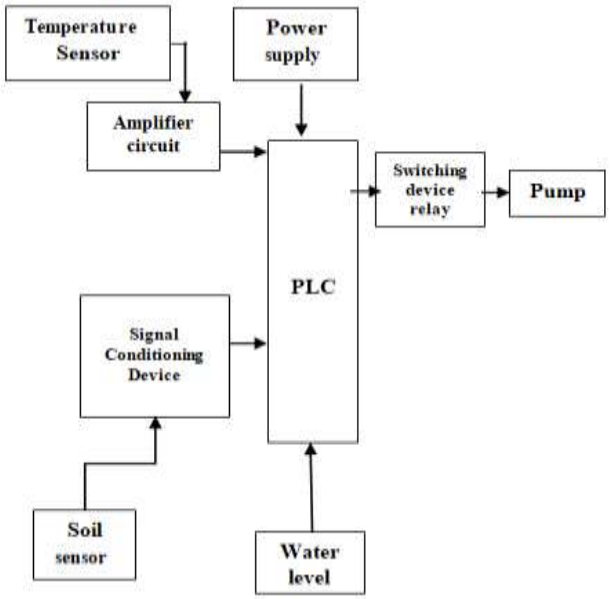

Figure 9: Block diagram of smart irrigation in agriculture sector by using PLC

B. Flow Chart

The flow chart of the smart irrigation in Agriculture sector by using PLC is as shown in below figure 8.

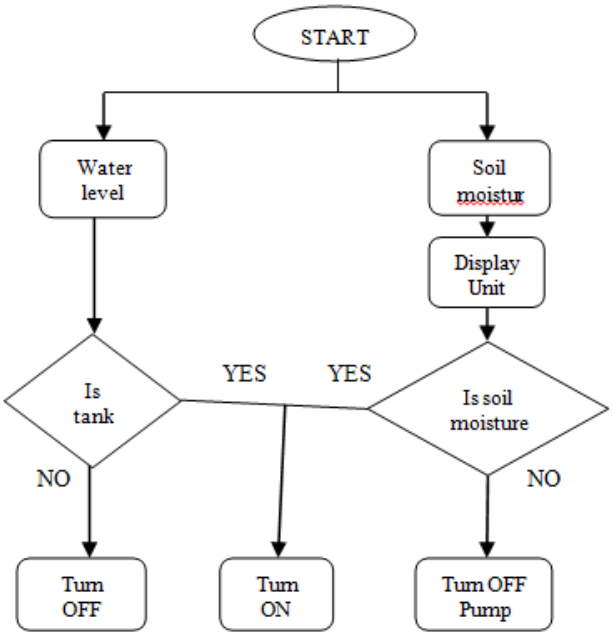

Figure 10: Flow chart of PLC based irrigation system

C. Circuit Diagram

The circuit diagram of the smart irrigation in Agriculture sector by using PLC is as shown in below figure 11.

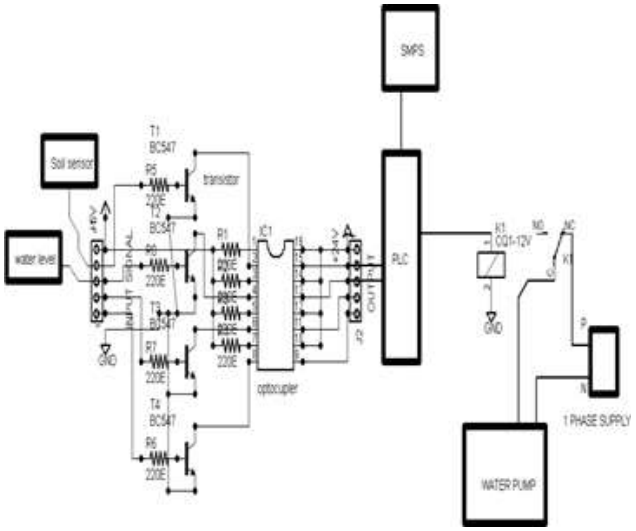

Figure 11: Circuit diagram of smart irrigation in Agriculture sector by using PLC

V. RESULT AND DISCCUSION

In this paper we have used Allen Bradly PLC. We have programmed this controller so that it controls the opening and closing of the master valve i.e. solenoid valve of the smart irrigation system and also controls the ON and OFF position of the water pump automatically to maintain the water level in the tank for irrigation purpose [2].

A. Ladder Diagram

Following is the ladder diagram of the smart irrigation in agriculture sector by using PLC.

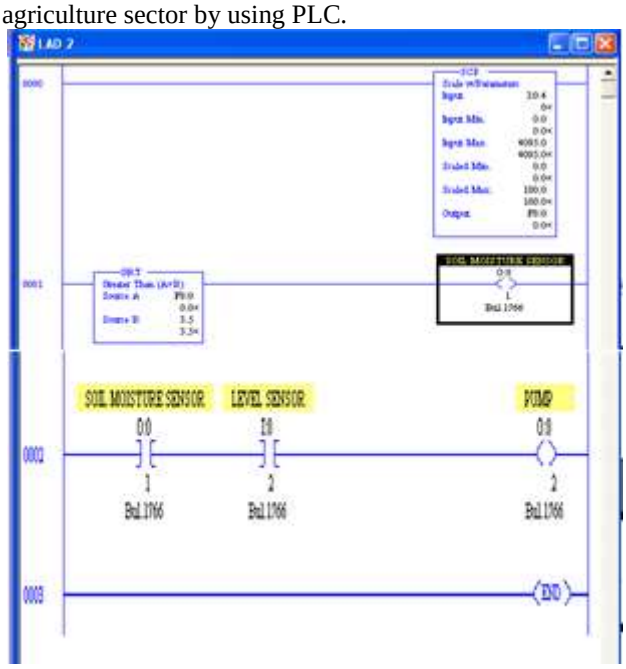

Figure 12: Ladder Logic

B. Logic Truth Table

Following is the logic truth table of the smart irrigation in Agriculture sector by using PLC. When soil moisture and water level sensor detects favourable conditions only when moisture below programmed threshold value and availability of water in the tank then pump will operated. Due to use of this logic truth table, pump will not necessary operated under less water condition. Hence the safety of pump will be achieved.

TABLE I
LOGIC TRUTH TABLE

Sr. No.	Soil Moisture Sensor	Water Level Sensor	Output of Pump
1.	0	0	0
2.	0	1	0
3.	1	0	0
4.	**1**	**1**	**1**

VI. CONCLUSION

Due to an increase in population, it is necessary to use natural resources especially water inefficiently way without wasting. Thus our prototype system addresses the solution to overcome the problem of the water to use efficiently in the farming sector. This paper of smart irrigation in the Agriculture sector by using PLC uses the logic truth table which can give an efficient way to use water pumps without damaging and prevent from excessive irrigation of land. Earlier techniques give the results into problems like dry running and overflow. This

automation helped to overcome these problems and it minimizes human efforts for the same. The system provides several merits such as pre simulation before implementation, I/O can be changed or modified according to user requirements, easy troubleshooting, capable to work in any environmental conditions, and PLC has a real- time clock so it can be programmed accordingly to the requirements of the user. This is a one-time investment system.

REFRENCES

[1] Prashik Satish Dhakne, Vivek Dattu Aldar, Sandip Jayavantrao Patil, Chetan Laxman Ghuge, Prof. Kiran P. Varade, “PLC based Greenhouse Automation”, International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 5 Issue IV, April 2017

[2] Naveen Kumar P, “Intelligent Irrigation System using PLC”, International Journal of Scientific Research in Science, Engineering and Technology, 2016 IJSRSET | Volume 2 | Issue 4 | Print ISSN: 2395-1990 | Online ISSN: 2394-4099

[3] Prof. .S. S. Punde, Vise Mayur Arjun, Sanap Machindra Baban, Kamble Amit Shankar, “PLC Based Irrigation System”, IOSR Journal of Electronics and Communication Engineering (PP 33-36). E-ISSN: 2278-2834, p- ISSN: 2278-8735

[4] Yogesh R. Risodkar, Deepali V. Ugale, “Polyhouse Automation using PLC”, 2018 International Conference On Advances in Communication and Computing Technology (ICACCT). 978-1-5386- 0926-2/18/$31.00 ©2018 IEEE.

