Analysis of Domestic Refrigerator and Compression Cycle using Microcontroller

Mrs. Meenakshi Patil1, Ankita Belhe2, Priyanka Patil3, Ritika Pawar4
1. Assistant Professor at ICEM, Paranwadi, Pune, 2. B.E. pursuing at ICEM, Paranwadi, Pune 3. B.E. pursuing at ICEM, Paranwadi, Pune

ABSTRACT
The project is designed to detect, record and display the on and off of the compression cycle of the domestic refrigerator with the respected temperatures. The project has already introduced combined compressor and thermoelectric module to analyze compressor cycle of the domestic refrigerator to increase the energy efficiency of the compression cycle. It is observed that by introducing thermoelectric effect, energy consumption of VCR(vapor compressor) is reduced by almost 10.92%. The main aim of the project is to detect the on and off of the compressor. After detecting the on/off state of the compressor the second goal is to save that timing related readings with the respected temperatures and display them whenever necessary. While analyzing the compressor cycle of the refrigerator the operator must take all the readings so that it will be easy to observe the compressor readings. But this task becomes difficult when it comes to take the readings at night or in the absence of operator. Arduino series of microcontroller is used for such a dedicated purpose which has a large storage capacity. A stored timing as well as related temperature readings in microcontroller can be displayed to the operator. So that the detection and analysis process of the compressor cycle as well as thermoelectric module can be carried out without fail in the absence of the operator.

General Terms
Compressor, Thermo-Electric Module

Keywords
Compressor, Thermo-Electric Module Temperature Sencor

1. INTRODUCTION
Refrigerators and air conditions are the most energy consuming home appliances and for this many researches had performed work to enhance energy efficiency of the refrigeration. Thermoelectric refrigeration is one of the techniques used for producing refrigeration effect. The project has already introduced the thermoelectric module with the combination of compressor which increases the energy efficiency of the compressor by increasing trip time and decreasing run time of the compressor. Run time of compressor is the time compressor works and trip time of compressor is the time compressor remains in the off state [1].

2. Thermoelectric cooling could be better alternative for the conventional refrigeration and air conditioning systems due to their distinct advantages. The coefficient of performance of the thermoelectric refrigeration is less when it is used alone, thermoelectric refrigeration is often used with other methods of refrigeration [3]. A compression system is better option to combine with TER system as it gives higher COP (coefficient of performance) values. A developed system includes advantages of VCR and TER i.e. high COP and better temperature control.

3. The peltier/ thermoelectric module has placed on the separator of cooler and freezer section. In such a configuration cold side of the module is inside the cooler compartment of refrigerator and hot side is exposed to atmosphere. And the readings are been carried out after turning on the refrigerators and initial temperature had noted down. An operator has to wait for compressor to trip & thermoelectric module to turn on as well as to note down the time and corresponding temperatures . Again an operator has to wait until the compressor goes in its on state (run time starts) and thermoelectric module turns off.

4. This process of detection of on and off of the compressor and TER as well as noting readings as per the respected time and temperature continues for the certain period of time. This has taken out for time span of 6-7 hours. It always requires the human interface (manual) to carry out the readings and to detect on and off the compressor cycle. A person must present for all the time otherwise some readings could miss out by an operator.
2. LITERATURE SURVEY

1. Sagar D. Patil, Prof. Kiran D. Devde [1] Combination of thermoelectric refrigeration (TER) and compressor is introduced to decrease overall power consumption due to the home appliances such as air conditions and refrigerators. And to increase efficiency of compressor by keeping compressor off by means of increasing the trip time of compressor of domestic refrigerators. For that two structures are mainly taken into the considerations. Structure I: Cold side of the module is exposed to cooler compartment while hot side is placed in freezer compartment. Structure II: Hot side is placed in cooler compartment & cold side is in freezer compartment. And observations are taken out. Every trip cycle of the compressor & readings are recorded. Procedure is carried out for the span of 6 hours. Similar procedure is carried out for experiment in combination with TER system in structure 1 & structure 2. Energy supplied to TER module. And this module is kept on during trip time only. But to take readings of both TER module when compressor turns off and when compressor turns on with respected time and temperature and to detect on and off the compressor cycle becomes difficult task during analysis.

2. S.B. Riffat *, Guoquan Qiu, [2] explain the three types of air conditions. And study gives the comparison of thermoelectric module used in air conditioners versus vapor and absorption air conditions. The basic cycle cycles of three types of air conditions are performed to calculate their coefficient of performance (COP). And after observing three types of air conditions analysis says that they have given the basic difference between the use thermoelectric module in the air conditions. These kind of thermoelectric air conditioners consumes much less power as compared to other vapor and absorption air conditions. And for analysis purpose continuous reading must taken out for further process of observations of thermoelectric air conditions and their power consumption.

This continuous observation procedure becomes problematic when there are not only one but two more air conditions are in the frame for analysis purpose. So human interaction with system requires more than [1] that means more number of labors for such purpose.

3. Gao Min, D.M. Rowe [3] Peltier modules/ thermoelectric cooler have been developed in various cooling appliances of small volume devices to increase the operating speed and unwanted noise of integrated circuits. However, thermoelectric refrigeration appears to have made little impact on the domestic refrigeration market. The main factors that determine the marketability of a thermoelectric refrigerator are price and running cost, together with reliability, quietness, flexibility and temperature stability as important considerations. Price reflects the manufacturing cost, while the running cost is mainly determined by the coefficient-of-performance (COP) of the cooling unit. So, it is clearly stated that thermoelectric module is important component in the analysis process. Operator can’t neglect temperature at the time when compressor turns off or turns on. It is very necessary to have appropriate timing and temperature records.

4. D. Astrain, A. Martinez, A. Rodriguez [4] This paper presents the improvement in the performance of a domestic hybrid refrigerator that combines vapor compression technology for the cooler and freezer compartments, and thermoelectric technology for a new compartment. Thus, the electric power consumption of the modules and the refrigerator decreases by 95% and 20% respectively.

From all the above papers it is stated that the overall study deals with the use of thermoelectric module in refrigerator for betterment of compressor, to reduce power consumption and to increase energy efficiency. This can be done by continuously operating and moderating on the compressor cycle (on/off) and according to that switching (on/off) of thermoelectric module. With appropriate and accurate timing and temperature records.

3. BLOCK DIAGRAM AND WORKING

In our system we are going to control the compressor temperature by reducing the run time increasing the trip time. Temperature sensor is used to record the temperature according to the change in compressor cycle. Finally all the timing and related temperature readings is stored in SD card to display in the excel sheet or in any other format to the operator. The SD card can be interface with the pc and can delete all the readings for the further storage.
4. ADVANTAGES
4.1 Less time consumption:
In absence of operator, it is impossible to carry out the temperature reading. So to overcome this problem the reading is stored directly in SD card. To save time consumption we can interface SD card directly to PC.

4.2 Large data storage:
Large number of data can be stored easily in the PC in the required format.

4.3 Efficiency:
Efficiency more because we decrease run time. Thus the system becomes more reliable.

4.4 Less labour work required:
Controllers store all readings of temperature and time so that the operator can refer the reading for further analysis even if he/she is not present on work field.

5. APPLICATIONS
5.1 Domestic Applications:
In the analysis of home appliances where energy efficiency is needed in air conditioner and refrigerators.

5.2 Medical Applications:
In operation theaters to monitor the timing readings of heart beats.

6. CONCLUSION
Individual and continuous readings contain the timing and related temperature that can easily carry out when operator is not present on the field and to reduce the energy efficiency of the compressor.

7. RESULT
Detect on and off of the compressor and according to that switching on or off the thermoelectric module.

8. REFERENCES