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Lab VIEW Based Real Time Monitoring of HVAC System: A Review

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Abstract: **-- This paper reviews the HVAC system. HVAC stands for Heating Ventilating and Air-Conditioning. The air conditioning system is operated in different weather conditions, a system used for controlling the humidity, temperature, and ventilation in building or vehicle to maintain comfortable conditions. The HVAC system used in modern commercial buildings. The LabVIEW is used for interfaces system parameters and evaluation of AC unit performance of an HVAC system. The LabVIEW is used to display environmental as well as electrical parameters, in LabVIEW we can show inside and outside temperature, voltage, current & power, irradiation, wind speed. There is the two-panel window is available first is the front panel and second is back panel. Front panel window interfaces this parameter continuously. This paper present and discusses the evaluation, monitoring, and analysis of an HVAC system. The main objective of this work is to achieve the comfortable temperature of real-time monitoring in all rooms of the residence. The system works effectively in real time and natural environment cooling concepts ensure the heat ventilation system maintain the minimum possible interior temperature. LabVIEW is graphical programming software and it helps us to visualize every aspect of your applications including hardware configuration, measurement data and debugging. In this paper, a real-time measurement and performance evaluation and monitoring system for metrological parameters and electrical variables for HVAC system are proposed. Automatic data acquisition, DAQ, technology made by National Instrument (NI) is used as hardware for monitoring the HVAC system performance. The software of the data acquisition system based on LabVIEW package is used to display, store, and process the collected data in the PC-hard disk. This system provided good support for research and educational purposes.**

Keywords:-- **(HVAC) Heating, Ventilation and Air Conditioning system; Virtual instrument (VI); Real time monitoring; Electrical and Environmental parameters effects, efficiency.**

I. INTRODUCTION

Air-Conditioning systems play a prominent role in residential area owing to its tropical nature characterized by high climate states such as temperature, humidity, warm wind, and dust storm. According to survey [1], around (55 to 65) % of the consumption of electrical energy in domestic buildings is utilized by air-conditioning systems. Thermal model of building has a special importance for assessment and online evaluation since the air conditioning load is consistently varying, the efficient energy consumption became a priority. Monitoring and controlling process variables such as temperature, pressure, flow and level control in system are build using LabVIEW [2]. The corresponding values are measured and converted into digital signals using NI-DAQ and these are controlled in LabVIEW. A temperature measurement module using DS18B20 digital temperature sensor is developed to work as a standalone system. The module is compared with other conventional temperature sensors used in space applications. A temperature and humidity monitoring system is constructed. A set of software by LabVIEW language was compiled. The program is operated in circular manner and automatically. Real-time temperature measurement and control system was developed based on LabVIEW. The monitoring charts displayed reinforce the security of system operation. A LabVIEW based design for humidity and temperature monitoring in ammunition storehouse was discussed. To adjust the storage environment the air condition and dehumidifier were controlled. The development a system to record and analyze parameters like wind speed, wind direction, pressure and temperature using LabVIEW is reported for an off-grid small wind turbine. The functions of the system include data collection, storing and data display. A multifunctional virtual power quality monitoring system is designed and implemented in LabVIEW environment. The root mean square (RMS) value, the waveforms of three-phase voltage and current, the harmonic components, the total harmonic distortion (THD) and S-transform analysis waveforms of the three-phase voltage and current signals can be calculated and displayed in the system .

II. LITERATURE SURVEY

A. Energy consumption of residential HVAC systems: a simple physically-based model

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This paper proposes a simple, physically-based model to simulate electric and heating energy consumption of residential HVAC systems during the year, starting from a limited set of household characteristic parameters. The model relies on fundamental principles of thermodynamics and heat transfer applied to a control volume including solely the air present in the household. The main purpose of an HVAC system is to indoor air quality through adequate ventilation with filtration and provides thermal comfort. Over 70% of residential building in the U.S. use central forced-air distribution systems for heating and air-conditioning purpose. The model proposed in this work uses an approach based on typical air based HVAC system. A control volume analysis, based on fundamental principles of thermodynamics and heat transfer is performed for the volume including solely the air present in the house.

B. Control of HVAC Systems via Scenario-based Explicit MPC

Heating, Ventilation and Air Conditioning (HVAC) systems play a fundamental role in maintaining acceptable indoor comfort levels; reports indicate that HVAC systems in developed countries contribute for approximately one fifth of the total national energy usages [3]. Current practice

shows its limits, with potential energy savings achievable by using systematic building management being estimated from 5% to 30% of the total consumptions [4], [5] . An effective controller for HVAC systems should incorporate time-dependent energy costs, bounds on the control actions, comfort requirements, as well as account for system uncertainties, e.g., weather conditions and occupancy. A natural scheme that achieves the systematic integration of all the aforementioned elements is the Model Predictive Control (MPC) [6]. HVAC system is composed of two parts: the ventilation system, supplying fresh air, and a radiator heating system. Fresh air is supplied by a central balanced ventilation system that operates only between 7:00 and 16:00 during work days. The ventilation system pre-conditions fresh air from outside and distributes it at a temperature of about 20-21°C. Part of this generated air flow is then conveyed directly into the room, while part can be further cooled by a cooling coil. The controllable actuators of the ventilation system are three: two dampers that regulate the opening of the inflow and outflow ducts, and a valve, that regulates the temperature of the air chilling circuit. When the central fan is on, a minimum level of the air flow rate is supplied independently of the occupancy level in the room. The heating system uses instead radiators as final units. The hot water circulating in them is provided by a district heating system and has a temperature that is determined by the external temperature conditions. The unique controllable actuator is the valve regulating the flow of the hot water. In particular, successful implementations are likely to be based on stochastic MPC schemes with probabilistic constraints, i.e., the so called chance constrained MPCs.

C. IoT-Based HVAC System for Future Zero Energy Building

HVAC systems are significant parts of ZEB technologies. However, the existing HVAC systems have several problems. To solve the problem, in this paper, we propose a IoT-based HVAC system (I-HVACS) for indoor air quality (IAQ) management and reduction of building energy consumption. The I-HVACS is implemented and demonstrated in a real building. The power consumption in the building is reduced by about 13.7% compared with the existing system. ZEB is nearly 100% energy self-sufficiency that balances the energy consumption and production of the building. Already, ZEB technologies such as passive and active house technologies are being explored to increase energy production and reduce energy consumption .On the other hand, a primary goal of the buildings is to provide shelter, to live, to secure space and to facilitate a comfortable environment for the occupants. This means that the ZEBs need to provide a comfortable environment with 100% energy self-sufficiency. if occupants are not provided with comfortable conditions, occupants often adapt in the most convenient and responsive way rather than in energy saving ways. Therefore, the comfort of occupants should be considered together with energy savings when ZEBs is designed and managed. With such necessities, the HVAC systems have been installed to operate in buildings. However, existing HVAC systems have several problems. The biggest problem of existing systems is their low extensibility and convenience, because they are operated without considering the building's purpose and the surrounding environment. To solve the problem, in this paper, we propose a IoT-based HVAC system. For each of floors and spaces, the I-HVACS that is installed in an IoT sensor network environment, manages fans and air conditioning system according to the characteristics of each of the them.

III. SYSTEM ARCHITECTURE

Following figure show the block diagram of HVAC system.

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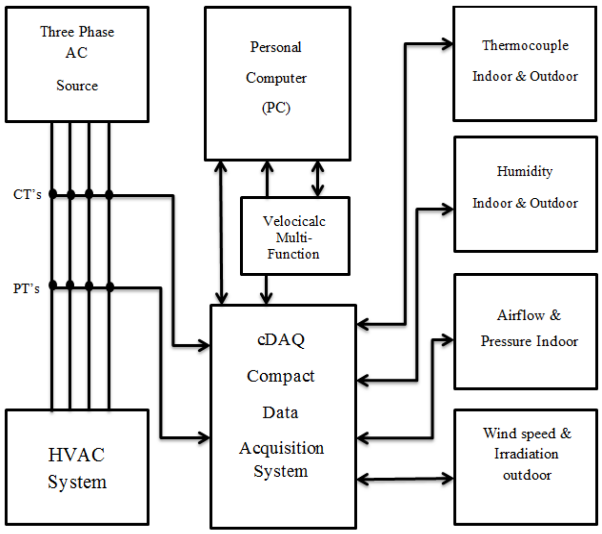

Figure1: Block diagram of HVAC monitoring and measurement system

A. Data Acquisition System

LabVIEW is a software program, which is normally taken as an instrument of virtual equipment and automation, it is used for system development to measure and analyze the data. Essentially this entire system involves the integration of sensors devices, personal computer (PC) and data acquisition (DAQ). The DAQ system has involved physical input/output signals, DAQ device/hardware, the driver software and the relevant software application.

IV. SYSTEM WORKING

The system measures several physical and electrical variables, as well as environmental parameters and stores the data on Excel files that will allow the evaluation and analysis of the data. Data acquisition systems incorporate signals, sensors, actuators, signal conditioning, data acquisition devices, and application software. The purpose of data acquisition is to measure an electrical or physical phenomenon such as voltage, current, temperature, pressure, or speed. PC based data acquisition uses a combination of modular hardware, application software (LabVIEW), and a computer to take measurements. LabVIEW programs are called virtual instruments (VI). The front panel is the user interface of the VI. Front panel with controls and indicators permit interactive actions of the VI. It allows an operator to input data into or extract data from a running virtual instrument. On the other hand, the Block diagram contains the graphical representation of function to control the objects that appears as terminals. Terminals are the entry and exit ports that exchange information between front panel and block diagram. In the block diagram, a DAQ Assistant block is dropped and placed. The DAQ Assistant is a configuration based step by step wizard that allows you to set up your measurement. Click on acquire signal, analog input, and temperature and then select thermocouple for measuring temperature. Next choose a channel 'AI 0' where thermocouple is connected to module 9219. Click finish, DAQ Assistant will present a series of options that can use to further configure and customize the measurement. Click OK button, the DAQ Assistant automatically generate the code in the background. Select the chart and connect the two together for data transfer. The data was visualized on the front panel. Similar procedures are applied to add all electrical and environmental parameters measurement. After getting the voltage and current, we multiply the current and the voltage to calculate the power. Later calculations will allow us to arrange the data in an array, showing the data in the table, storing the data on the files and the plotting of parameters, such as the RMS voltages, RMS currents, solar irradiation, power, temperature, wind speed, pressure, etc. that are also monitored on front panel through graphical representation on LabVIEW.

V. CONCLUSION

HVAC System performance monitoring system was achieved using LabVIEW VI modules. The completely integrated system achieved real time measurements of HVAC System for Residential Load. The developed LabVIEW shell was running for all month continuously under different environmental conditions. The shell succeeded to of display several parameters and variables simultaneously. The multi-scale window frame capability shows very useful correlation analysis, for education and control purposes. The developed graphical LabVIEW modules were smoothly communicating with several hardware components at a time. The measured environmental parameters and instantaneous voltages and currents as well the corresponding averages were successfully tracked, appended and stored. The development of LabVIEW block diagram module were easy to reach, flexible, fast to follows and to display. The measurement and monitoring based on LabVIEW features and capabilities in such real time manner provide a very rich and educative environment about the comfort objective inside the house and would allow a better control for efficient energy use.

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