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Room Temperature Based Automation on Air Conditioning

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ABSTRACT: this project started out as a classic A/C modification by adding a thermo regulator and maintaining a comfort temperature in our surrounding with respect to the room temperature. There are lots of techniques implemented to control the combination of cooling and heating element, which makes it more automated. Further it can be controlled and monitored by using IOT technology. The air conditioning with the help of this proposed system makes us more comfort throughout the year irrespective to the climatic condition. The combination of heating and cooling unit into a single air conditioner makes our device to be a portable one.

KEYWORDS: Air Conditioning, Heating Unit, Cooling Unit, Sensing Element (temperature and humidity), IOT.

I. INTRODUCTION

We are in the era where automation is available in each and every device. The controlling of those devices is available within our hands in the form of mobile applications. Such a way in our proposed system we are going to control our air conditioner by means of IOT. The controlling process itself the second step of innovation. People nowadays are mainly conscious on the comfort for every household devices in which they are spending their money. In our proposed air conditioning system both the heater and cooler units are combined into a single air conditioning system. And air conditioning is based on sensing the room temperature and humidity in the surrounding air. Thus the device leads to maximum comfort and tends to be a portable one than existing device.

In this Project, Node MCU ESP8266, Motor Driver Circuit, PIR(Proximity Infrared Sensor), DHT 11 Sensor (Temperature and Humidity Sensor) as input, Air Conditioner (Combination of Heater and Cooler) and Softwares like Android Studio, Arduino IDE and THINKSPEAK(matlab) are used.

II. DETAILED STUDY

The normal Air conditioner can be made as combining form of heater and cooler purpose by mechanically embedding heater coil in the air conditioner. The controlling (on/off) can be achieved by using 1) Motor Driver Circuit which acts as Pin Enable Relay. 2) Node MCU ESP8266 which is an open-source firmware and development kit is used to control all over the air conditioning system and sensing elements. The MCU is programmed based on code like Arduino but interactively in LUA script. 3) DHT11temperature and humidity sensor is used to sense the room temperature and humidity in air and gives its output to Node MCU ESP8266. 4) PIR (Proximity Infrared sensor) which detects the presence of human in the surrounding by sensing the temperature from the human body. 5) Actuator is used to switch the operation of heater or cooler based on the readings given by the DHT11 sensor. The whole arrangement is controlled by using mobile application. For this process we are using Cloud technology. The motor driver circuit acts as pin enable relay which gives necessary supply for primary elements. Manual operation can be also made in our proposed system. Hence Button and Remote Control is also provided.

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III. PROPOSED ARCHITECTURE

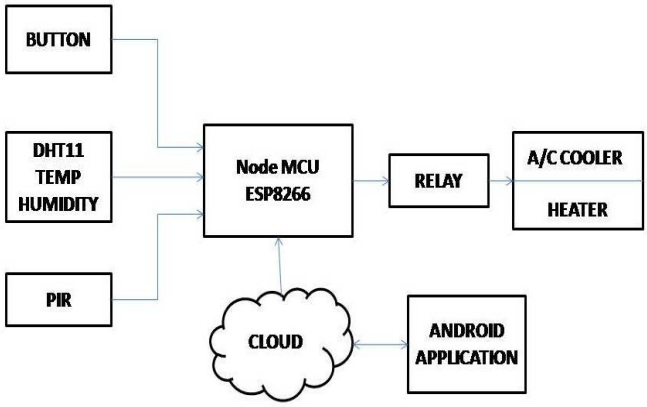

Fig: 1 Block Diagram

Architecture contains the NodeMCU ESP as a central unit and two sensors i.e DHT11 (combination of temperature and humidity sensor) and PIR(proximity infrared sensor) are connected to MCU. For manual control button is also provided as input.

As shown in fig 1 sensor is connected as input to the MCU. The threshold temperature and humidity is pre-programmed in MCU. The MCU switches the relay as well as actuator based on the readings given by the sensors. Once the sensor sensed ratings lesser than threshold level A/C works as heater. If it sense rating less than the threshold level A/C work as cooler. The actuator is the one which switches the operation between heater mode and cooler mode. The whole arrangement is monitored as well as controlled (switching operation) by mobile application by means of cloud technology.

A) DHT 11 SENSOR

DHT11 temperature and humidity sensor features a temperature and humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

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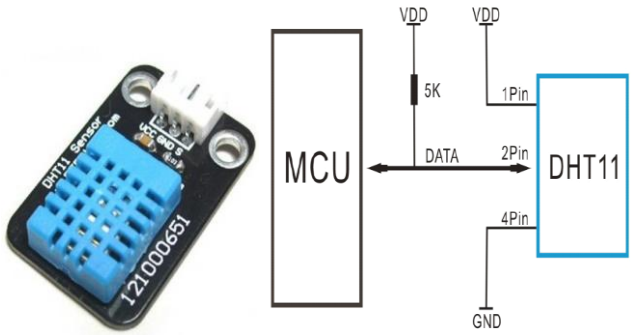

Fig: 2 DHT11 Block Diagram

B) PIR

PIR sensor allows us you to sense motion of humans. It is always used to detect whether human has moved in or out of the sensors range. These sensors are small, inexpensive, low-power, easy to use. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.
PIRs are basically made of a pyroelectric, which can detect levels of infrared radiation. Every object emits some low level radiation,
That particular radiation is sensed by PIR sensor. The pin is enabled when the PIR senses any object and the A/C will be turned ON.

Fig: 3 PIR Sensor

Specifications

- Voltage: 5V -20V.
- Power consumption: 65mA.
- Temperature: -15°c to +70°c.
- Delay time: Adjustable (0.3mins).
- Sensing range: less than 120 degree, within 7 meters.

The PIR sensor itself has two slots. Each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the

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sensor).When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors.

C) NODE MCU ESP8266

The Node MCU is an open-source firmware and development kit that helps us to Prototype our IOT product within a few Lua script lines.

Fig: 4 Node MCU ESP8266.

Features:

- Open-source.
- Interactive.
- Programmable.
- Low cost.
- Simple.
- Smart.
- WI-FI enabled.

It facilitates arduino like hardware IO which has advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware.Code like arduino, but interactively in Lua script.

Specification:
The Development Kit based on ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board.
Power your development in the fastest way combining with Node MCU Firmware.

- USB-TTL included, plug & play.
- 10 GPIO, every GPIO can be PWM, I2C
- FCC CERTIFIED WI-FI module.
- PCB antenna.

Hardware connections

The hardware connections required to connect to the ESP8266 module are fairly straight-forward but
There is a couple of important items to note related to power as follows:

- The ESP8266 requires 3.3V power.
- The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs, so we need level conversion to communicate with a 5V microcontroller like most Arduino.

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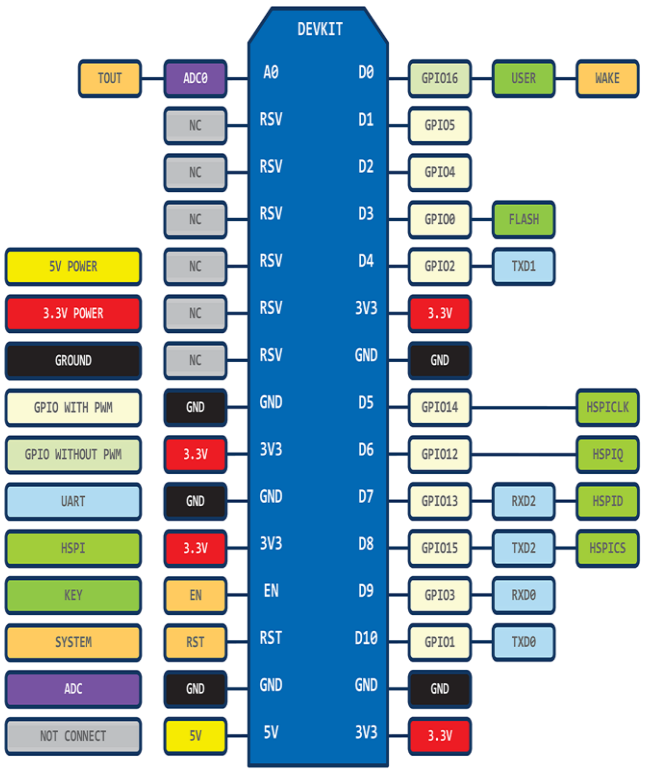

Fig: 5 Node MCU ESO8266 Pin Configurations.

D) RELAYS

There are two relays used in our proposed system to overcome the current deviation between heater and cooler.

The relay module is an electrically operated switch that allows you to turn on or off a circuit using voltage and/or current much higher than a microcontroller could handle. There is no connection between the low voltage circuit operated by the microcontroller and the high power circuit. The relay protects each circuit from each other. The each channel in the module has three connections named NC, COM, and NO. Depending on the input signal trigger mode, the jumper cap can be placed at high level effective mode which 'closes' the normally open (NO) switch at high level input and at low level effective mode which operates the same but at low level input.

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Fig: 6 RELAY.

Specifications

- On-board EL817 photoelectric coupler with photoelectric isolating anti-interference ability strong
- On-board 5V, 10A / 250VAC, 10A /30V DC relays.
- Relay long life can absorb 100000 times in a row.
- Module can be directly and MCU I/O link, with the output signal indicator.
- Module with diode current protection, short response time.
- PCB Size: 45.8mm x 32.4mm.

Pin configurations

Pin 1. VCC: 5V DC

Pin 2. COM: 5V DC

Pin 3. IN1: high/low output

Pin 4. IN2: high/low output

Pin 5. GND: ground

E) A/C COOLER

The normal air conditioner consists of a compressor inside it. It works to compress and pump the refrigerant gas. Compression of refrigerant produces heat. To dissipate this heat, compressed refrigerant is pumped to the condenser coils where a fan blows the heat to outer atmosphere. During this process, refrigerant takes the liquid form. The liquid refrigerant is pumped towards the refrigerant valve. Expansion valve releases the appropriate amount of refrigerant to evaporator (cooling coils) where liquefied refrigerant takes gaseous form. Conversion from liquid to gaseous state due to expansion causes cooling because energy is absorbed from the surrounding. When Air passes through fins get cooled

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and blown to the room. The gaseous in cooling coils then enters the compressor and gets compressed once again. The cycle continues unless the compressor is shut down.

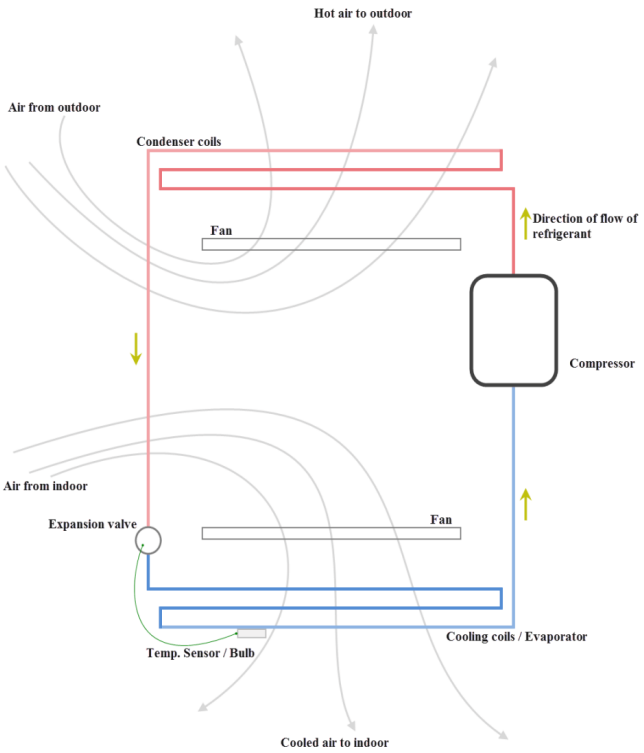

Fig: 7 AIR CONDITIONER MECHANISMS

In a nutshell, air conditioner draws heat from indoor and releases it to the outdoor. Indoor acts as source and outdoor acts as a sink for heat.

The cooler used in our system requires supply of 220V, 30 amps.

F) A/C HEATER

A heating element converts electricity into heat through the process of resistive or Joule heating. Electric current passing through the element encounters resistance, resulting in heating of the element. Unlike the Pettier effect, this process is independent of the direction of current flow.

Copper is the widely used as heater coil because of its high thermal conductivity and its physical properties.

COPPER

Copper is a chemical element with symbol Cu and atomic number 29. It is a soft, malleable, and ductile metal with very high thermal and electrical conductivity.

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G) FLOW CHART:

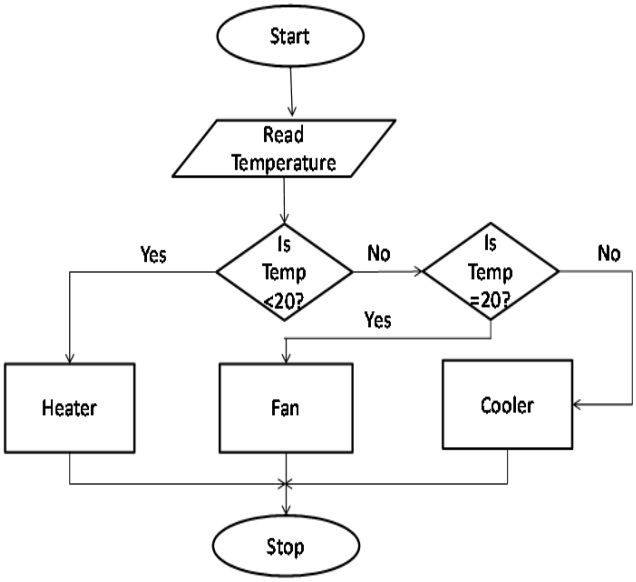

Fig: 8 Flow Chart

Steps in the Process:

1) Considering threshold temperature as 20.
2) Initially read the Room Temperature.
3) If temperature is less than threshold limit then activate HEATER.
4) If temperature is greater than threshold limit then activate COOLER.
5) If the temperature is equal to the threshold limit then activate Fan mode of operation.
6) Stop.

IV. MOBILE APPLICATION:

Our device is also controlled and monitored by mobile application using IOT. Server and Client are the two fundamental elements of our app. Server is our mobile app and client is the customer. Client gives order to the server and the server get activated according to the comment given by the client.

Configuration:

GPIO5 : Heater
GPIO4 : Cooler
GND : Stop

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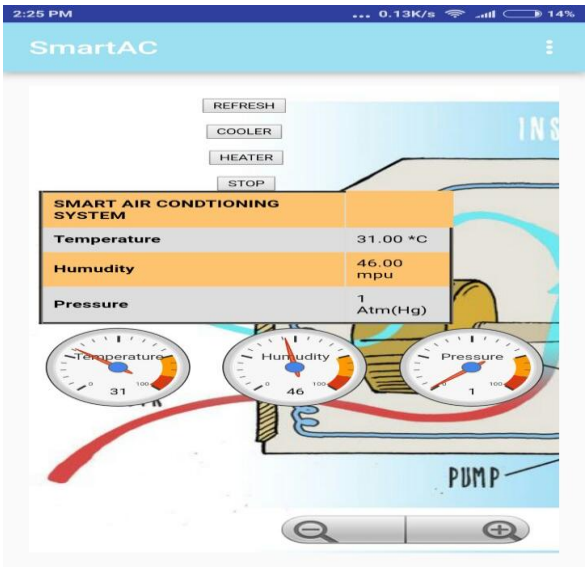

Fig: 9 Mobile Application

- The control and monitoring process can be carried out in this system by android application.
- It has the readings of the heater and cooler unit.

It also have options like REFRESH, COOLER, HEATER AND STOP options for manual operations

V. LITREATURE SURVEY:

Jun Wei Chuah [1] Localized Heating for Building Energy Efficiency, Commercial and residential buildings account for a large share of any country's energy consumption (*e.g.*, 40% of total energy consumption in the United States). Within buildings, a major portion of the expended energy is used to provide heating and the cooling purpose. However, most buildings are heated and cooled regardless of the occupants' locations, presenting a significant opportunity for improving their energy efficiency.

Carol Caceres [2] Transient Modeling and Validation of Chilled Water Based Cross Flow Heat Exchangers for Local On-demand Cooling in Data Centers, Hybrid air/liquid cooling systems used in data centers enable localized, on-demand cooling, or "smart cooling" using various approaches such as rear door heat exchangers, overhead cooling systems and in row cooling systems. These systems offer the potential to achieve higher energy efficiency by providing local cooling only when it is needed, thereby reducing the overprovisioning that is endemic to traditional systems. At the heart of all hybrid cooling systems is an air to liquid cross flow heat exchanger which regulates the amount of cooling that the system provides by modulating the liquid or air flows or temperatures.

Koichi Hirose [3] possibility of enhancements of cooling performance on heating surface by intermittent of jet flow, A possibility of an improvement of cooling performance on the surface of heating elements by using an intermittent jet flow a geyser in nature. An impinging jet flow is widely used for electronics cooling such as CPU coolers and advanced mini-channel devices because the high heat transfer performance can be generally obtained.

Gavish Bhatia [4] Room Temperature based Fan Speed Control System using Pulse Width Modulation Technique, The design and simulation of a novel fan speed control system based on room temperature using Pulse width Modulation Technique. The duty cycle is made to vary according to the room temperature and the fan speed is controlled

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accordingly. This paper elucidates how the autonomous speed control of fan is done based on data from the temperature sensor. The design proposed here is appropriate according to the modern lifestyle.

VI. CONCLUSION

Thus our system has lot of techniques implemented to control the combination of cooling and heating element, which makes it more automated. The combination of heating and cooling unit in a single air conditioner makes our system more economical.

VII. FUTURE SCOPE

1. Energy consumption can be made better
2. Advanced sensors can be implemented for commercial purpose.
3. High thermal Insulating material can be used between heater and cooler unit.
4. Voltage fluctuation can be improved.

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