

Heating, Ventilation and Air Conditioning System Using RASPBERRY PI and Interfacing Touch Screen

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Abstract - The title of the research is "Heating, Ventilation and Air Conditioning system using Raspberry Pi".

The research is the model of the small and large scale of Building management automated system. The operation of the research is to control four chambers simultaneously on different temperatures taken directly from sensors and showed on screen while providing sufficient cooling/heating. All four chambers containing smoke sensors to detect and monitor smoke effect. The cooling/heating in a chamber is circulated by a fan. Comfort application for different structure building types are relatively dissimilar and is designed according to the need of process applications and the need of the buildings and with the aim to provide a suitable environment for the people and things conceded out, despite of inner temperature and humidity loads and external climate situation. The significance of this research is that whenever the desired temperature is reached, the system stops and the temperature is monitored. When the temperature is out of the desired condition the Peltier starts and cooling/heating is circulated by the fan. The working of temperature controlling system is directly proportional to the room temperature while keeping the required temperature constant.

Key Words: RASPBERRY PI, Touch Screen, Expansion Board of PI and Model B+.

1. INTRODUCTION

Energy savings and thermal comfort are important for both facility managers and occupants. As a result, they are open to new and innovative ways or even replace currently existing practical methods that might not keep pace with the most recent advancement in the technology. The aim of the research is to meet the cooling and heating requirement of home automation and BMS with continuous monitoring. This research is offering centralized security for temperature monitoring as the touch screen is interfacing with it. It can be applicable to

any automated house or buildings. As far as the internal working is concerned hidden inside the chambers. The research will aim to control the Peltier unit to provide sufficient cooling or heating to the four chambers. The four chambers are designed to maintain different temperature as according to the requirement. The research is interesting in that sense that we utilize the controlling of Raspberry PI, we have to design the automation system that will give the temperature in each chamber and then monitors it after a few minutes that will be set by the user. The temperature will be shown on a touch screen which is operated automatically from Raspberry Pi. The most suitable technique for reducing power consumption introduced in this paper by using BMS & the HVAC system for optimizing the electric energy. The main vision to install BMS & HVAC systems in Karachi firstly as it is the biggest city and the industrial HUB of Pakistan having many multi-national companies are situated there. Besides this many huge residential, shopping and educational buildings consume the extra amount of power.

Economical Consideration – the primary thing that rings a bell when selecting an undertaking is whether it is prudent or not. The accomplishment of a venture is specifically interfaced to it being temperate or not. This venture is truly efficient when contrasted with the compressor plan as it has less upkeep fetched furthermore framework is programmed and mechanical structure of the undertaking is wooden based which makes it much less expensive than having a mechanical structure of metal.

The maximum objectives to achieve were To Interface touch screen with raspberry Pi, Centralize cooling and heating of chambers, Data logging, Emergency alarm against smoke, Analog to digital conversion through Microcontroller.

System statement of scope – In the development the system is termed for heating and cooling system that are deliberated to effort a supplementary system aimed at the BMS and Home Automation of the research is to meet the cooling and heating requirement for BMS and HOME AUTOMATION through touch screen monitoring using Raspberry Pi.

It has a monitoring system that will be operated by the user to set the desired time. All four chambers can accommodate with different four temperatures. Cooling and heating is carried out by peltier. Whereas the research provides a smoke free secure environment in all four chambers.

1.1 Building Automation System– More mind boggling HVAC frameworks can interface to Building Automation System (BAS) to permit the building holders to have more control over the warming or cooling units. The building holder can screen the framework and react to cautions created by the framework from nearby or remote areas. The framework can be planned for inhabitation or the arrangement can be transformed from the BAS. In some cases the BAS has specifically controlled the HVAC parts. Contingent upon the BAS distinctive interfaces can be utilized.

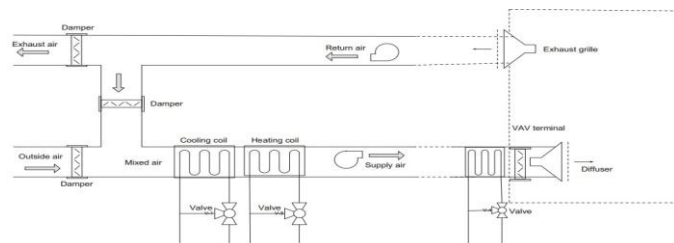


FIGURE [1] DIAGRAM OF A TYPICAL HVAC SYSTEM

1.2 HVAC AND RASPBERRY PI

The HVAC system can be defined as the measure by which the building or the system lives up to its design purpose in a real life situation. It is a control system that applies regulation to a heating and/or air conditioning system and it is also a control framework that applies regulation to a warning and/or ventilating framework. Generally a sensing gadget is utilized to analyze the real state (e.g, temperature) with a target state. At that point the control framework reaches an inference what move must be made.

The RASPBERRY PI is a minimal effort, charge card measured machine that fittings into a machine screen or TV, and practices a typical console and mouse. It is a

skilled little gadget that empowers individuals of all ages investigate figuring, and to figure out how to program in Dialects like Scratch and Python. It's fit for responsibility all that you'd anticipate that a desktop machine will do, from scanning the web and playing high-definition feature, creating spreadsheets, word-handling, also playing diversions. The Raspberry Pi can associate with the outside world, and has been utilized as a part of a wide exhibit of advanced creator ventures, from music machines and guardian finders to climate stations and tweeting bird enclosures with infra-red cams. We need to see the Raspberry Pi out how to program and see how machines function.

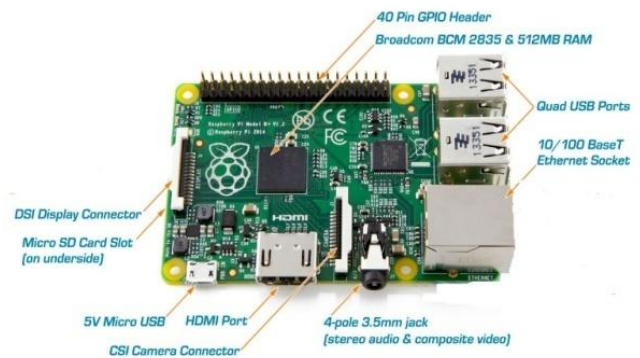


FIGURE [2] RASPBERRY PI ELECTRONIC MODULE

2. WORKING OF THE SYSTEM

The versatile design of the Heating, Ventilating, and Air-Conditioning (HVAC) required different handoffs with activities through a professional practitioner of different engineering field. A typical variable air volume (VAV) heating, ventilating, and air conditioning (HVAC) system includes a chiller, a chilled water cooling coil, a heating coil, a mixing box, a supply fan, a return fan, pumps, dampers, and VAV boxes [13]. AA schedule of operations and occupancy is highly important for energy efficiency in HVAC systems. To minimize the use of energy in HVAC system it needs to be turned off and protects from over conditioning and fan or pump operation. Therefore the HVAC system operates only when necessary. The possible reducible method for energy is to use the regular scheduling of the buildings with the help of timers to start and stop functions for operation and maintenance (O&M) automatically so that the peak possible performance of the whole mechanical systems of the building. The thermal system designed to require your choices to make it comfortable. The design should be as good as the execution and neglects the bed replacements to avoid misunderstanding of the system. Continuous commissioning is the best operation and maintenance

practice, improve energy up to 20 %. System performance is the key approach for good O&M and HVAC. The thermal comfort of the use of the energy specified should be continuously provided in the HVAC design. Commissioning agents are responsible to perform the audits and in future the improvement in technology would increase the performance of HVAC with unique design.

The operation in a system that we are designing based on cooling and heating and to maintain temperature in four different chambers simultaneously. The temperature is monitored through the microcontroller. The Raspberry Pi is responsible for switching Peltier on and off. As the system starts LM35 the temperature sensor will sense the temperature. The analog signals will then get converted to digital then provide Raspberry Pi with digital data through the microcontroller. If the temperature is not up to the level, Raspberry Pi will switch the Peltier on. In case of heating chamber the desired temperature will be attained by raising the temperature above the room temperature. In case of cooling chamber the temperature will be dropped below the room temperature. The outdoor airflow rate is determined using the damper model, and fan power and the airflow are determined using the fan model. The cooling calculated through the detailed cooling coil mode [14].

Raspberry Pi will compare the voltage level according to the programming and will take the decision whether to switch on the Peltier or not. The program is in Raspberry Pi where the digital data will be given by the microcontroller through the sensors in the room. Data logging is there to monitor the entire scenario. The circulation of the temperature throughout the chamber will be carried by the fan. On reaching the desired level the fan and the Peltier will turn off. The batter will be turned on/off through the switching of the relay. All four relays are used for the Peltier devices and 2 are used for the blind. Microcontroller converts the analog signals to digital signals. A 10-bit (ADC) Microcontroller is used for the process. All chambers must remain smoke free. MQ2 has been utilized for the sensing of smoke. With the help of solenoid valve, the fluid or gas stream is controlled when electric current passes through it, simultaneously opening its valve to ventilate air. Moreover, touch screen is also taken to aid which demonstrate the temperature and helps to maintain checks and update it.

Further, expansion board is attached below the touch screen to process information and exhibit programming

again. The touch screen has the capability of information logging which can show the history of each chamber and this information could be accessed by the client.

3. FLOW DIAGRAM

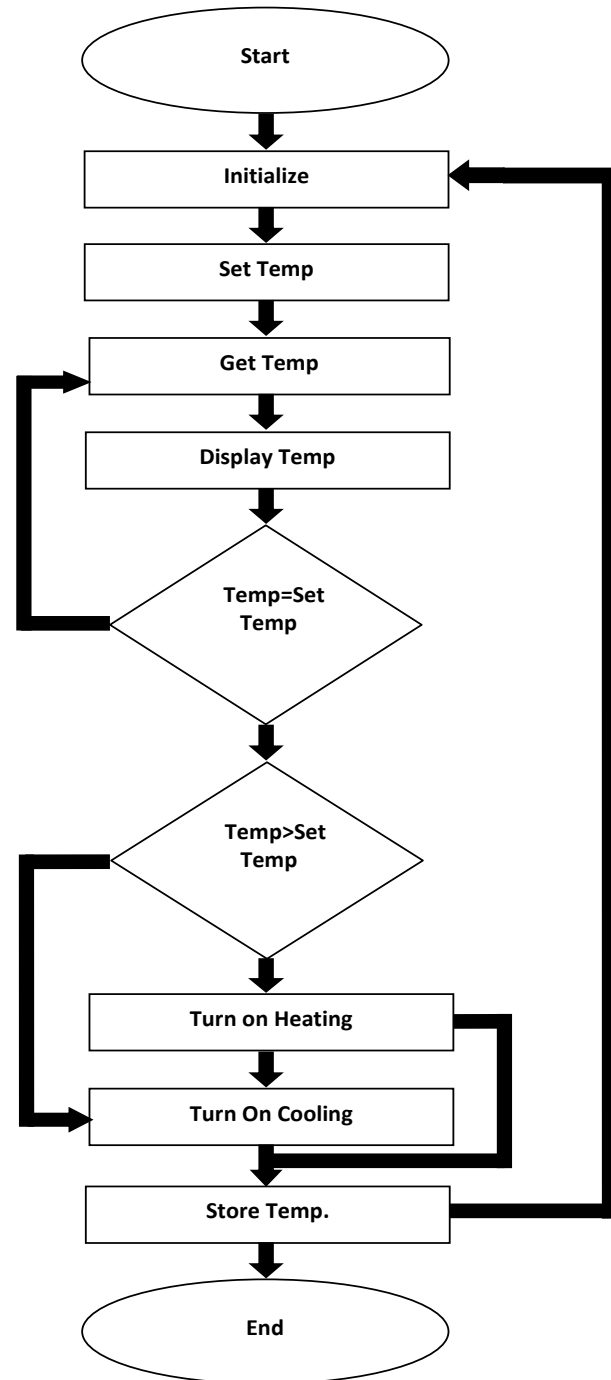


FIGURE [3] SYSTEM FLOWCHART

4. Block diagram of the system

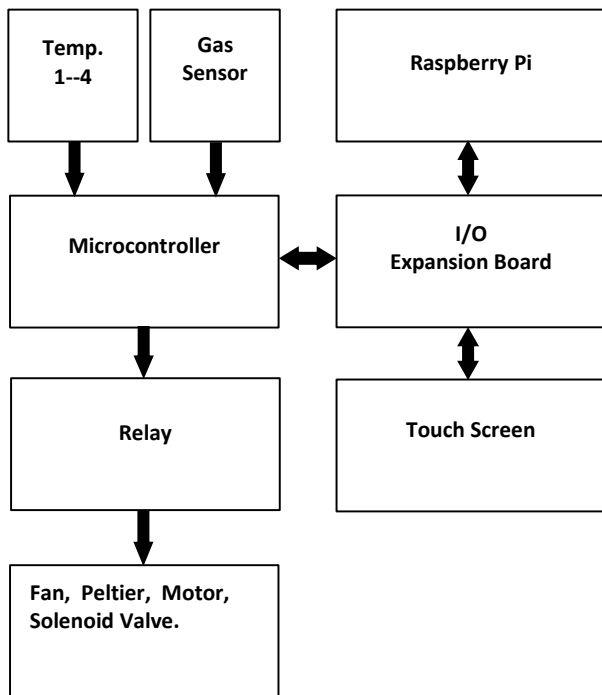


FIGURE [4] HVAC SYSTEM FUNCTIONAL BLOCK

5. ENERGY CONSUMPTION

The total energy consumed by the HVAC system installed in a building includes two major components: the energy consumption of an air handling unit (AHU) EAHU and the reheating energy of the variable air volume (VAV) box EVAV expressed in Eq. (1). The energy consumed by the air handling unit EAHU includes the energy of the chillers ECHL, the energy consumption of the supply fan and the return fan EFan, and the energy consumption of the water pumps EPump expressed in Eq. (2) [15].

$$ETOTAL = EAHU + EVAV \quad (1)$$

$$EAHU = ECHL + EFAN + EPUMP \quad (2)$$

6. INSIGHT TO RASPBERRY PI

The Raspberry Pi is a minimal effort, charge card measured machine that fittings into a machine screen or TV, and practices a typical console and mouse. No doubt it has taken the technology by storm. If we look at it from these scientific perspectives, the Raspberry Pi is a credit card-sized single-board computer.

The Raspberry Pi is focused around the Broadcom Bcm2835 framework on a chip (Soc), [1] which

incorporates an Arm1176jzf-S 700 MHz processor, Video core IV Gpu, [8] and was initially transported with 256 megabytes of RAM, later redesigned (Model B & Model B+) to 512 MB. [2] [9]. It also has an HDMI port, through which it can be connected to any display device, like the monitor or the projector Another great facility which Raspberry Pi provides is the presence of USB ports, where one can connect his pen drive or USB mouse/Keyboard

The framework has a Secure Digital (SD) or Micro sd (Model A+ and B+) attachments for both media and tireless stockpiling. In Raspberry Pi the highest spec variation is B+ and implemented on July 2014. Model B+ has an additional feature GPIO header, it has 40 pins despite of 26 pins and 4 USB (2.0) ports despite of 2 ports as in Model B+, hot fitting also over current conduct. Along with the old contact fit Micro SD card attachment has been supplanted with a much more pleasant push-push micro SD rendition. Moreover, it is equipped with lesser power utilization i.e. by supplanting direct controllers with exchanging ones we've diminished force utilization by somewhere around 0.5w and 1w. Let's not forget its enhanced sound where the sound circuit consolidates a committed low-clamor power supply. Finally, it provides with the tidier structure component by adjusting the USB connectors to the board edge, moving merged feature onto the 3.5mm jack, and including four unequivocally put escalating openings.

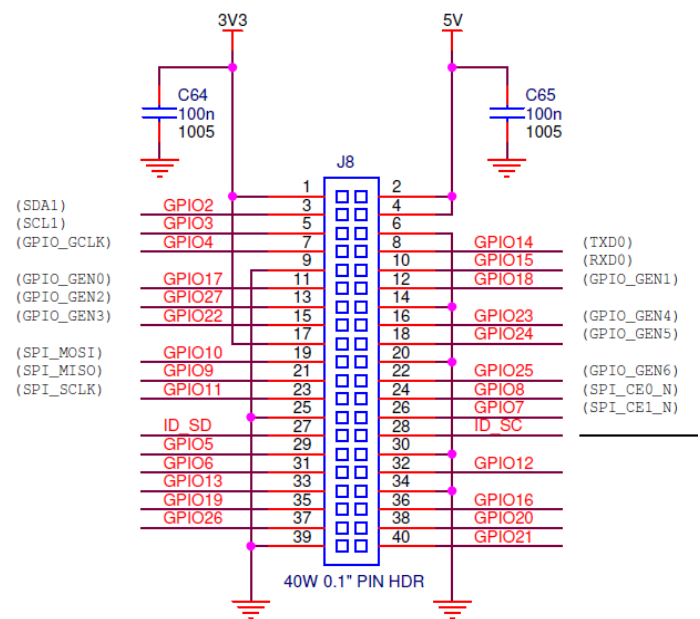


FIGURE [5] GPIO CONNECTOR IN RASPBERRY PI

7. SOFTWARE

Proteus utilizes our showed Schematic catch programming to present the earth for outline entrance and improvement. Proteus is a since quite a while ago settled item and joins usability with capable altering devices. It is fit for supporting schematic catch for both recreation and PCB plan. Plans entered into Proteus for testing can be net recorded in PCB format, either with our PCB Plan items or with outsider PCB design instruments. Proteus additionally gives a high level of control over the drawing appearance, regarding line widths, fill styles, text styles, and so forth. These abilities are utilized to the fullest in giving the illustrations important to circuit activity. Proteus ISIS Proficient programming is a PCB plan programming incorporated with the reenactment of the circuit you outline. It is incorporated with an ongoing reenactment of the electronic circuit and test whether your composed circuit is working legitimately or not.

PUTTY is an open source and cost free emulator with serial reassure and system record exchange application. It upholds several network conventions, including scope, ssh, Telnet, rlogin, and crude attachment association. It can likewise interface with a serial port (since form 0.59). The name "PUTTY" has no conclusive importance; however "tty" is the name for a terminal in the UNIX convention.

SSH, Telnet and Rlogin are three methods for doing likewise thing: logging into a multi-client machine from an alternate machine, over a network. Multi-client working frameworks, for example, UNIX and VMS, typically introduce an order line interface to the client, much like the 'Summon Brief' or 'MS-DOS Immediate' in Windows. The framework prints a brief, and you write summons which the framework will comply. Utilizing this sort of interface, there is no requirement for you to be sitting at the same machine you are writing charges too. The charges, and reactions, can be sent over a system, so you can sit at one machine and offer orders to another, or even to more than one. SSH, Telnet and Rlogin are system conventions that permit you to do this. On the machine you sit at, you run a customer, which makes a system association with the other machine (the server). The system association conveys your keystrokes and charges from the customer to the server, and conveys the server's reactions again to you. These conventions can likewise be utilized for different sorts of console based intelligent session. Specifically, there are a ton of release sheets, talker frameworks and Muds (Multi-Client Cells) which

help access utilizing Telnet. There are even a couple of that help SSH.

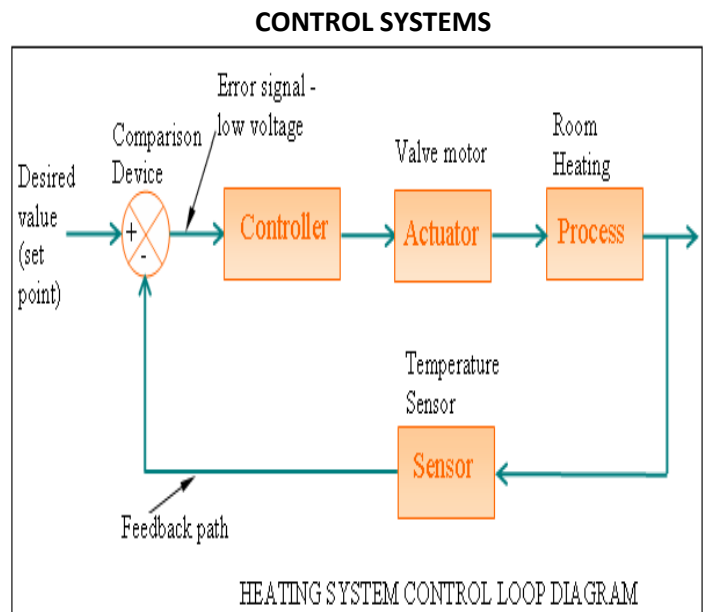


FIGURE [6] CLOSED LOOP SYSTEM HEATING

Figure beneath delineates a fundamental control circle for room warming. In this illustration the indoor regulator gathering contains both the sensor and the controller. The motivation behind this control circle is to keep up the controlled variable (room air temperature) to some fancied worth, called a set point. PID is an exacting procedure control application and is proposed in frameworks where the heap changes regularly and the controller is relied upon to repay consequently because of incessant changes in set point, the measure of vitality accessible, or the mass to be controlled

8.APPLICATION

The world uses one third of the basic energy spend on residential and commercial buildings where it accounts 25 – 30 %. Related to carbon dioxide emissions. However, lacks in many levels proper knowledge of energy efficient building management is the responsibility. Its principle destined to give a suitable environment to a methodology being done, paying little respect to inside hotness and dampness burdens and outer climate conditions. In spite of the fact that regularly in the solace range, it is the necessities of the process that focus conditions, not human inclination. Healing facilities working theaters, in which air is separated into abnormal states to decrease contamination hazard and the dampness controlled to breaking point understanding parchedness. In spite of the fact

that temperatures are regularly in the solace extend, some authority methodology, for example, open heart surgery obliges low temperatures (around 18°C, 64°F) and others, for example, neonatal moderately high temperature (around 28°C, 82°F). Clean rooms for the making of coordinated circuits, pharmaceuticals, and so forth, in which abnormal amounts of air cleanliness and control of temperature and dampness are needed for the methodology. Offices for rearing research center creatures.

9. CONCLUSION

This research is based on peltier for temperature control that has not been used in abundance primarily because not so satisfying on high temperatures. Well it's a bit expensive and less power efficient. More scientist and researchers are trying to make improvements in Peltier and its high temperature issues with expensiveness and power efficiency. When Peltier gets power efficiency than many industries and different other BMS places even homes will use it as we know that it has many advantages and it's a compact device as well. Another big enhancement may seem that Raspberry Pi is improving its features day by day. They are nearly introducing Pi own screen that does not need any expansion board and work directly. This research will be more compact, electronically then. Also Raspberry Pi's company is launching different models with exciting enhancements in, the board so there is a vast scope to improve this research or many different researches with the help of new models of Pi. We have used Touch screen for data logging of temperature only. But in the future this research can also be enhanced with smoke and gas or other important HVAC things to monitor in a chamber.

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BIOGRAPHIES



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