

Intelligent Residential Air-Conditioning System Using Embedded Linux

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Abstract— Air conditioners and air conditioning system are now an essential part of almost every building and institution. They consume a significant part of total energy consumption. Studies suggest that in locations like auditoriums, indoor stadiums and conference halls, air conditioning can contribute as much as 75% of total energy intake. Even in homes and offices, energy consumed by air conditioners is significant. Thus, a new scheme is provided which proposes a compact design to maintain the temperature and the humidity close to the comfortable temperature. A camera is fixed to capture images of the room & the images are sent to the Beagle Bone Black via USB. Here the images are analyzed using image processing technique via OpenCV. The background differencing is performed based on a referenced image of the room to find out the density of persons and there by controls the speed of the Air conditioner. The system also regulates the speed of the fan automatically according to the room temperature and humidity by using a temperature and humidity sensor connected with the Beagle Bone Black. The real time room temperature and humidity will be shown in the LCD display provided and the data can also be saved in the USD card for future analysis. The proposed system will extremely reduce the use of remote control and human endeavor and maintains the reduction of the electrical energy consumption of the AC compressor/fan by controlling the switch and speed of the cooler fan while utilizing all available resources in the most efficient manner.

Index Terms- Beagle Bone Black, LCD display, Image processing technique, USD, Humidity Sensor, Temperature Sensor, Vedio Camera

1 INTRODUCTION

The percent of energy in most buildings comes from the air conditioning system, especially in large building or big organization. These buildings install 20 units of air-conditioners or more. It is the split type air-conditioner; Fan-coil unit and Condenser unit. Its functions are to control the temperature, speed fan, timing and swing mode. The power management problems are the remote control, low temperature adjustment which result from carelessness of the consumers. They do not pay attention in switching on/off. This case leads to energy loss.

The Intelligent Residential Air-Conditioning System is designed based on Embedded Linux which is used in many consumer devices due to its low cost and ease of customization. The system ensures the reduction of energy consumption by maintaining the temperature of the air conditioner close to the comfortable temperature while calculating the density of people in the room and switching it off when there is no one present. The system uses the sensors, beagle bone and the technique of image processing to accomplish these requirements which is developed using embedded system design.

2. EXPERIENTIAL DESCRIPTION

2.1 Project Description

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function. Since the embedded system is dedicated to specific tasks, design engineers can optimize it reducing the size and cost of the product and increasing the reliability and performance.

Intelligent Residential Air Conditioning system is to develop a prototype of a system based on Embedded Linux which is used for maintaining the temperature of a room close to the comfortable temperature. Also at the other hand, a surveillance camera is used to capture the images of the room to calculate the density of people present in the room. It involves developing a prototype for an automated air conditioning system in conference halls, malls etc. In the proposed system, the images are sent to Beagle Bone Black and the image is processed using image processing technique.

The LCD connected to the system displays the real time room temperature and humidity. Also, the data can also be saved in the USD card for future analysis.

2.2 Block Diagram

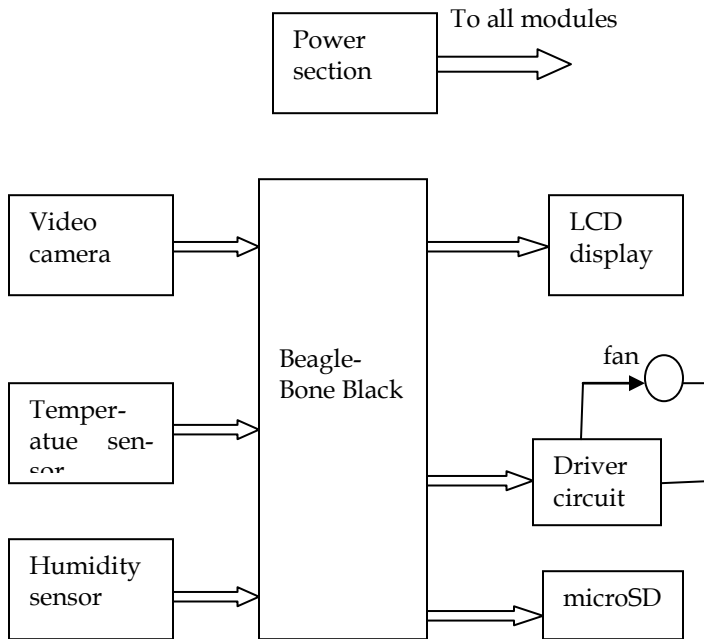


Fig1:Block Diagram

2.2.1 Block Diagram Description

The beagle bone black is the block which processes the entire system where the sensors, drivers, web cam and the SD card is connected to the ports available in the beagle bone board. A camera is fixed to capture images of the room which is connected to the beagle bone via USB. The image data captured by the camera is sent to the beagle bone and is processed using image processing technique via Open CV. The data obtained is video live streamed and then this streamed data is converted to a number of frames where each frame is a data image. Each image is processed separately by running the face identification algorithm. The image processing by the face detection is done here by the method of Haarcascade face detection technique. This process calculates the count or density of people for the control of Air-conditioner. The L293D Driver is used to control the speed of Air-conditioner. The humidity sensor SY-HS-220 gives the moisture content density and the LM35 precision centigrade temperature sensor gives temperature of the

room. The output of both the sensors are analog in nature where it is converted to digital form by processing it at the beagle bone. The temperature is then checked and the speed of the air conditioner is controlled accordingly. The information at each instant is written to the sand-disk (SD) card for future reference. The SD card is inserted to the slot given in the beagle bone. The LCD displays the current humidity, temperature and density of people.

2.2.3 Algorithm

- 1.start
- 2.input temp//temperature
- 3.input hum//humidity
- 4input dof//density of people
- 5.if (dof>0)
- 6.if (temp>27 && hum>50)
- 7.switch on the motor1
- 8.elsif (temp<27 && hum>50)
- 9.switch on motor1 and motor2
- 10.else switch the motor1 and motor2 off
- 11.print temp
- 12.print hum
- 13.print dof
- 14.stop

3. Stimulation

The Proposed system consists of a temperature sensor, a humidity sensor, a LCD and three fans for controlling the temperature of the air conditioner. The count of the people in the room is calculated by using the haar cascade image processing technique. If the temperature exceeds a specified limit, the first fan will be switched on. Also, the other fans will be switched on according to the number of people in the room. Thus, the temperature of the room can be controlled effectively. The temperature and humidity of the room will be regularly displayed in the LCD.

4. Conclusion

The project "INTELLIGENT RESIDENTIAL AIR CONDITIONING SYSTEM" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented. Finally we concluded that EMBEDDED SYSTEM is an emerging field there is a huge scope for research and development.

Acknowledgment

This paper was supported and guided by our beloved teacher Mrs. Nikitha V P. It is also supported by Mr. Krishna Kumar (HOD of ece department, RCET). The authors would like to acknowledge the comments made by teachers and friends which contribute to improve the paper.

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