Automatic DRI Environment Control Chamber (HVAC)

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Abstract: **HVAC (Heating, ventilating and air conditioning) system means to a system which not only maintain the temperature but also the humidity to live or operate in the comfortable and pleasant environment. So to achieve the required target we first understand the basics of temperature and humidity environment and also the effect of the step we are taking to solve the problems. In this paper a chamber (room) environment (temperature & humidity) is controlled using a PLC with analog solenoid valve. In this case the RS Logix 500, RS Linx & RS Emu 500 software is used for writing and run the program in PLC.**

Key Words: Analog solenoid valve, Contactor, Motor, Overload Relay, PLC, RS Logix 500, RS Linx RS Emu 500, Temperature and Humidity Sensor.

1. INTRODUCTION

The heating, ventilation and air conditioning (HVAC) system is useful to develop and maintain a comfortable nvironment for the living or any work operation within a building. It includes maintain of Temperature, Humidity and Fresh air movement. Fresh air which is used for ventilation is also a carrier of heat for local regulation. Fresh air is energy efficient only in case of the device equipped with feedback temperature and humidity sensors. There is central being preparation of heating and cooling energy conveyed by thermal exchangers for a particular area and air systems for bringing fresh air conditioned in air chambers. When this HVAC is done manually it takes more power, less accuracy and also less secure operation. Hence the PLC (programmable Logic Controller) based HVAC system used for the operation. In this paper, the PLC (with analog output card) is used as it has analog solenoid valve as output.

HUMIDITY

The humidity refers to the presence of moisture in the atmosphere. Quantitatively it can be expressed either on a relative basis or on an absolute basis. In the measurement of moisture content in the matter (air) must be considered to be present in all the three distinct phases (viz., free or surplus moisture, physically bound moisture, chemically combined hydrogen and oxygen.)

The moisture content in a matter is expressed by different terms.

Percentage of moisture (% MR)

$$\% MR = \{(W - D) \div D\} * 100$$

Where W = weight of net material before drying,

D = weight of dry material after drying.

SENSORS

The device which converts the physical quantity into measurable electrical quantity is called sensor. The electrical signal could be voltage or current.

TEMPERATURE

The temperature of a matter is called the degree of hotness or coldness. This is the thermal state of a body which determines whether it will receive from or give heat to other bodies. A wide range of temperature sensors and temperature measurement systems have been developed for different application requirements. Here the RTD (Resistance Temperature Detector) sensor is used to measure the temperature RTDs are connected in a Wheatstone bridge circuit. The lead wire is used for connecting the RTD's introduces error, hence compensation is required. This will obtained by 3-wire or 4-wire compensation, but 3-wire compensation is mostly used in the industry.

The RTDs are available in many configuration and sizes for immersion and surface application.

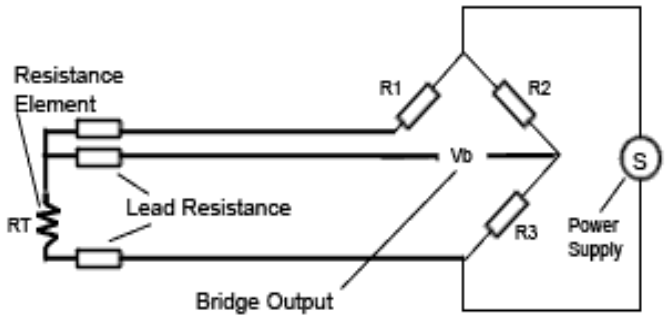
The significant characteristic of metals used as resistive elements is the linear approximation of the resistance versus temperature relationship between 0 and 100 °C. This

temperature coefficient of resistance is called alpha, α. The equation below defines α; its units are ohm/ohm/°C.

$$\alpha = \frac{R_{100} - R_0}{100 R_0}$$

$R_0 =$ the resistance of the sensor at 0°C

$R_{100} =$ the resistance of the sensor at 100°C



A Typical Diagram of Three wire RTD

R T=R0+R0 α [T-δ {(T/100)-1}(T/100) –β[{(T/100)-1}(T/100)3]

Where:

RT = Resistance at Temperature T
Ro = Resistance at T = 0°C

α = Temperature coefficient at T = 0°C (typically +0.00392Ω/Ω/°C)

δ = 1.49 (typical value for .00392 platinum)

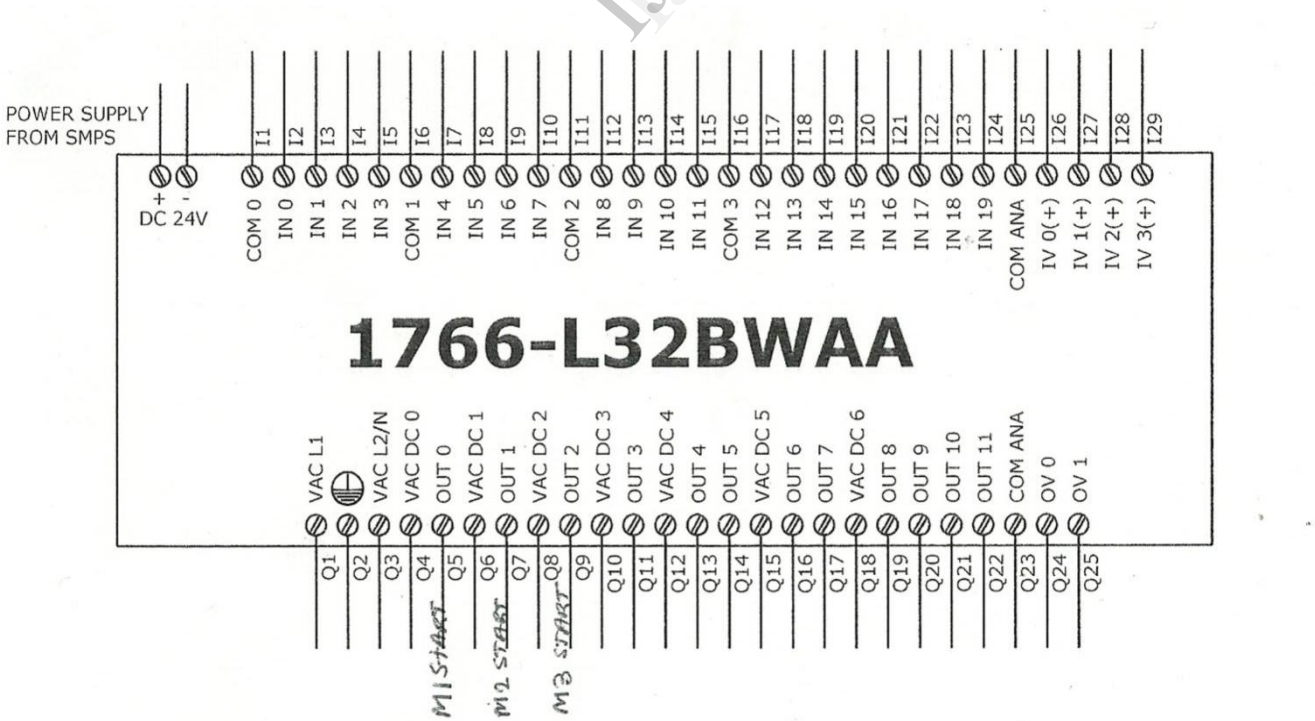
β = 0, T > 0
0. 11 (typical) T < 0

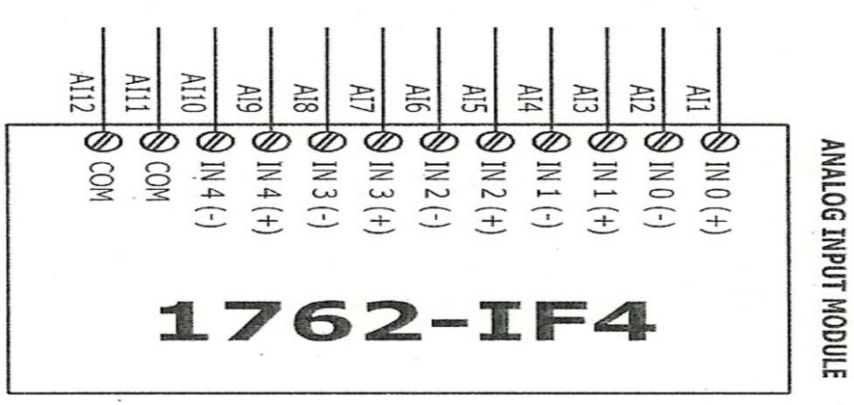
PLC

The Programmable Logic Controller is used to

automate the operation. In this we can write the program of operation. This program is written into the PLC by programming languages. The programming languages are ladder logic, functional block diagram (FBD) statement list

etc. this program is written into the ladder logic. We can also make changes while online according to the requirements. Here the Allen Bradley PLC-Micro Logix processor-(1766-L32BWAA) with 4 point Analog input card (1762-IF4) is used.





ANALOG SOLENOID VALVE

The analog solenoid valve is operated by a.c. supply. It also open and close on a percent basis i.e. different from digital which is only on and off (o or 1) state. This controls the chilled water flow.

MOTORS

The motor is used to transfer the electrical energy into mechanical energy. Here the three phase motor is used for sensible wheel.

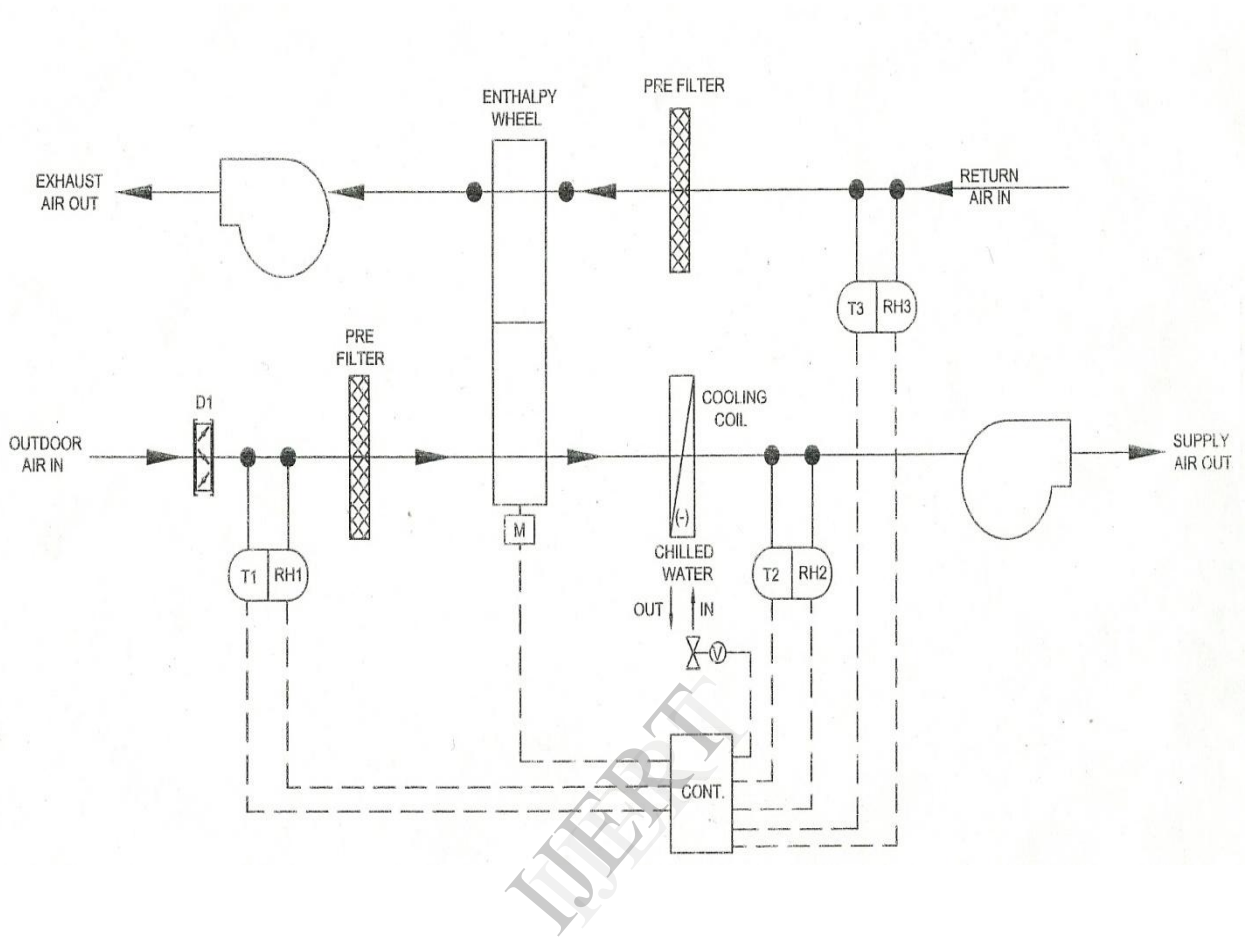
CONTACTOR

The contactor is used to start and stop the motor. In the contactor, there is NO (normally open) and NC (normally close) contacts are used.

OVERLOAD RELAY

The overload relay is used for the protection of motor. If it draws more current than the rating adjusted, it will cut the contactor holding supply. As a result the contactor will cut the supply to motor.

Proposed P & ID Diagram



METHODOLOGY

The three position analog controlled solenoid valve (cooling coil) is used to control the flow of chilled water in the chamber as and when required.

The opening closing of solenoid valve (cooling coil) will be controlled based on the temperature difference of T2 and T3. The solenoid valve will be closed on minimum temperature difference and opened to the maximum at maximum temperature difference.

The exhaust air and supply air fans are continuously powered ON as and when this machine is started. There are one pre-filter used in the chamber to filter the air during suction and inducing the air in the chamber.

The enthalpy wheel will be switched 'ON' whenever the temperature sensor T1 is greater than or equal to 16˚C or humidity sensor is less than or equal to 75% otherwise the enthalpy wheel is will remain OFF.

As per the temperature difference between T2 and T3 the speed of sensible wheel is controlled ON. The sensible wheel will run at maximum speed.

CONCLUSION

As we may see that this system operate the analog solenoid valve so its accuracy is better and also this system is energy efficient as it only ON when the enthalpy wheel when T1 is greater than 16˚C or humidity is less than 75% . This system is PLC based automatic system and Automatic system along with the manual overrides facility and also performs in the difficulty in troubleshooting in case of fault occurrence. It also has the authorized level of parameter changing with the password protection so it is quit safe too.

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