

SMART VILLAGE MONITORING AND CONTROL USING PLC AND SCADA

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Electronics and Instrumentation Engineering

by

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**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL - 2021



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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **HARITHA.K** (Reg.No: 37180008) and **KARTHIKA.G** (Reg.No: 37180011) who carried out the project entitled **Smart Village Monitoring and Control using PLC and SCADA** under my supervision from November 2020 to April 2021.

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March 19, 2021

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- PLC – Allen Bradley

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DECLARATION

I **Haritha K** hereby declare that the Project Report entitled **Smart village monitoring and control using PLC and SCADA** done by me under the guidance of **T.THAJ MARY DELSY, M.E., (Ph.D)** and **ABDUL RAHMAN, B.E.** at **AR Global Automation and Instrumentation, Chennai** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Electronics and Instrumentation**.

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I wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Electronics and Instrumentation Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

The development of a country always depends on the development of villages. By combining technology and automation, rural areas can be developed and their social, economic and environmental conditions can be improved. In this regard, the data from Athipattu village has been taken to develop the concept of smart village. Athipattu is a village near Minjur in Thiruvallur district of Tamil Nadu.

As part of the smart village concept, we need a system which monitors, control and automate the process involved in Agriculture, Water Management, Power saving and storing of cultivated products in a safe and long lasting environments. The existing projects have smart agriculture or smart power distribution or water management individually. Our project integrates the above features with an additional cold storage room for monitoring and controlling a smart village using PLC and SCADA. Supervisory Control and Data Acquisition (SCADA) is a graphical representation of entire smart village automation system, even a common man can understand the smart village automation system from SCADA screen. The data can be gathered from village and used for present and future automation process. Programmable Logic controller (PLC) is digital computer which gets data from the field device and passes the control variables to SCADA Software. PLC is a device which links hardware and software together by which the smart automated system can be obtained. The moisture level in field is monitored and automates the irrigation systems for the crops, vegetable and farming related activities. The power can be saved by automating lights in public places like streets, parks etc. The availability of water is monitored from the resources like river and the water distribution is automated for the domestic and irrigation purpose. The public cold storage room also can be monitored and controlled where a farmer can keep his cultivated items for further processing. The Micrologix 1400 PLC by Allen Bradley and the Intouch Wonderware SCADA software are used in this project.

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LIST OF ABBREVIATIONS

PLC	-	Programmable Logic Controller
SCADA	-	Supervisory Control And Data Acquisition
NO	-	Normally Open
NC	-	Normally Close
EN	-	Enable bit
DN	-	Done bit
TON	-	Timer ON
WIFI	-	Wireless Fidelity
AOUT	-	Analog Output
GND	-	Ground
SMPS	-	Switch Mode Power Supply
NEUT	-	Neutral
VDC	-	Volts Direct Current
VAC	-	Volts Alternating Current
CPU	-	Central Processing Unit
DC	-	Direct Current
AC	-	Alternating Current
PC	-	Personal Computer
IP	-	Internet Protocol
RAM	-	Random – Access Memory
RTU	-	Remote Terminal Units
NEMA MG	-	National Electrical Manufacturers Association Motors and Generators

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CHAPTER – 1

INTRODUCTION

More than 50% of the population of the country lives in rural areas. The advanced technology and automation are easily available in urban areas and cities, but the rural areas lack of those features. Villages are the heart of any nation. They do significantly contribute to the growth of the country. Hence it is necessary for the development of rural areas and villages. Smart villages are villages in rural areas that use digital technologies to implement the process and improve their economic and environmental conditions. Also, Prime Minister Narendra Modi has launched the smart village concept to adopt a rural village and develop it into a model. The scheme is known as Sansad Adarsh Gram Yojana. The concept of smart village has become trend and popular now-a-days because they contribute significantly to the development of nation.

With this note, the study of Athipattu village is carried out for the development of the prototype of our project. Athipattu is a village in Minjur block in Thiruvallur district of Tamil Nadu, India. It is situated in northern part of Chennai and has a population of 2502 according to the census India 2020. The development in north Chennai is less as compared to south Chennai. While there are many factories and industries in north Chennai, they lack technological advancements and digital features. Hence we have chosen the Athipattu village located in North Chennai village, as the smart village for our project.

Food, water and electricity are the basic amenities which are required for the village. The continuous monitoring and controlling is required in field of agriculture, water distribution and energy maintenance for the development of village. This project concentrates on agriculture, water distribution, energy maintenance and cold storage for the cultivated products. These four processes are controlled by PLC and the SCADA is used for the graphical representation of the entire automation system.

The Micrologix 1400 PLC by Allen Bradley and the Intouch Wonderware Scada software is used in this project.

Agriculture is a very important process. Traditional and manual systems have many disadvantages. Shortage of laborers, time consuming, human errors, constant monitoring of the parameters are a few disadvantages that can be named. To overcome the above problems, automation can be implemented. For the crops to grow well, we need to have soil with good nutrients, proper humidity and moisture levels. So it is necessary to measure the moisture and humidity values. A soil moisture sensor and dht22 sensor is used to monitor the parameters in this project. If the value is not in the desired range, an alarm is enabled to alert the people. Water is an essential need for every human. We need to use it wisely and effectively. Proper distribution of water to every street is very important in order to avoid water wastage and scarcity. A flow sensor is used to measure the water entering into the pumping station and another sensor is used to measure the water flow coming out and being distributed to the streets. If the difference in water loss is high between the two sensors, an alarm system is used to alert the people.

Electric power maintenance is an important aspect. Unwanted lights during day time lead to power wastage. Hence power distribution has to be executed well. Street lights have to be turned off when the sunlight intensity is more like day time and on during night time. A light intensity sensor is used here. So according to the light intensity, street lights are turned on and off automatically. During day time, lights are not required and lights are turned on at night, when intensity of light is low. The aftermath of agricultural production is a very important step. The vegetables have to be stored safely before being distributed into the markets. Hence a cold storage room with long lasting environment is required. The temperature of each room is maintained according to the type of crop stored, which works on the principle of refrigeration cycle.

CHAPTER – 2

LITERATURE SURVEY

2.1 SMART AGRICULTURE:

Niteen Naik et al. in 2016 discussed automatic water drip system, automatic fertilizer spray system and automatic fertilizer preparation. Methodologies used in this paper are Delta PLC. In automatic drip system, the field is divided into two parts and two valves are used. One valve for controlling water supply and another valve for another part. The valve works based on time or volume of water in well. It is controlled using PLC. In automatic fertilizer spray system, they use robot drives to spray fertilizer row by row. For continuous operation, it moves automatically to another row, if row is complete. In automatic fertilizer preparation, the water and fertilizer gets mixed and it is given for automatic fertilizer spray system. If the level of the produced fertilizer is low, then it starts to produce new fertilizer for continuous operation. Thus, agriculture automation using PLC is achieved for better cultivation and production.

Sheetal K.Bhongle in 2016 discussed for increasing and decreasing room temperature. Methodologies used in this paper are PLC and SCADA. Main functions are maintaining temperature and humidity. In this project, they are controlling temperature and humidity using HT7S11. For increasing temperature, 240 V bulb is used. For decreasing temperature, cooling fan is used. Solenoid valve for automatic watering to increase humidity. SCADA is used to display readings of temperature and humidity with graph. PLC is used to control temperature sensor, humidity sensor and cooling fan.

2.2 SMART POWER DISTRIBUTION:

T. Vignesh et al. in 2015 discussed for monitoring switch yards in substation. Methodologies used in this paper are PLC and SCADA. In power grid system, the power generated is stepped up and it is connected to transmission network. From transmission network, it reaches the substation. In substation, it is stepped down

using a transformer and it is sent to a bus for feeding power all over the country with 3 phase power supply. All the major streets have substation and it has a backup connection to alter the substation, if there is any fault in the used substation. It has 3 works namely Generation, Load and Transmission. SCADA has 5 windows to monitor control rooms, for substation, for indication and for alarm & trends. In Control window, to monitor the voltage and current values of transformer. In Substation window, to monitor the connection of switches and circuit breakers. In Indication window, to monitor circuit breakers and to identify fault location using indicating light. In Trend window, to monitor voltage and current using graphs. In Alarm window, to indicate low and high ratings of current and voltage. It is used to reduce manpower and time delay.

P. Thamarai et al. discussed in 2014 for monitoring the amount of current used by industries. Methodologies used in this paper are PLC and SCADA. Energy meter readings are collected using PLCs. PLC information are sent to RS485 to Ethernet converter. From Ethernet converter, the data is fed into hub and a copy of data is sent to database server for updation. It provides user with frond end services through VB.

S. Angayarkanni et al. discussed in 2018 for replacing large control panels. Methodologies used in this paper are PLC and SCADA. The aim of this paper is to replace larger control panels into smaller one. To easily identify the area of trip and for continuous monitoring SCADA is used. LabView is used, which is highly dynamic and cost effective. The monitoring system is highly trained using GUI (Graphical User Interface). These components are cost effective and more efficient.

2.3 SMART COLD STORAGE:

Suraj Mahadeo Shende in 2018 has explained the design and working of cold storage in detail. The methodology used in this paper is direct evaporative cooling system. Before the invention of cold storage, food preservation techniques like pickling, salting, canning were followed. Pickling is a technique used to preserve food in an acid having low p^H . Salting is done by choosing raw salts like rock salts, sea salt, etc. However the preservation lasts only for a few days. Canning is a process

where foods are kept in jars and subjected to heating. The cold storage concept was introduced to eliminate the disadvantages of ancient food preserving techniques. It increases the life span and supply of the products. After the crop is harvested, it is necessary to have proper storage conditions. The temperature and humidity must be kept in check. Fresh fruits and vegetables require low temperatures and high humidity. Different vegetables and fruits require different temperature and humidity. So the cold storage has to be designed in such a way that it has small rooms with more flexibility. A direct evaporative cooling system is implemented here. It lowers the temperature and increases the humidity. Most of the local produce gets wasted due to lack of storage facilities. Hence this system utilizes less electricity and the room space is also less.

Amit Soni et al. in 2017 have made an analysis of cold storage filled with potatoes. The storage conditions such as temperature, humidity, pressure, presence of NH_3 must be well defined. The appropriate temperature of an early crop fresh potato is in the range of 4-10 degree Celsius. The setup consists of a compressor and an evaporator. The compressor is used to control the circulation of the refrigerant and cool the refrigerator. The evaporator is used to remove the heat from the product to be cooled.

2.4 SMART WATER DISTRIBUTION:

T. Baranidharan et al. in 2015 has proposed an automated water distribution system using PLC and SCADA. The aim of the system is used to distribute the water to all the streets in equal share. A flow sensor is used to measure the flow rate of water. A set point is determined. When flow reaches that point, a solenoid valve will turn off automatically. The PLC is used to control the water distribution and SCADA is used for monitoring the data. The advantages are that it eliminates the water wastage, reduce manpower, avoid wastage of water and water theft in pipelines.

Pratiksha Hattikatti et al. in 2015 have come up with a PLC controlled water distribution system. Leakage results in reduction of water pressure in pipeline. They have come up with a solution to ensure effective water supply and detecting the leakages. A pressure transmitter is introduced in the network at various location to

measure the variation of pressure. The values are then compared with a fixed value. A level sensor is used to measure the level of water in water tank. PLC is the main controller. The SCADA system is used to display and monitor all the information. The General Packet Radio Service (GPRS) is used as communication medium. In future the system can be modified to detect the exact location of pressure drop.

Harish KM et al. in 2016 have proposed a project using PLC and SCADA to distribute the domestic water to all individual houses in an apartment and accordingly tariff will be applied. A set point is fixed for every house. If the water flow reaches the set point, a message is sent by GSM module to the consumer and tariff will be applied for extra water consumed. PLC is used for controlling and SCADA for monitoring. A Dual Tone Multi-Frequency (DTMF) is used as a signaling system. It acts as an interface between consumer and the system. The consumer can communicate with the controller for automatic on and off of valves, allocation of extra water, etc. The advantages are that it provides a secure system, ensures availability of water and creates awareness about water conservation. In future it can be applied into android applications to check the status of water usage and grey water monitoring can be included.

Soundhrya M et al. in 2016 have come up with a solution to check the quality of water that is being distributed to the customer. The quality is measured by using p^H sensor, UV sensor and flow sensor. By measuring the p^H value, the water supply is stopped if the value is not equal to seven. PLC is used to control the field devices and SCADA stores data from the PLC. The salt level testing is introduced to desalinate the salt water and produce fresh water for consumption. The UV test is used to treat the bacteria. The ultraviolet radiation is effective for testing microorganisms. The advantage of this system is that the quality of water is provided to the consumer by automatic measurement of chlorine and p^H displays in the SCADA screen.

CHAPTER – 3

AIM AND SCOPE

The aim of the present work is to develop a smart village, in which agriculture, water distribution, energy maintenance and cold storage for cultivated product are controlled and monitored automatically to the development of village. PLC and SCADA is used for automation and monitoring of the data based on Ashipattu village.

3.1 BLOCK DIAGRAM:

The field input data is collected by the sensors. The information is passed to PLC through Modbus. The Modbus converts TTL signal to RS485 for long distance communication. RS485 is a standard serial communication protocol for data transfer. Based on the customized PLC program, the output is performed. By using WIFI module, the PLC is interfaced with SCADA and the entire process can be visualized in SCADA screen.

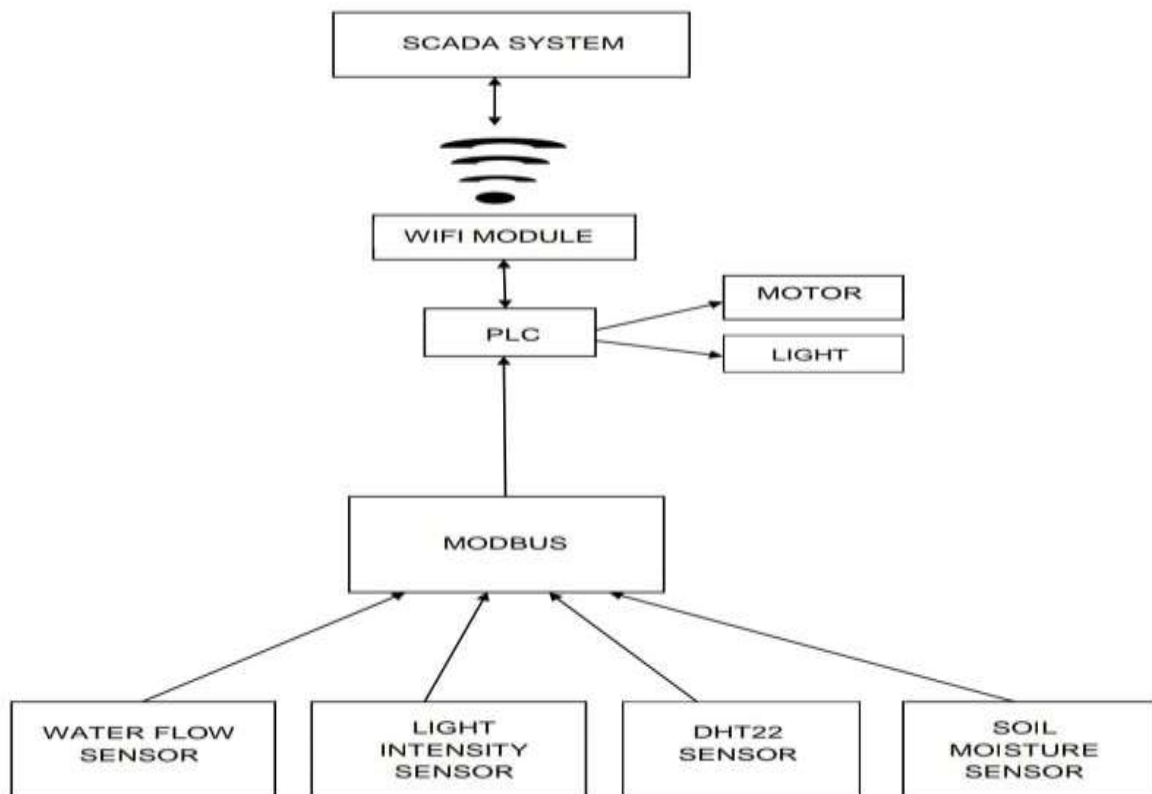


Fig. 3.1: Block diagram

3.2 EXISTING SYSTEM:

Many people have come with many ideas to automate the agriculture, water and energy maintenance process. It involves single applications like water distribution, electric energy maintenance, smart agriculture and cold storage. Two or more process are not controlled and monitored fully together. The idea of taking up a real village and monitoring the process has not been fully established yet. The existing system involves partial automation in domestic purposes.

3.2.1 Disadvantages:

- Monitoring and controlling of a single application with partial automation.
- Automation of an entire village has not been successfully implemented yet.

3.3 PROPOSED SYSTEM:

The proposed system is to make a smart village by monitoring and controlling the process namely automated water distribution in agriculture, energy maintenance in street light, water distribution for domestic use and cold storage for cultivated products. This project involves the integration of many automation processes for the automation of the entire village.

In order to perform the project, the case study on Athipattu village has been done. The water source of this village is Kosasthalaiyar River and power source is Vallur Thermal Plant.

3.3.1 Advantages:

- Agriculture, water distribution and energy maintenance, along with an additional cold storage room is implemented.

CHAPTER – 4

METHODS AND PROCESS USED

4.1 CIRCUIT DIAGRAM:

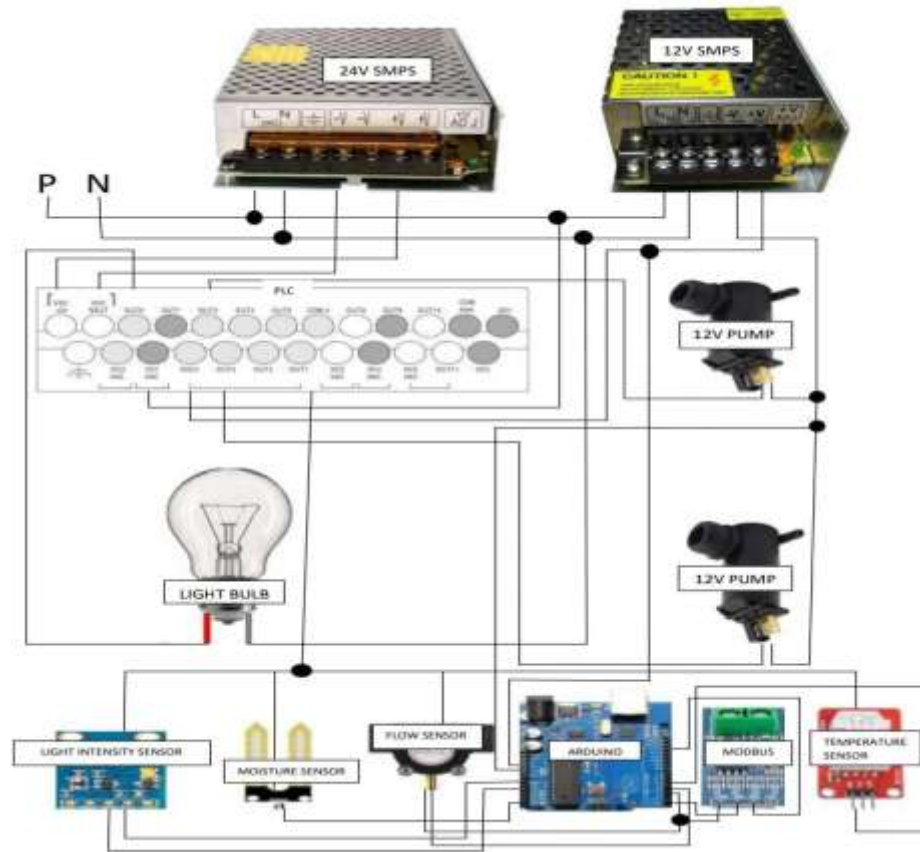


Fig. 4.1: Circuit diagram

Phase(P) is connected to the phase of power source, Live(L) of 24V SMPS, Live(L) of 12V SMPS and DC1 VAC of PLC. Neutral(N) is connected to the neutral of power source, Neutral(N) of 24V SMPS, Neutral(N) of 12V SMPS and Negative of light. V+ of 24V SMPS is connected to VDC +24. V- of 24V SMPS is connected to VDC NEUT. V+ of 12V SMPS is connected to VDC2 of PLC and 12V of Arduino. V- of 12V SMPS is connected to negative of pumps and GND of Arduino. Positive supply of pumps is connected to OUT2 and OUT3 of PLC. Positive of light is connected to OUT0 of PLC. 2 and 3 Interrupt pins 2 and 3 of Arduino are connected to flow meters. In light intensity sensor, SDA pin is connected to A4 of Arduino and

SCL pin is connected to A5 of Arduino. AOUT of Soil moisture sensor is connected to A0 of Arduino. AOUT of temperature and humidity sensor is connected to pin 4 of Arduino. TTL to RS485 Modbus is connected to 1, 2 and 13th pin of Arduino. The power for light intensity sensor, temperature & humidity sensor, soil moisture sensor and Modbus is given from PLC.

4.2 SMART AGRICULTURE:

Agriculture is the backbone of our country. To increase production rate, land and crops should be taken care properly. For this project, we have selected Athipattu village, which is located near Ponneri in Thiruvallur district. According to the case study in Athipattu village, it contains loamy soil where wheat, black gram and sesame are grown. In day-to-day life, we cannot able to predict the weather condition properly, which affects the plants growth and production. The main step for growing crops is to select seeds, suitable land, establishing crops, monitoring crop health, adding nutrients and harvesting. In this, watering is the important and tough task because we need to water daily. Over watering and under watering results in decreased growth rate and production and sometimes degradation. Another major cause is that farmers cannot maintain large fields. So, we need additional monitoring for fields. Our main aim is to overcome this using PLC and SCADA. The main water source for Athipattu village is Kosasthalaiyar River. For this project, we have used pump to water for agricultural use. According to the need of plant, the water will be fed into the agricultural land. We have used soil moisture sensor and dht22 sensor for constant checking of humidity and moisture in soil. In this project, we have shown the fields of wheat, black gram and sesame. Using this project, we can save water, power and crops. It has both auto and manual mode. If it is in manual mode for long time then alarm will be triggered.

4.2.1 WHEAT FIELD:

Wheat cultivation is usually found in northern regions like Punjab, Haryana and Bihar. Wheat is grown in fertile loamy and clay soil. It requires a rainfall of 75 -100 cm. The temperature while sowing is 10-15 degree Celsius and 21-26 degree Celsius while harvesting. It occupies main position in food all over the world which is next to

rice. Temperature requirement for germinating is 20 to 25 degree Celsius, for tillering 16 to 20 degree Celsius, for accelerating growth 20 to 23 degree Celsius and for proper grain filling 23 to 25 degree Celsius. They are very sensitive to cold or frost. Sowing period is between October to December. Harvest period is between February to May.

4.2.1.1 BLOCK DIAGRAM:

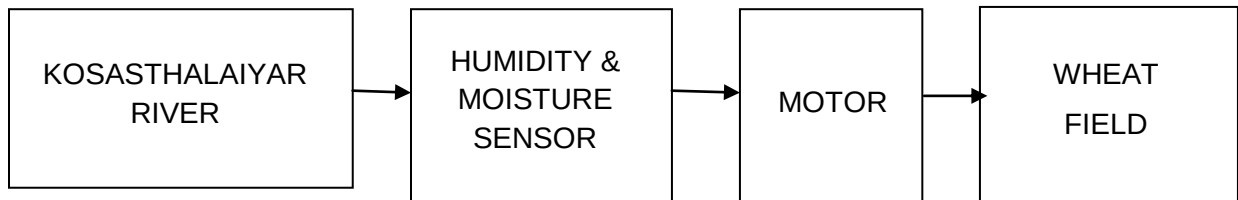


Fig. 4.2: Block diagram of wheat field

4.2.1.2 FLOW CHART:

AUTO MODE:

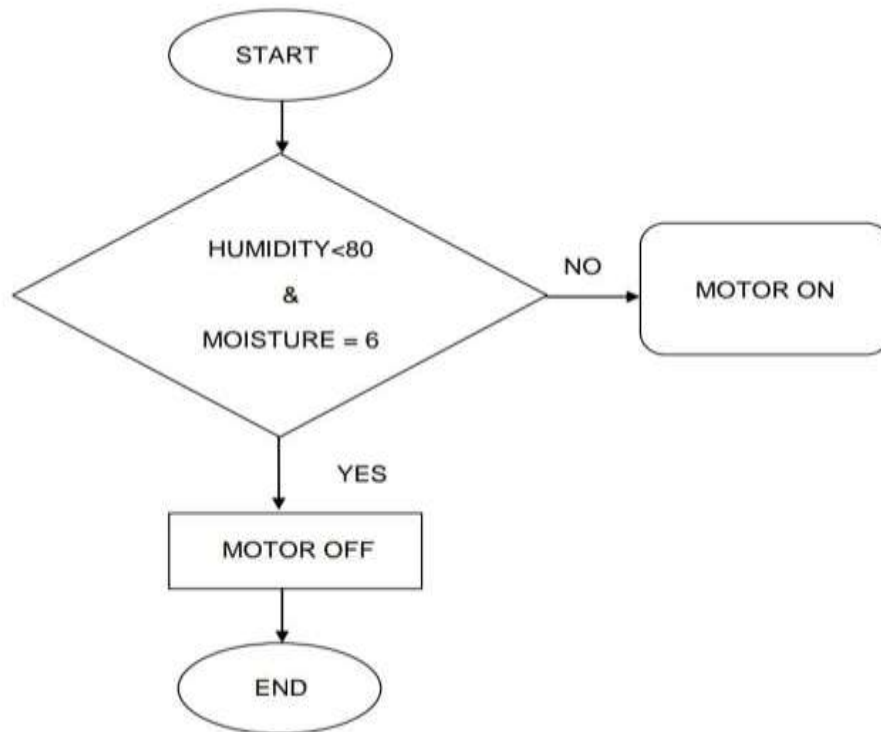


Fig. 4.3: Flow chart in auto mode for wheat field

Less than operator is used to compare the humidity of soil and the pre-set value. If the humidity of soil is less than the pre-set value then the motor will be turned ON otherwise it will be in OFF condition. Switch will be connected, to represent the mode.

Humidity and moisture value is monitored continuously. If the switch is in auto mode, the water is fed from Kosasthalaiyar River through pump according to the moisture value, the motor will be turned ON. In manual mode, the pump is turned on and off using separate switch.

4.2.2 BLACK GRAM FIELD:

Black gram is one type of pulse crop. It is grown in Punjab, Madhya Pradesh and Orissa. It is suitable for moist and hot weather. The temperature should be between 25 -30 degree Celsius. The soil type should be sand loam, heavy clay loam or heavy soils. It is most important crop grown in India which is very nutritious for health and controls soil erosion. It increases soil fertility and fixes nitrogen level in soil. 60 to 75 cm of rainfall is suited for this plant. A well managed crop produces 12 to 15 quintals of grain per hectare. Sowing period is between September to November. It is harvested in middle of May. It requires irrigation in interval of 10 to 15 days. During harvest, it needs at least 20 to 22% of moisture. It produces 12 to 15 quintals per hectare.

4.2.2.1 BLOCK DIAGRAM:

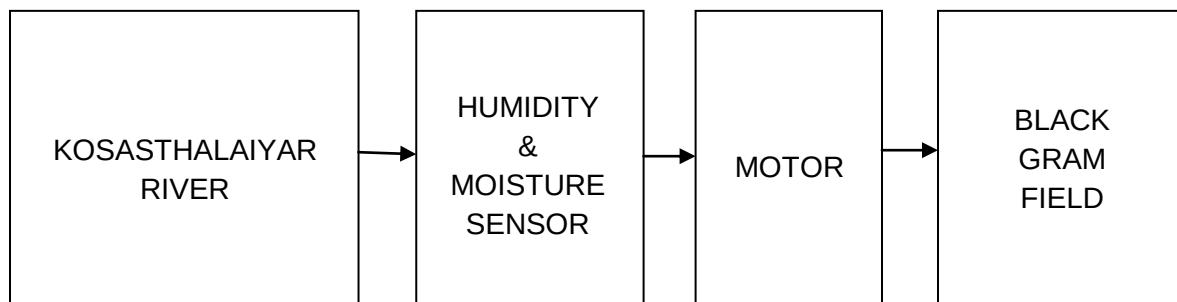


Fig. 4.4: Block diagram of black gram field

4.2.2.2 FLOW DIAGRAM:

AUTO MODE:

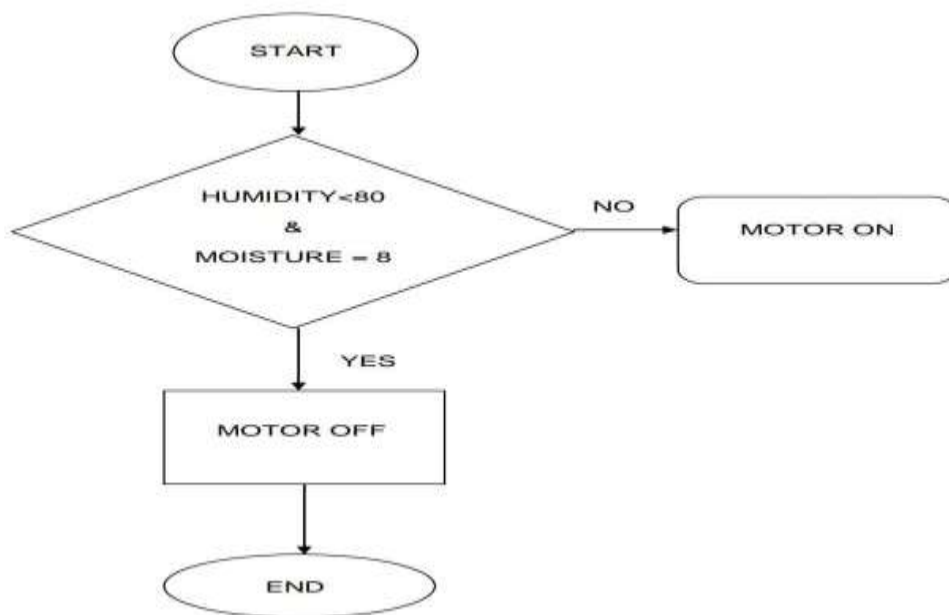


Fig. 4.5: Flow chart in auto mode for black gram field

Less than operator is used to compare the humidity of soil and the pre-set value. If the humidity of soil is less than the pre-set value then the motor will be turned ON otherwise it will be in OFF condition. Switch will be connected, to represent the mode.

Humidity and moisture value is monitored continuously. If the switch is in auto mode, the water is fed from Kosasthalaiyar River through pump according to the moisture value, the motor will be turned ON. In manual mode, the pump is turned on and off using separate switch.

4.2.3 SESAME FIELD:

Sesame is an oil seed crop. It is grown in Bihar, Tamil Nadu, Uttar Pradesh and Orissa. The suitable temperature is 25-35 degree Celsius. The soil type should be well drained to medium type. Acid or alkaline type soils are not preferred. The rainfall should be between 20 to 26 inch. India ranks first in producing sesame with 8.66 lakh

tonnes. It can be stored for about one year when packed in polybags and tins. During seeding, the soil should have at least 21 degree Celsius. It takes 90 to 150 days for harvest. The best sowing period is February and March. It takes 100 to 135 days for successful harvest. It takes 3 to 5 months from the date of sowing for harvesting.

4.2.3.1 BLOCK DIAGRAM:

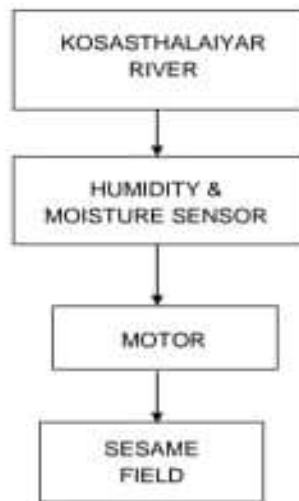


Fig. 4.6: Block diagram of sesame field

4.2.3.2 FLOW DIAGRAM:

AUTO MODE:

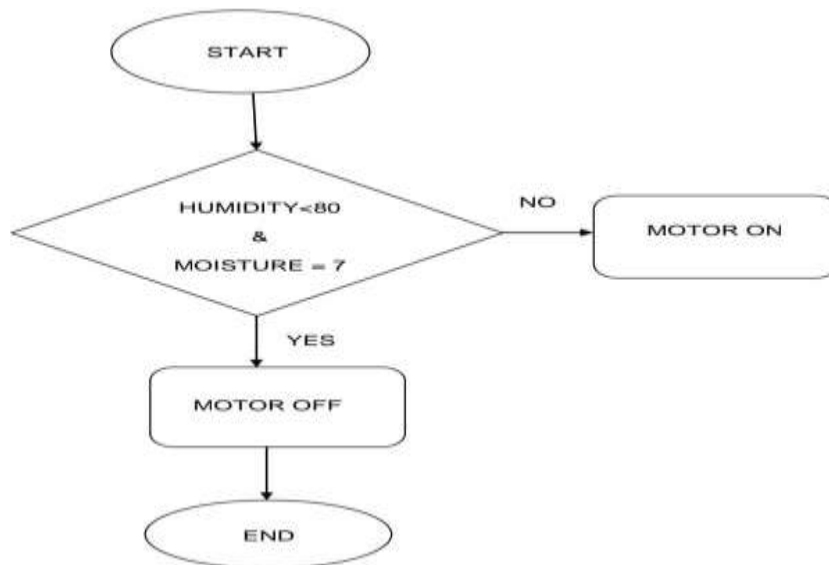


Fig. 4.7: Flow chart in auto mode for sesame field

Less than operator is used to compare the humidity of soil and the pre-set value. If the moisture of soil is less than the pre-set value then the motor will be turned ON otherwise it will be in OFF condition. Switch will be connected, to represent the mode.

Humidity and moisture value is monitored continuously. If the switch is in auto mode, the water is fed from Kosasthalaiyar River through pump according to the moisture value, the motor will be turned ON. In manual mode, the pump is turned on and off using separate switch.

4.3 SMART ENERGY MAINTENANCE:

Energy is very important in day-to-day life. Without energy, the day seems to be long and hatred. It becomes part of our lives. We need to use those resources wisely. Our main aim in this project is to save energy efficiently. These can be implemented by turning on or off of street lights when not in use.

From Thermal Power Plant 11, 11.5, 12 or 13kV is stepped up to 220 or 500kV using step-up transformer which is primary transmission. Then, it is stepped down to 132 or 66kV using step-down transformer, from which it is divided to 3 phase 3 wire systems. Again it is stepped down to 11kV using step-down transformer which is secondary transmission. Then it reaches the substation. Then it uses vacuum circuit breaker which is used to interrupt current and it requires less maintenance. The part between substation and transformer is called primary distribution. It reaches the distribution transformer. Then it uses air circuit breaker, which is used to prevent short circuit. When it reaches the residents, its readings are maintained at 11kV / 400 and 230 V. The part between distribution transformer and residential consumers is called Secondary distribution.

For this project, we have selected Athipattu village which is located near Ponneri in Thiruvallur district of Tamil Nadu. This area consists of Thermal power plant which is called North Chennai Thermal Power Station, which is located 25kms from Chennai. Its total capacity is of 1830MW (2,450,000hp). Its exact location is Athipattu Pudunagar, Chennai, Tamil Nadu. It is distributed by Tamil Nadu

Generation and Distribution Corporation. It is one of the major power plant in Tamil Nadu. We have automated street lights for three streets namely Venugopal street, Ganthi street, Rukmani street.

4.3.1 BLOCK DIAGRAM:

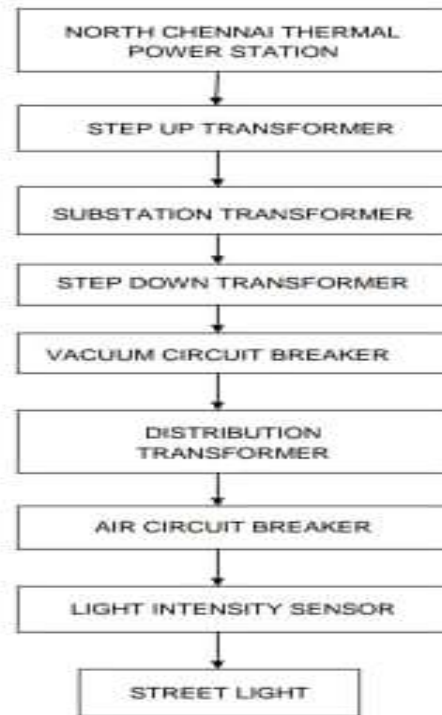


Fig. 4.8: Block diagram for energy maintenance

4.3.2 FLOW DIAGRAM:

AUTO MODE:

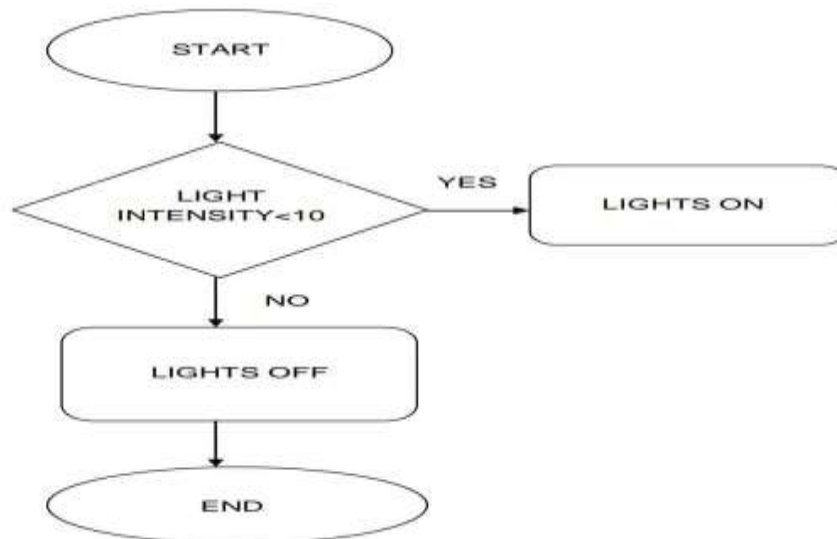


Fig. 4.9: Flow chart in auto mode for energy maintenance

Light intensity sensor will be connected to all street lights. If the intensity of light is less than 10, then light should be turned ON. By using this method, we can able to save energy.

Three streets will be shown in the SCADA Screen. In auto mode, the lights turn on automatically using the light intensity sensor value. In manual mode, the light will be turned on manually according to the light intensity on the environment. The SCADA screen of the screen shows the extreme look of streets which looks like real time image.

4.4 SMART WATER DISTRIBUTION:

Water is the basic need for all species in the world. Therefore it has to be consumed wisely and effectively. Improper water supply and distribution leads to water wastage. Pipe breaks, leakages or malfunctions of the pump also disturbs the water supply chain. To avoid water wastage during water distribution, automation is implemented here. When automation is implemented, it leads to less wastage, high accuracy, avoids human errors, etc.

For households and domestic water purposes, the water source is either groundwater or from a nearby water source. The water source can be rivers, reservoirs, rain water, surface water, etc. Water from the source cannot be supplied directly to the household. A water pumping station acts as an intermediate. Water pumping station is used to transport water from one location to another. The pumps are driven by selected motors which have to be in accordance with NEMA MG1. Usually the pumping station is located near the water source. From the water pumping station, water is distributed to our houses through canals and underground pipes.

In our project, Kosasthalaiyar River is the main water source. Kosasthalaiyar River is a 136 KM long river originating near pallipattu and draining into Bay of Bengal, A small dam called Vallur Anicut has been constructed near Minjur. It is used to monitor water levels, supply water to irrigation channels and used for domestic water purposes in the surrounding areas of Minjur. The river water is fed into the water pumping station. The aim of our project is to calculate the water distribution

system loss. By subtracting the total water supply fed into the pumping station and the water outlet from the motor being distributed, water loss is known. If the water loss is higher, an alarm system is incorporated to alert the user. In this way, water wastage can be avoided. The water loss determination is done with the help of water flow sensors. The sensor contains a Hall Effect sensor and a rotor inside. When water flows, the rotor is rotated. By observing the speed of the rotor, the water flow is determined. The output is given as a pulse signal by the Hall Effect sensor. One water sensor is placed near the incoming water from the river and the other is placed at the output of the pumping station. Also, the sensor can be placed at every street to know the water flow. The entire process is automated and it does not require any human intervention. An alarm is attached to indicate if there is any water loss. We have taken three streets for example to show the water distribution.

4.4.1 BLOCK DIAGRAM:

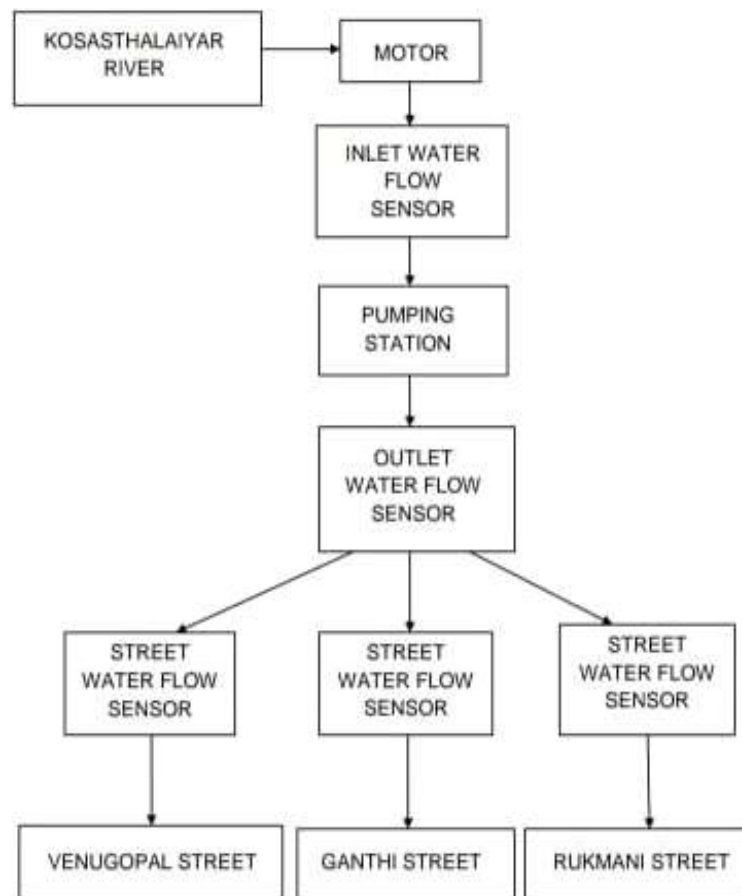


Fig. 4.10: Block diagram for water distribution

4.4.2 FLOW CHART:

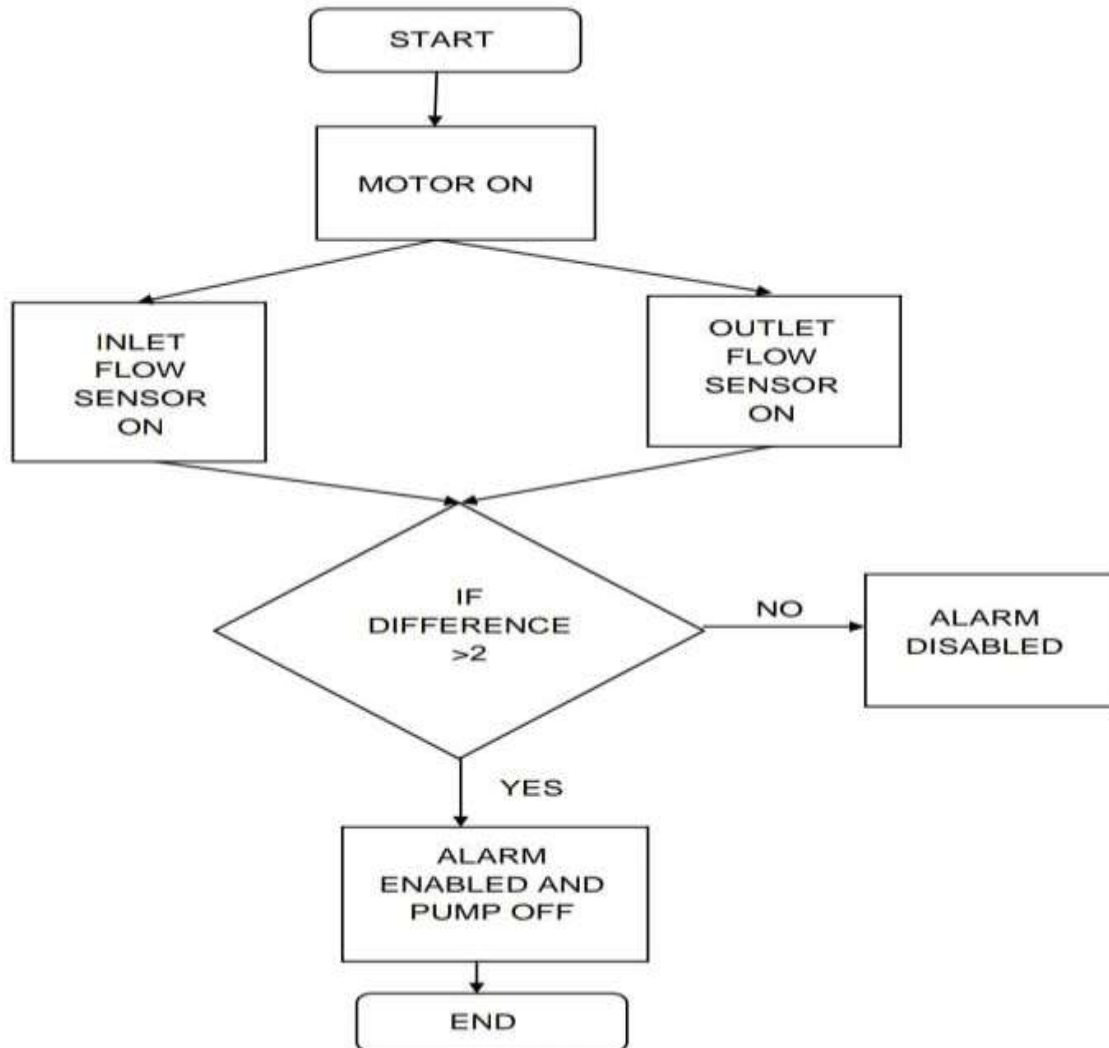


Fig. 4.11: Flow chart for water distribution

When the switch is ON, the motor will be turned ON. Both inlet and outlet flow sensor will also be turned ON to measure the water flow rate. If the difference between the two flow sensor is greater than 2, then the alarm is enabled and motor is turned OFF.

Water from Kosasthalaiyar River enters to the pumping station. From there, it is distributed to Venugopal Street, Ganthi Street and Rukmani Street through water pipes. The water flow sensor gives the water flow values in the screen. The entire water distribution process can be visualized in the SCADA screen.

4.5 SMART COLD STORAGE:

Storage of agriculture products is very important. When the crops are harvested, they have to be stored safely. Usually, the export of the product takes some time. So during that period, the vegetables and fruits cannot be left as such. They have to be stored at a low temperature so that they maintain the same quality and also do not spoil. A cold storage room is a kind of large refrigerated room. It is used to store perishable products like vegetables, fruits and meat below the outdoor temperature. The main objective of cold storage room is to store the perishable products for a long period of time so that they do not spoil. Every product has to be maintained at a different temperature. The cold storage room has to be designed according to the requirement.

The cold storage room is usually built with insulated materials like concrete or brick so that it prevents the cold leakage. Usually the materials are chosen in such a way that it has low thermal conductivity. The cold storage room works on the principle of refrigeration cycle. There are five main components in a cold storage room. They are Compressor, condenser, expansion valve, evaporator and blowers.

1) Compressor:

The compressor is the heart of the cold storage room and the refrigeration cycle usually starts and ends with the compressor. The refrigerant flows into the compressor where the volume is reduced. A high pressure gas is created which causes the temperature to rise. Now the refrigerant is a hot gas. The compressor is a power consuming device.

2) Condenser:

The hot gas now enters the condenser. It is cooled by air or water and the gas is turned into a hot liquid. It also absorbs some of the heat. It condenses or changes the phase of the refrigerant.

3) Expansion valve:

In the expansion valve, the refrigerant is expanded resulting in loss of pressure and heat. In this process cooling is produced. The hot liquid changes into cold refrigerant.

4) Evaporator:

The evaporator evaporates the low temperature liquid refrigerant. The exchange of heat takes place here where the liquid absorbs the heat and turns into a gas.

5) Blowers:

The chilled gas from the evaporator enters the blowers. It circulates the chilled air in the refrigerated area to cool down the stored fruits and vegetables.

4.5.1 BLOCK DIAGRAM:

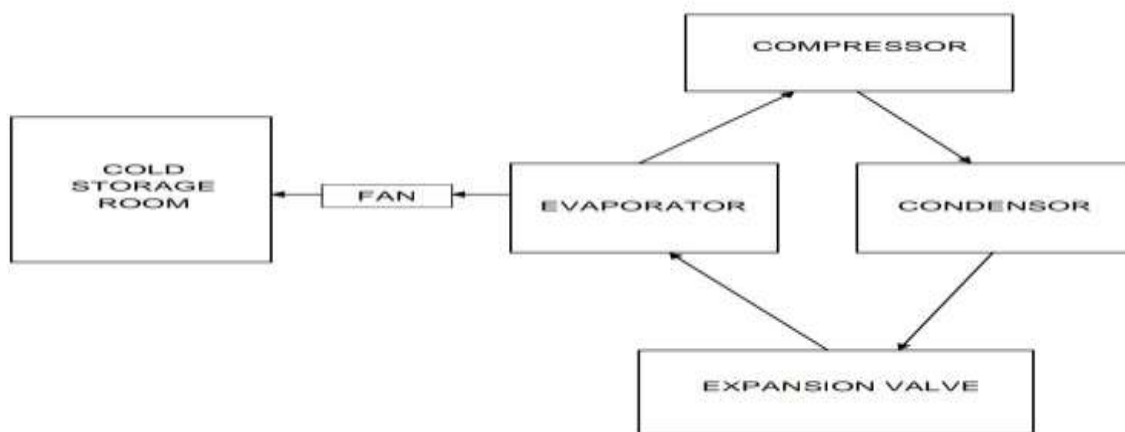


Fig. 4.12: Block diagram for cold storage

4.5.2 FLOW CHART:

AUTO MODE:

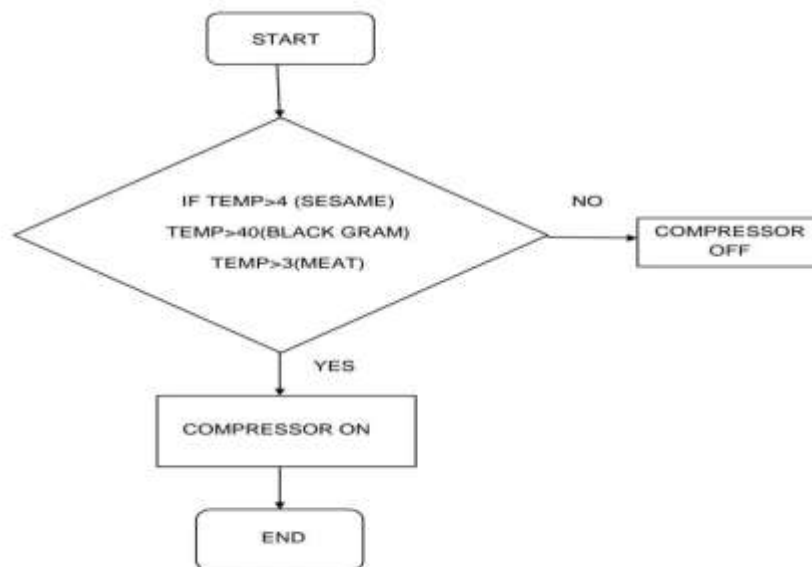


Fig. 4.13: Flow chart in auto mode for cold storage

The cold storage room can be operated in two modes, auto and manual. If the temperature of sesame is greater than 4, the temperature is decreased using the fan. In auto mode, the temperature has to be decreased. In manual mode, temperature starts increasing as refrigeration does not take place. Similarly, for black gram the maximum temperature is 40 in auto mode. For meat the maximum temperature is 3 in auto mode.

The cold storage room is designed for sesame, black gram and meat. It works on the principle of refrigeration cycle. Another SCADA screen is developed to show the working of refrigeration cycle.

4.6 HARDWARE REQUIREMENTS:

- Allen-Bradley PLC
- SMPS
- Light intensity sensor
- Flow sensor
- Arduino UNO board
- Modbus
- Soil moisture sensor
- Temperature and humidity sensor
- DC voltage regulator

4.6.1 PROGRAMMABLE LOGIC CONTROLLER:

Programmable Logic Controller (PLC) is a user friendly industrial digital computer which is mainly adapted for the control of manufacturing process. According to our need of inputs and outputs, the PLC varies from small modular devices to large rack mounted modular devices. PLC input includes switches, sensors and analog inputs. PLC output includes lights, motors, solenoids, relays and analog outputs. If we need extra input or output, we can able to add external I/O module which is fixed to a field bus that is plugged into the PLC. PLCs interact with people for controlling configuration and alarms. To avoid total or partial process shutdown, redundant CPU or I/O is used. Mechanical design for PLC is of two types.

They are,

- Single box or Brick
- Modular PLC

Single box or Brick is a mechanical design which fits all units and interface into one compact casing. Modular PLC provides space for modules, which can be customized. It is administrated by single processor. It has thousands of inputs and outputs.

PLC consists of processor unit (CPU), power supply unit, a memory unit, an I/O interface and a communication interface.

- Processor unit – According to the input, it executes the program and sends output signal.
- Power supply unit – To convert AC to DC voltage.
- Memory unit – To store program.
- I/O Interface – To receive and send data to external devices.
- Communication interface – To transmit data.

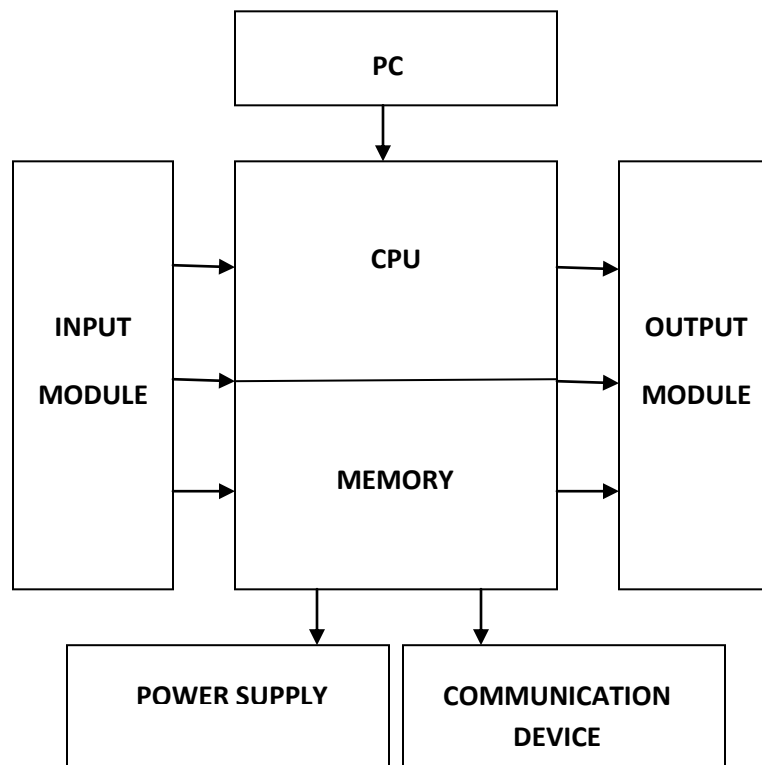


Fig. 4.14: Block diagram of PLC

PLC works on three steps namely,

- To read inputs.
- To execute the program.
- To implement output.

Special feature in PLC is simulation which helps us to test and to debug programs easily, which improves quality and increases level of safety. If this feature is not available it leads to production loss, time loss and money loss, which results in dangerous condition.

4.6.1.1 PLCs AND ITS DEVELOPED COUNTRIES:

- SIEMENS PLC – GERMANY
- ALLEN BRADLEY PLC – UNITED STATES
- ABB PLC – SWITZERLAND
- DELTA PLC – TAIWAN
- SCHNEIDER PLC – EUROPE
- MITSUBISHI PLC – JAPAN
- OMRON PLC – JAPAN
- HITACHI PLC – JAPAN
- GE PLC – UNITED STATE
- HONEYWELL PLC – UNITED STATE
- FATEK PLC – TAIWAN
- BOSCH – GERMANY

4.6.1.2 DEVELOPMENT:

Dick Morley was called “Father of PLC”. The PLC was first developed in automobile manufacturing industry to replace hard-wired relay logic systems for its higher reliability. It was built in 1969 by Bedford Associates, which was their 84th project. A company was introduced to produce this PLC named as MODICON

(Modular Digital CONTroller). This brand was first sold in 1977 to Gould Electronics and later, it was sold to Schneider Electric. In olden days, PLC use non-volatile magnetic memory, which has minimal memory capacity. Cassette tape cartridges were used for storing program.

4.6.1.3 PROGRAMMING:

In PLC programming, each row is called rung. Serial set of instruction perform logical AND operation and parallel set of instruction perform logical OR operation. According to the PLC models, the instructions will be limited. Nowadays, programs are stored in programmable memory, non-volatile flash memory and battery backed up RAM.

Types of PLC programming languages used are Ladder diagram, Functional block diagram, Instruction list, Structural list, Sequential flow chart. In this graphical programming languages are ladder diagram, functional block diagram and sequential flow chart. Textual programming languages are structural list and instruction list. These programming languages are mainly adapted from BASIC and C.

According to the PLC models, evaluation of rungs is executed two orders mainly left to right rung or right to left rung and top to bottom. It takes tens of milliseconds to implement the program. Fundamental programs are similar for all programs except addressing, memory organization and instruction sets.

4.6.1.4 PLCs AND ITS SOFTWARE:

- SIEMENS PLC – Step 5 – Microwins, Step 7 – Simatic Manager
- ALLEN BRADLEY PLC – RX Logix(RS Logix 5, RS Logix 500, RS Logix 5000)
- ABB PLC – Automation Builder AC010, AC500
- DELTA PLC – WPL Soft, ISP Soft
- SCHNEIDER PLC – PL 7, TwidoSuite, ProWORX 32
- MITSUBISHI PLC – Gx Developer, Gx Works 2, MELSOFT series
- OMRON PLC – CX-One, CX programmer
- HITACHI PLC – EH-150
- HONEYWELL PLC – HRA

- FATEK PLC – WinProladder
- BOSCH – Bosch Rexroth

4.6.1.5 COMMUNICATION:

For communication purpose, Modbus, Ethernet, RS-232, RS-422, RS 485 are used for communicating with external devices and systems. For larger I/O systems, Peer-to-Peer communication is used.

4.6.1.6 ADVANTAGES:

- User friendly.
- Easily extensible.
- Immunity to electrical noise.
- Extended temperature ranges.
- Compact and less maintenance.
- Resistance to vibration and impact.
- Digital and analog inputs and outputs.

4.6.1.7 ALLEN-BRADLEY PLC:

Odo Josef Struger, sometimes known as the “Father of the Programmable Logic Controller”. He was the inventor of Allen-Bradley. It is a major PLC manufacturer in US. This company was owned by Rockwell Automation. It was found over a period of 1958 to 1960.

ALLEN-BRADLEY PLC supports multiple programming techniques. It is easy to manage and configure. Main features of this PLC are mass production of code, communication with 3rd party hardware and exporting & importing tags from excel to SCADA databases.

For working with ALLEN-BRADLEY PLC, we need ALLEN-BRADLEY Power supply, ALLEN-BRADLEY Rack and cards for safety communication ports. It uses American protocols like Ethernet IP, DeviceNet and ControlNet. It is expensive but it is very effective. Technical support charges will be based on the amount of hardware installed. It offers limited customization options.



Fig. 4.15: Allen-Bradley PLC

4.6.1.8 SPECIFICATIONS:

- MODEL : MicroLogix 1766-L32BXBA
- INPUT POWER : 24V DC
- MEMORY : Non-Volatile battery backed RAM
- USER PROGRAM / DATA SPACE : 10K configurable
- DATA LOGGING / RECIPE STORAGE : 128K (without recipe) / upto 64K (after subtracting Data Logging)
- BATTERY BACK-UP : Yes
- BACK-UP MEMORY MODULE : Yes
- DIGITAL INPUTS : (12) Fast 24V DC and (8) Normal 24V DC
- DIGITAL OUTPUTS : (3) Fast DC, (3) Normal DC, (6) Relay
- ANALOG INPUTS / OUTPUTS : (4) Voltage Inputs / (2) Voltage Outputs
- SERIAL PORTS : (1) RS232C / RS485, (1) RS232C
- SERIAL PROTOCOLS : DF1 Half Duplex Master / Slave, DF1 Full Duplex, DF1 Radio Modem, DH-485, Modbus RTU Master / Slave, ASCII, DNP 3 Slave
- ETHERNET PORTS : (1) 10 / 100 EtherNet / IP port
- ETHERNET PROTOCOLS : DNP3 over IP, Modbus TCP / IP and EtherNet / IP messaging.

- TRIM POTENTIOMETERS : 2 Digital
- HIGH-SPEED INPUTS : Up to 6 channels @ 100 kHz
- REAL TIME CLOCK : Yes, embedded
- PID : Yes (stack memory and limited by loop)
- PWM / PTO : 3 channel PTO (100kHz) \ PWM (40kHz)
- EMBEDDED LCD : Yes
- FLOATING POINT MATH : Yes
- ONLINE EDITING : Yes
- OPERATING TEMPERATURE : -20⁰ C...+60⁰ C
- STORAGE TEMPERATURE : -40⁰ C (or -30⁰ C)...+85⁰ C
- Micrologix 1400 series have 540 Digital I/O, 16 Analog I/O, 20kb Memory

4.6.2 SMPS:

SMPS is also called as Switched Mode Power Supply which is used to convert DC or AC source to filtered DC power supply. It is used because of its size, weight, efficiency, cost and overall performance. It was invented by Hewlett Packard in the year 1972. The common current rating for small system is 2 to 10 amps and for large systems upto 50 amps. We need two smps with ratings 60V and 120V. The main features are high quality, no minimum load, LED power supply for LED lighting, built-in EMI filter, to improve signal precision, 100% full load burn-in test and auto recovery. Output voltage has adjustment range of $\pm 20\%$. Its shell material contains metal case or aluminium base. It protects from over load, over voltage and short circuit. It works efficiently. It produces only low heat. It ensures the stability of power supply. It is widely used in industrial control equipment, LED lighting, scientific research equipment, security, monitoring, advertising lights, military industry equipment, entrance guard etc.

4.6.3 LIGHT INTENSITY SENSOR:

Light intensity sensor is used to measure the intensity of light. It is produced by Japan ROHM Semiconductor. It has built-in 16-bit ADC. It supports f/s mode. It has wide range and high resolution. It consumes low current by power down function. It depends on the light source lightly. It has very small infrared influence. Its variations

are $\pm 20\%$. GND pin is used to connect with cathode for power supply. ADD pin is used for IIC. SDA pin is used for I²C data. SCL is used for I²C clock. VCC is connected to anode for power supply. It produces direct digital output. It has standard NXP IIC communication. It is mainly used for 1-lux high precision measurement.

4.6.3.1 SPECIFICATIONS:

- CHIP NAME: BH1750FVI
- Power supply ranges from 3 – 5 V
- Light ranges from 0 to 65535 lx
- Its size is approximately 3.2cm * 1.5cm

4.6.4 FLOW SENSOR:

- MODEL NAME: YF – 21
- PRODUCT NAME: Hall sensor
- FLOW RANGE: 1 – 30L/MIN
- GND connection given to anode and VCC connection is given to cathode.
- VOLTAGE RANGE: 3.5 – 24VDC
- PULSE CHARACTERISTICS: $F = 7Q(L/MIN)$
- EXTENT OF ERRORS: $\pm 5\%$
- FLOW PULSE: 2L/MIN=16Hz, 4L/MIN=32.5Hz, 6L/MIN=49.3Hz, 8L/MIN=65.5Hz, 10L/MIN=82Hz.
- FLOW RANGE: 100L/H-/1800H-L/H
- ERROR RANGE: $\pm 10\%$
- It consists of impeller, rustless steel axis, magnet, leak press valve, valve body, screw, bonnet and connection wire.

4.6.5 ARDUINO UNO BOARD:

The Arduino Uno board is a basically a microcontroller board based on the ATmega 328P microcontroller. The Arduino boards are used to read inputs from sensors and turn it into an output such as turning on a light or motor. The Arduino boards were created by David cuartielles and Massimo Banzi at the Interaction Design

Institute in Ivrea, Italy in the year 2005. The Arduino software is based on the Arduino Integrated Development Environment (IDE). The IDE is used to write and upload programs to Arduino using C and C++.

The ATmega 328P is an 8 bit microcontroller from Microchip. It has 32 KB flash memory, 1 KB EEPROM, 32 registers and 10 bit analog to digital converter. It is based on the RISC architecture. It consumes low power and lost cost. Hence this type microcontroller is used in Arduino boards. Arduino boards are inexpensive when compared to microcontrollers. Also Arduino software can run in almost all operating system such as Windows and Linux. The Arduino software (IDE) is flexible and easy to use. So Arduino boards are used as an alternative to microcontrollers.

4.6.5.1 SPECIFICATIONS:

- MICROCONTROLLER - ATMEGA 328P
- OPERATING VOLTAGE - 5 VOLT
- DIGITAL I/O PINS - 14 (6 for PWM OUTPUT)
- EEPROM - 1KB
- CLOCK SPEED - 16 MHZ
- LENGTH - 68.6 mm
- WIDTH - 53.4 mm
- WEIGHT - 25 g

In our project, the Arduino UNO board is used to read input from water flow sensor, light intensity sensor and moisture sensor. A Modbus is connected to the Arduino to communicate with the PLC.

4.6.6 MODBUS:

The Modbus is a standard serial communication protocol developed by Modicon in 1979. It is mostly used in industries for serial communication and provides serial communication between two electronic devices. It is often used with PLC or to connect remote terminal unit (RTU) with computers in a SCADA system. Modbus works on the principle of master and slave approach. One master and a minimum of one slave device is required. The communication is done by serial buses. The master

device is used to initialize the request to the slave. The slave performs the action and initializes response back to the master where it receives it. The slave functions the code and the response is achieved.

The Arduino cannot communicate directly with a PLC due to difference in voltage levels. Hence a Modbus is used between the two. The output of the arduino is usually a TTL signal. TTL stands for Transistor-Transistor Logic. The TTL level is between 0 and Vcc. TTL levels are weak signals and cannot be transmitted over long distance. So TTL has to be converted to RS 485. RS 485 is a standard electrical protocol for serial data transmission used in industries. Both RS 485 and RS 232 is used for serial communication. But RS 485 has good noise immunity, faster communication, has 32 transmitters and receivers, the direction is bi-directional and a multi-point connection network when compared with RS 232.

To connect an Arduino with a PLC, a Modbus capable to convert TTL to RS 485 signal is required. The D0 (RX) and D1 (TX) pins is connected to Modbus Tx (transmit) and Rx (receive) lines of Modbus.

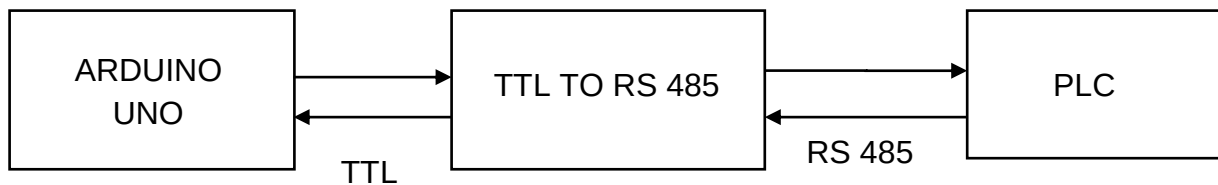


Fig. 4.16: Block diagram of Modbus

4.6.7 SOIL MOISTURE SENSOR:

Measurement of soil moisture is an important parameter in agriculture. Knowing soil moisture will help the farmers to know when to water the crops and helps to achieve a better irrigation system. Hence a soil moisture sensor is used to measure the moisture and irrigate the plants automatically. So by measuring this, the farmers can know the moisture of soil and grow crops according to it.

The soil moisture sensor has two exposed conductor probes in the shape of a fork. It is inserted inside the soil where moisture has to be measured. An electronic

module is connected to the probe. The probe acts as a variable resistor. The resistance value changes according to the water content in the soil. Resistance is inversely proportional to the soil moisture. Greater the water content in soil results in low resistance values and vice versa. The sensor produces an output voltage according to the resistance value.

4.6.8 TEMPERATURE AND HUMIDITY SENSOR:

DHT22 is a low cost sensor with single wire interface. It uses thermistor to measure temperature and capacitance to measure humidity. It produces output for every 2 seconds.

4.6.8.1 SPECIFICATIONS:

Power supply: 3.3 to 6V

Output signal: Digital signal via 1-wire bus

Sensing element: Polymer capacitor

Operating range: Humidity - 0 to 100%RH; Temperature – 40 to 80 Celsius

Accuracy: Humidity $\pm 2\%$ RH(Max $\pm 5\%$ RH); Temperature $< \pm 0.5$ celsius

Resolution or sensitivity: Humidity 0.1%RH; Temperature 0.1 Celsius

Repeatability: Humidity $\pm 1\%$ RH; Temperature ± 0.2 Celsius

Humidity hysteresis: $\pm 0.3\%$ RH

Long-term stability: $\pm 0.5\%$ RH/year

Sensing period: Average: 2s

Interchangeability: Fully interchangeable

4.6.9 DC Voltage regulator:

DC voltage regulator is used to convert 12V DC to 5V DC which is used for sensors.

4.7 SOFTWARE REQUIREMENTS:

4.7.1 RS LOGIX 500 ENGLISH:

4.7.1.1 TO CREATE AND RUN PROGRAM:

- Step 1: Open RSLogix 500 English.
- Step 2: Open New and click New.
- Step 3: Select processor type.
- Step 4: Select NO, NC, Coil and create a program.
- Step 5: Enter description, if needed.
- Step 6: To download.
- Step 7: Revision Note popup will be displayed, in that click OK.
- Step 8: Downloading program will be displayed, in that click YES.
- Step 9: Popup will be displayed, in that click YES.
- Step 10: To Run.
- Step 11: New popup will be displayed, in that click YES.
- Step 12: After running the program.
- Step 13: Toggle the given inputs.
- Step 14: After toggle, the output will be activated.

4.7.1.2 INTERFACING WITH PLC:

- Step 1: Open RSLogix Classic and select Communications and click Configure Drivers.
- Step 2: Select the driver type in it and start.
- Step 3: Open RSLogix 500 Pro and Select Comms and click System Comms.
- Step 4: Select the communication path and return to enter the program.
- Step 5: Go to control panel, open Network and internet.
- Step 6: In Network and network, open Network and sharing center.
- Step 7: In Network and Sharing center, double click on Connections.
- Step 8: In Connections, open Properties.
- Step 9: In Properties, double click on Internet Protocol Version (TCP/IPv4).
- Step 10: Enter the IP address given for PLC, Subnet mask and Gateway address.

- Step 11: To check whether the PLC is communicating with PC, open Command prompt and type the IP address of PLC then enter.
- Step 12: In RS Logix 500, open channel configuration.
- Step 13: In General option, enter the driver name as Modbus RTU Master.
- Step 14: In Channel 0, enter the driver as Modbus RTU Master, Baud as 9600, Parity as EVEN, Stop Bits as 1 and Data Bits as 8.
- Step 15: In channel 1, enter IP address, Subnet mask, gateway address and disable BOOTP.
- Step 16: Click apply.
- Step 17: In RS Logix, click on MSG.
- Step 18: In MSG, set Channel as 0(Integral), Modbus Command as 04 Read Input Registers (3xxxxx), Data Table Address as N7:10, Size in elements as 8, Message Timeout as 5, MB Data Address as 1, Slave Node Address as 1 and Modbus Address as 30001.

4.7.2 Wonderware Intouch SCADA:

The quickest and easiest way to create Supervisory control. It is famous for visualizing and controlling the plant process using animated design. SCADA is used to control and monitor physical processes. The main advantage of SCADA is, we can use it in computer after installing the software. SCADA stands for Supervisory Control And Data Acquisition. It is a central control system which includes input and output. Wonderware was now owned by Aveva and it is renamed as Wonderware Aveva. The founders of AVEVA are Dennis Morin and Phil Huber.

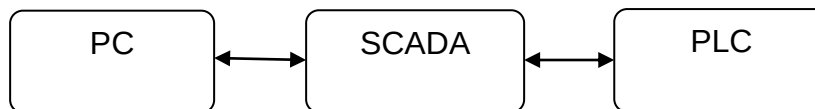


Fig. 4.17: Block diagram of SCADA

- **Software name :** Wonderware Intouch
- **Communication :** KEP Server

4.7.2.1 To Create and Run program:

- Step 1: Open Wonderware Intouch and go to File and click New.
- Step 2: Click Browse and enter the location to save the program.
- Step 3: After entering the location, click Next.
- Step 4: Enter the Name and give Finish.
- Step 5: New application name will be displayed in Application Manager, now select the newly created application.
- Step 6: After opening the new window, open File and click New window.
- Step 7: It shows Window Properties popup, enter the new window name and click OK.
- Step 8: New window will be displayed.
- Step 9: Select symbols from Wizard Selection.
- Step 10: Choose symbols from SymbolFactory which has realistic graphics.
- Step 11: Place the symbols on development screen.
- Step 12: Save window after placing the symbols.
- Step 13: Write Application script in Application option which is present under scripts and click validate then OK.
- Step 14: Click Runtime and see the SCADA screen.

CHAPTER – 5

RESULT AND DISCUSSION

A case study on Athipattu village helped us to design smart agriculture, smart water distribution, smart energy maintenance and smart cold storage. Home screen which shows cold storage, agriculture, EB, distribution, water and alarm buttons in a single screen. It shows temperature of the city in home screen.



Fig. 5.1: Home screen

The following picture is the hardware setup. The PLC, two SMPS for voltage conversion, an arduino board, a TTL to RS 485 Modbus, a voltage regulator, a Wi-Fi modem, two flow sensors, a light intensity sensor, a soil moisture sensor, a humidity and temperature sensor, a light bulb, a small amount of sand and two buckets are used. The light intensity sensor is used to measure the intensity of light and accordingly will turn on and off the street lights. This can be viewed in the SCADA screen. A small amount of soil is taken, The soil moisture sensor is used to measure the moisture of the soil. According to its value, the motor is turned on or off for the crops. Two water flow sensors and two buckets are used to demonstrate the water management process. One sensor is used to measure the inlet flow and the other sensor is used for outlet flow. The flow values are displayed in the screen. If the loss is more, the motor is stopped and alarm is enabled. All the process can be simultaneously viewed and controlled in the SCADA screen.

**File name**

IMG_20210320_153203

Time

3/20/21 15:32:03

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu, 600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.49 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 225

Path: Phone storage/DCIM/Camera/IMG_20210320_153203.jpg

Fig. 5.2: Hardware Setup

5.1 SMART COLD STORAGE:

Cold storage window shows separate space for each cultivated product and for meat. Below image shows manual mode of cold storage, where it shows room temperature.

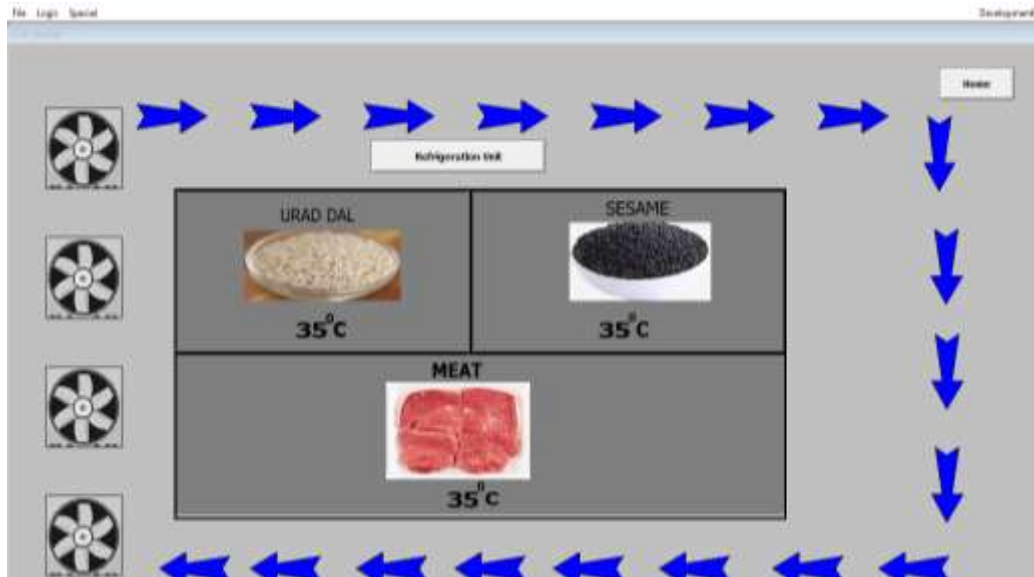


Fig. 5.3: Manual mode of cold storage room

Manual mode of refrigeration unit is shown below which contains compressor, condenser, expansion valve and evaporator. Auto/Manual switch will be present which is used to change auto or manual mode.

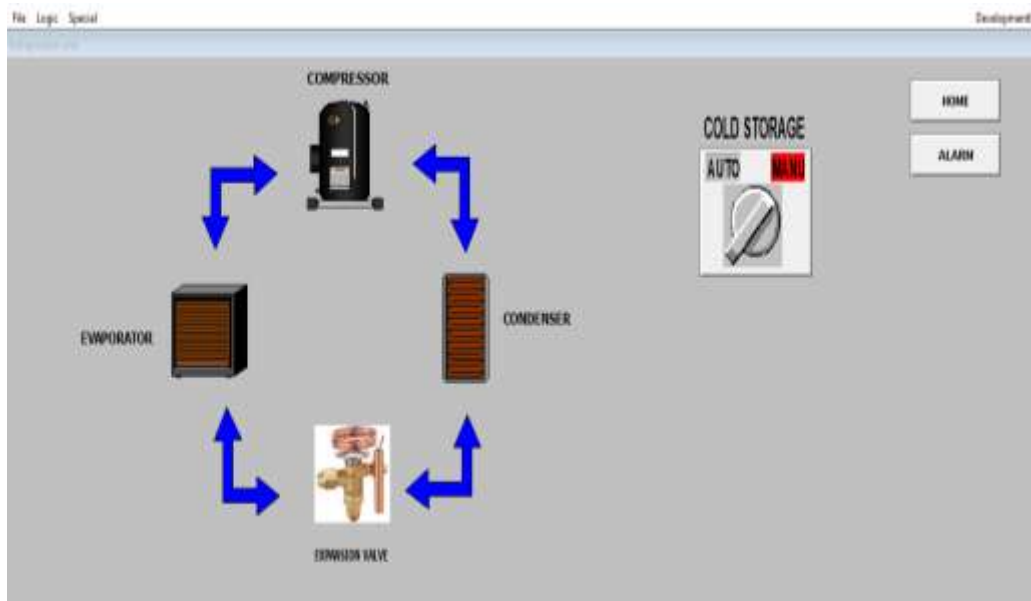


Fig. 5.4: Manual mode of refrigeration unit

In the below image, it shows the auto mode of refrigeration unit. The working of refrigeration unit is simulated in SCADA screen.

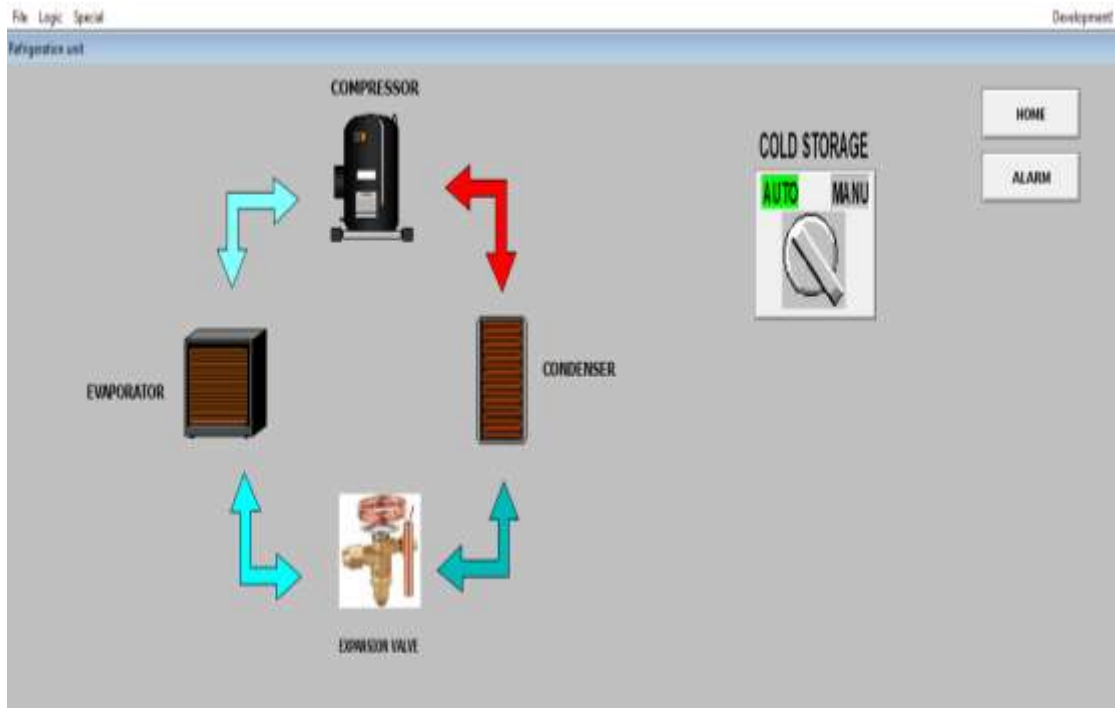


Fig. 5.5: Auto mode of refrigeration unit

If it is in auto mode, the temperature of the room will be maintained to the set-point according to each crop and meat.

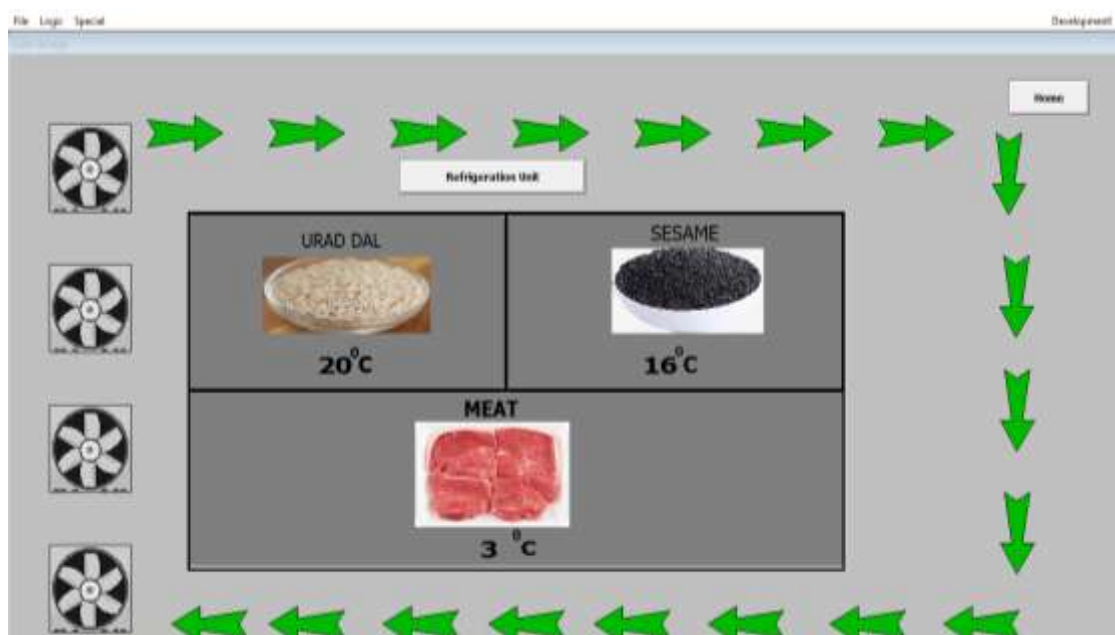


Fig. 5.6: Auto mode of cold storage room

5.2 SMART ENERGY MAINTENANCE:

The energy distributed from Vallur thermal plant is shown in the below image. If the VCB is turned ON then the VCB starts to pass currents to each street.

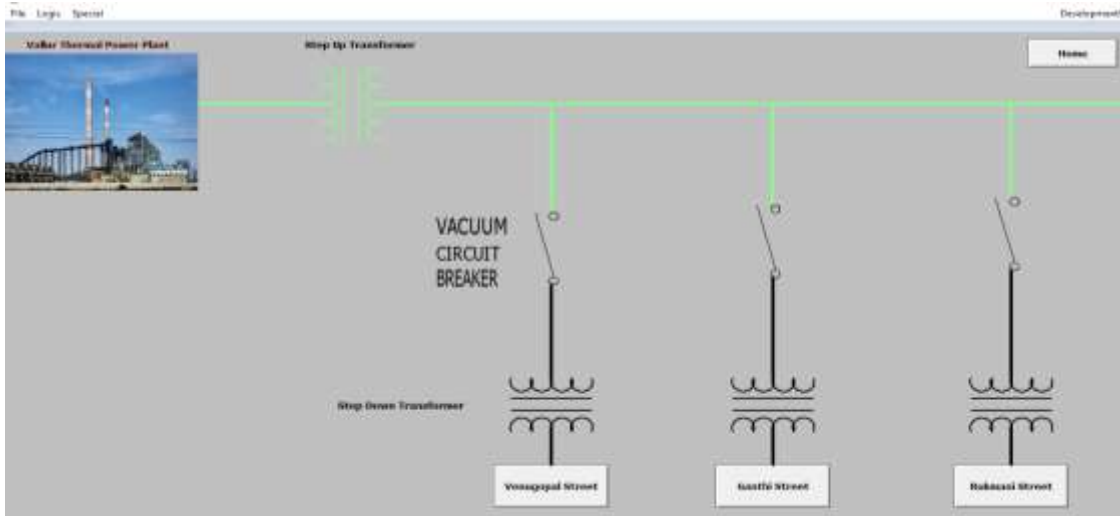


Fig. 5.7: Energy distribution from Vallur thermal power plant

When VCB is ON it turns ON air circuit breaker which passes current to each street.

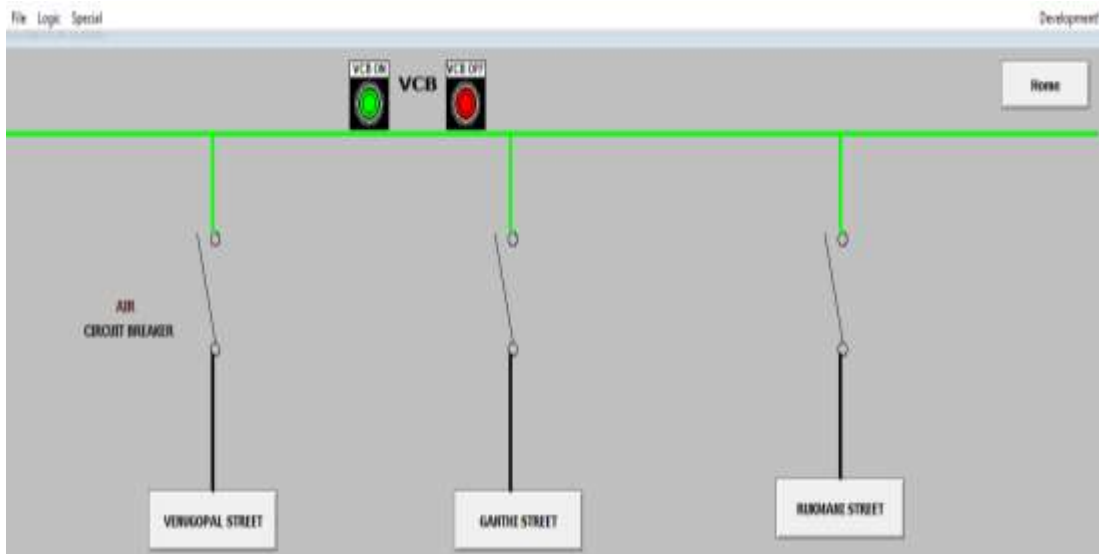


Fig. 5.8: Energy distribution from ACB to Streets

According to the light intensity, the street lights will be turned on and off manually and automatically. The light intensity sensor is used to measure the intensity of light. When intensity is less, the street lights are turned off. When intensity of light is more, the street lights are turned on.

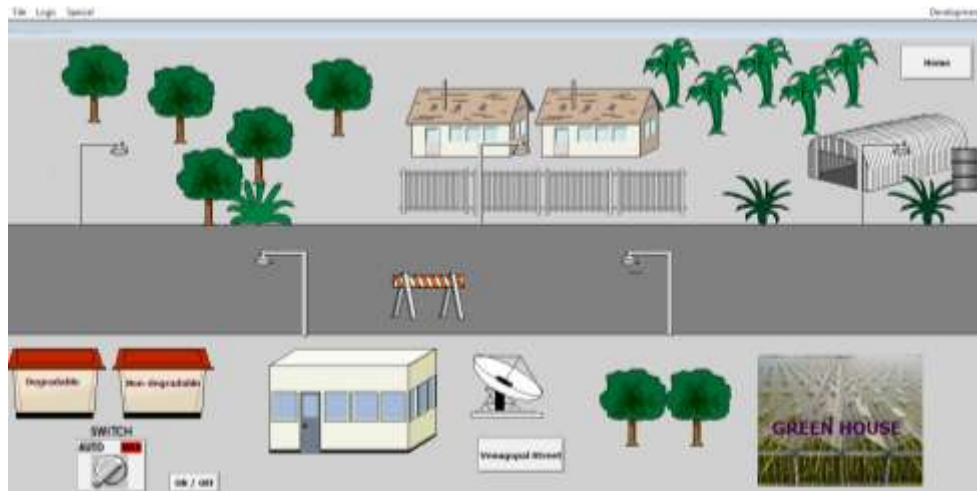


Fig. 5.9: Energy distribution to Venugopal street

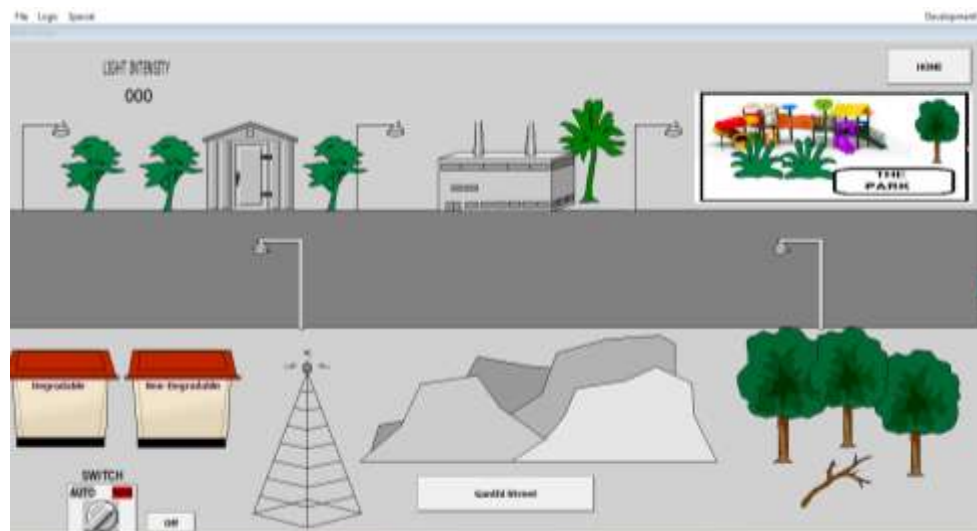
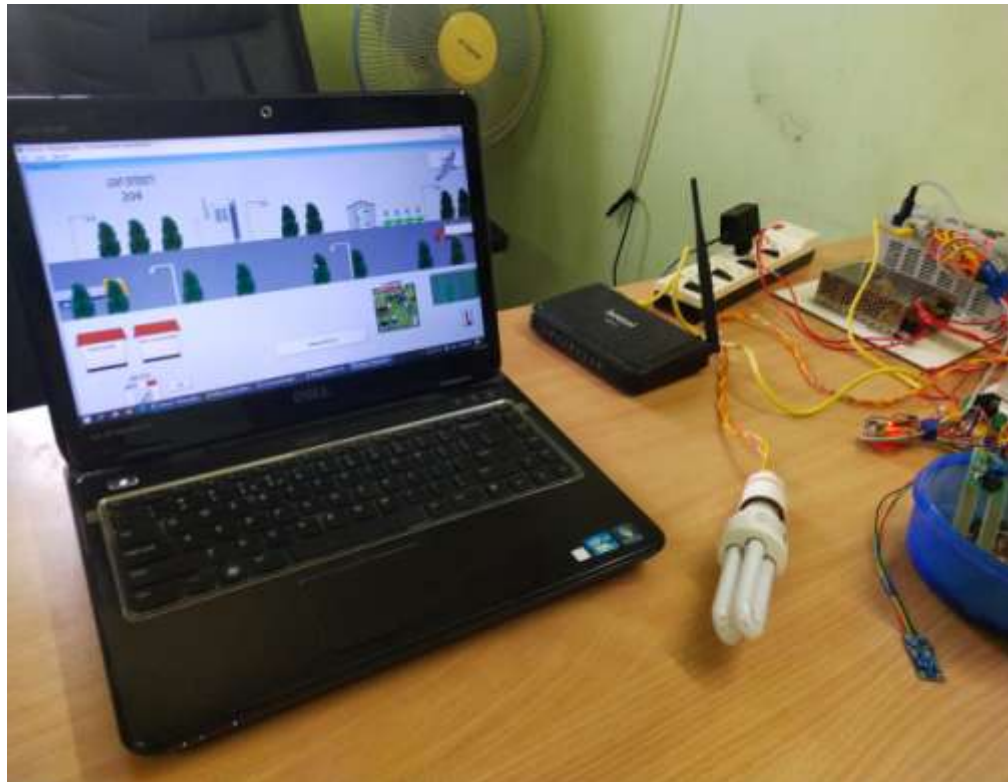


Fig. 5.10: Energy distribution to Ganthi street



Fig. 5.11: Energy distribution to Rukmani street

**File name**

IMG_20210320_171033

Time

3/20/21 17:10:33

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu, 600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.18 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 158

Path: Phone storage/DCIM/Camera/IMG_20210320_171033.jpg

Fig. 5.12: Light intensity high, light turned off

**File name**

IMG_20210320_170941

Time

3/20/21 17:09:41

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu,
600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.41 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 87

Path: Phone storage/DCIM/Camera/IMG_20210320_170941.jpg

Fig. 5.13: Light intensity low, light turned on

5.3 SMART WATER DISTRIBUTION:

The water from Kosasthalaiyar River is fed to pumping station from which it is distributed to each street. Two flow sensors are used to measure the inlet and outlet flow. The difference between the inlet and outlet flow is calculated. Volume and flow rates are shown near flow meter. If there is any decrease in flow rate, alarm will be triggered and the motor is turned off automatically.

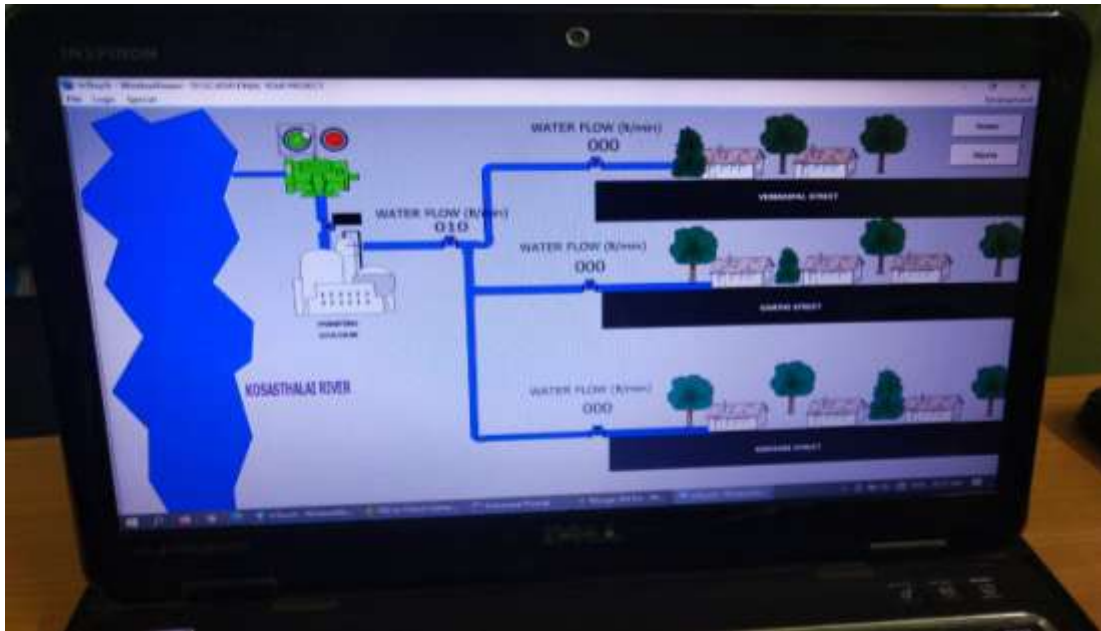


Fig. 5.14: smart water distribution SCADA screen

**File name**

IMG_20210320_181318

Time

3/20/21 18:13:18

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu, 600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.32 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 246

Path: Phone storage/DCIM/Camera/IMG_20210320_181318.jpg

Fig. 5.15: Smart water distribution

5.4 SMART AGRICULTURE:

A small amount of soil is taken in a bowl and the soil moisture sensor is inserted. The moisture and humidity of the soil is displayed on the SCADA screen. If the moisture of the soil decreases then motor will be turned on automatically using Soil moisture sensor and DHT22 sensor according to the set point of each crop. In the figure 5.15, the value of moisture is high so, motor is turned off automatically using soil moisture sensor. In the figure 5.16, even though the value of moisture is low, the motor is not turned ON in manual mode.

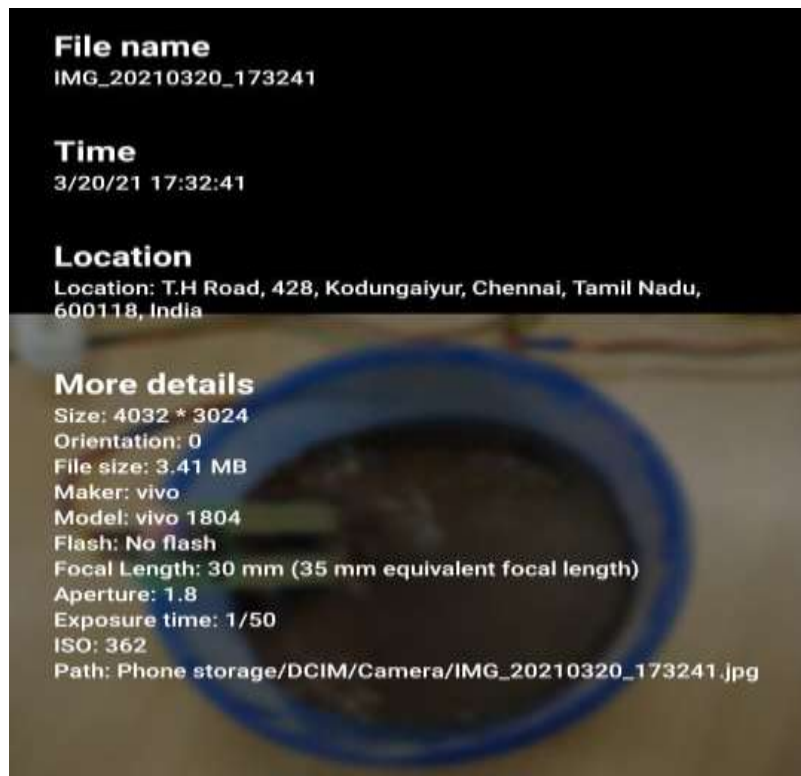
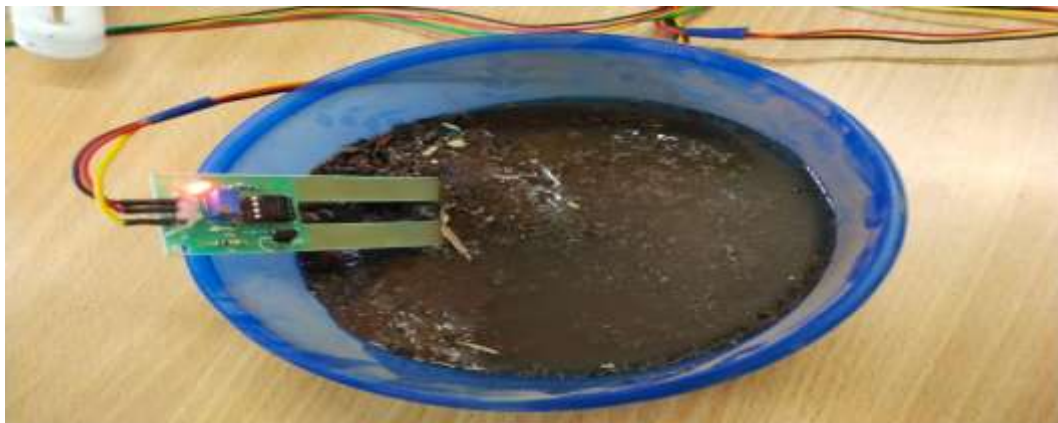


Fig. 5.16: Soil moisture sensor



File name

IMG_20210320_172351

Time

3/20/21 17:23:51

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu, 600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.41 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 261

Path: Phone storage/DCIM/Camera/IMG_20210320_172351.jpg

Fig. 5.17: Smart agriculture in auto mode

**File name**

IMG_20210320_173247

Time

3/20/21 17:32:47

Location

Location: T.H Road, 428, Kodungaiyur, Chennai, Tamil Nadu, 600118, India

More details

Size: 4032 * 3024

Orientation: 0

File size: 3.29 MB

Maker: vivo

Model: vivo 1804

Flash: No flash

Focal Length: 30 mm (35 mm equivalent focal length)

Aperture: 1.8

Exposure time: 1/50

ISO: 225

Path: Phone storage/DCIM/Camera/IMG_20210320_173247.jpg

Fig. 5.18: Smart agriculture in manual mode

[illegible]

Fig. 5.19: Alarm screen

This is the alarm screen which notifies when any process is in manual mode for long time and if there is any decrease in flow rate of water.

CHAPTER – 6

CONCLUSION AND FUTURE SCOPE

With the help of Smart Village, power, water and agricultural products can be saved. Implementing these ideas all over the world will be helpful for our future as it saves power, water and agricultural products. Water is the essential for human to live. Saving water from today can save us in later life. Now a days, major problem for farmer is, not getting space for storing their agricultural products from rain and heat. Many agricultural products are wasted because there is no storage room. Government should implement these storage rooms near every agricultural areas to save agricultural products. Saving energy helps us to save money by lowering the amount of energy consumed. Increased production of electricity in power plants leads to global warming as it produces high amount of carbon-di-oxide. If the usage of electricity decreased then the amount of electricity produced in power plants are reduced and the saved energy can be used for electric powered vehicles which reduces pollution and saves our environment. In future, home automation can be included as it helps to us to save power and water efficiently then there will be no way of wasting resources.

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