

# PLC based Modern Monoculture Farming System

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**Abstract:** Agriculture occurs on a large scale. Agriculture businesses grow food to distribute in mass quantities and at all points throughout the year – regardless of the food's peak season. Monoculture is the agricultural practice of producing or growing a single crop, plant, or livestock species, variety, or breed in a field or farming system at a time. Monoculture is widely used in both industrial farming and organic farming and has allowed increased efficiency in planting and harvest. Now, for this practice and maintaining this procedure automatically and with a low amount of labor a scheme based on programmable logic controller is presented in this work. Simulations are used to study the performance of this scheme. The simulations showed that the proposed scheme works satisfactorily.
**Keywords:** programmable logic controller, farming; automation, ladder diagram.

## 1 INTRODUCTION

As population is increasing day by day, so is the requirement of food. Moreover, due to industrialization and population boom, the fields are decreasing radically. These areas are used instead for new factories or buildings etc. Thus it is highly required that there is efficient farming within small spaces so as to produce more and waste less. These problems drew our attention to modern farming methods, the problems in it and encouraged us to find a solution. Thus we decided to choose automation, in farming. Programmable Logic Controllers are used for the physical implementation of the controllers [1, 2]. Some problems in physical realization in PLCs are dealt with [3].

The main objective of our project is to automate the modern farming methods and thus try to avoid the errors done by human. This method in one hand will decrease the human labor, whereas in the other hand it will increase the efficiency of farming. Through automation we have performed ploughing, seeding and irrigation systems in our project. This can be enhanced more in many directions which we will discuss later. Programmable logic controller (PLC) is the most common name in the field of automation for executing sequential control. Through it we can synchronize and manage all the activities in a field with minimum labor. The basic working principle of PLC is it accepts input, processes it and produces the desired output. The PLC is programmed with a ladder diagram developed as per the logic.

## 2 PROBLEM STATEMENT

We all know that the use of automation is not limited in the fields of factories and production of goods. From this we are inspired to bring automation for farming. Many people have developed the irrigation procedure, but we aimed of developing the whole structure. [4] As farming is a main objective of living so to bring automation


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in this field in the mere future is a great opportunity for us. The main objectives of these project is:

**2.1 Low cost as it is a one-time investment**
The setup which would serve us for the next couple of years is basically a one-time investment except for the maintenance.

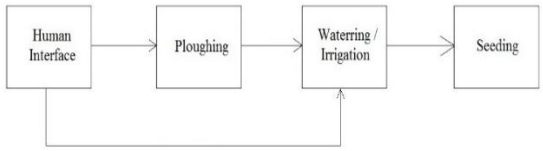
**2.2 Less wastage of seeds**
As we know for farming, farmers throw away the seeds all over the field in case of sowing. But that leads to wastage of a large amount of seeds. This mechanism will help us to sow the seeds without any wastages in a proper manner.

**2.3 Less power consumption**
Though a mechanism needs a lot of power to drive across the field. But the same power source can be replaced with the help of solar energy.

**2.4 Reduction of human labour**
The main aim of this electronic procedure is to reduce the human labor. In our daily farming procedure the humans have to work a lot to harder to grow a crop. But in this farming system they need not have to go out and absorb the heat of the sun whereas they can sit in a control room and monitor every procedure that is being taking place.

**2.5 Modification allowed as per the requirement of the crops**
Now as we all know that different crops have different requirements for water and fertilizers [5]. Based on that there are simple procedures that can be followed to achieve a good yield of crops [6]. There are timers for water management which can be set as per the crop that is being yield. Also drainage system which can be controlled in case of extra water which is harmful for the particular crop.

## 3 DESIGN OF THE SYSTEM




The design that is being developed is only an initial stage of the whole mechanism. This only gives an overview of how there will be the flow in the controls. Mainly there are four stages, but there are few intermediate process.

Here are the descriptions of the blocks and the intermediate process that is taking place.

**3.1 Human Interface**

- ***Emergency start/stop***

This single switch controls the entire circuit. The power supply is directly not produced to the circuit to avoid accidents/ any type of damage to the circuit. Here an ON-OFF push button is used. Once it is pressed a signal is passed on to the forward motor which starts running. The current continues to flow in the circuit until the switch is re-pressed.

- ***Pump control switch***

This switch is used to control the pump which is used for irrigation purposes. The initial watering is although done automatically, but later as depending on the requirement of water by the crop or depending on the climatic conditions of that area it may be required to water the field more often/less. For this purpose, this external switch is provided to manually control the pump as per requirement. Though for this situation also it is necessary that the emergency switch is kept on.

**3.2 Ploughing**

- ***Forward Motor***

After receiving the signal from the power supply, a set of dedicated relays passes on the power to the forward motor, which then starts a conveyor belt on which a mechanical shovel system is attached which starts moving in a particular direction on the field in a prefixed path which is a zig-zag [7]. For simplification we have considered the path to be circular in this work. This forward motor continues to run until the shovel mechanism reaches the proximity sensor 1.

- ***Proximity Sensor 1***

As this sensor senses the approach of the shovel system towards it, it passes a signal to another set of relays which in turn cuts off the power supply to the forward motor and produces a power supply to the reverse motor. Again, for simplicity here we have emulated this proximity sensor with a switch.

- ***Reverse Motor***

As the reverse motor receives the signal, it starts running and the shovel system retraces the same zig-zag path back to its initial position from where it was started and continues to run until another proximity sensor, senses, and signals the relays to cut off the power supply to the reverse motor.

- ***Proximity Sensor 2***

Senses that the shovel mechanism has returned to its initial position and thus signals the relays to cut off reverse motor's power supply and to start the initial watering procedure.

**3.3 Initial Watering / Irrigation**

- ***Pump***

As the proximity sensor 2 senses the return of the shovel system, and produces signal, a set of relays turns on the pump. As soon as the pump is switched on, a timer circuit starts running. This pump draws water from the nearby reservoir and produces it to

the field through sprinkler or any other available method. This pump continues to run until the timer signal's it to stop through relays. This pump may again be manually controlled through a pump control switch provided so as to irrigate the field as per requirement.

### 3.4 Timer

This circuit is used to control the irrigation as the water requirement is different for different crops. We can switch on/off the pump as per requirement as different pins of timer IC produces different time delays. It is switched on by a signal from the relay after proximity sensor 2 indicates that the shovel system has reached back and the pump is switched.

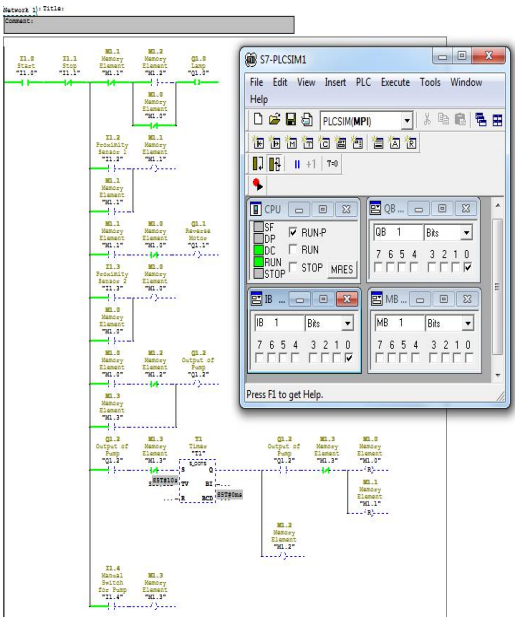



Figure 1. "Forward Motor" is turned on when "Start" switch is pressed.

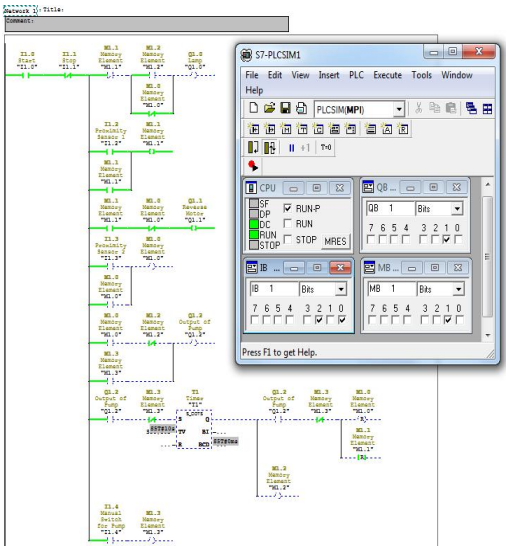



Figure 2. "Reverse Motor" is turned on when "Proximity sensor 1" senses.

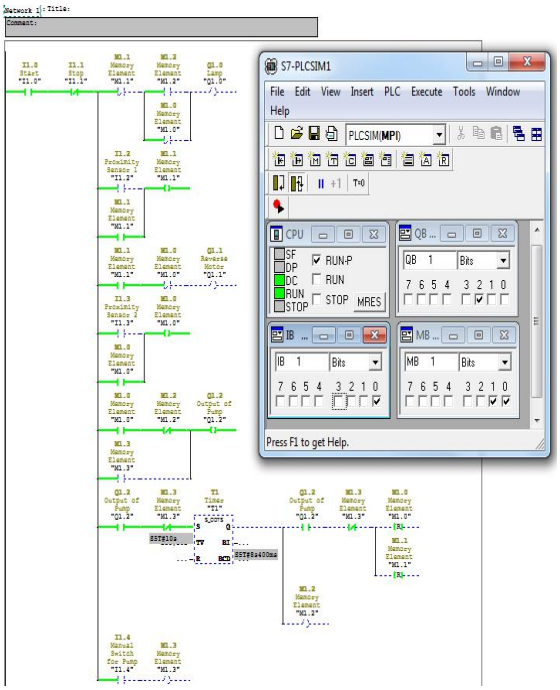



Figure 3. "Pump" and "Timer" is turned on when "Proximity sensor 2" senses.

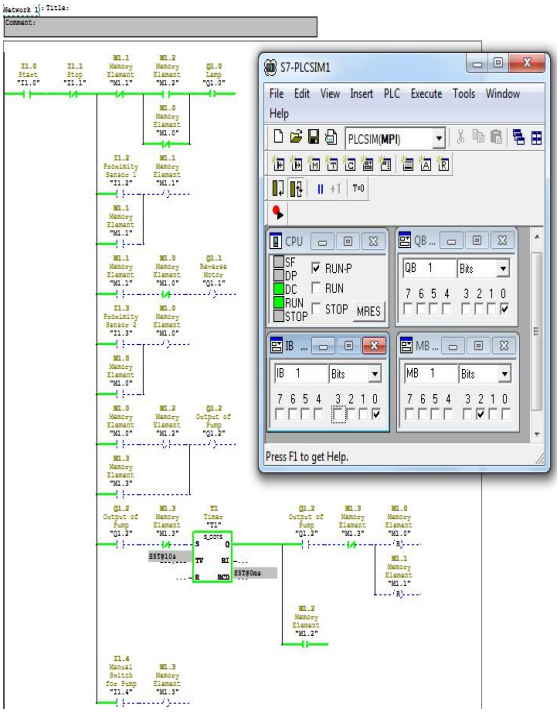



Figure 4. "Pump" turns off and "Forward Motor" again turns on when "Timer" stops.

### 3.5 Seeding

The components of the seeding and the working principle are same as that of the ploughing system except that instead of shovel mechanism, there is a funnel system in which the seeds are poured as they

are passed through the fields. There is another difference that the pump does not turns on automatically for the second time after receiving signal from the proximity sensor 2.

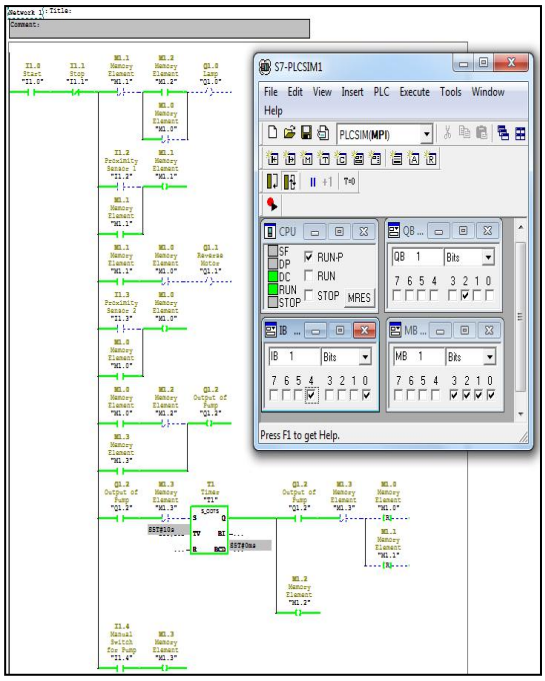



Figure 5. "Pump" is turns on when "Manual Switch" is pressed.

## 4 CONCLUSION

This scheme is implemented by using a programmable logic controller. However, for the work presented in this paper, we have used simulations.

Now, in this section we have presented the different simulation pictures of what the logic is working on, and how the different blocks are working and how the whole system is flowing and making it possible to figure out a way to help our farmers cultivate the lands in a better way.

This was all that is being achieved from the simulation and it is working properly based on what we have intended to make out of this project.

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