Implementation of Automation System In Polyhouse Using PLC

Mr. Shinare Mahesh Dattatray[1], Ms. Mate Sadhana Balasaheb[2], Ms. Kulat Harshada Balasaheb[3], Ms. Kulat Pranati Rajesh[4], Ms. Bhambare Shubhada Prabhakar[5], Prof. Mandhare S. S.[6]

[1, 2, 3, 4, 5] Dept of Electrical Engineering

[6]HOD, Dept of Electrical Engineering

[1, 2, 3, 4, 5, 6] PDVVP COE,Ahmednagar

Abstract- *Polyhouse is basically naturally ventilated climate controlled system. In poly-house various crops are grown under their favorable environmental conditions. Environmental conditions such as temperature within the poly-house, humidity of soil and atmosphere etc. Every crop needs different climatic conditions and to provide that conditions farmers need man power to do labourwork. The system we designed and implemented on small working model of poly-house reduces labour and man power. The info about favorable condition and need of plant is provided by the various agricultural universities and agricultural experts. Today we have cheap sensors and more precise and programmable controllers such as PLC available in the market. With the help of temperature, light intensity, humidity sensors and PLC automation of poly-house can be done. With the help of automation minimum and effective use of valuable resources can lead to achieve maximum crop.*

Keywords- Polyhouse, Programmable Logic Controller (PLC), RS Logix, pH Transmitter

I. INTRODUCTION

Even in the modern era of industrial development, cultivation plays a very vital role on the overall socio-economic growth of India. The pillar of Indian Economy is Agriculture.43 percent of India's sector comes under agricultural domains. Around 52 percent of India's people is getting employment only because of agriculture along with other associated fields like forestry and logging. Farming also accounts for 8.56 percent of the country's entire exports.

As per the investigation made in 2007, agriculture accounts for 16.6 percent of India's Gross Local Product. Polyhouse is supreme for proper plant growth and high vintage of the crop, where the climatic parameters can be controlled automatically. Polyhouse farming is the current, one of the most intensive, is considered highly fruitful and environment friendly cultivation practice. Polyhouses are built using an ultraviolet plastic sheet of width 1501 m which go on for a leastof 5 years. Bamboos or iron pipes is used to build it. In overall the width of 4–5 feet and length of polyhouses is 25–30 feet. The size of the polyhouse may differ according to the condition.

II. BLOCK DIAGRAM AND DESCRIPTION

To get a brief knowledge of any project or plant in a simple way, we require some block diagrams and flowcharts, which is been mentioned and explained below:-

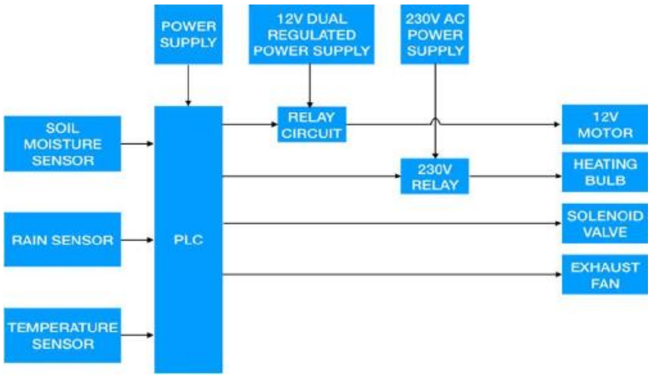

Figure 1: Block diagram of the project

The Fig 1 gives the block diagram of the project. Each section could be explained as follows. Several sensors were placed on the field. They include rain sensor, soil moisture sensor, and temperature sensor. The workings of the sensors are given below:

Rain sensor: Check whether it is raining or not

Soil moisture sensor: Check the moisture level of the soil.

Temperature sensor: Check the temperature of the field

The output of the above mentioned sensors was given to the control unit through PLC. The control unit consists of Shield: Act as an umbrella for the field. Valve: Provide water for the soil in the field. Exhaust fan: Provide cooling effect.

Window: Provide protection from heavy wind.

Process Flowchart

The Fig 2 provides us the detailed knowledge about the process of the project.

Rain sensor was placed on the field. When rain falls on the field, its shorts the rain sensor and activate the shield via PLC. The shield rolls a sheet across the field. Now, when raining stops, the shield was activated to its initial state.

Thus rain sensor PLC shield provides protection from rain.

Soil moisture sensor was placed across the field to check the moisture level. The moisture level was classified into 3 types: low, medium, high. According to the above moisture level, the valve was opened. When the moisture level is low, the valve was opened up to its 50 percent of the soil moisture. As soon as the soil moisture sensor reaches to its 50 percent of the moisture the valve gets off until and unless the moisture of the soil decreases up to its 40 percent.

Temperature sensor was placed on the field. When the temperature was high, the exhaust fan was activated via PLC. The critical temperature at which the fans get activated was decided by the PLC. The fan was able to reduce the temperature, as the temperature decreases to its critical temperature, the fan became inactive. Thus the temperature sensor helps in stabilizing the temperature with less tolerance. All the above were assembled together to get the final product, which help in control of irrigation system automatically.

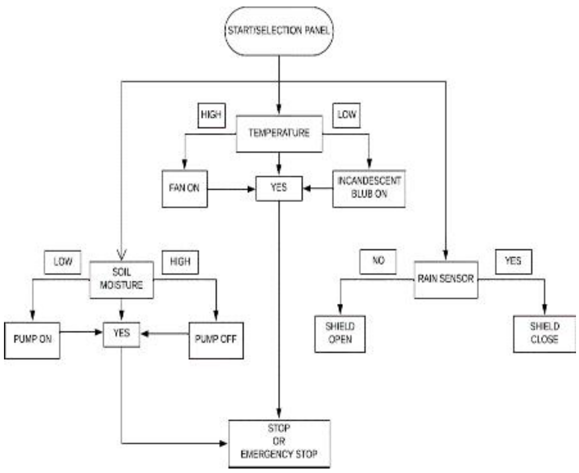

Figure 2: Process Flow Diagram

III. IMPLEMENTATION OFWORK

1) Programmable Logic Controller(PLC)

A Programmable Logic Controller (PLC) is an industrial digital computer which has been ruggedized and adopted for the control of manufacturing processes, such as assembly lines or robotic devices, or any activity that requires high reliability control and ease of programming and process faultdiagnosis.

PLCs were first developed in the automobile manufacturing industry to provide flexible, ruggedized and easily programmable controllers to replace hard wired relays, timers and sequencers. Since then, they have been widely adopted as high reliability automation controllers suitable for harsh environments. A PLC is an example of a “hard” real time system since output results must be produced inresponse to input conditions within a limited time, otherwise unintended operation will result.

PLCs can range from small modular devices with tens of inputs and outputs (I/O), in a housing integral with the processor, to large rack mounted modular devices with a count of thousands of I/O, and which are often networked to other PLC and SCADA systems. They can be designed for multiple arrangements of digital and analog I/O, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed up or non-volatile memory.

]PLC programs are typically written in a special application on a personal computer, then they are downloaded by a direct connection cable or over a network to the PLC.

The computer is connected to the PLC through USB, Ethernet, RS-232, RS- 485 or RS - 422 cabling. It is also possible to view and edit the program in functional block diagram, sequence flow charts and structured text. The PLC used in this project is ALLEN BRADLEY MICROLOGIX 1400 SERIES A.

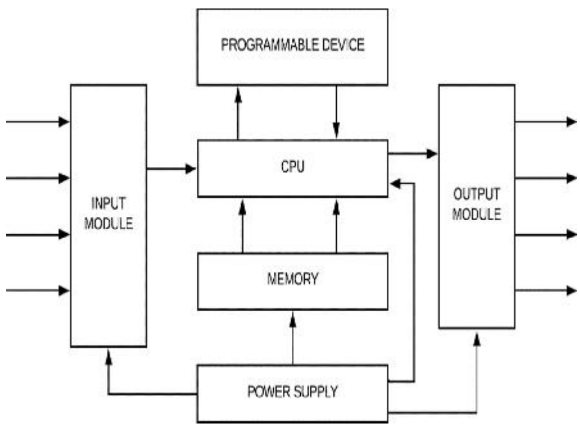

Figure 3: Block Diagram of PLC

2) Temperature Sensor(LM35)

The LM35 series are precision integrated circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an ad- vantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The low output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 micro ampere from the supply, it has very low self-heating of less than 0.1 degree Celsius in stillair.

The LM35-series devices are available packagedinhermetic TO transistor pack- ages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small- outline package and a plastic TO-220 package.

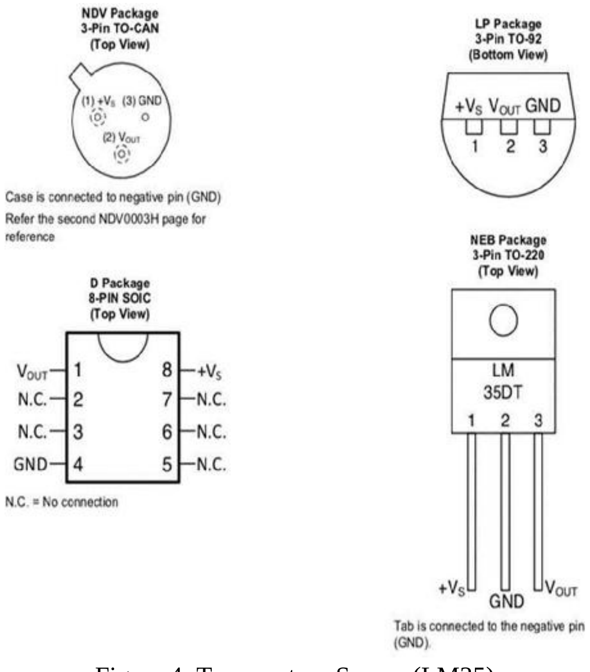

Figure 4: Temperature Sensor (LM35)

3) Soil MoistureSensor

This is a simple sensor that can be used to detect soil moisture/ relative humidity within the soil the module is able to detect when the soil is too dry or wet. Great for use with automatic plant wateringsystems.

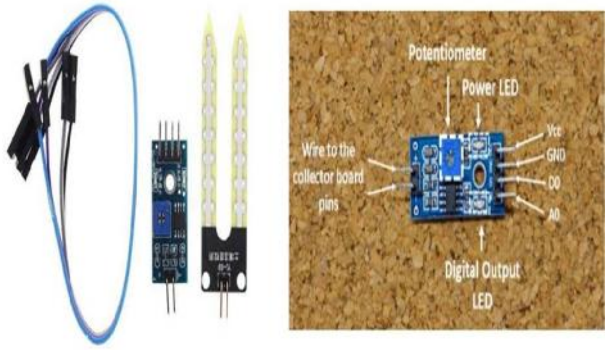

Figure 5: Soil Moisture Sensor

4) Rain Sensor

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though apotentiometer.

The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level.

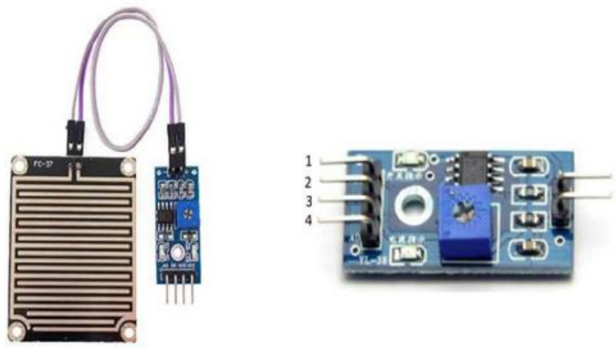

Figure 6: Rain Sensor

IV. SOFTWAREDESCRIPTION

1) RS Logix Link 500

The RS Logix Link 500 is the software produced by Rockwell Automation, used to program the Programmable Logic Controller (PLC).The RSLogix family of IEC-1131-compliant ladder logic programming packages helps you maximize performance, save project development time, and improve productivity. This family of products has been developed to operate on Microsoft Windows operating systems. Supporting the Allen- Bradley SLC 500 and MicroLogix families of processors, RSLogix 500 was the first PLC programming software to offer unbeatable productivity with an industry-leading user interface.

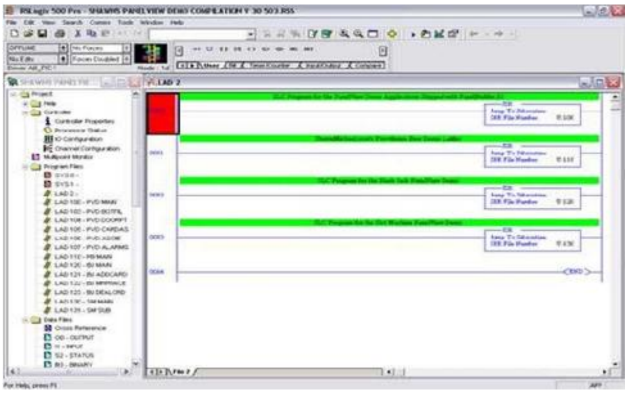

Figure 7: RS Logix 500 Software

2) Ladder ProgrammingAlgorithm

Ladder logic is the Primary programming language of programmable logic controllers. Since the PLC was developed to replace relay logic control systems, it was only natural that the initial language closely resembles the diagrams used to document the relay logic. By using this approach, the engineers and technicians using the early PLCs did not need re- training to understand the program. To introduce ladder logic programming simple switch circuits are convertedtorelay logic and then to PLC ladder logic. Any control task modifications are done by changing the program. This is why the use of the PLC is preferred to the traditional hard wired circuits in industrial controls.

3) Interfacing ofPLC

HMI and PLC interfaces based on communication protocols that hardware support. There are many ways PLC and HMI can communicate like RS-232, RS-485, ethernet. its depends on specifications of PLC or HMI. Some PLC only supports serial communications or ethernet. In current scenario manufacturers came with products which have multiple communication options, PLC and HMI have more than any one port for communication and also supports multiple communication protocols.

The interface card is used between the sensors output and PLC for interfacing purpose. In this system card used is opto-coupler. When the input is detected by the sensor then a current limiting resistor is used for reducing the current and drops the voltage for a certain limit. When sensors provide output then a resistor is used in series with the opto-coupler.

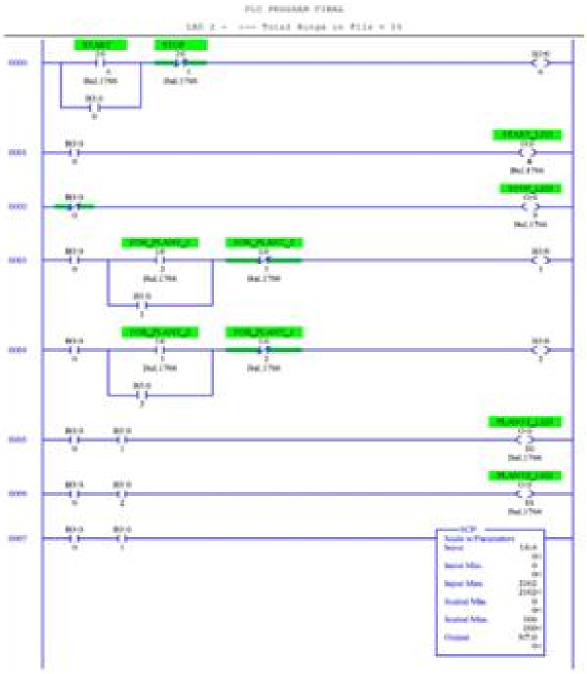

Figure 8: PLC Programming

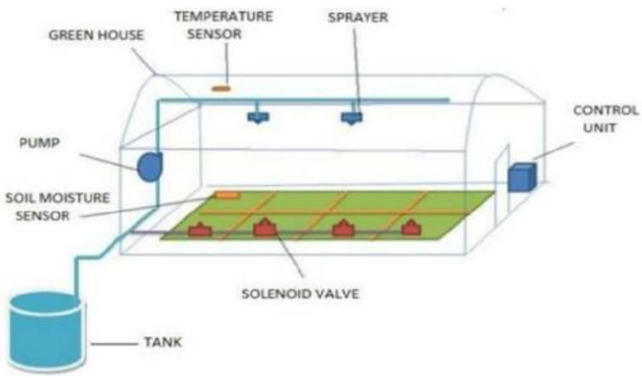

Figure 9: Structural Initialization

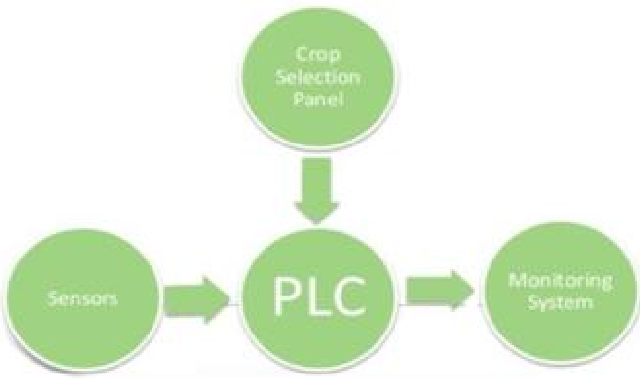

Figure 10: PLC Automation

V. PERFORMANCEANALYSIS

1) Test point Soil Moisture sensor

The working of this sensor can be done by inserting this sensor into the earth and the status of the water content in the soil can be reported in the form of a percent. This sensor mainly utilizes capacitance to gauge the water content of the soil (dielectric permittivity).

2) Test point Temperature/ Humidity sensor

Temperature/ Humidity sensor detects the amount of temperature and humidity variations in the polyhouse environment. According to the amount of the variations occurred sensor sends signals to the microcontroller in form of electrical signals. De- pending upon the amount of the humidity present in the polyhouse the fogger valve operates as per the given instant of time.

3) Test point pH Transmitter

pH transmitter detects the pH level of water present in the tank. According to the detected pH level the dosing pump operates on adding the corresponding acidic and basic solution.

[1] Fertigation according to respective Crops Cabbage

- pH level- 6.5 to7
- EC- 2.5 to3
- Optimum Temperature- 150C to180C
- Minimumtemp.-50C
- Maximum temp.-240C
- Relative humidity-80 to 90percent

[2] Capsicum

- pH level- 6 to6.5
- EC- 1.8 to2.2
- Optimum Temperature- 210C to240C
- Minimumtemp.-180C
- Maximum temp.-270C
- Relative humidity-80 to 90percent

[3] French Bean

- pH level- 6 to6.5
- EC- 1.8 to2.4
- Optimum Temperature- 150C to210C
- Minimumtemp.-100C
- Maximum temp.-270C
- Relative humidity-80 to 90percent

VI. RESULT ANDDISCUSSION

Several experiments were done step by step and following results were obtained. Soil moisture sensor was designed. It was seen that as water level in the soil varies, the resistance across the probes varied.

Rain sensor was later designed. When rain falls on the rain sensor, the circuit becomes short. Similarly when the PCB becomes dry, the circuit was open.

After the designing both the sensor, temperature sensor was then designed. In the above, as the temperature was varied the output of the temperature sensor was varied. The variation in temperature was verified using a soldering iron.

Later the control unit was designed step by step. Control unit includes the valve, shield, exhaust and window. The control unit was interfaced using the PLC (Ladder Logic). The soil moisture was connected to valve via PLC. As the soil moisture was low; the valve was open until the moisture reaches up to its 50 percent. As soon as the moisture content of the soil reaches to its set point the valve is closed.

The rain sensor was connected to a shield via PLC. When water was poured on to the rain senor, the PLC activates the shield and a sheet was rolled over the field. Similarly when the rain was dry, the PLC activates the motor so that sheet was wrapped into its initial state. The temperature sensor was connected to the exhaust fan via PLC. When temperature exceeded the critical temperature, the exhaust fan became working. When the temperature was reduced below the critical temperature, the fan was switched OFF and the incandescent light bulb is made on to maintain its set point.

Thus a working model of the project was obtained and found working.

VII. CONCLUSION

From this project, we came to the conclusion that for controlling the environment parameters we should have a firm understanding or knowledge of the control processes so that we can operate the whole process precisely and in controlled manner.

From this project, we came to the conclusion that for controlling the environment parameters we should have a firm understanding or knowledge of the control processes so that we can operate the whole process precisely and in controlled manner.

- We can automate the whole poly-house using PLC only. As we know very well that growth of crop is very important, so in the same way increase number of poly-houses is one of the better options.

- This project will result in greatly profitable for farmers and even for those who are not from the farming field due to the use of new techniques.
- Polyhouse cultivation provides proper irrigation system and reduces the wastage of water.
- The main advantage is that the system's action can be controlled according to different atmospheric conditions for various types of crops.

VIII. APPENDIX

Polyhouse automation system is the technical approach in which the farmers in the rural areas are benefitted by automatic monitoring and control of Polyhouse environment. It replaces the direct supervision of the human. In greenhouse, for proper plant growth soil nutrient parameters are equally important.

IX. ACKNOWLEDGMENT

With great pleasure, we avail this opportunity to express our profound gratitude and deep regards to our project supervisior Prof. S. S. Mandhare for his spirited guidance, monitoring and constant encouragement throughout the completion of this seminar report. We have deep sense of admiration for his innate goodness and inexhaustible enthusiasm, it helped us to work in right direction to attain desired objective.

We are also thankful to Prof. G. K. Shirsath, Project coordinator and Prof. Dr. A. R. Laware, Head, Department of Electrical Engineering, PDVVP COE, Ahmednagar for their generous support, devoting their valuable time and helped us in all possible ways towards successful completion ofthis work. We thank all those who have contributed directly or indirectly to this work.

We take this privilege to express our sincere thanks to Dr. Uday P. Naik, Principal, PDVVP COE, Ahmednagar for their support, encouragement and providing the much necessary facilities. We extend thanks to our friends who have supported in every stage of these report. We cannot end without thanking our lovely family for their encouragement.

REFERENCES

[1] G. Sahitya, N. Balaj, C.D Naidu, S. Abinaya,"Designing a Wireless Sensor Network for Precision Agriculture Using Zigbee", IEEE 7th International Advance Computing Conference, 2017.

[2] LUO Quan, QIN Linlin, LI Xiaofeng, WU Gang, "The implementation of wireless sensor and control system in greenhouse based on ZigBee", Proceedings of the 35th Chinese Control Conference, July 27–29,2016.

[3] Yang Shulian, Zhang Yu-"Wireless Measurement and Control System for Environmental Parameters in Greenhouse"-2010 International Conference on Measuring Technology and MechatronicsAutomation

[4] Yunseop (James) Kim, Member, IEEE, Robert G. Evans, and William M. Iversen"Remote Sensing and Control of an Irrigation System" Using a Distributed Wireless Sensor Network"-IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 57, NO. 7, JULY20