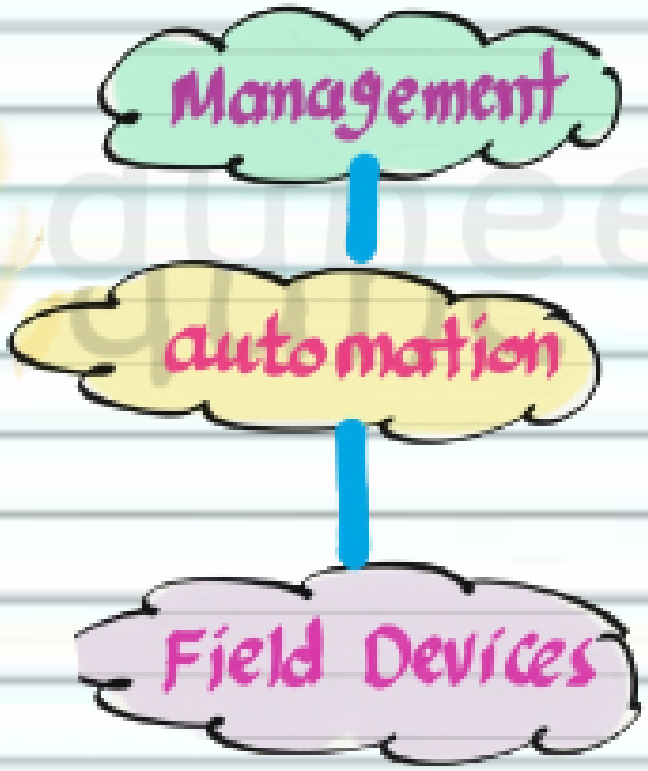
automation Level

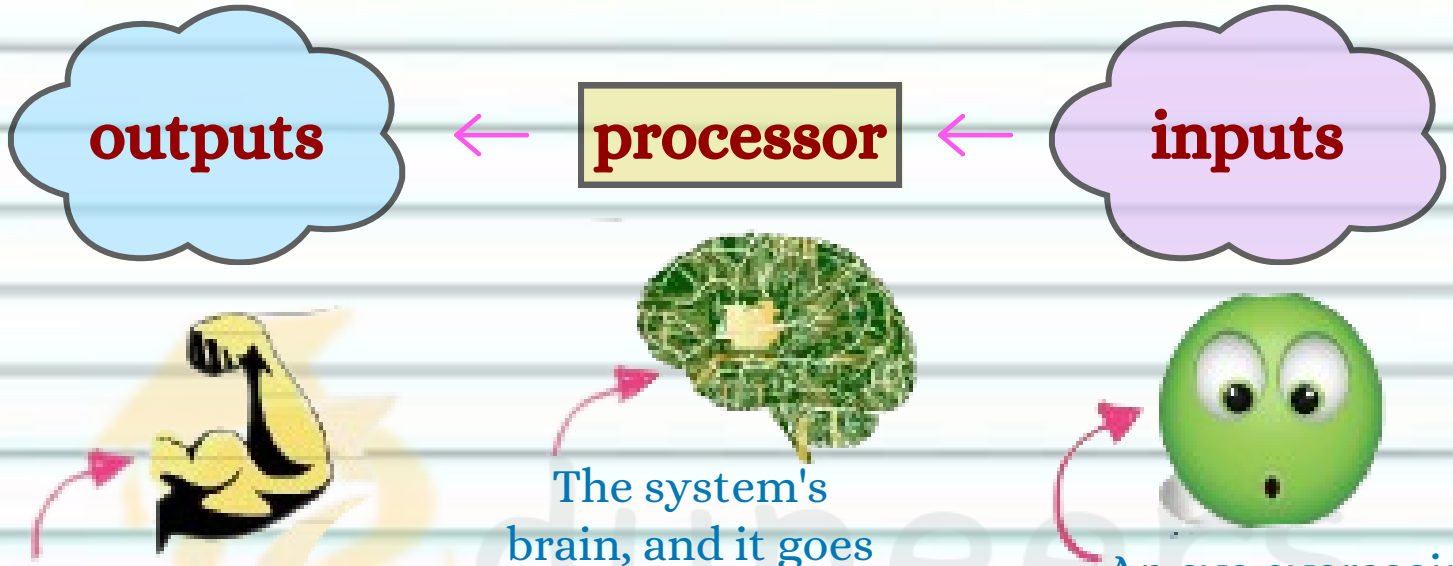
- In the previous lectures, we learned that the BMS consists of three levels. These levels are:



- In the last lecture, we discussed the level related to on-site devices, and today, Insha'Allah, we will talk about the second level (Control)

Before anything else... what does control mean?

- Let's explain the meaning of the word in a simple way and say that "control" is a system composed of three fundamental components



The muscles of the system through which the equipment is either disconnected or activated.

- Contactors
- Actuators

The system's brain, and it goes to everything you want to do

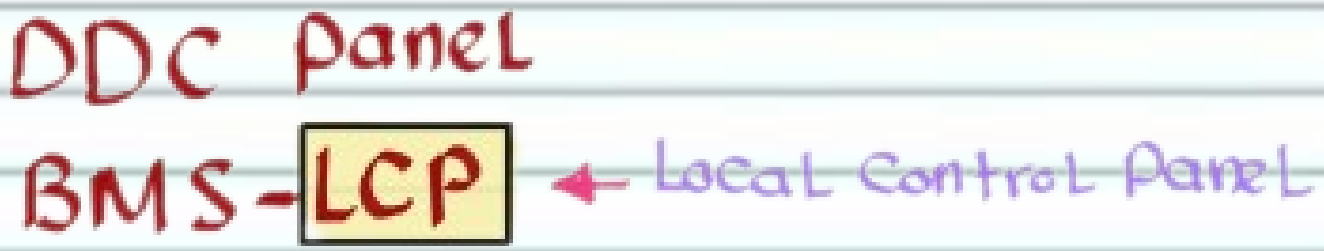
An eye overseeing what's happening.

- Sensors
- Switches

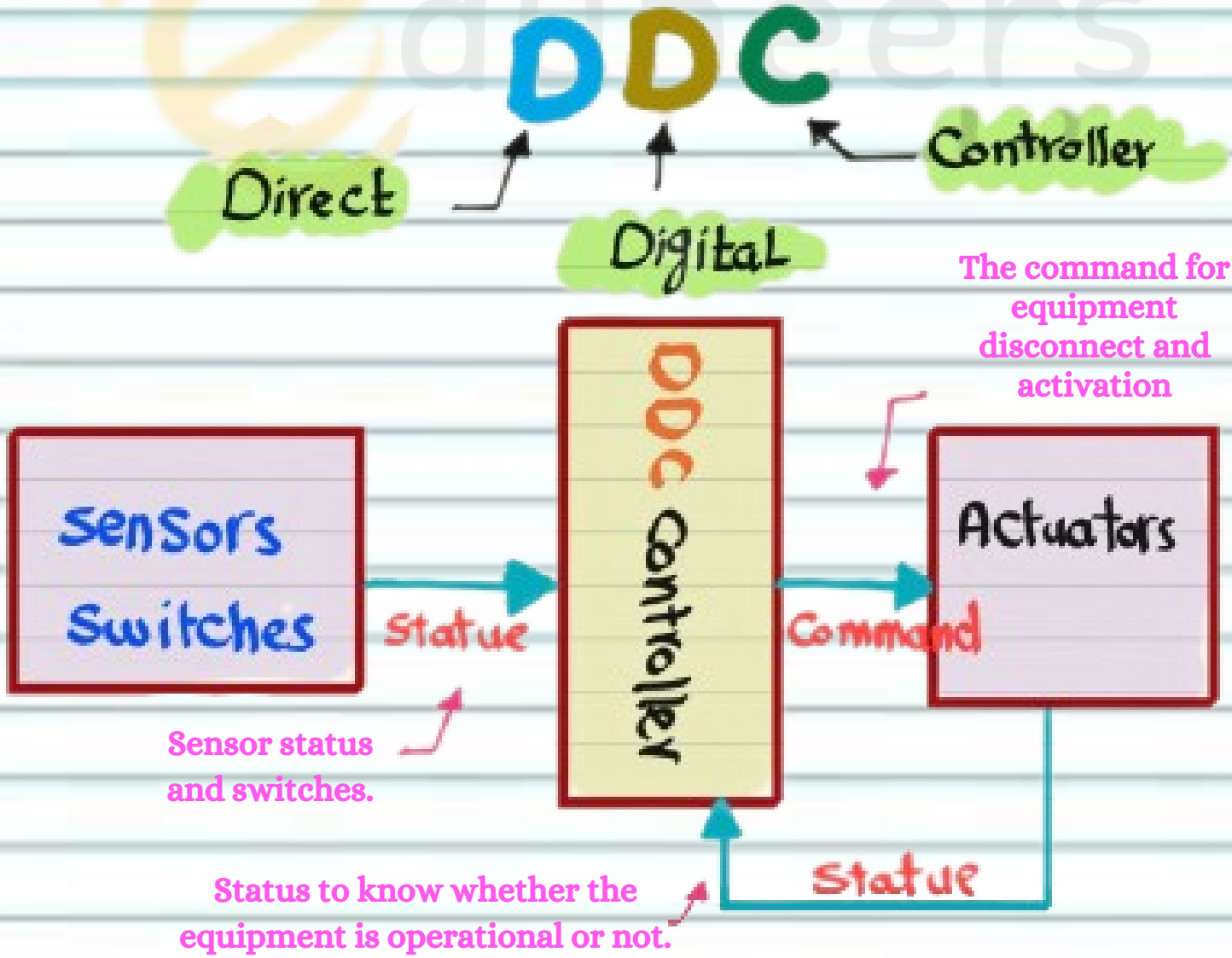
- We discussed inputs and outputs in the last lecture, and they are simply components of the level : Field Devices

Components of the automation level:

- I can say that the components of this level are confined within a panel called the widely used panel in projects:



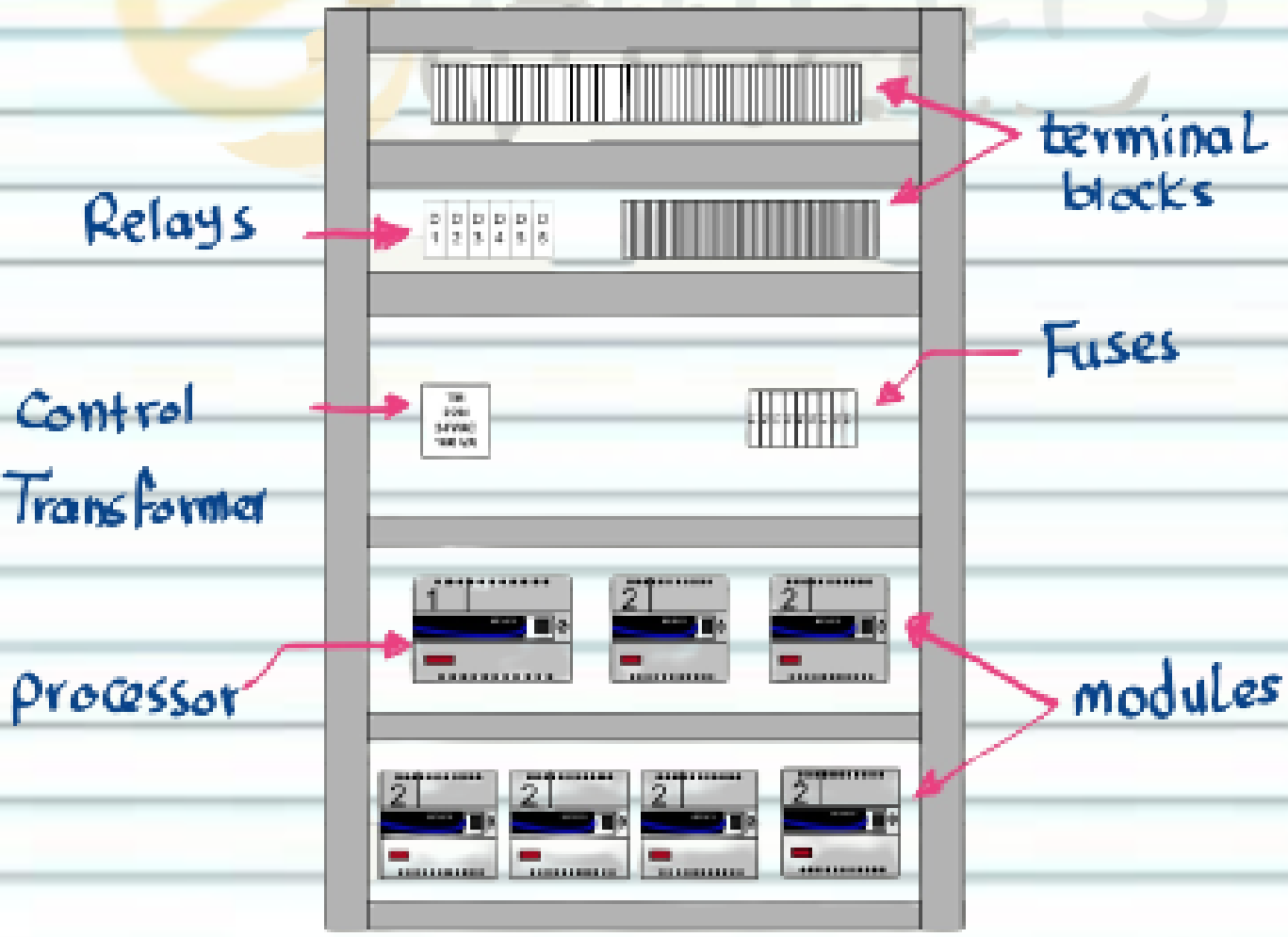
- DDC is the controller (processor or system brain) used with the BMS, and the acronym stands for:



DDC Panel

- **The most important components are:**

1. Processor
2. modules
3. Control Transformer
4. Terminal block
5. Relays



Controller "processor"

- This is simply the mastermind of the entire system.

- It has a program written on it representing the steps that the system will follow.

- Example: Consider it as, for instance, when it receives a signal from the fire alarm panel indicating a problem in the building, it sends commands to close the fresh air fans and activate the smoke exhaust fans, and so on.

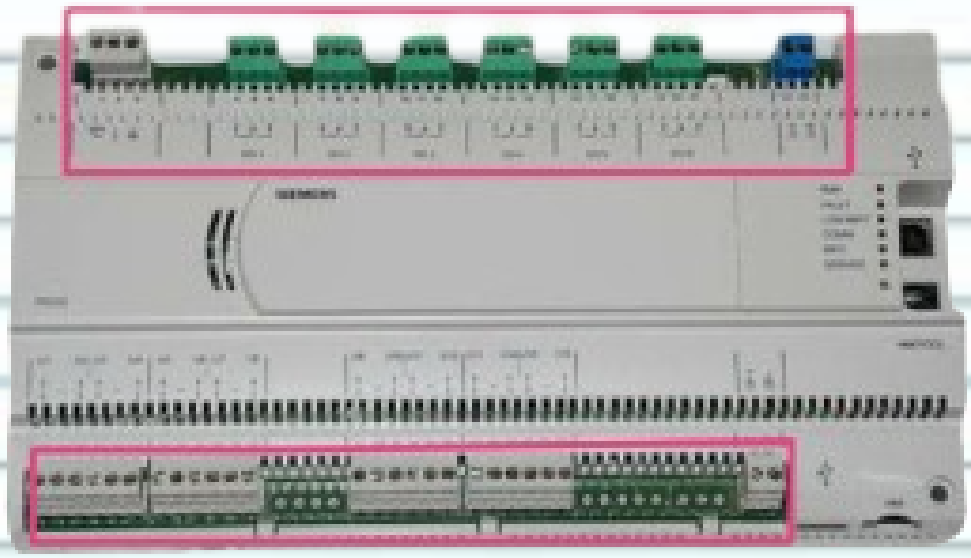
- Regardless, the scenario that takes place in the building is calculated within the program using predefined steps, and this is what they refer to as the 'Logic.

A logical thinking scenario to solve a problem or make a decision

- **The types are:**

- The controller receives the points to which the sensors and actuators are connected.

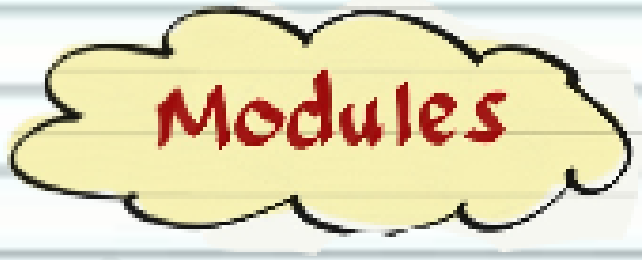
- The use of this type is not widespread due to the limited number of points, and also because the second type offers greater flexibility in usage as an alternative.



The modular:

- The most widespread type in projects, where the processor is separate, and there are modules to which sensors and actuators are connected individually

- We will explain the first modules before you see examples of the controller because the two are interconnected.



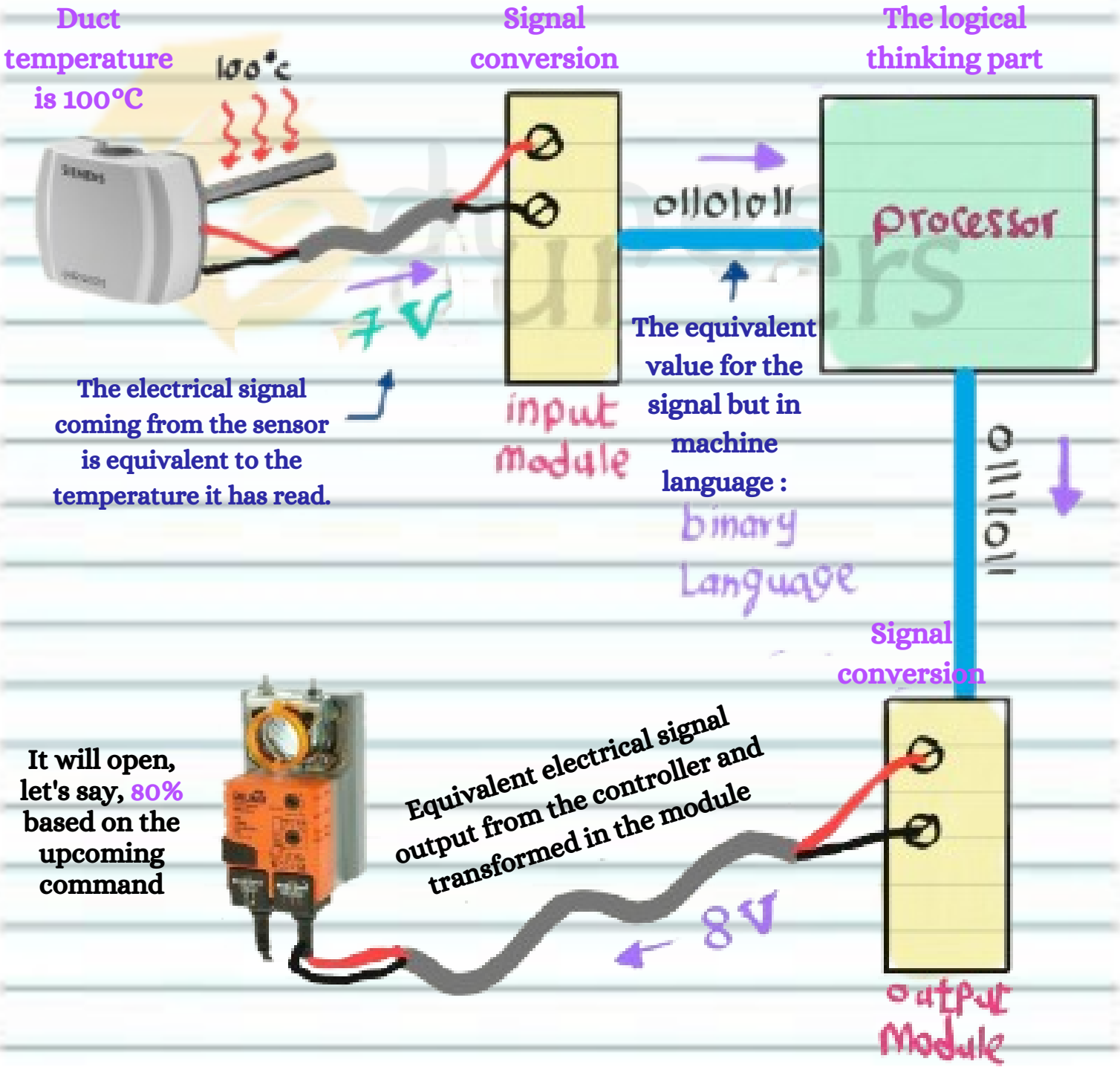
- Every controller in the world understands one language (machine language). This language is entirely composed of (0 , 1)

Any input signal needs to be in the (0,1) format for it to be understood.

Any output signal from it will be in the form of (0 , 1)

So, what's next..??

- We know that a sensor, for example, reads a value, let's say temperature, and outputs an electrical signal equivalent to that value. Now, we understand that the controller won't comprehend the meaning of the electrical signal coming from the sensor directly. It will need something in front of it to convert the signal to an equivalent value in the (0,1) format, and this is the function of the module.



- Our conclusion is..

The module is a device used to convert signals, whether incoming to the controller from sensors and switches (input module), or outgoing from the controller to the actuators (output module)

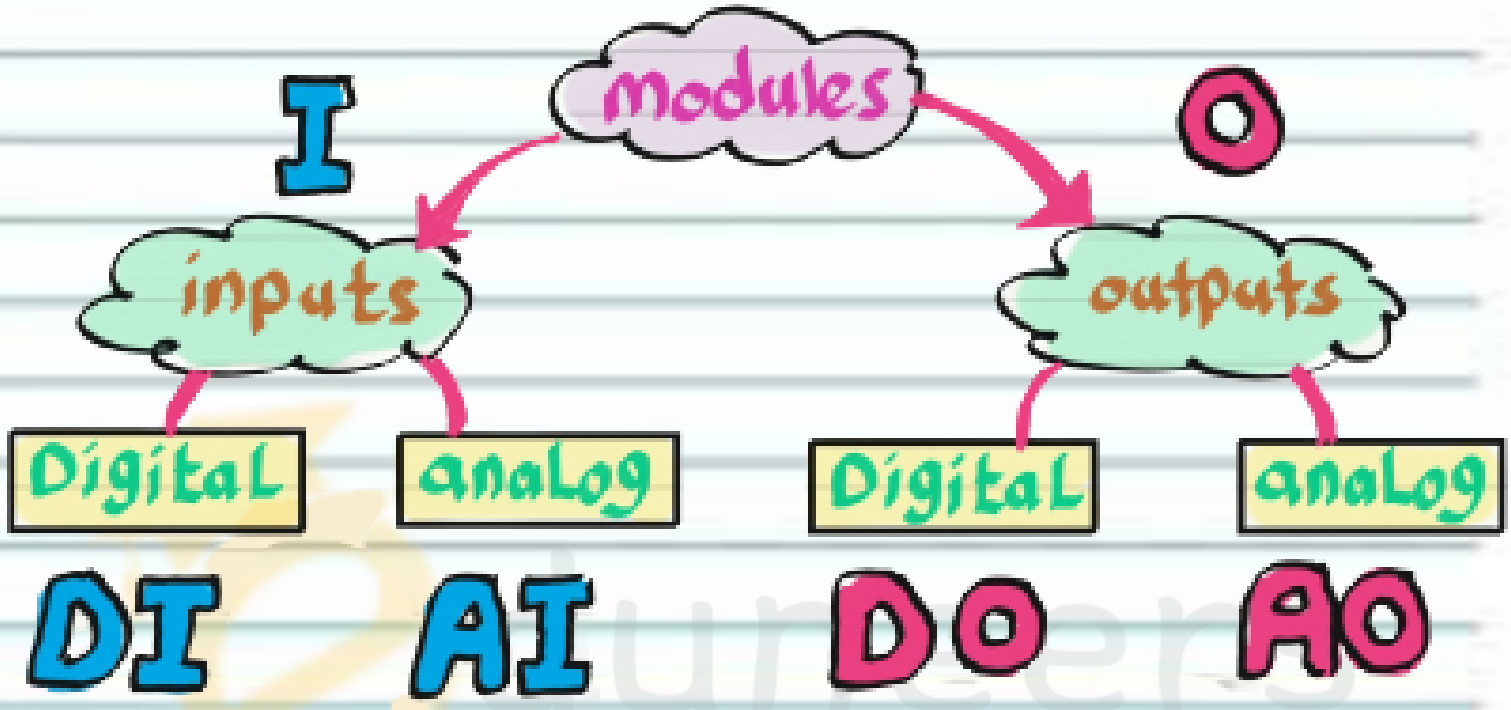
- You will encounter many terms...

Status: Any incoming signal to the controller to inform it about the value of a specific thing or the status of a particular device.

Command: Any outgoing signal from the controller to activate or disconnect a specific thing.

What are the types of modules?

- We know that we will connect the on-site devices using it, and thus, it will be divided based on the types we explained in the on-site devices, which are..



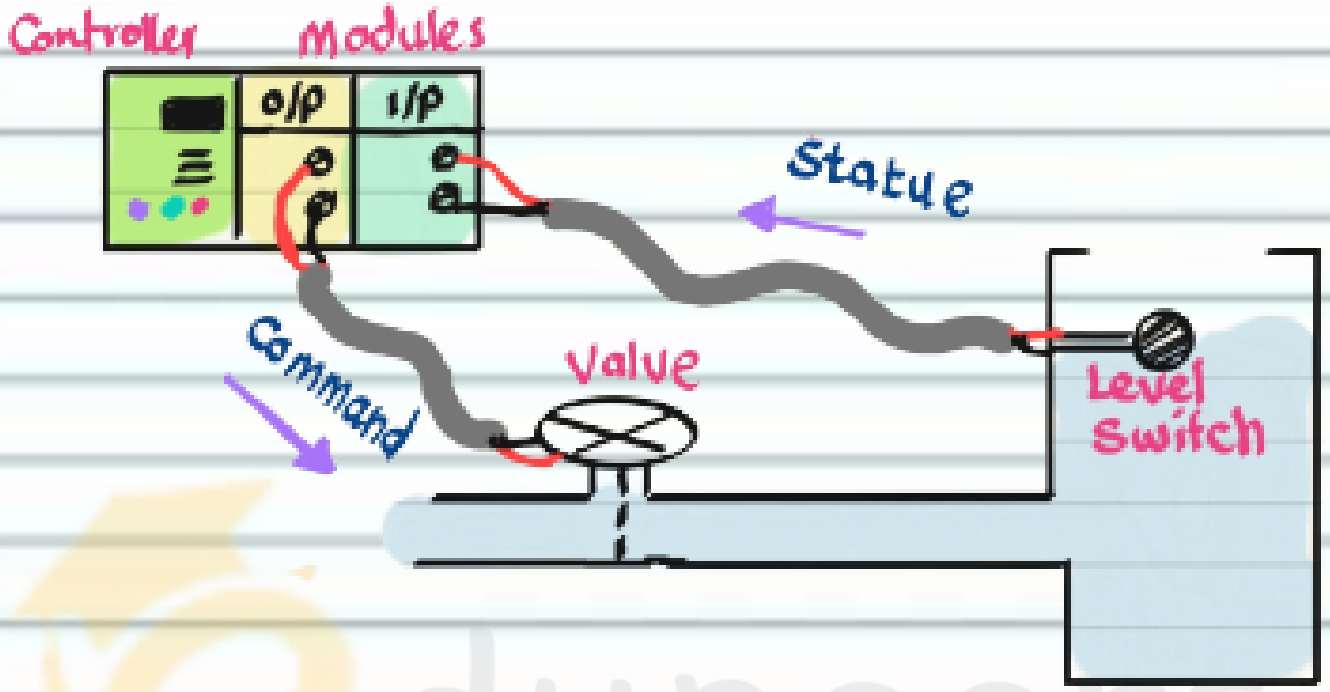
There is a third type that you might encounter, called universal module. This type of module can receive both digital and analog signals.

UI ← universal input DI + AI

UIO ← universal input/output

AI + DI + AO + DI

For example, we've defined on-site devices, the controller, and modules. Now, let's understand how these components work together through some simple examples.



- You have a sensor installed to measure the liquid level. When the liquid first reaches it, it sends a signal indicating its status to the controller. The controller then interprets this signal, and based on the code programmed inside, it might send a command to the actuator, which is connected to the valve. For example, the command could be to close the valve and prevent any more water from entering the tank since the desired level has been reached

- Exactly, as you can see, for the processor to understand what's happening, there needs to be a module that translates the incoming states and translates the commands going out to the actuators.

In the simple example we discussed earlier, we applied the full meaning of the BMS ,the ability to :

Monitor Control

Examples

Let's look at some examples to understand how to differentiate between different types of signals

Digital Signal:

- If I have an electrical panel controlling a motor in a specific machine and I need to disconnect and operate the motor.
- also to know its status, you must answer these questions .

Do you need to know the status or do you need to issue a command?

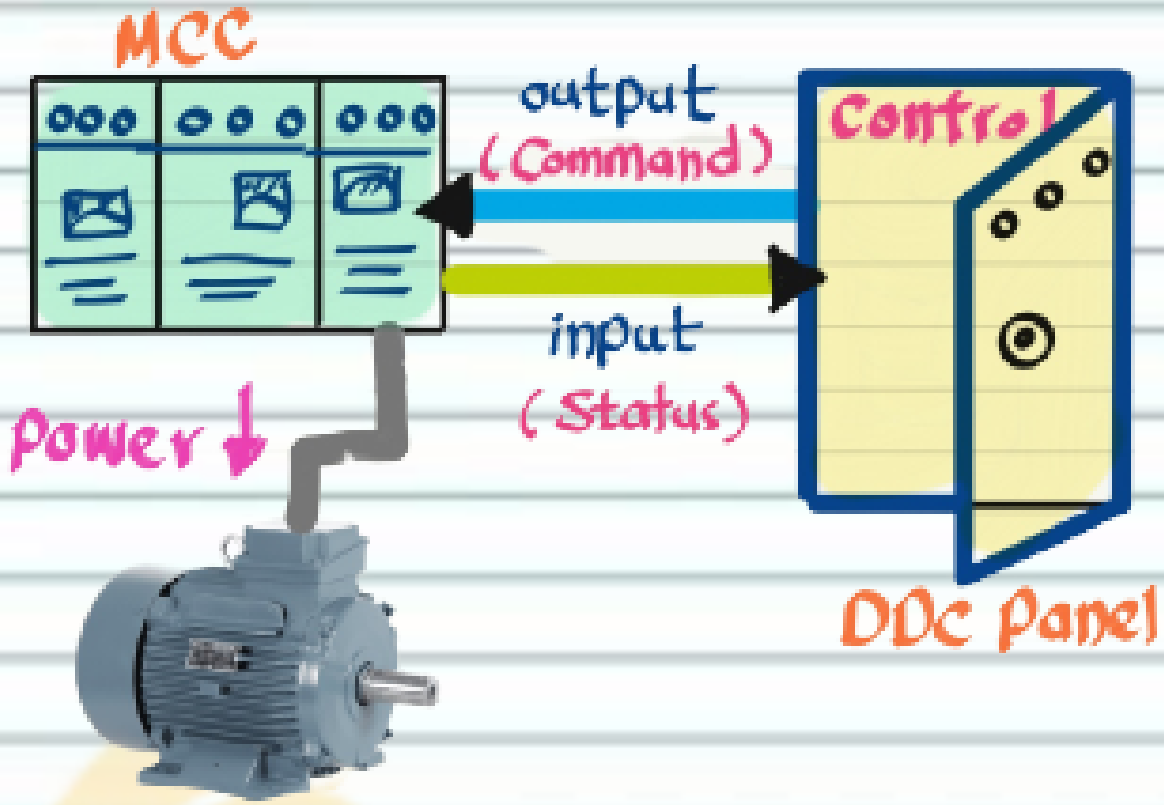
- Here, you need to know the status of the motor, whether it is running or not.

Status

- You also need to issue the command to start or stop it (Command)

Command

From the answer to the previous question, we know that you need the following :



The second question is:

Is control only binary, or are there more possibilities?

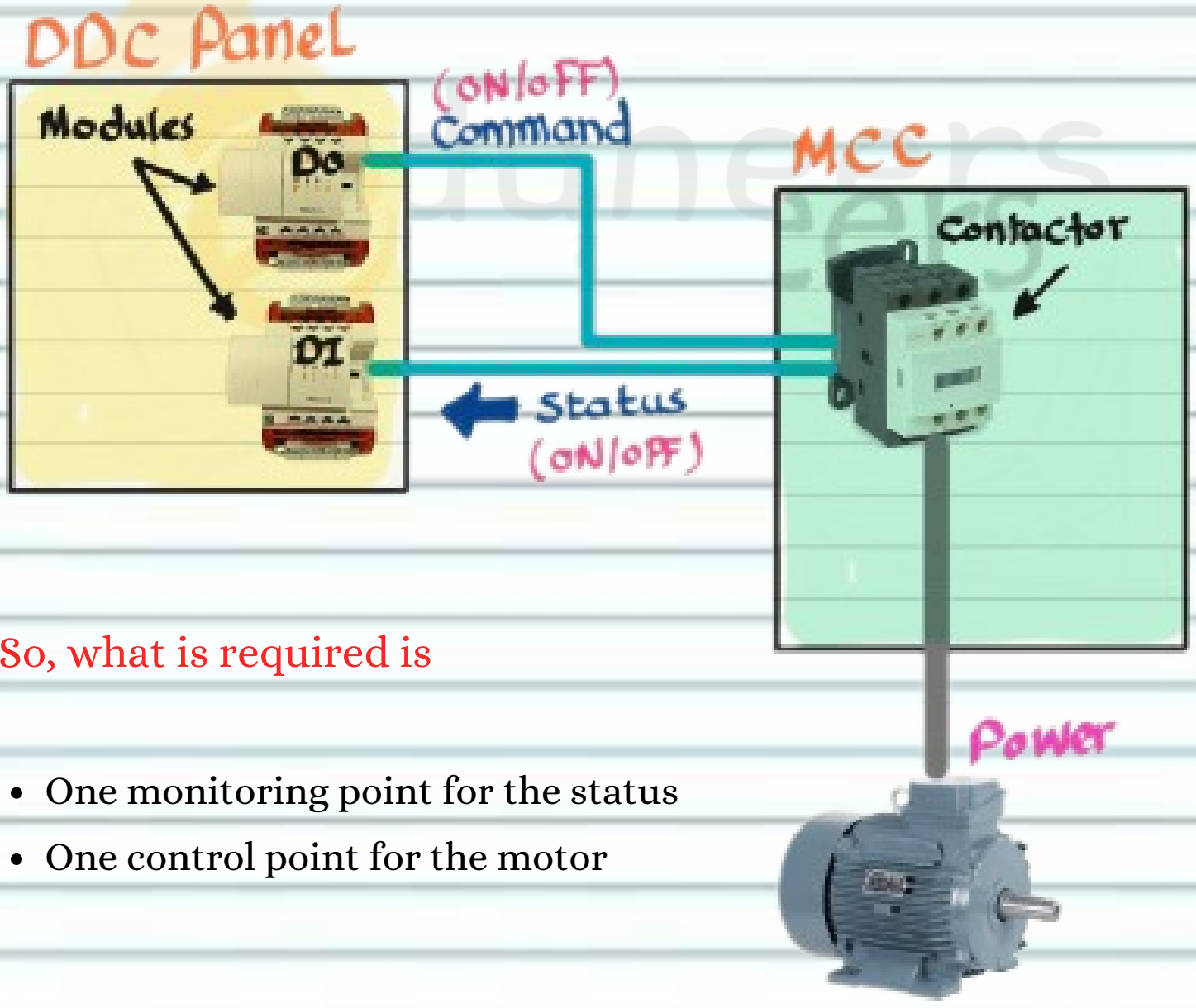
- Firstly: the status you want to know is the state of the motor, which is only two possibilities: (either it's running or not running). Therefore, this is a Digital signal that we agreed has only two values, either 0 or 1 (ON-OFF)

- Secondly: the command you want to control is to instruct the motor to start or stop, so again, it has only two possibilities (two states). Therefore, this command is also a Digital signal.

- From the answer to the second question, I understood that the signals you need will be Digital, whether it's the status you want to know or the command you want to execute
- When we combine the answers to both questions, we find that we need the following

Knowing the status of the motor → Digital input

The command to disconnect and operate the motor. ← Digital output



So, what is required is

- One monitoring point for the status
- One control point for the motor

Ex (2):

- I have a DPS (pressure differential switch) to measure the pressure difference across two points on a filter in the central air conditioning system, and I want to know if the value displayed on its indicator is correct or not

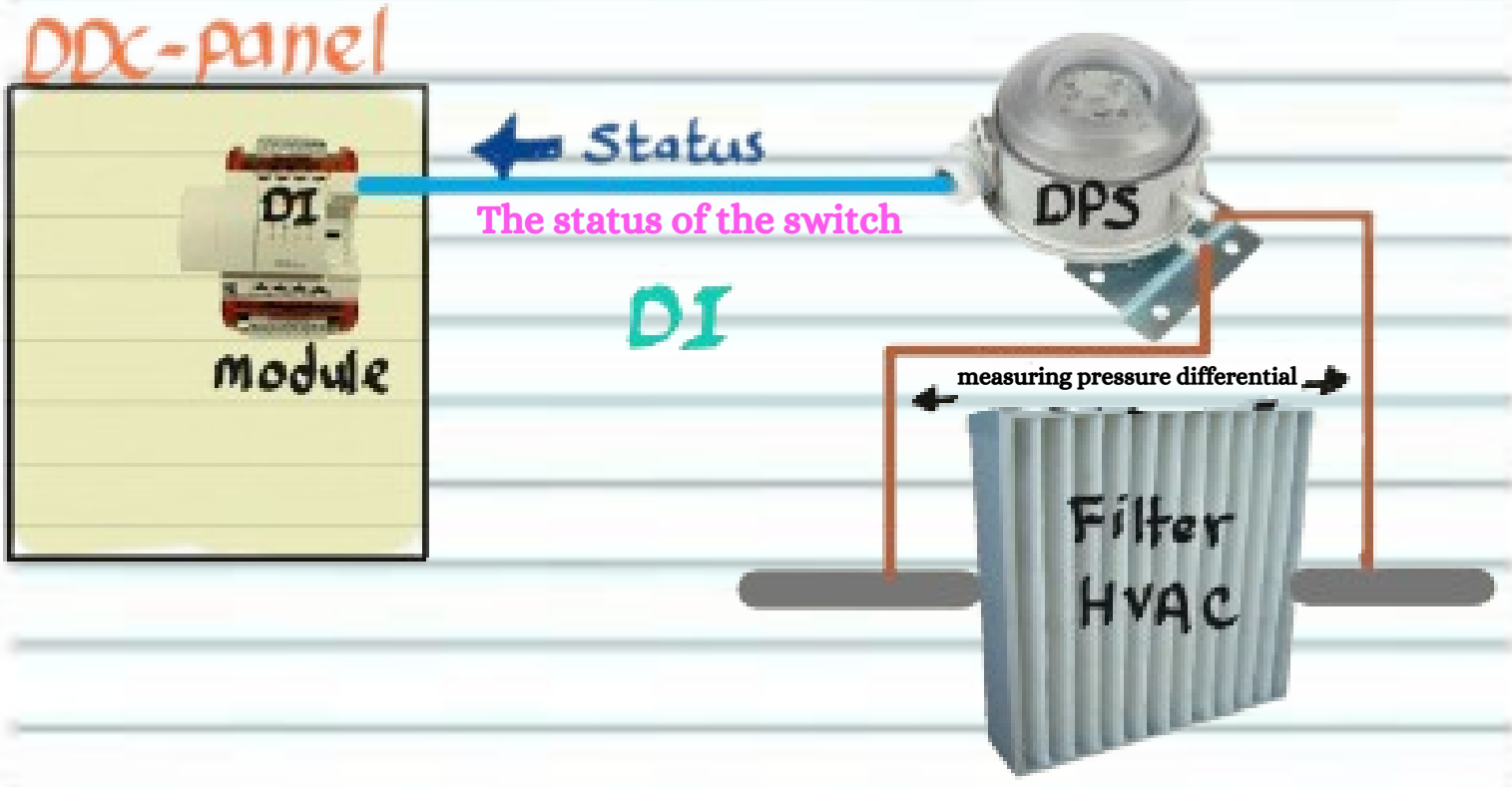
We ask the same two questions....

- First: do I need to know the status of the DPS or control it?

Here, I need to know if the DPS has reached a pressure difference equal to the set value or not (to know its status)

- Secondly: does the condition I want to know have only two possibilities or more?

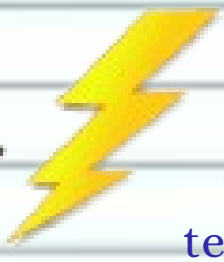
The DPS will help me determine if the pressure difference has reached the set value or not (only two possibilities)



Analog Signals:

- I have a temperature sensor, and I want to continuously monitor the values it reads.

Sensor temperature.



It outputs an electrical signal equivalent to the temperature value it observes

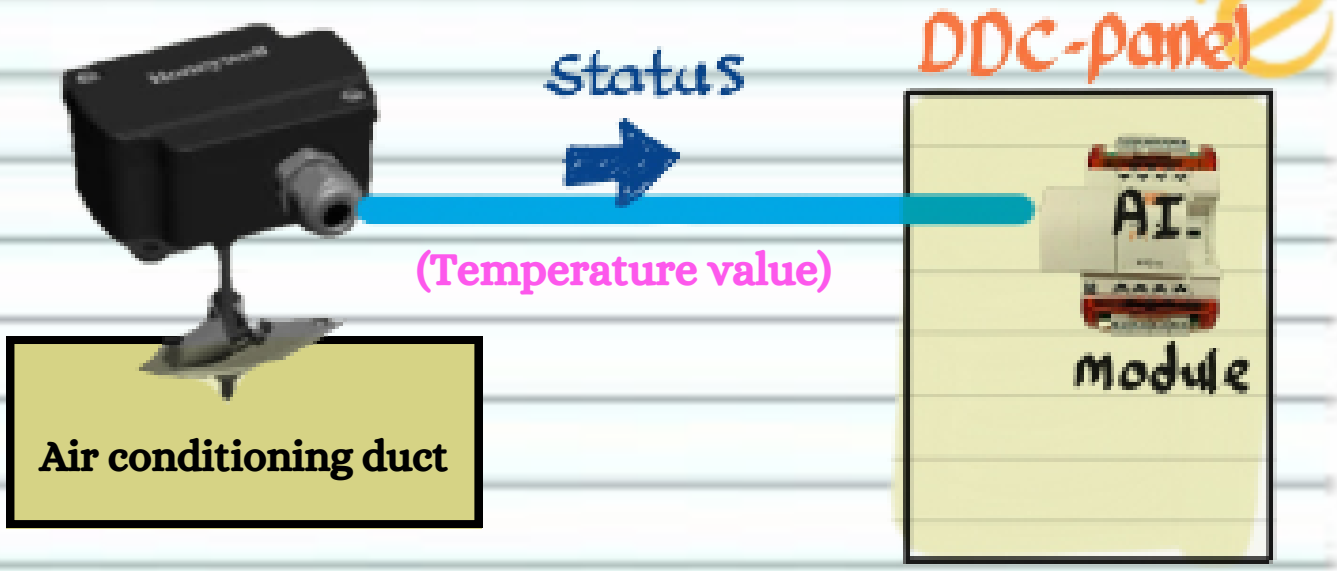
Question (1): Do I need to know the status of the sensor, or am I controlling it?

- I need to know the temperatures it reads (I want to know the status).

Question (2): Does this status have two possibilities or more?

- These possibilities don't have a specific number because at one moment the temperature can be 50, then a bit later it rises to 155, and then it drops to 30, and so on continuously (the possibilities he will see are very large).

I want to define the status, and also, the status has many possibilities.



Ex(3):

We have a damper that is controlled for opening and closing using a [Rotary Actuator], and I need to be able to open it to the desired percentage, for example, 10%, 20%, 30%, as desired

Question (1): Do I need to know the status of the actuator, or do I control it?

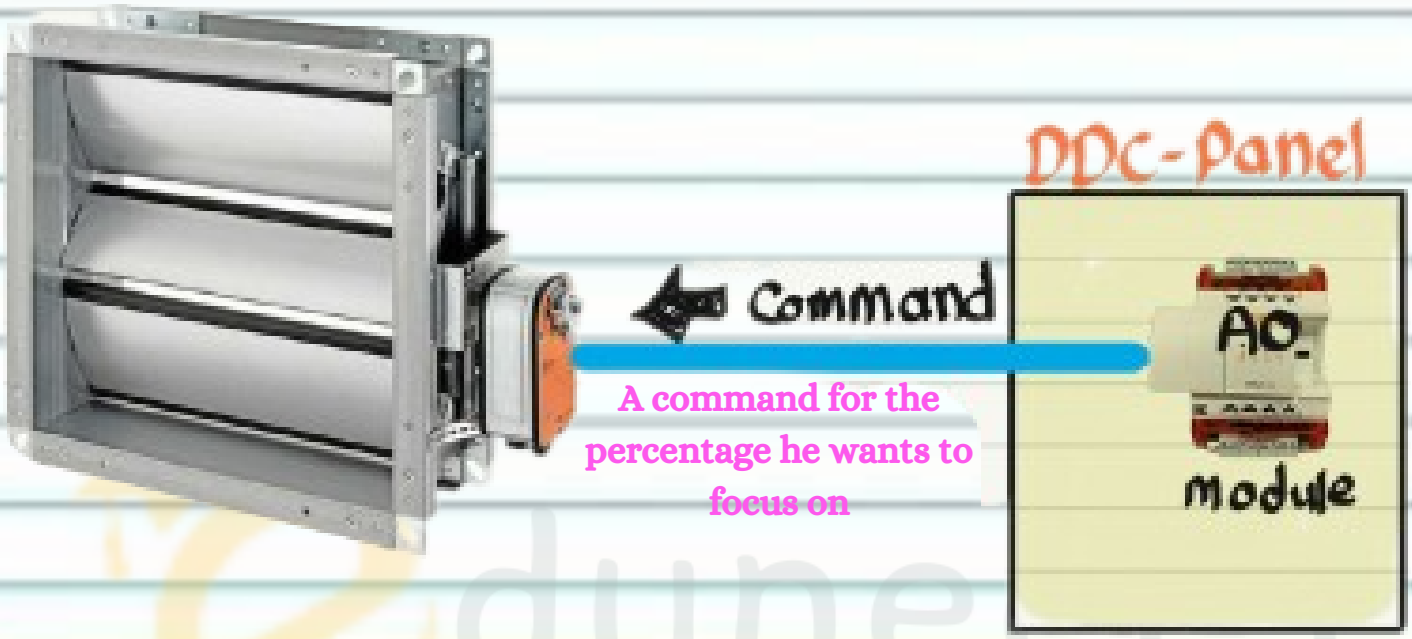
This is needed for controlling the opening and closing (output).

Question (2): Is this control only two possibilities, meaning ON and OFF, or are there more possibilities than that?

These possibilities are significant because I want to control the percentage of the opening, for example, by increments of 1/10, 1, and 20 (analog).

I want to control, and there are many possibilities for control

output **Analog**



Insha'Allah, in the next lecture, we will continue with the remaining components of the BMS panel and understand the things you need to consider when choosing the controller and modules

تم بحمد الله

<< Translated by me >>

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