AUTOMATED AIR HANDLING UNIT USING PLC AND SCADA

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***Abstract:-*Air Handling unit(AHU), is a device used to manage and flow the conditioned air as a feature of a heating, ventilating, and Air conditioning (HVAC)system. Air handlers normally associate with Duct work ventilation framework that circulates the conditioned air through the structure and returns it to the AHU.In a structure almost 40% of vitality devoured by HVAC framework in a complete structure utilization So comapre to different supplies HVAC types of gear like AHU's and Chiller's are expending more vitality so as to lessen the vitality utilization of the building,Along with that security precautionary measures like engine wellbeing, crisis stop,and Fire Alaram status , Occupancy based control of VAV unit and to improve the System execution and to give adapted air to the floor space need to actualize the new framework Technologies called Automted Air Handling unit Using PLC and SCADA**

The aim of this project is to Automate the air handlig ca unit with the assistance PLC programming and SCADA Screen. AHU screen is created in SCADA , The checking, controlling of preparing parameters of sensors like (Temperature,carbon dioxide, Static pressure, Differential pressure and Air quality senors and DPS and so on..) according to the set point with utilization of PID control ,VFD drives and Energy valves or Motorized valve Actuators are done in genuine time,A Graphical perspective on procedure is watched and recorded.The primary goals are improved tenant solace, proficient activity of structure frameworks, decrease in vitality utilization and working expenses, and improved falsehood cycle of equipment,Typical Air Handling Unit(AHU) is of variable volume type and intended to supply consistent release air temperature and keep up Humidity level ,This is accomplished by controlling rate of the AHU utilizing VFD's and adjusting the valve actuators in chilled water coils.Air is re-circled as a piece of ventilation and furthermore helps in vitality sparing and management,Each AHU has a DDC Controller which controls the AHU in a productive manner.A regular grouping of activity has been made to cover the general usefulness of the AHU operation.Inputs enable a controller to peruse Temperatures, Humidity, Pressure, ebb and flow CHW stream, Air stream, and other fundamental elements. The yields enable the controller to send direction and control sign to slave gadgets, and to different pieces of the framework. .

Keywords-Automation PLC,SCADA ,VFD,PID,Sensors, Actuators

1 INTRODUCTION

A.OVERVIEW

The term Building Automation framework, inexactly utilized, alludes to any electrical control framework that is utilized to control a structures warming, ventilation and cooling (HVAC) system,Most building robotization systems comprise of an essential and auxiliary transport which associate abnormal state controllers (for the most part specific for structure computerization, however might be nonexclusive programmable rationale controllers) with lower-level controllers,input/yield gadgets and a client interface(also known as a human interface gadget). ASHRAE's open convention called Bacnet convention. .

Air dealing with Unit blend return and outside air so less temperature/stickiness molding is needed.This can set aside cash by utilizing less chilled water. Some outer air is expected to keep the structure's air sound. To streamline vitality effectiveness while keeping up sound indoor air quality (IAQ), request control vetilation (DCV)adjusts the measure of outside air dependent on estimated dimensions of occupancy.A progressively productive unit is a "Variable Air Voume (VAV) air-taking care of unit", AHU'S supply pressurized air to VAV boxes, typically one box for every room or zone. A VAV air handler can change the weight to the VAV boxes by changing the speed of a Fan or blower with a Variable Frequency Drive ,The measure of air is controlled by the necessities of the spaces served by the VAV boxes.Each VAV box supply air to a little space, similar to a Cabin,Meeting Room. Each container has a damper that is opened or shut dependent on how much cooling is required in its space. The more boxes are open, the more air is required, and a more prominent measure of air is provided by the VAV air-dealing with unit.A least and greatest CFM must be determined to VAV boxes to guarantee sufficient ventilation and appropriate air balance. Simple or computerized temperature sensors might be put in the space or room, the arrival and supply Air channels , and here and there the outside air. Actuators are set on the chilled water valves, the outside air and return air dampers. The supply fan (and return whether appropriate) is begun and halted dependent on either time of day, temperatures, building weights or a combination.Controllers are basically little, reason manufactured PCs with info and yield.

B.EXISTING SYSYTEM

In Existing *system* AHU's are operated manually and they are unable to see the operating performnce of AHU's motors and chilled water coil.Energy consumed by the fan or blower readings taking manually ,Demand control ventillation is not monitoring while running in manual mode this factor is very important because if in case increase in the C02 level in the building leads to sofocation to the employee ,AHU fan's are running at full speed irrespective of the load we can't reduce the speed of the fan even though load demand is less , hence it is consuming same power for less load also ,as per the survey nearly 40% of energy consumed by HVAC in a building hence reduction of energy in HVAC sytem is more importanr, as we know that while desining the HVAC system they are consider extra 20% load demand, hence nearly 4 to 5 times it will reach to full load in a year So if reduce that 20% of speed also you can save 48.8% of energy and another important factor in case of fire happens in a building it has chances to circulate fire over the building through the HVAC duct and also Automatic emergency stop options not available and maulay operated AHU'S buildings require more man power for operation and maintenace this lead to incerease in operating and maintenance cost.

C. PROPOSED SYSTEM

1. AHU Startup:
Each AHU has its own Time Schedule (adjustable) based on which the unit operates. On receipt of requirement to run from an automated routine or by operator override the AHU will be enabled for operation.
Time Schedule: AHU will run based on the pre-defined time program.
Override On: AHU will be switched On irrespective of time schedule defined.
Override Off: AHU will be switched Off irrespective of time schedule defined.

2. AHU Shutdown:

- The supply fan will be switched Off whenever,
- The AHU is in Override Off OR
- AHU is in Schedule Off OR
- Auto/Manual selector switch is in Manual position OR
- AHU has failed i.e. Supply fan command is On, but status remains Off for pre-defined duration of time delay OR
- Fire/Smoke alarm signal is active

3. Supply Fan VFD Speed Control
The VFD/Bypass selector switch / command should be in VFD mode in order to achieve speed control through VFD drive.
Whenever the AHU is enabled for operation, after completing the optimal start routine, the supply fan will start and ramp to its minimum speed (adjustable). On receiving the run / air-flow status the VFD speed will be varied based on the duct static pressure and its set point.
Whenever the pressure in the duct increases the speed of the drive will be ramped down and when the pressure decreases the speed control signal will be ramped up. This is achieved by using a P+I control routine.
Alarm will be generated in case of the following conditions,

- When the return air temperature is below/above limits
- When the duct static pressure is above limit (as applicable)

4. Chilled Water Valve Control
The Chilled water coil installed within the AHU acts as the medium of heat transfer. The amount of heat transfer is proportional to amount of water being circulated through the coil.
The amount of water flowing through the coil is controlled by a modulating valve using a motorized actuator.
The chilled water valve actuator will be controlled to maintain the supply air temperature at its set point (adjustable).
Whenever the supply air temperature from the AHU increases the valve actuator will be modulated to open. Whenever the supply air temperature in the duct decreases the valve actuator will be modulated to close. This is achieved by using a P+I control routine.
Alarm will be generated in case of the following conditions,

- When the supply air temperature is below/above limits

5. Occupancy based control for AHU
For meeting rooms the occupancy sensors that are being used for lighting controls will be used for controlling HVAC equipment's.
During occupied mode, the VAV will be controlled based on 24°C.
During unoccupied periods, the temperature set-point will be reset.
Unoccupied Temperature Set-point: Reset to 27°C. (Applicable for cabins and meeting rooms

D. GOALS OF THE PROPOSED SYSTEM

Scheduling: Automatic Scheduling guarantees preventive support measures for the hardware. Powers programmed intermittent keeps an eye on hardware and it's keen task.

Comfort: Maintains temperature and stickiness precisely results in diminished temperature and moistness related grumblings from tenants Intelligent use of HVAC dependent on inhabitance level

Energy Management: Active checking and Intelligent control of all real vitality devouring hardware. Recognizes issues in the beginning times - Reduces high upkeep expenses and working expense. Gives vitality utilization reports, clever structure examination.

Integration with 3rd Party for energy meters integration to provide real time energy analytics.
Alerts: Pop-up caution windows. Organizes cautions dependent on seriousness.

It enables building proprietors to diminish their labor, increment tenant's solace and furthermore to expand gear life expectancy.

II. LITERATURE SURVEY

A. RELATED WORK

[[1]. The examination papers and pragmatic investigations on vitality proficiency and vitality sparing possibilities on HVAC frameworks at the structures are exhibited ,Suitable drives for HVAC make keeping up a structures safe place simple, speedy and vitality proficient. The drives control the speed of siphon, fan and blower engines utilized in air taking care of units, cooling towers, chillers and other HVAC applications. They help diminish the HVAC frameworks vitality utilization by up to 70 percent, and regularly have recompense times of not exactly a year.

[2].The paper is hence composed as pursues: After this Overall change/transfer advance starting segment, the technique of pharmaceutical industry vitality review framework is clarified; the goals of the framework is given in III, the portrayal of cooling frameworks, warming framework and VRV/VRF of HVAC are displayed in Section IV. Framework advancement of HVAC frameworks are examined in Section V. Information obtaining and examination on HVAC frameworks are exhibited in Section VI with pragmatic activities. Lastly, the preferences and noteworthy aftereffects of the investigation are outlined in ends.

[3]. Variable Air Volume (VAV) System One of the most famous HVAC applications, the Variable Air Volume (VAV) application, is intended to convey low vitality cost, low support, low warm vitality waste, IAQ and great warm solace execution. In Constant Air Volume (CAV) frameworks, be that as it may, a steady volume of air is provided to the molded space and the supply air temperature is fluctuated with variety of room load. The favorable circumstances by and large ascribed to VAV frameworks are their adaptability in individual zone controlled space and multi zones. By and large, these frameworks are viewed as vitality proficient by plan investigation.

[4].The utilization of vitality by HVAC hardware in mechanical and business structures comprises 40% of the world utilization. The real disadvantage of the steady volume frameworks is that they for the most part utilize more vitality.. Vitality utilization in cooling frameworks is viewed as a basic piece of a structure's useful prerequisite.

III. ARCHITECTURE

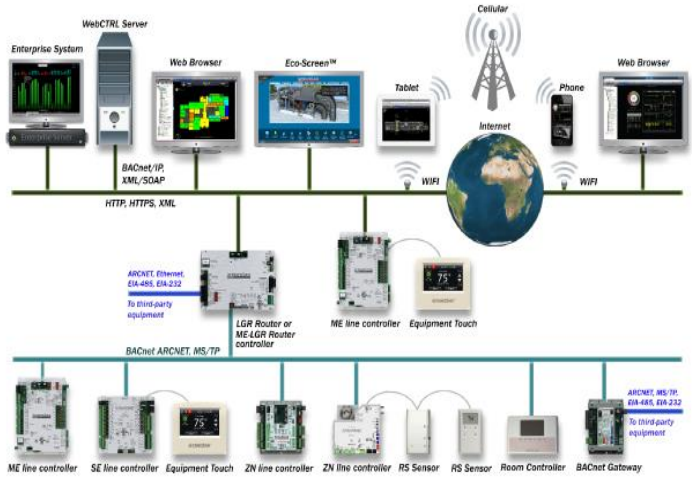

Fig 1: Automation for Air handling unit Architecture

BAS is the place mechanical and electrical frameworks and gear are united with microchips that speak with one another and conceivably to a PC. This PC and controllers in the structure mechanization framework can be organized to the web or fill in as an independent framework for the nearby shared controller arrange as it were. Furthermore, the BAS controllers themselves needn't bother with a PC to process the control capacities as the controllers have their own interior processors.

In an engineering you can see two layers of correspondence conventions, In the last layer the controllers are SE line controllers they are legitimately speak with the field level gear and these controllers accumulate the data from field gadgets and store it and send it to the following dimension controller since this controllers don't have Bacnet correspondence conventions, The following layer controllers which contain Bcanet convention and fills in as passage convert non Bacnet to Bacnet convention.

DDC - Direct Digital Control of a HVAC framework A strategy for checking and controlling HVAC framework execution by gathering, handling, and sending data utilizing sensors, actuators, and microchips.

DDC Control Loop Building Automation

To see Direct Digital Control (DDC) we should comprehend the fundamental control circle. Indeed, even the most capable HVAC control professionals advantage in their work from returning to the essential control circle to tackle issues or stall and comprehend complex DDC control algorithms.For a fundamental DDC Controls or building computerization control circle we have to comprehend three things.

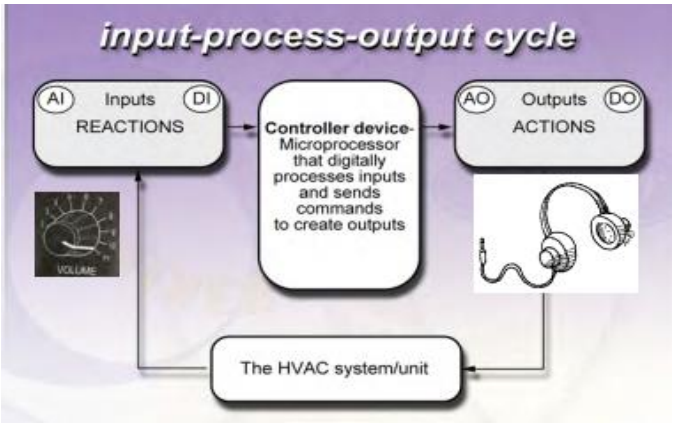

Fig 2: Proposed Framework Block Diagram

Information

The control circle starts with the information sensor or switch. A gadget that estimates something, for example, temperature, dampness, carbon dioxide, carbon monoxide, or even a switch that closes or opens can be the information signal for DDC. DDC building computerization inputs essentially measure a medium or screen the HVAC frameworks, for example, smoke locators and high/low utmost switches. DDC sources of info measure temperature, mugginess, weight, momentum, wattage, and air and water stream among other things.These input gadgets are associated legitimately to the controller for next procedure in the DDC Control Loop

Handling

In the processing,we have a DDC or building mechanization controller to process data which holds the rationale or programming. In this progression the DDC or building mechanization controller is handling the data from the info device(s) and dependent on the calculation, perhaps sending a yield sign to a gadget to make proper move if important

Output

We currently have Input and Processing lastly, we need Output to an Output gadget. This can be either a simple sign or a parallel sign where we turn something on or off or balance something dependent on the information and the program in the processor of the controller.

IV.COMPONENTS

A.ME812U-E CONTROLLER

The ME812u arrangement of controllers have the speed, power, and memory and I/O adaptability to deal with the most requesting control applications in the business. Fit for controlling different bits of HVAC gear at the same time, this strong Bacnet controller can bolster complex control procedures with a lot of memory for patterns, and is able to do outsider joining utilizing other correspondence conventions

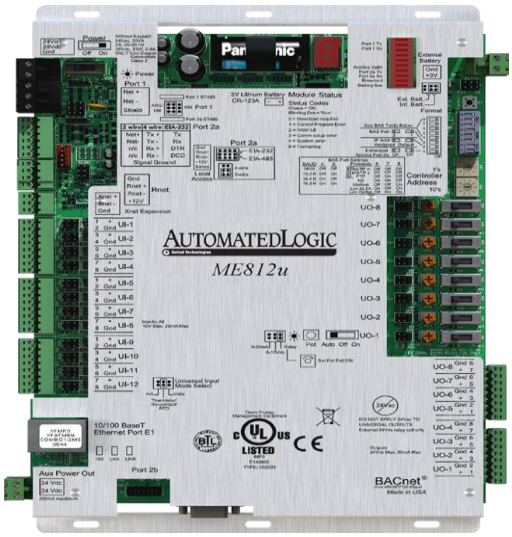

Fig 3: ME812U-E CONTROLLER

The ME812u arrangement of controllers have the speed, power, and memory and I/O adaptability to deal with the most requesting control applications in the business. Equipped for controlling different bits of HVAC hardware at the same time, this hearty Bacnet controller can bolster complex control techniques with a lot of memory for patterns, and is able to do outsider reconciliation utilizing other correspondence conventions.

Equipment Features

•This controller contains 12 all inclusive info and 8 general yield

- High-speed local BACnet correspondences to handle gadgets over TCP/IP, Ethernet, rapid ARCNET 156 K bps or BACnet MS/TP systems
- Universal information sources and yields, with abrogate switches and potentiometer modification accessible on all yields
- Graphically modified with self-reporting control arrangements and a live perspective on all succession segments
- Fully graphically programmable, with full correspondences with other Automated Logic controllers

B. Temperature and humidity sensor

At whatever point the supply air temperature from the AHU expands the valve actuator will be tweaked to open. At whatever point the supply air temperature in the pipe diminishes the valve actuator will be regulated to close. This is accomplished by utilizing a P+I control schedule.

Alert will be produced if there should arise an occurrence of the accompanying conditions,

C. Carbon dioxide Sensor

Demand Controlled Ventilation adjusts the Fresh/Exhaust air flow based on the ventilation demand created by the occupants. This is measured by using a carbon-monoxide (CO2) sensor installed in occupied space or in return air path. The ventilation demand is directly proportional to the number of occupants.

If the CO2 level difference between the ambient and conditioned space increases more 530ppm, the Fresh air and Exhaust air dampers will be modulated to open.

D. Static pressure sensor

Whenever the pressure in the duct increases the speed of the drive will be ramped down and when the pressure decreases the speed control signal will be ramped up. This is achieved by using a P+I control routine

E. Variable Frequency Drive(VFD)

Variable Frequency Drives (VFDs) are a standout amongst the most widely recognized vitality sparing gadgets utilized particularly in Industries. VFDs are introduced in the middle of the electrical power source and the engines.

Fig 4: Variable Frequency Drive(VFD)

These are mainly used in the centrifugal equipment like Pumps fans, blowers etc.

Abbevation VFD is variable frequency drive, VFDs varies the operating frequency (F) & voltage (V) of the incoming electrical supply and keeping the V/F ratio constant (for constant magnetic flux and smooth operation of motor) and thereby controlling the speed of the motor.

In centrifugal equipment, laws of affinity are applicable which says that

Motor speed is always proportional to square times head of the load (pump/fan) and

Motor speed is directly proportional to cube times power consumed (pump/fan)"

i.e. If motor speed is reduced by 10%, the pump/fan flow is automatically reduced by 10%

If motor speed is reduced by 10%, then the pump/fan head developed is reduced by 19% and

If motor speed is reduced by 10%, the pump/fan electrical power consumption is reduced by 27%

V. SOFTWARE TOOL

AUTOMATEDLOGIC
United Technologies

A. WebCTRL Version 6.5

While there's a great deal of buzz around enormous information in the present structures, information is just amazing when it tends to be sorted out, comprehended and used to settle on keen choices. That is the place Automated Logic comes in. We're known all through the business for giving the local essential arrangement of investigative arrangements that convey the understanding, brief activity and verifiable record you need.

Since its start, Automated Logic has concentrated on one goal: to create inventive, canny structure mechanization frameworks that advance operational opportunity, adaptability and convenience. The majority of our equipment and programming items add to an astute

structure biological system — structures that are intended to augment inhabitant comfort, while guaranteeing vitality reserve funds.

With the presentation of the Internet came new open doors for structure control innovations to join with the new worldwide correspondences stage. Not at all like different frameworks that only adjusted to the web, WebCTRL®, Automated Logic's electronic structure mechanization framework, received rising web innovations, making the business' most open, coordinated and full-included savvy building control system. For the first occasion when, we had the capacity to get to data and control structures from anyplace, utilizing a wide range of gadgets. Quick forward to the present: Automated Logic is as yet a world head in vitality arrangements, always making new innovation that makes it simpler than any time in recent memory to investigate, comprehend and appropriately deal with your facility. Our savvy building arrangements endeavor to give vitality productivity and cost reserve funds to our clients. Our WebCTRL item offers highlights, for example, Open ADR, inhabitance based controls, Environmental Index™ device, utility metering and Energy Reports™ bundle, that enable you to expand both tenant solace and vitality investment funds. At Automated Logic, we make information huge to make structures shrewd.

WebCTRL®Building Analytic s

Take a gander at your structure mechanization framework as the social affair place, the storehouse of every single working datum and data identified with your structure. Regardless of whether it is temperature history, utility metering, pattern information or solace estimation, your structure computerization framework must almost certainly insight fully and viably bundle the data you requirement for the executives of your offices. The WebCTRL framework does only that without the requirement for outsider checking or irksome membership administrations.

REFERENCES

[1].“Rotorn regenerative blowers” company. Ltd from blower manual on 1505/2013.

[2].About humidity parameters drawn from practical guide published in ASHRAE journal-April 1999 by Kenneth M. Elovitz, P. E.

[3].About PID and its applications are alluded from the article distributed by American control gathering Arington June 25/27/2001.

[4].Solution of air taking care of units" for 1000 to 10,00 0 CFM manual from YORJ by

Jackson Controllers.

[5]."Air Handling Unit Design For High Performance Buil dings "by J. Michal Carson2001. Purdue University.

[6.].Variable recurrence drives and hypothesis hand book from HSL Automation pvt ltd.

[7].General detail for air dealing with units Ref . A12 June 2011.

[8].About WinCC wayfarer SCADA variant 7 online assistance from Siemens.

[9].Automating with simatic by Hans berger second modified release, 2003.

[10].About presentation PLC, programming essentials, are taken from study materials