IoT Based Sensor for Humidity and Temperature Measurement in Smart HVAC Systems

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Abstract*: The initials HVAC stand for Heating, Ventilation and Air Conditioning. They describe the functions of an HVAC system. This mechanical system's design is primarily an attempt to take control of the environmental conditions inside the space of work by controlling and monitoring the temperature of a room through heating and cooling. It also controls the humidity level in that environment by controlling the movement and distribution of air inside the room. For determining the temperature and humidity, costly sensors are required. These sensors are the traditional mechanical sensors which can't offer any additional services like cloud support, data storage, etc. Hence here I am proposing an IoT based sensor with cloud data storage using Arduino-Uno development board, ESP8266 and Thingspeak cloud. This sensor is economical and supports automatic reading and controlling of the humidity and temperature and sends this data to a secured server and thus monitors and controls the temperature and humidity of the system.

***Keywords*: Arduino-Uno, Humidity and temperature measurement, Internet of Things, Smart HVAC systems.**

I. INTRODUCTION

In the past few years a lot of new technologies have been developed like IoT, cloud computing, machine learning, artificial intelligence, data science and data analytics.

This all was possible with the growth of internet. The modern electronic gadgets and devices are increasingly connected to internet for automation, control and data observation. This developments lead to the growth of Internet of Things.

II. CONCEPT OF SMART HVAC SYSTEM

Smart HVAC system is a HVAC system that integrates a smart sensor for humidity and temperature measurement with cloud storage support. The HVAC system connects to the internet with wireless access. The data of temperature and humidity is stored in cloud server using the Wi-Fi module.

III. SYSTEMATIC FRAMEWORK FOR IOT BASED SMART HVAC SENSOR

The IoT based smart HVAC system is a result of massive development in the internet and electronics technology. The aim is to develop an embedded system which consist of temperature sensor, humidity sensor, Wi-Fi module and microcontroller for data reading, wireless communication and processing capability to establish a transparent HVAC system for user [1]. The framework for the IoT based smart HVAC system is shown in Fig.1.

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The smart HVAC system block contains humidity and temperature sensors, microcontroller development board, voltage regulator, dc fan and Wi-Fi module.

The smart HVAC system block is interfaced with the cloud server through internet. All the data is stored in the cloud server. The user can access the data stored in cloud using a computer through internet.

IV. SYSTEM DESIGN FOR IOT BASED SMART HVAC SYSTEM

The smart HVAC system basically consist of sensors, microcontroller, Wi-Fi module. User can easily monitor the data of humidity and temperature in a given space.

The main function is the complete real time monitoring of the environment, temperature and humidity of the given space, automatic controlling of temperature and to transmit information to the cloud server using wireless network. The smart HVAC system is comprised of embedded controllers, supporting hardware devices and functional modules [2]. The system design is shown in Fig. 2.

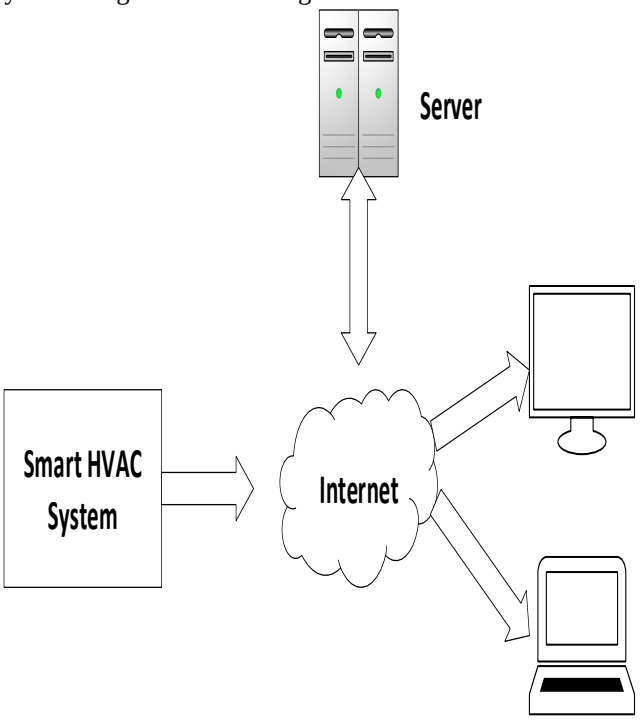

Fig. 1 Framework for IoT based smart HVAC system

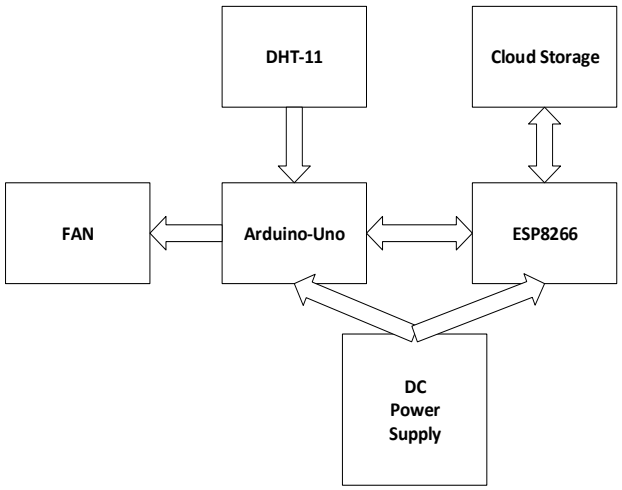

Fig. 2 System design of smart HVAC system

V. IMPLEMENTATION OF SMART HVAC SYSTEM

A. IoT Gateway

In the entire smart HVAC system, the IoT gateway plays a very important role. It works as a bridge between traditional HVAC system and server. It obtains data from the sensors by controlling terminal communication through serial ports and transmits data to the cloud server through the Wi-Fi module [3], [4], [5].

The DHT-11 sensor sends temperature and humidity data to the Arduino-Uno development board. The microcontroller development board is interfaced with Wi-Fi module ESP-8266.

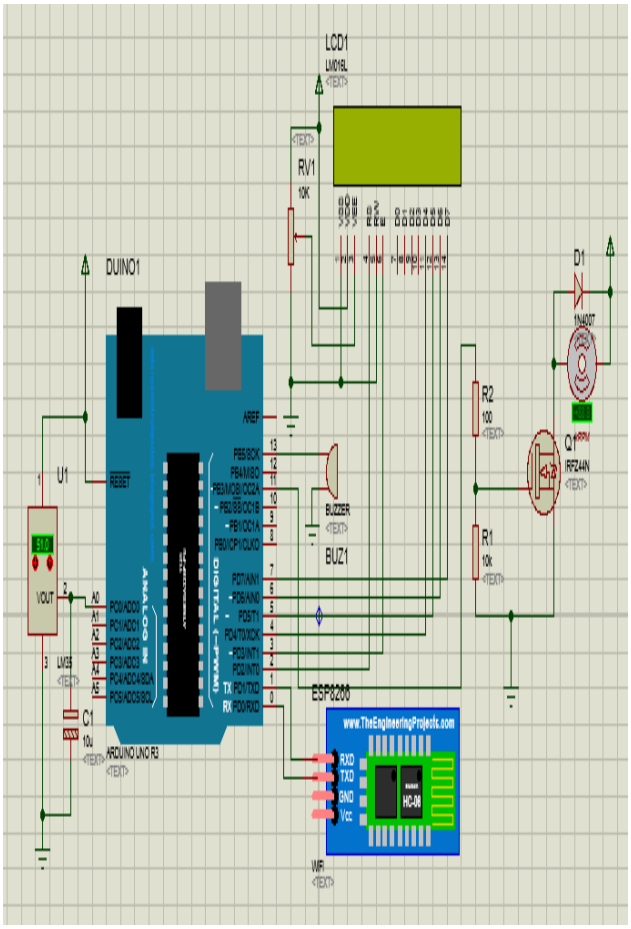

Fig. 3 Network interfacing for smart HVAC system

The data is processed in the microcontroller board and then it is feed to Wi-Fi module. The cloud server is interfaced with HVAC system through internet. The humidity and temperature data are stored in cloud and can be represented in tabular and graphical form. The fan is temperature controlled and its speed depends upon the temperature of the system.

B. Web Server

The main function of the IoT Based Smart HVAC System is to connect a traditional HVAC system to the Internet. The role of the Web server is to display on internet the data stored in the database for the humidity and temperature in order that users can easily view through the Web server at any time information like status, temperature and humidity, etc. of the HVAC system. The website used for the IoT based smart HVAC system is Thingspeak. A system home page can be seen on the interface and information for humidity and temperature can be checked after login.

VI. SYSTEM TESTING, RESULTS AND DISCUSSION

Installation of sensors, microcontroller development board, Wi-Fi modules, has been properly done. Environmental parameters like temperature and humidity of a given space can be checked on the server. Real time monitoring of the data on cloud server through internet is implemented. All the system devices like sensors, microcontrollers, modules have been tested before use. Software capability is also tested. The following result has been obtained from the software testing.

Fig. 4 Humidity data on server

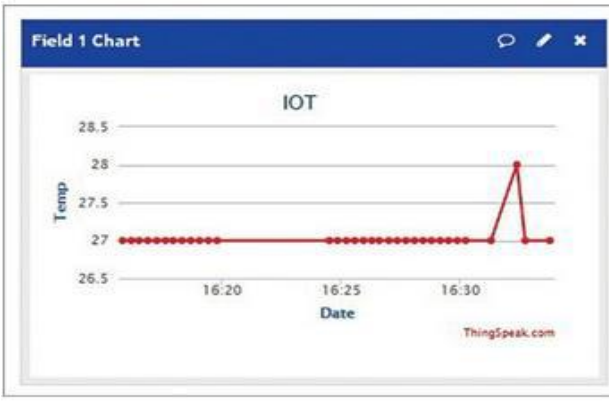

Fig. 5 Temperature data on server

Fig. 6 Temperature and fan speed on LCD

Table- II: Temperature, Humidity and Fan speed data on web server

Temperature (C)	Humidity	Fan Speed
25	34	37%
27	35	42%
28	37	45%
30	42	52%

VII. FUTURE SCOPE

The system can be further modified to control the fan through internet. The system can also be modified by interfacing Bluetooth module in order to control fan speed using mobile phone applications.

VIII. CONCLUSION

In this paper, an intelligent HVAC system based on IoT has been studied, an integrated framework for the system has been introduced in detail, hardware and software were implemented and tested. With this system, information between a HVAC system and the Internet can be shared by connecting the whole system to the Internet. This data is stored in csv files on the cloud server and can be represented in the form of graphs and charts. Control of temperature is achieved using an automatic fan whose speed is proportional to the temperature of the system. The system is robust, efficient, economic and highly reliable. A HVAC system with sensor network is therefore implemented. The system has large data storage on cloud.

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