Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 05, May-2016

Automated Operation of Packaged AC for Industrial Cooling using Microcontroller

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***Abstract*—This project deals with automation of operation of PACs(Packaged Air Conditioners) for industrial cooling using microcontroller. So instead of switching manually ON and OFF the number of PAC required for cooling, the process is automated to avoid power wastage and reduce manual interface. The whole process is simulated using Proteus 7.0 as it is highly effective for real time applications.**

Keywords—PAC; Temperature sensor; Proteus; Atmel;

I. INTRODUCTION

In industries machines are intended to run continuously for days together. So they dissipate large amount of heat which is to be removed to avoid breakdowns and failures. Many industries like battery manufacturers, food processing firms use PACs for cooling purposes. PACs are generally used when the TR (Ton OF Refrigeration) is above 10 TR. So in order to cool down the machines, the PACs are also to be in running continuously. Some PACs are kept idle and they are switched manually ON and OFF according to the heat load. In this project PACs are made to control automatically using temperature sensor i.e., the number of PACs to be in operation is automatically decided by microcontroller according to temperature.

II. EXISTING SYSTEM

At present, in industries the PACs are controlled in such a way that all the PACs goes OFF when the temperature reaches set point temperature. Whenever the temperature increases all the PACs gets ON automatically. Also some PACs are kept idle and they are manually made to operate when any of the PAC fails. Idle PACs are also switched ON when the heat load is very high.

III. PROPOSED SYSTEM

A new system is proposes in which all the PACs are controlled by a single microcontroller. The temperature is monitored from temperature sensor and whenever the temperature reaches ser point one of the PACs is switched OFF. Now after some preset time the microcontroller again checks the temperature. If the temperature is still less than or equal to set point, another PAC is switched OFF or if temperature increases, again the PAC is made to switch ON. Also, in this system, running times of each of the PACs is calculated and after some preset time, idle PAC is changed dynamically according to their running hours. This makes to avoid continuous running of only particular PACs

IV. OBJECTIVE OF THE PROJECT

Automation of operation of PACs using microcontroller, sensors and relays. Replacement of manual effort for switching ON and OFF of the PACs. Temperature of the zone is monitored continuously by the sensor and control the PAC accordingly. The Idle PAC will be changed dynamically with respect to running times of PACs.

V. WORKING PROCEDURE

At first all the PACs are in running mode. now the temperature from the chargers is calculated by LM35 temperature sensor and sends it to the microcontroller. This temperature is compared with the set point temperature. If temperature is less than set point, then one of the 4 PACs is switched OFF. Now again the temperature is taken and compared after some preset time. If the temperature is still less, then another PAC is switched OFF else switch ON the idle PAC. This procedure goes on repeating for some time. Mean while the microcontroller counts the running time of each PAC. After some preset time the loads gets shifted. It means the idle PAC is changed according to their running time. This makes uniform distribution of load so overload on single PAC can be avoided.

VI. COMPONENTS REQUIRED FOR AUTOMATION

1.MICROCONTROLLER:

Microcontroller used in this project is Atmel AT895c2.

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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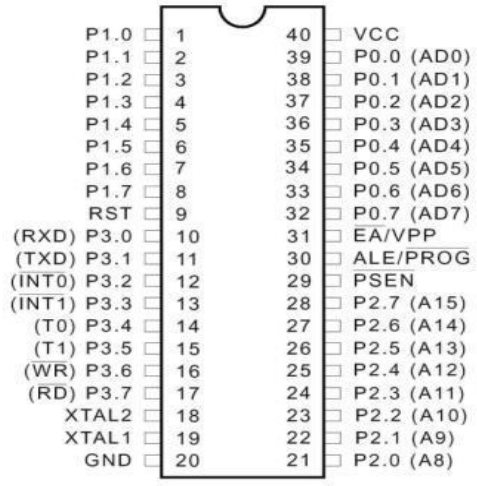
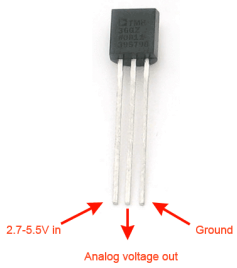


2. TEMPERATURE SENSOR

Temperature sensor used in this project is LM35. It senses the temperature and sends proportional voltage to the microcontroller. The received volts can be calibrated into temperature. Temperature can be measured more accurately than a thermistor. It generates higher output voltage, so amplification is not necessary unlike thermocouples. The output voltage generated is proportional to temperature in celsius. It generates 100mv for every one degree celsius raise in temperature.



3.RELAYS

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

In this project relays are used to operate compressors of PACs which operate on high currents. PACs usually work on 3 phase AC which makes difficult for microcontroller to switch OFF and ON. So relays are used to operate even with a low current.

VII. PIN CONNECTIONS IN SIMLATION

- XTAL 1 & XTAL2 are connected to crystal oscillator
- PIN1.0 is connected to temperature sensor output which is the input to controller
- PINS 0.0-0.7 are connected to resistor pack
- PINS 2.0,2.1,2.2 are connected to LCD power supply
- PIN 2.6 is connected to relay2 and 2.7 is connected to relay 1
- PINS 3.6 and 3.7 are connected to cathode ray oscilloscope (CRO).

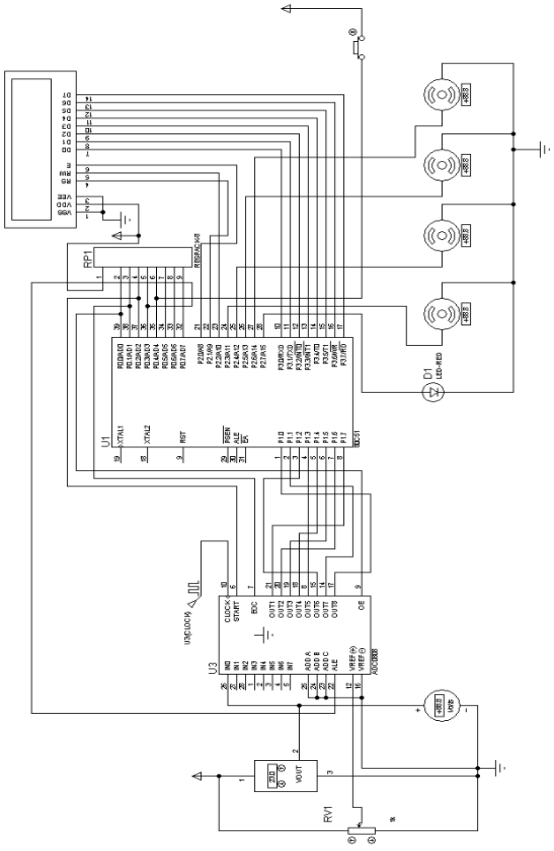
LCD used for simulation is LM016L as it can display alpha numerical and symbols along with alphabets and special characters.

VIII. SIMULATION

1. PROTEUS SOFTWARE:

Simulation of this project is done in Proteus7.0 software. Proteus 7.0 is a Virtual System Modelling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using on-screen indicators and/or LED and LCD displays and, if attached to the PC, switches and buttons.

2.CIRCUIT DIAGRAM



3. ALGORITHM

- Initially when the system is simulated, all the PACs run continuously.
- So whenever the start button is pushed, the actual system is initiated.
- The set point temperature (Tp) given here is 24 degree centigrade.
- The four PACs can be considered as A, B, C and D.

International Journal of Engineering Research & Technology (IJERT)
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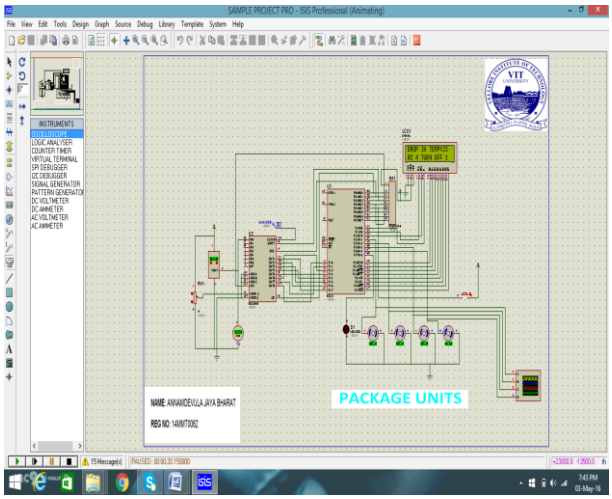
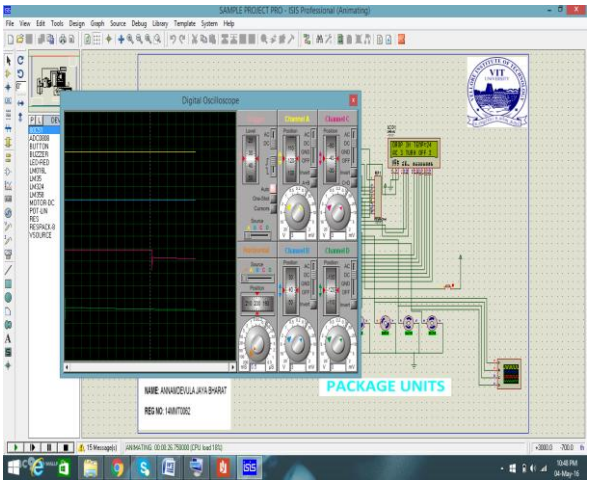
- So microcontroller compares Tp with current temperature (Tc) and if Tc>Tp all the PACs will be in operation.
- If Tc ≤ Tp then PAC D will turn OFF.
- Now again after some preset time (here given 2sec) the microcontroller again check for condition Tc ≤ Tp. If so PAC C will turn OFF else PAC D will turn ON.
- This process goes on repeating for all the PACs this is D, C, B, and A in a sequence.
- Mean while the running time of each PAC is monitored.
- Now after completion of loop once, the microcontroller shifts the load, that means the control loop changes according to their running times instead of D, C, B and A.
- So in this way the idle PAC is changed every time accordingly to avoid load only on one PAC.
- This process repeats continuously without any manual interface.
- CRO (Cathode Ray Oscilloscope) is connected to the PACs to monitor voltage across time.
- The results have been displayed accordingly.





The graph indicates voltage with respect to time. Yellow line represents operation of PAC A. Blue line represents operation of PAC B. Pink line represents operation of PAC C. Green line represents operation of PAC D

CONCLUSION

Simulation is done successfully which is similar to that of real time. PACs are made to switch ON and OFF automatically by change in temperature. This makes to run only the required number of PACs as per the temperature. Heat load is made to shift dynamically among PACs according to their running times. Thus breakdowns of PACs can be minimized. By automation of operation of PACs, process efficiency can be greatly increased. Graphs have been generated in the oscilloscope as per the operation of operation of PACs. High precision results can be obtained as there is no manual interference

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