

Palestine Polytechnic University

College of Engineering



Design of automatic control system for poultry farm

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(قل اعملوا فسيرى الله عملكم ورسوله والمؤمنون)

صدق الله العظيم

إلهي لا يطيب الليل إلا بشكرك ولا يطيب النهار إلا بطاعتك .. ولا تطيب اللحظات إلا بذكرك
... ولا تطيب الآخرة إلا بعفوك .. ولا تطيب الجنة إلا برويتك

.. إلى من بلغ الرسالة وأدى الأمانة .. ونصح الأمة .. إلى نبي الرحمة ونور العالمين

سيدنا محمد صلى الله عليه وسلم

إلى من كلله الله بالهيبة والوقار .. إلى من علّسني العطاء بدون انتظار .. إلى من أحمل اسمه بكل افتخار ..
أرجو من الله أن يمدني عمرك لتري ثماراً قد حان قطافها بعد طول انتظار وستبقى كلساتك نجوم أهدي بها
.. اليوم وفي الغد وإلى الأبد

(والدي العزيز)

إلى ملاكي في الحياة .. إلى معنى الحب وإلى معنى الحنان والتفاني .. إلى بسمة الحياة وسر الوجود

إلى من كان دعائها سر نجاحي وحنانها بلسم جراحني إلى أغلى الحبايب

أمي الحبيبة

في مثل هذه اللحظات يتوقف اليراع ليفكر قبل أن يخط الحروف ليضعها في كلمات ... تتبعثر

الأحرف وعبثاً أن يحاول تجسيعها في سطور

سطورا كثيرة تمرني اخيال ولا يبقى لنا في نهاية المطاف إلا قليلاً من الذكريات وصور تجمعنا برفاق كانوا إلى

جانبنا

فواجب علينا شكرهم ووداعهم ونحن نخطو خطواتنا الأولى في غمار الحياة
ونخص بالجزيل الشكر والعرفان إلى كل من أشعل شمعة في دروب عملنا و
وإلى من وقف على المنابر وأعطى من حصيلة فكره لينير دربنا
إلى الأستاذة الكرام في كلية الهندسة وتتوجه بالشكر الجزيل إلى

الدكتور

نزار عمرو

الذي تفضل بإشراف على هذا البحث فجزاه الله عنا كل خير فله منا كل التقدير والاحترام

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Abstract

By using PLC Technology we are looking to change the poultry farm system from manual use to automatic system ,To become smarter ,cheaper and easier to use, By using global programming .

By this way we reduce the cost of system ,decrease the errors percentage in the system ,saving energy and increase system efficiency.

نسعى من خلال التحكم البرمجي إلى تغيير التحكم في مزارع الدواجن من التحكم اليدوي إلى التحكم الأوتوماتيكي (بلغة برمجة عالمية) .وذلك للحصول على مزرعة ذكية أقل تكلفة وأسهل بالاستخدام ، وهذا سيققل من تكلفة النظام ، ويقلل من الأخطاء ، ويوفر بالطاقة ، ويزيد من فاعلية النظام .

CHAPTER 1

Chapter one

Introduction

1.1. PROBLEM DEFINITION

1.2. PROBLEM SOLUTION

1.3. SMART POULTRY FARM SYSTEMS

1.4. FLOW CHART OF SYSTEM

1.1 PROBLEM DEFINITION

Any project idea to become an effective, it should solve a serious problem, So We choose this project idea because Poultry occupies an important position as a source for the production of meat and eggs with excellent nutritional value in the human food.

We designed smart “programmed system” to reduce wasted resources (energy and water) comparing to old manual systems in this field.

- **The problems are:**

- A- The cost of the system and working hands.
- B- Waste energy.
- C- Waste water.

- **Risks of manual poultry farm: Human mistake.**

Main goals of our Project:

- Saving energy.
- Saving water.
- Reduce running cost.
- Increase productivity.
- Increase system efficiency.
- Change manual to automatic.
- Reduce human errors.

1.2 Problem Solution

Our project solving these problems by using (Automatic Control) category by creating a control system using programmable logic control (PLC) and human machine interface (HMI).

-What is the methodology to solve these problems?

1.3 Smart Poultry farm systems:

We will solve these problems by creating a control system using programmable logic control (PLC) and human machine interface (HMI), to change the poultry farm system from manual use to automatic system, to become smarter, cheaper and easier to use.

- Our project will make an intelligent system according to these ideas:

1- Feeding: We will use conveyor belts for the feeding inside the farm. The conveyor belts will feed through tank dedicated to eat according to the deadlines for eating.

2- Watering: We have two systems used in watering

1) System in first 7 days.

2) Another system from day 7 to the end of the period. and will talk in detailed later in this chapter.

3- Lighting: We will use a LED bulbs to reduce the energy consumption ,and we will Controlling lighting and darkness hours in the farm

4- Temperature: Measuring the temperature and decide the control method if warming (using heaters) or cooling (using air conditioning &fans).

5- Supply system: Main grid, PV system and Auxiliary generator.

1.3.1 Feeding:

Providing good feeding is one of the basics of successful fattening cycle. We will use conveyor belts for the feeding inside the farm. The conveyor belts will feed through tank dedicated to eat according to the deadlines for eating.

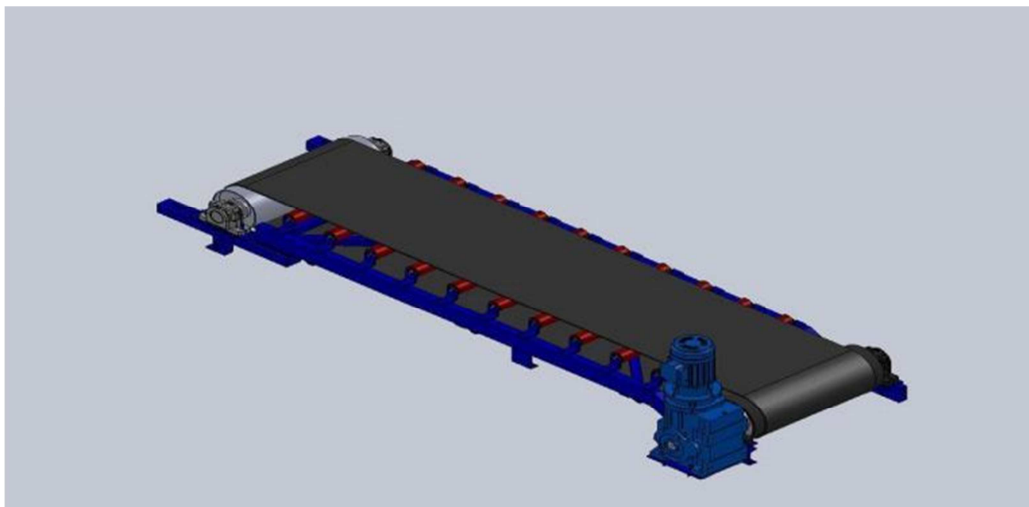


Fig (1.1) “Feeding belt “

1.3.2 Watering:

We have 2 systems in watering:

A) First 7 days:

We will use a path entire the farm and it will feed through water tank with the use of water level sensor to detect the quantity required.



Fig (1.2) “watering path in first 7 days “

Cleaning water's path: it is necessary to cleaning and purifying the lines of drinking water where pumping water by high-pressure to try to remove the sediment thickness which occurred.

A)from day 7 to the end of the period :

We will use –only-- “ Nipple watering system “ this system will help in saving wasted large amounts of water used in normal watering path beside saving amounts of water used in cleaning that normal path (no cleaning system is required).

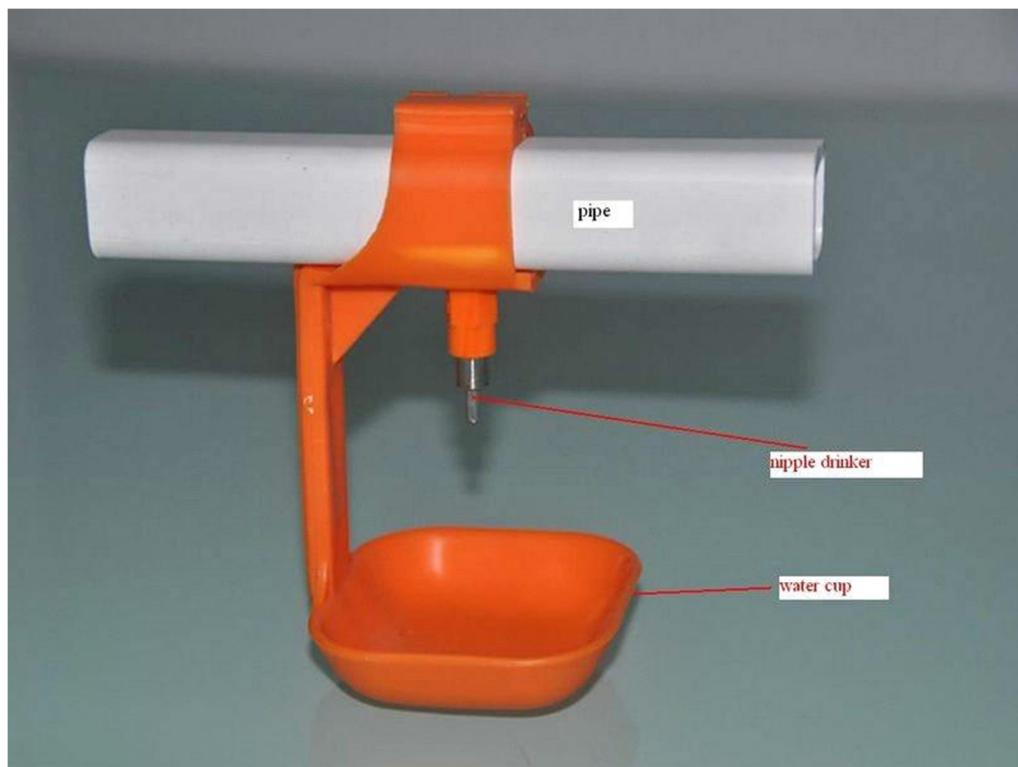


Fig (1.3) “Nipple watering system “

1.3.3 Lighting

Controlling lighting and darkness in farm is very important because that's help at the following points:

1. Increasing growth rates because of increasing food digestion.
2. Reducing number of lighting hours per day help the small chicken to use to darkness in sudden cut of electricity besides to be quiet in their places.
3. Darkness for specific hours per day reduce infected by some diseases happens to chicken while a lot of light.

For that we will use a LED Bulbs to achieve best lighting with lower cost and we will control the lighting and darkness hours depending on the age of poultry .



Fig (1.4) “LED BULBS “



Fig (1.5) “control in lighting “

1.3.4 Temperature:

Temperature and moisture is an important part for chicken life continues it provides the suitable surrounding conditions from temperature and water percentage in the air.

- Measuring temperature is the most common way of assessing the climate in a house. Such a measurement can give a lot of useful information.
- There are several ways of measuring the temperature, such as Temperature sensors.
- Like LM35 Precision Centigrade Temperature Sensors

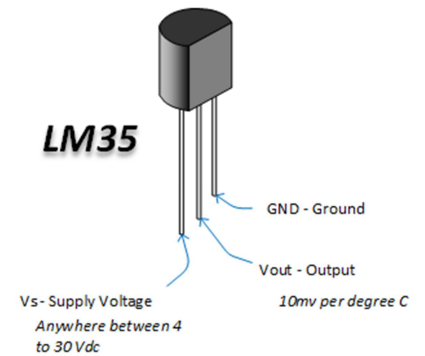


Fig (1.6)LM35

- **Warming and cooling:-**

The chickens can maintain their body temperature and grow very well in a thermo neutral zone of 33° to 43° c. If the temperature is under or higher than this zone, Chickens reduce their food consumption rate in hot weather, so you must have to control the temperature in any way.

- **Warming** (Heaters).
- **Cooling** (Air conditioning).

And this all controlled by our PLC project.

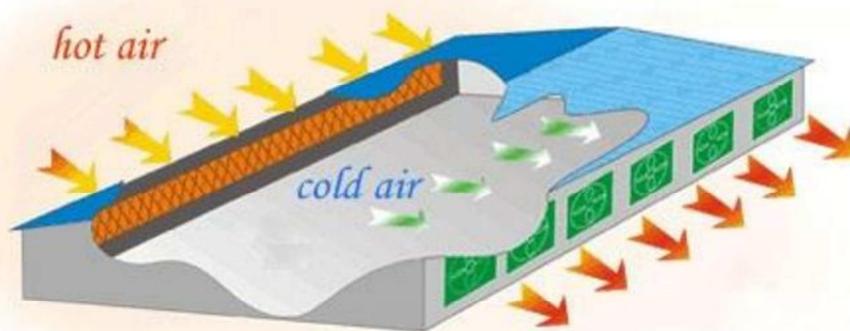


Fig (1.7) “Cooling the air in the poultry “



Fig (1.8) “Heating and cooling in the farm “

1.3.5 Supply system:

In supply our farm with energy we depend on main grid beside PV system and auxiliary generators stand-by.



Figure (1.9) “Main grid”



Figure (1.10) “PV system “



Figure (1.11) “Auxiliary generators stand-by”

1.4 Flow Chart of systems:

Flow chart is the sequence of the operations in the entire system, it is very important to know how the system operates in each stage, also know algorithm of all processes separately.

And to avoid interconnection between system tasks, it is shown in figure (1.12).

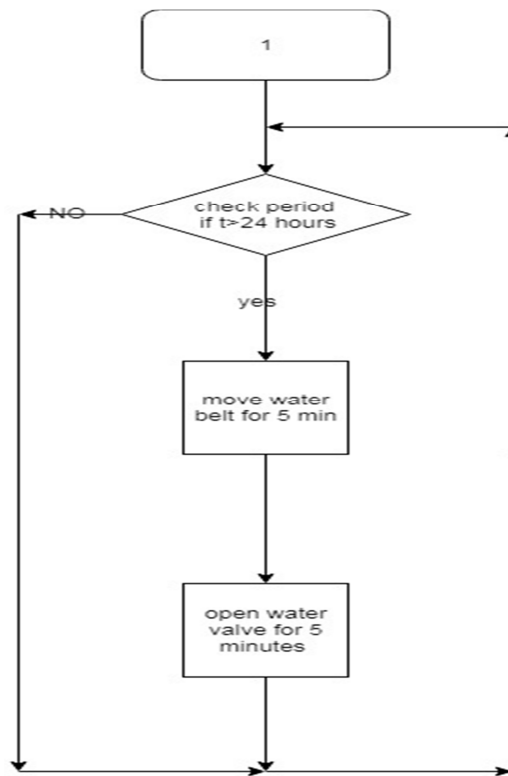


Fig (1.12) Cleaning feeding belt

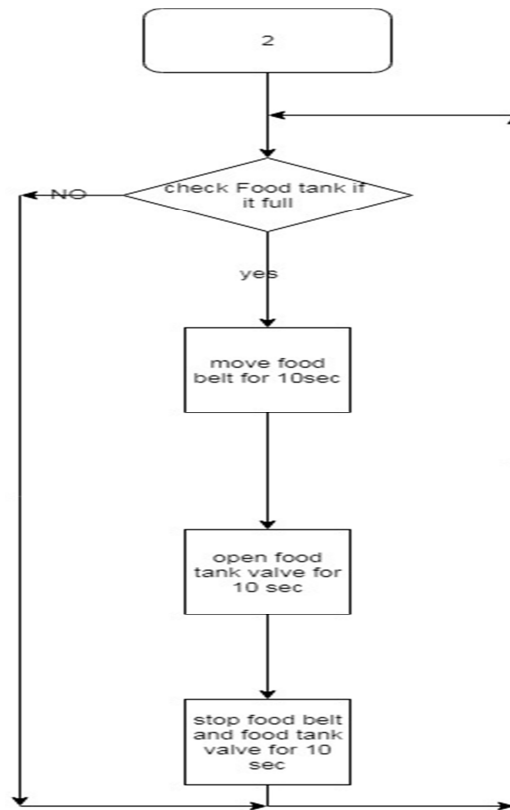


Fig (1.13) Feeding flow chart

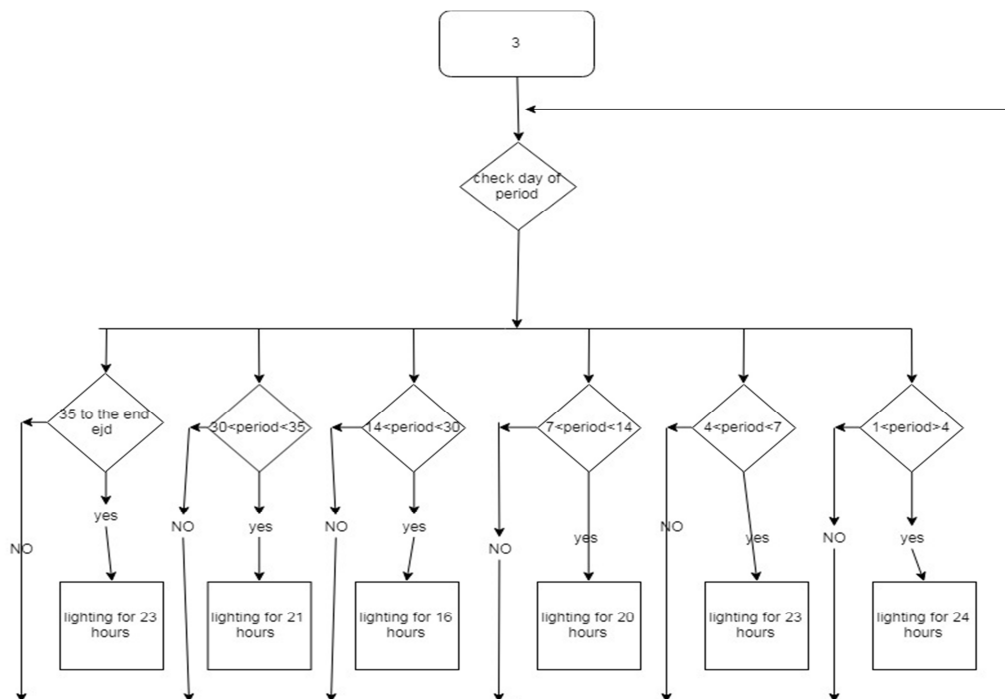


Fig (1.14) Lighting flow chart

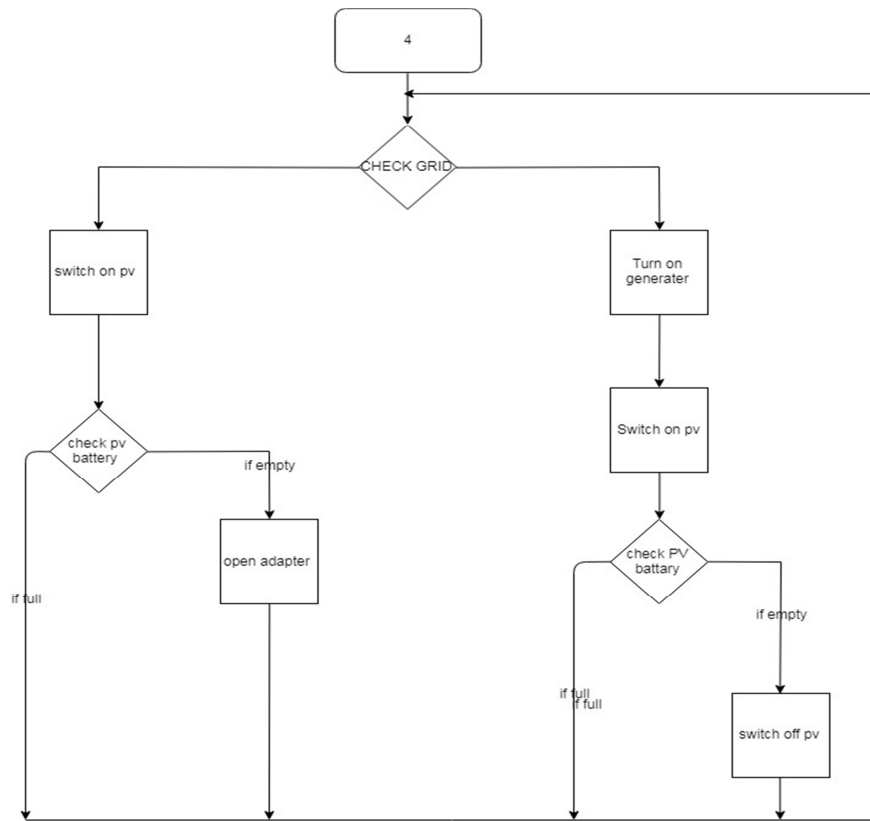


Fig (1.15) Supply system flow chart

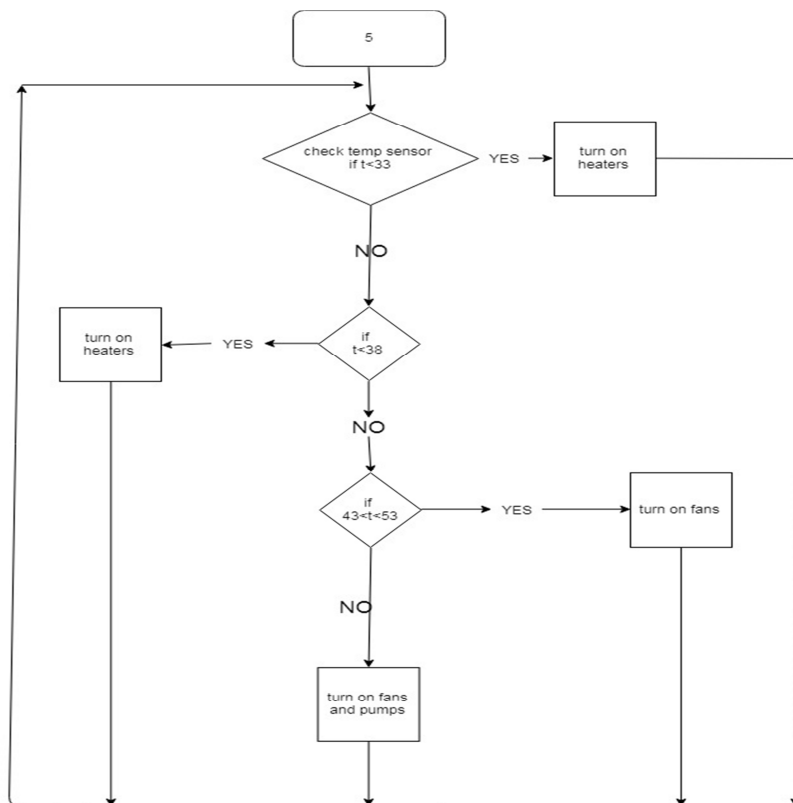


Fig (1.16) Temperature flow chart

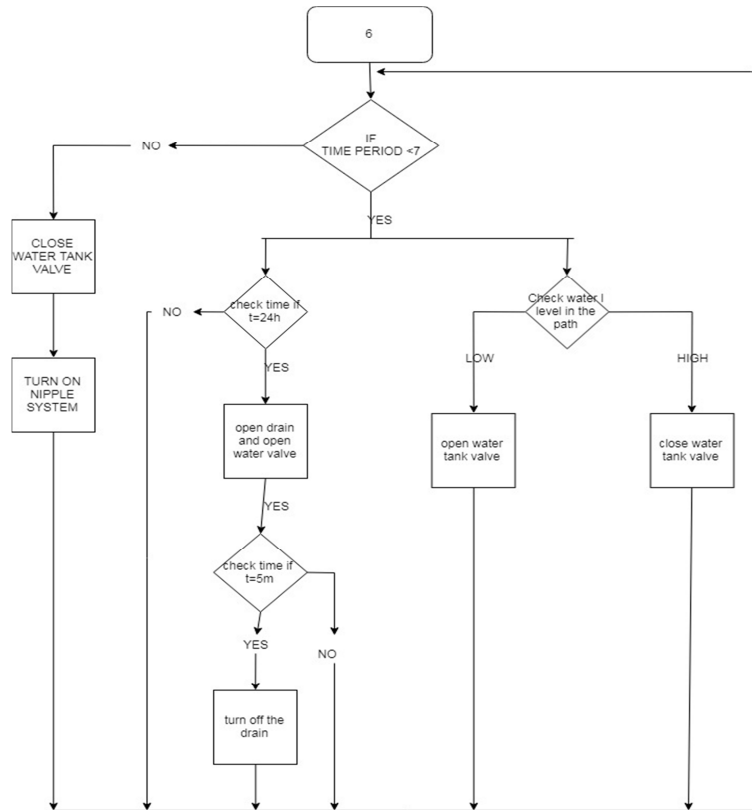


Fig (1.17) Watering flow chart

CHAPTER 2

2.1 What is a Project?

A project is an activity to meet the creation of a unique product or service and thus activities that are undertaken to accomplish routine activities cannot be considered projects.

2.1.1 What is Project Management?

Project Management is the art of managing all the aspects of a project from inception to closure using a scientific and structured methodology.

- Project management is very important in production of goods and services. Idea generation to final production of product or service, each step can be categorized as individual projects. Any project requires a project manager, who leads the project to its logical conclusion. Project manager is responsible for appointing team members with different background but essential in completion of the project.



Fig (2.1) Project Management

2.2 Rational approach to project management in organization:

The rational approach to organizations is appealing to most managers because of the comfort factor in such an approach. It is common for managers to avoid complexity and ambiguity in their working environment and hence taking an approach that has been described as “being purposeful” which enables managers to work towards “specific goals” as the preferred alternative.

2.3 Project Characteristics:

A project is not normal day to day activity undertaken by organization rather it is specific, non-routine activity of varying time frame and impact viability of the business in the long run. A typical project has following characteristics:

- a) **Timeline:** A project has a definite timeline with measurable starting and end point.
- b) **Resources:** A project has limited resource of capital and manpower.

c) Tools: Special type of tools and techniques are used for project management (Gantt Charts, etc.)

d) Team: Project management requires diverse team stretching across departments and functions.

2.4 Project Life Cycle:

A typical project is divided into following phases. Each phase of the project has its own importance and impact on overall success of the project.

- **Initiation Phase:** In this phase of the project, feedback received from customers is analyzed and brainstorming is done as to develop new product or modify existing product to meet the new demands.
- **Project Definition Phase:** In this phase of the project efforts are made to define the solution for the problem posed by customers.
- **Feasibility Study:** In this phase, planning of the project is made and definite milestones are established.
- **Project Execution:** In this phase all activities and milestones established in the earlier phase are executed in a timely and orderly manner. This phase utilizes maximum of all resources.
- **Project Conclusion:** This is the last phase of the project. In this phase, final product or service is handed over to the operations team for commercial production.

2.5 Project Management Activities:

Project management activities are mainly divided into three main categories Planning, Scheduling and Controlling.

- 1. Planning:** Planning activities include defining project objective, resource planning, etc.
- 2. Scheduling:** scheduling activities include developing detailed milestones and guidelines for the project. These activities are performed typically before actual initiation of the project.
- 3. Controlling:** Controlling activities include developing budget and finance control points, measuring of scheduling tasks are performed.

2.6 Time plan:

Accurate time estimation is a skill essential for good project management. It is important to get time estimates right for two main reasons: 1. Time estimates drive the setting of deadlines for delivery and planning of projects, and hence will impact on other people’s assessment of your reliability and competence as a project manager. 2. Time estimates often determine the pricing of contracts and hence the profitability of the contract/project in commercial terms.

So we put a time plan for the project as shown below in Table 1.1

| Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|--------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| Task 1 | 1 | 0 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Task 2 | | | | | | | | | | | | | | | | | |
| Task 3 | | | | | | | | | | | | | | | | | |
| Task 4 | | | | | | | | | | | | | | | | | |
| Task 5 | | | | | | | | | | | | | | | | | |

Table 1.1

Task 1: selecting project title.

Task 2: Collection Data and information on the subject of the project.

Task 3: identify function and task

Task 4: design and analysis.

Task 5: documentation

CHAPTER3

3.1 Review:

3.1.1 What is a PLC?

A Programmable Logic Controller or PLC for short, a programmable logic Controller (PLC) is a digital computer used for automation of electromechanical Processes, such as control of machinery on factory assembly lines, amusement rides, or Lighting fixtures. PLCs are used in many industries and machines. Unlike general purpose Computers, the PLC is designed for multiple inputs and outputs arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact.

Programs to control machine operation are typically stored in battery backed or non-battery backed or non-volatile memory. (Fig3.1 shows PLC Hardware).



Fig (3.1) PLC Hardware

A PLC is an example of a real time system since output results must be produced in response to input conditions within a bounded time, otherwise unintended operation will result.

3.1.2 PLC components:

- Processor or Central Processing Unit (CPU)
- Rack or mounting assembly.
- Input module.
- Output module
- Power supply
- Programming unit, device, or PC/software

(Fig 3.2& Fig 3.3 show PLC components)

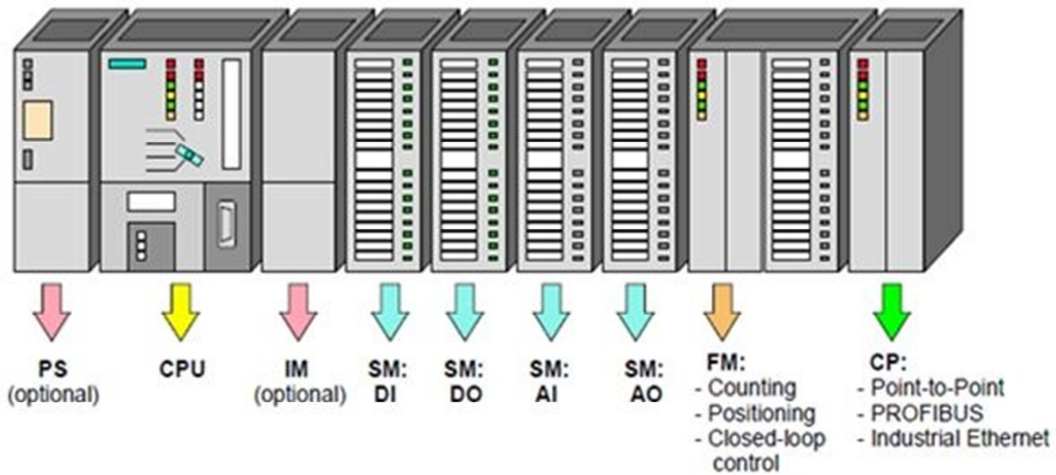


Fig (3.2)

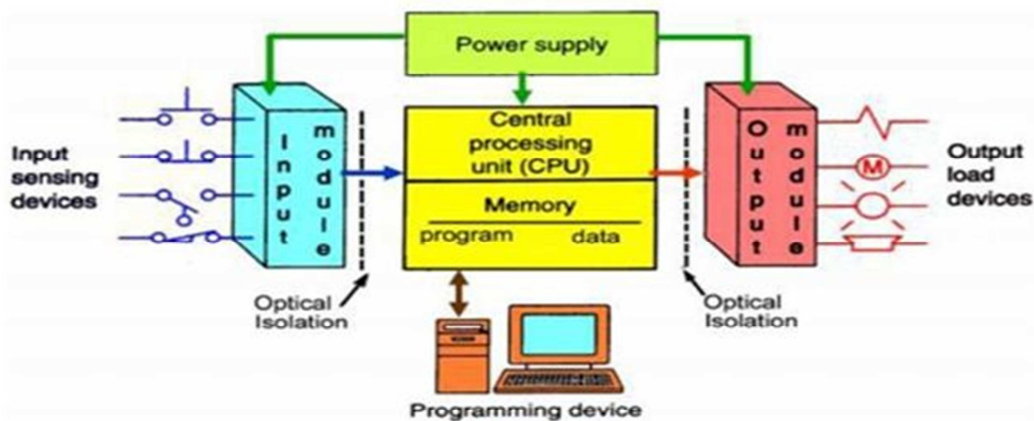


Fig 3.3

Now we will start explaining these components :

1- Processor (CPU)

The processor, Central Processing Unit, or CPU is the “brain” of the PLC. The CPU consists of a microprocessor, memory chip and other integrated circuits to control logic, monitoring and communications. The CPU has different operating modes. In programming mode it accepts the downloaded logic from a PC. The CPU is then placed in run mode so that it can execute the program and operate the process. As shown in figure (3.4).

S7-300™: CPU Design



Fig (3.4) CPU

2- Rack Assembly:

Most medium to large PLC systems are assembled such that the individual Components (CPU, Input/Output, and Power Supply) are modules that are held together within a rack. In smaller PLC systems all of these components may be contained in a single housing or “brick” these smaller systems are sometimes referred to as “bricks” or “shoebox” PLCs.

3- Input/output module:

Input module provides the electrical connection between field devices (Push Buttons, limit Switches, Photo Eyes) and internal process of the PLC. Outputs are the devices that the PLC uses to send changes out to the world. These are the actuator the PLC can change to adjust or control the process - motors, lights, relays, pumps, etc.- As shown in figure (3.5).



Fig (3.5) Input/output Module

4- Power Supply:

The power supply provides power for the PLC system. The power supply provides Internal DC current to operate the processor logic circuitry and input/output assemblies. Common power levels used are 24V DC or 120 VAC.

PLC can be reprogrammed through an appropriate programming device:

- PC.
- Hand Programmer (Shown in figure 3.6).



Fig (3.6) Programming Device

3.1.3 Types of PLC programming languages:

Can be textual or graphical languages as shown in Figure 3.7

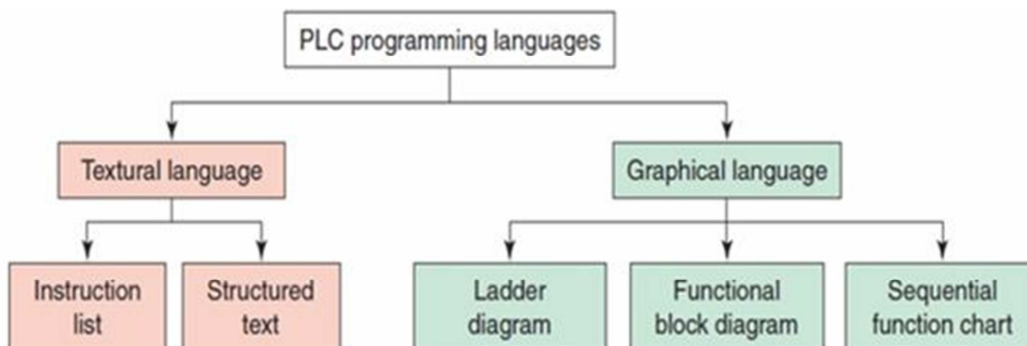


Fig 3.7 Programming language

❖ Ladder diagram:

A very commonly used graphical method of programming PLCs is based on the use of ladder diagrams. Writing a program is then equivalent to drawing a switching circuit.

The ladder diagram consists of two vertical lines representing the power rails. Circuits are connected as horizontal lines, i.e., the rungs of the ladder, between these two verticals.

❖ Function Block Diagram (FBD):

It is a graphical language for programmable logic controller design that can describe the function between input variables and output variables. A function is described as a set of elementary blocks. Input and output variables are connected to blocks by connection lines.

❖ Sequential Function Charts (SFC):

It is similar to a flowchart of your process. The program is split into steps with multiple operations happening in parallel branches.

❖ Instruction List (IL):

It uses very simple instructions similar to the original mnemonic programming languages developed for PLCs. It is the most fundamental level of programming language - all other programming languages can be converted to IL programs. Most programmers do not use IL programming on a daily basis, unless they are using hand held programmers.

❖ Structured Text (ST):

It is text-based, compared to the graphics-based ladder diagram. Structured text is a high level language primarily used to implement more complex procedures.

3.1.4 PLC Operation:

A PLC works by continually scanning a program. We can think of this scan cycle as consisting of three important steps. These steps as shown in Fig 3.8 are:

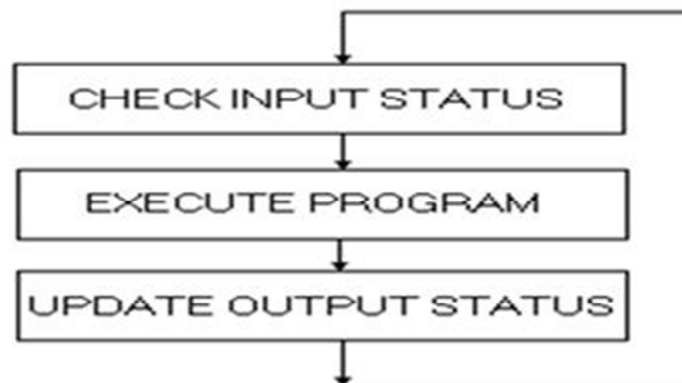


Fig (3.8) PLC Operation

1-Check Input Status:

First the PLC takes a look at each input to determine if it is on or off. In other words, is the sensor connected to the first input on? How about the second input? How about the third... It records this data into its memory to be used during the next step.

2-Execute Program:

Next the PLC executes your program one instruction at a time. Maybe your program said that if the first input was on then it should turn on the first output. Since it already knows which inputs are on/off from the previous step it will be able to decide whether the first output should be turned on based on the state of the first input. It will store the execution results for use later during the next step.

3-Update Output Status:

Finally the PLC updates the status of the outputs. It updates the outputs based on which inputs were on during the first step and the results of executing your program during the second step. Based on the example in step 2 it would now turn on the first output because the first input was on and your program said to turn on the first output when this condition is true. After the third step the PLC goes back to step one and repeats the steps continuously. One scan time is defined as the time it takes to execute the 3steps listed above.

3.1.5 Advantages of PLC:

- 1) **Flexibility:** One single Programmable Logic Controller can easily run many machines.
- 2) **Correcting Errors:** In old days, with wired relay-type panels, any program alterations required time for rewiring of panels and devices. With PLC control any change in circuit design or sequence is as simple as retyping the logic. Correcting errors in PLC is extremely short and cost effective.
- 3) **Space Efficient:** Today's Programmable Logic Control memory is getting bigger and bigger this means that we can generate more and more contacts, coils, timers, sequencers, counters and so on. We can have thousands of contact timers and counters in a single PLC. Imagine what it would be like to have so many things in one panel.
- 4) **Low Cost:** Prices of Programmable Logic Controllers vary from few hundreds to few thousands. This is nothing compared to the prices of the contact and coils and timers that you would pay to match the same things. Add to that the installation cost, the shipping cost and so on.
- 5) **Testing:** A Programmable Logic Control program can be tested and evaluated in a lab. The program can be tested, validated and corrected saving very valuable time.

3.2 Features of PLC device:

- Siemens PLC, modular PLC, STEP7 S7-300 CPU 314C-2 DP MPI interface onboard
- PROFI BUS DP master/slave interface
- 24 digital inputs
- 16 digital outputs
- 4 analog inputs
- Technological functions:
 - 1) Counting
 - 2) Closed loop control
 - 3) Frequency measurement
 - 4) Pulse width modulation
 - 5) Pulse generator
 - 6) Positioning

3.3 Algorithm of program

- **Part one (temperature system):**

Turn on system

The system is operating normal and repeatable

If

The temperature less than low_rang2

OR

Manual heating button pressed

Then

Turn on all Heaters

Else If

The temperature less than low_rang1

OR

Manual Heating Button pressed

Then Turn on Half number of Heaters

Else If

The temperature more than high_rang1

OR

Manual fans button pressed

Then Turn on fans

Else If

The temperature more than high_rang2

OR

Manual air conditioning Button pressed

Then

Turn on air conditioning

End If

- **Part two (watering system):**

If Number of days (period) less than 7

Then

turn on watering system

If

level sensor high

Turn on water pump

Else

Turn on water pump

End if

if time ==24

then

turn on pump & drain for 5 minutes

End If

Else

Turn off watering system

End If

- **Part three (feeding system):**

If

Food tank full

Then Open tank food valve and turn on food belt for ten seconds and stop it for ten seconds

Else If

Period after putting food equal 24 hours

Then

Move water belt and open water valve for 5minute

Else if

Food tank empty Then Send alarm

End If

End If

End if

Part five (lightning system):

If

Period more than one day and less than four days

Then

Lighting on for 24 hours

Else if

Period more than four days and less than seven days

Then

Lighting on for 23 hours

Else if

Period more than seven days and less than fourteen days

Then

Lighting on for 20 hours

Else if

Period more than fourteen days and less than thirty days

Then

Lighting on for 16 hours

Else if

Period more than thirty days and less than thirty five days

Then Lighting on for 21 hours

Else if

Period more than thirty five and to the end of the period

Then

Lighting on for 23 hours

End if

End if

End if

End if End

if End if

- **Part six (supply system):**

If
 Grid connected and PV battery empty
 Then
 Turn on adaptor
 Else If
 Grid disconnected
 Then
 Turn on generator
 End if
 End if

3.4 PLC Program:

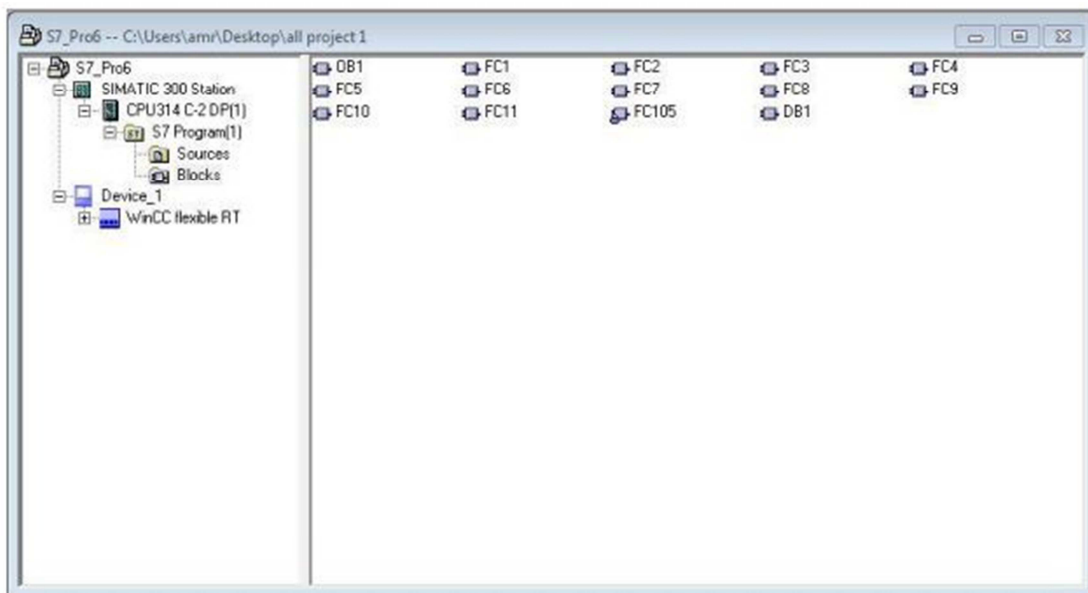


Figure (3.9) Program Window

-The program consist of one (OB) and 11 function.

- **Organization Block (OB1):**

Contain on /off switch to turn on and off the system, in addition to contain all functions that program executes. Contain functions which contain all condition or situation can be happened.

- **Function 1 (FC1)** This function contain watering system to turn on or turn off the pump according to level sensor Which found in watering path ,and for cleaning the path it open drain after 24 hours for 5minute.
- **Function 2 (FC2)** This function is programmed to scale the temperature sensor output and take the required action to keep the temperature as the user wants it to be.
- **Function 3 (FC3)** This function is to activate indicators in fault cases .
- **Function 4 (FC4)** This function is programmed to control feeding system in the farm and washing the feeding belt.
- **Function 5 (FC5)** This function is programmed to control supply system to the farm and change between Grid, Generator and PV.
- **Function 7 (FC7)** This function control lighting system of the farm according to the required amount of lighting during the day and along the period.
- **Function 8 (FC8)** This function controls the manual mode system.
- **Function 9 (FC9)** This function controls in the stop system.
- **Function 10 (FC10)** This function control in the valve drain of water path system.
- **Function 11 (FC11)** This function is representing the switching mode.

Data block : The data block (DB) is a block in which you can, for example, store values for your machine or plant to access. In contrast to a logic block that is programmed with one of the programming languages Ladder Logic, Statement List, or Function Block Diagram, a data block contains only the variable declaration section. This means the code section is irrelevant here and so is programming networks.

- When you open a data block, you can either view the block in the declaration view or in the data view.

3.4 HMI:

3.4.1 Review:

3.4.1.1 Introduction

This section about developing a Human Machine Interface (HMI) for Smart Poultry Farm with Saving Energy using Siemens Sematic Advanced Software which presents processed data to a human operator on a Screen and through this the human operator monitors and controls the process.

3.1.1.2 Overview of a Human Machine Interface (HMI)

A Human Machine Interface (HMI) is a device for providing the means of controlling, monitoring, managing and visualizing device processes. With controls and readouts graphically displayed on the screen, the operator can use either external buttons or the touch screen to control the machinery.

HMI can also be defined as the interaction between a PLC system and an operator. The interaction is presented by a screen with dynamic icons, figures and text. An operator can monitor the production and control it to a certain level by the help of an HMI panel or PC. As technology systems grow more complex, issues of end-product equipment safety, ease of operation and reducing the risk of human error are becoming extremely important.

The user interface includes hardware and software components. User interfaces exist for various systems and provide a means of input allowing the users to manipulate a system, and output allowing the system to indicate the effects of the users' manipulation.

3.1.1.3 The developed HMI should be able to:

- Communicate with Siemens Sematic Step 7 brand of PLC.
- Give a very realistic view of poultry farm.
- Reduce hardware by replacing many pushbuttons, selector switches and lights.

3.1.1.4 An HMI system assumes the following tasks:

- Process visualization:

The process is visualized on the HMI device. The screen on the HMI device is dynamically updated. This is based on process transitions.

- Operator control of the process:

The operator can control the process by using of input field. For example, the operator can turn on or off the lights or the fans

- Displaying Alarms:

Critical process states automatically trigger an alarm, for example, when the motor couldn't build up

- Process and machine parameter management:

The HMI system can store the parameters of processes and machines in recipes



Figure (3.10) Screen

3.1.1.5 Advantages of HMI

- **High quality graphics for realistic representations of machinery and processes :**

This will give the operator and the management a very realistic view of the system. The operator can control the system without in one central location, this could be very useful when there is a security concerns. The operator does not need to be close to the equipment to control of monitor.

- **Alarms (Real Time / Historical):**

Viewing alarms will help the operator to locate and react faster to any multifunction of any anomalies. Some of the alarms could be of preventive type, for example to create a warning alarm on low level of water or feeding quantity. Historical Alarm logging is very useful to track problems. It could be used to optimize process which in turn would increase productivity and reduce lost time.

- **Trends (Real Time / Historical) :**

Trends are very useful to providing data. You can view the curve used to view the feeding quantity consume. Study of certain values will result in optimizing your process, and it will certainly make if much more efficient.

- **Simulation :**

Some of the high quality HMI's will be so flexible that you can simulate a farm in your office. This will help PLC program developers test their program without having single equipment or devices. This kind of simulation is used more and more to reduce startup time.

- **Communication :** Today most HMI's can communicate with many different brands of PLC's. For example we use the MPI Cable to communicate.

CHAPTER4

4.1 Systems components :

I. Lighting system: The output is LED Bulbs and the controlling element is the poultry age .

II. Ventilation system : A controlled vacuum cleaner is used to help in clean and refreshable air and it controlled depending on temperature value.

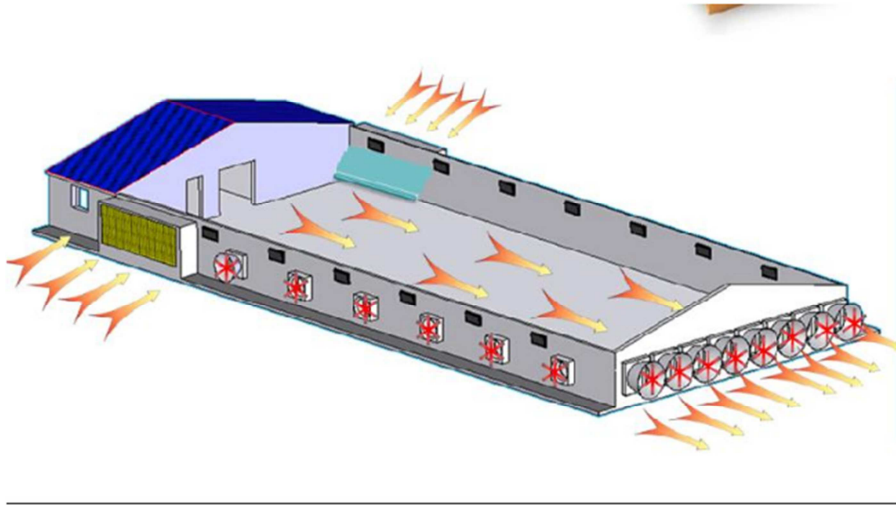


Figure (4.1) Ventilation system

III. Feeding system: Represent as food tanks that provide with valves which provide food to two moving paths which controlled by motor with gear box.

IV. Watering system: Is a path of water used for 7 days as first stage then we use nipple as second stage to reduce water consumption.

V. Cooling system : The coolers used water on cardboard or Rice straw and air is hauled through it by hoods in case of increasing of temperature.

The Structure of a Combi-Tunnel System

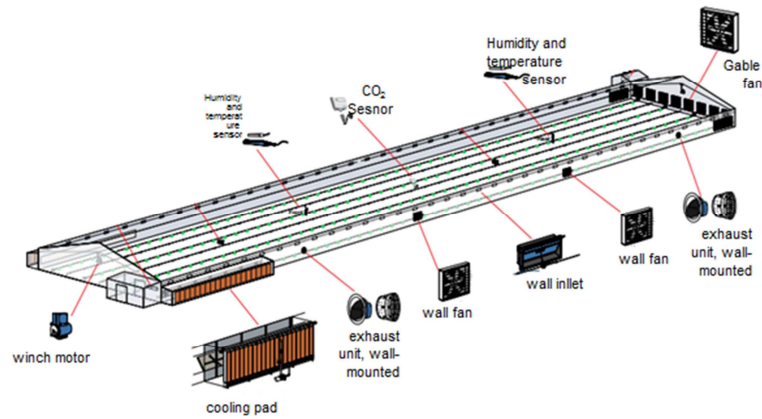


Figure (4.2) Combi_tunnel system

VI. Heating system: Heater used in this system in case of temperature dropping under the limit which maybe dangers.

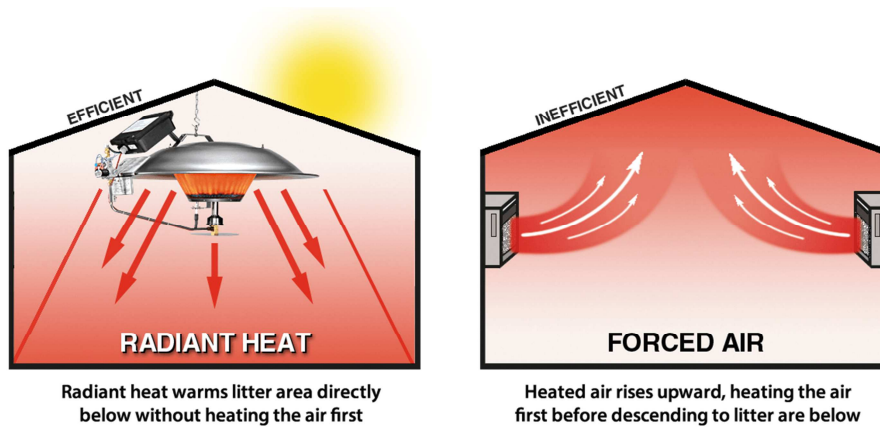


Figure (4.3) Heaters

VII. PV system: PV panels are fixed allow the renewable energy to help in saving power consumption.

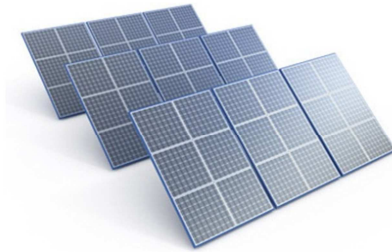


Figure (4.4) PV panels

4.2 Sensors:

A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

4.2.1 Temperature Sensor:

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage 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 LM35 device does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ$ cover a full -55°C to 150°C temperature range... The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only $60\ \mu\text{A}$ from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a -55°C to 150°C temperature range, while the LM35C device is rated for a -40°C to 110°C range (-10° with improved accuracy).

5.2.1.2 Features:

- i. Calibrated Directly in Celsius (Centigrade)
- ii. Linear + 10-mV/ $^\circ\text{C}$ Scale Factor
- iii. 0.5°C Ensured Accuracy (at 25°C)

- iv. Rated for Full -55°C to 150°C Range
- v. Suitable for Remote Applications
- vi. Low-Cost Due to Wafer-Level Trimming
- vii. Operates from 4 V to 30 V
- viii. Less than $60\text{-}\mu\text{A}$ Current Drain
- ix. Low Self-Heating, 0.08°C in Still Air
- x. Non-Linearity Only $\pm 1/4^{\circ}\text{C}$ Typical
- xi. Low-Impedance Output, $0.1\ \Omega$ for 1-mA Load

LM35 Transfer Function:

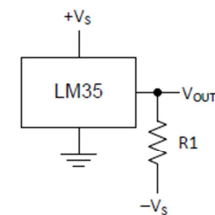
The accuracy specifications of the LM35 are given with respect to a simple linear transfer function:

$$V_{\text{OUT}} = 10\ \text{mV}/^{\circ}\text{C} \times T$$

where:

- V_{OUT} is the LM35 output voltage
- T is the temperature in $^{\circ}\text{C}$

Full-Range Centigrade Temperature Sensor



Choose $R_1 = -V_S / 50\ \mu\text{A}$
 $V_{\text{OUT}} = 1500\ \text{mV}$ at 150°C
 $V_{\text{OUT}} = 250\ \text{mV}$ at 25°C
 $V_{\text{OUT}} = -550\ \text{mV}$ at -55°C

Figure (4.5) LM35 Full range centigrade

4.2.2 Limit switch:

Limit switches serve as the mechanism that tells the computer the limits of the CNC machine. When one of the axes moves to an axis limit, the switch is activated and the machine stops as shown these limit switches are also use to inform computer with the current position. Typically, 6 of these switches are needed two per axis.

For limit switch use for CNC machines, it will be connected to signal voltage levels like 5v. Also you have the option of using this switch as an interlock to turn off something when a door is opened figure (4.9) shows the limit switch.

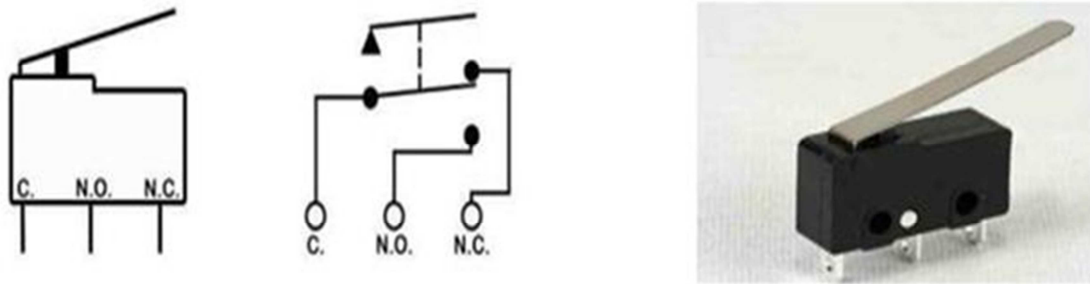


figure (4.6) Limit switch

4.3 Wiring:

4.3.1 Control panel:

Standard arrangement of two or more components such as motor controllers, relay, fused disconnect switches, and circuit breakers and related control devices including push button, Selector switches, timers, switches, and control relay, with associated wiring, terminal blocks, pilot lights .

4.3.2 Rack:

The rack used to install the controller (PLC). It can be the same as chassis but it may also be pluggable component limited in length only by the maximum I/O of the PLC. The chassis is a full frame to support the CPU/I/O figure (4.7).



Fig (4.7) Rack

4.3.3 The PLC unit consists of:

- 1- CPU.
- 2- Input module.
- 3- Output module.

4- Memory.

4.3.4 ADIN rail Or Omega Rail:

It Is a metal rail of a standard type used for mounting circuit breaker and industrial control equipment inside equipment racks It looks like the rack but it is smaller in size We used it to install some additional component such as a mechanical relay, circuit breaker.....etc



Fig (4.8) ADIN

4.3.5 Ducts:

Wiring ducts along with conduit wire ways and cable carriers are often used as basic components of a cable management system.

1- Wiring ducts are used to organize and protect cables within enclosures. They typically include features that allow cables and wires to be easily re-routed and terminated within the enclosure.

2-Wireways are typically used in limited portions of a cable management system due to their relatively high cost.

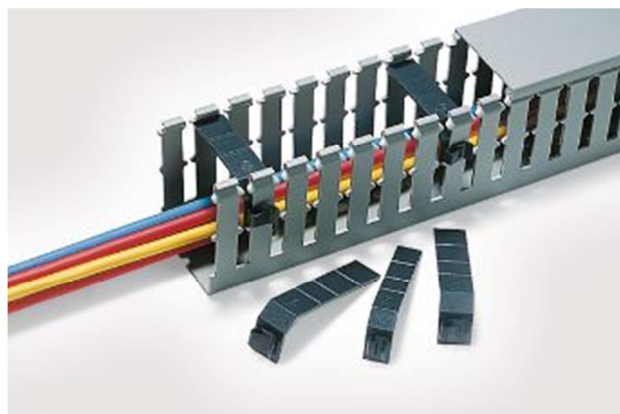


Fig (4.9) Duct

4.3.6 Terminal:

This selection of professional grade wire terminals, also referred to as electrical terminals or terminal connectors is one of the largest assortments available in the industry. They are used to connect or terminate wire and cable in vehicles and other electrical applications that utilize wire to transfer an electrical current. The wire terminals listed below are split into groups by wire terminal type. The types include bullet connectors, butt connectors, push-on, ring, spade, and pin; as well as specialty sealed each type of wire terminal and connector is available with an array of insulation options including heat shrink, vinyl and nylon non-insulated and high temperature.

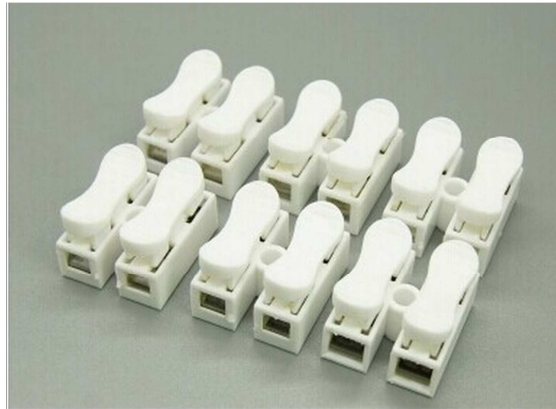


Fig (4.10) Terminal

These different characteristics ensure that the electrical connection demands are met depending on the vehicle and electrical application to eliminate the bad connection as well as specialty sealed each type of wire terminal and connector is available with an array of insulation options including heat shrink, vinyl and nylon non-insulated and high temperature. These different characteristics ensure that the electrical connection demands are met depending on the vehicle and electrical application to eliminate the bad connection between the wire and the input/output of any device or component and to improve the connection quality between the components we have to use the wiring terminal the wiring terminal has a several types as.

4.3.7 Fork / Spade Terminals:

Spade terminals come in a variety of configurations for both insulated spade terminals, and Non-insulated spade terminals also referred to as spade connectors are used to mate, connect and terminate a single wire while allowing for it to connect to a screw or stud type electrical connection. The shape of the terminals resemble a fork hence the term spade terminal or spade connector each spade terminal carries different characteristics such as amperage rating, insulation type and gauge size.



Fig (4.11) Fork

The variety of characteristics insures that each terminal meets the demands in motorcycle, automotive and marine applications. All backed by the best personal service in the industry, Del City is your one stop shop.

5.3.8 Pin Terminal:

Pin terminals come in a variety of configurations for both insulated pin terminals, and Non-insulated pin terminals. To install the “wire terminal “correctly on the wire we choose a suitable terminal type and size and also use an equipment called terminal Crimper Pin terminals, also referred to as pin terminal connectors, offer quick and easy connections in applications where set screws or clamps are used to make electrical contact with the wire. A pin terminal is designed to Simplify the insertion of stranded wire into terminal blocks and other components. Additionally, each terminal prevents wire strand fold back, assuring a proper electrical contact and a stronger connection than just wire alone. As shown in figure (4.12) pin terminal and figure (4.13) crimper.



Fig (4.12) pin terminal



Fig (4.13) crimper.

4.3.9 Contactor:

When a relay is used to switch a large amount of electrical power through its contacts it is designated by a special name contactor. Contactors typically have Multiple contacts and those contacts are usually (but not always) normally-open, so that power to the load is shut off when the coil is de-energized. Perhaps the most Common industrial use for contactors is the control of electric motors. As shown in figure 4.14



Fig (4.14) Contactor

5.3.10 Relay:

We know that most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.

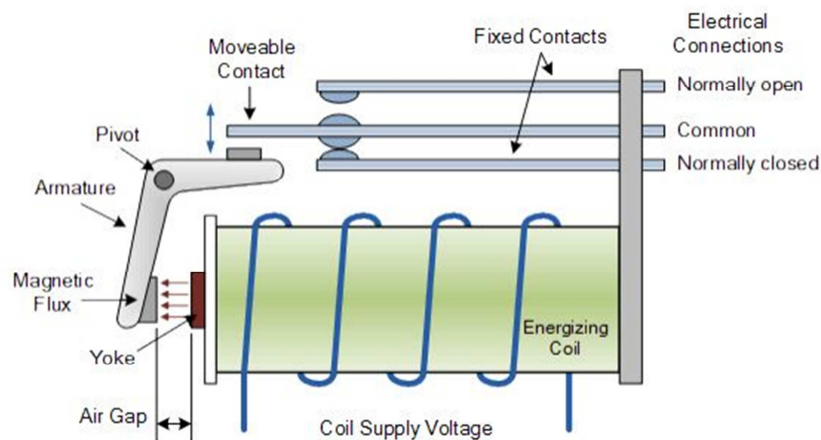


Fig (4.15) Relay construction

4.3.11 Number and letters:

To enhance the troubleshooting for the control system in the case of the error or unordinary output and to minimize the time of the troubleshooting we must give an IP address to each wire in the system, this achieved by using number or/and letter, the numbers, each wire was given an unique number or/and letter To make a designation between the wires, to find or make Attest on Any wire you have just to know the IP of the wire We have to make Number stable which include all the IPs of the wires and the corresponding.



Fig (4.16) Number and letters

4.3.12 switches:

A mechanical switch is a device that can open or close thereby allowing a current to flow or not. As you have no doubt observed, switches come in many different shapes, sizes, and configurations, so the switches are simply connect/ disconnect the electrical power by mechanical action, we used three types of switches.

4.3.13 Push-Button Switches

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state.



Fig (4.16) Push-Button Switches

Different people use different terms for the "pushing" of the button, such as press, depress, mash, hit, and punch. In industrial and commercial applications, push buttons can be connected together by a mechanical linkage so that the act of pushing one button causes the other button to be released. In this way, a stop button can "force" a start button to be released.

This method of linkage is used in simple manual operations in which the machine or process have no electrical circuits for control. Pushbuttons are often color-coded to associate them with their function so that the operator will not push the wrong button in error. Commonly used colors are red for stopping the machine or process and green for starting the machine or process. Red pushbuttons can also have large heads (called mushroom heads) for easy operation and to facilitate the stopping of a machine. These pushbuttons are called emergency stop buttons and are mandated by the electrical code in many jurisdictions for increased safety.

4.3 Software's :

- For PLC Siemens programming used step7 program:



Fig (4.17) Step7 logo

- For HMI design we used WinCC



Fig (4.18) WinCC logo

- For flowchart design we used web site (<https://www.draw.io/>)

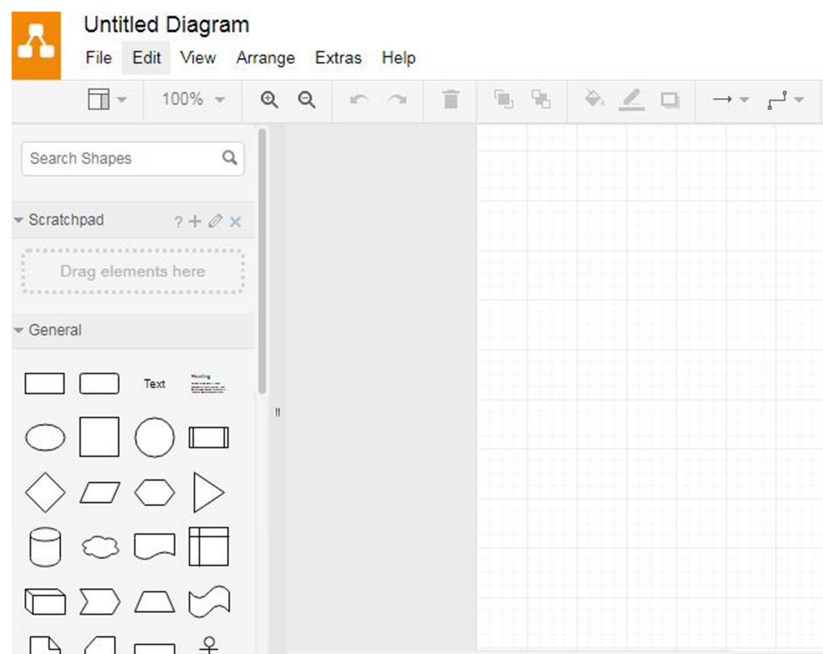


Fig (4.19) draw.io

CHAPTER 5

5.1 Definition:

Business Model Canvas is a strategic management and lean startup template for developing new or documenting existing business models. It is a visual chart with elements describing firms or product's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs.

5.2 content of business model canvas:

5.2.1 Customer segments:

- a) Rural area
- b) Distribution places
- c) Low power sources
- d) Farmer owners
- e) Investors
- f) Farm workers in general

5.2.2 Value propositions:

- a) Saving in energy sources
- b) Reduce waste of water and electricity
- c) Reduce the price of the final product
- d) Reduce human error
- e) Exploitation of renewable energy
- f) Exploitation of remote locations

5.2.3 Channels:

- Companies and investors
- Workers in the same sector

5.2.4 Customer Relationships:

- Discounts
- Good customer service

5.2.5 Revenue Streams:

- Saving electricity and waste water
- Increase production

5.2.6 Key Resources:

- Renewable Energy (Solar)
- The Farms located far from the main grid

5.2.7 Key Activities:

- Saving electricity and waste water
- Increase production
- Reducing employment and cost gives a project value
- Marketing (we will talk in detailed later in this chapter)

7.2.9 Cost Structure:

- Initial Structure “Control System”
- PV System

5.3 Marketing:

What is marketing?

Marketing is the process of teaching consumers why they should choose your product or service over your competitors. It's that simple! The key is finding the right marketing method and defining the right marketing message to use to educate and influence your consumers. Figure 5.1 show how to think about marketing.

Marketing is everything that the consumer encounters when it comes to our business, from advertising, to what they hear, to the customer service that they receive, to the follow-up care that you provide.



Figure 5.1 Think about the marketing process

5.4 The purpose of marketing

- Capture the attention of a target market.
- Facilitate the prospect's purchasing decision.
- Provide the customer with a specific, low-risk and easy-to-take action.

With these purposes in mind, coupons, sales and even merchandising, or how products are displayed, are parts of the marketing process. Since marketing is the cornerstone of every business, the overall objective is to sell more products or services.

5.5 Steps of marketing principals

- i. Type and nature of work
- ii. Conducting a situation analysis
- iii. Research market
- iv. Educate on external opportunities and threats

5.6 The four marketing mixture elements

Product: Owning the product or service that fits the market in which we operate.

Price: Sell the product or service you offer at an amount that would make the target customer feel that the purchase represents a good deal.

Promotion: Create appropriate customer perceptions across multiple channels, including print publications such as direct mail, flyers, brochures, postcards, ad flashes on TV or radio, newspaper and magazine ads, the Internet and more.

Place: Distribute your product on sites where target customers can easily find it.



Figure 5.2 marketing mixture elements

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- 1- <http://kenanaonline.com/white-chicken>
- 2- <https://www.vegetronix.com/Products/AquaPlumb>
- 3- <https://www.wonderware.com/hmi-scada/what-is-scada/>
- 4- <http://plc.mavjuz.com/en/siemens/simatic/step7/adapters.html>
- 5- <http://zr3h.mosw3a.com/arabq4818/>

For HMI we used many of YouTube videos like

- 1- <https://www.youtube.com/watch?v=KyMIlu5LSak>
- 2- <https://www.youtube.com/playlist?list=PLVkWK0yLJLC6X4HmGSv3XrkUBmbWQTcx>
- 3- <https://www.youtube.com/watch?v=JH5CGu2Bxug&list=PLVkWK0yLJLC6X4HmGSv3XrkUBmbWQTcx&index=8>

General Search:

- 1- <https://www.youtube.com/watch?v=F0m1839Gtok>
- 2- <http://kenanaonline.com/users/white-chicken/posts>
- 3- <https://www.draw.io/>
- 4- <https://www.thebalance.com/what-is-marketing-2296057>

BOOKS

ROSS BROILER MANAGEMENT MANUAL BY

Lighting-for-Broilers BY DR. HANK CLASSEN