2.5 SMART AIR-CONDITIONING UNITS

The need for man and his interest in conditioning is due to ancient times. for example, ancients enjoyed drinking cold water without having any kind of ice in their countries by putting water in pottery vessels and leave them on the roofs of their houses at sunset and long nights, Dry desert air vaporizes the water that passes through the pores of pottery vessels and the water inside it becomes cold. The Romans and the Greeks used their slaves to bring the snow from the mountain tops and then store it in huge conical pits in the ground, lined with leaves and covered to use it when needed. Also, the great Alexander used this natural ice to cool wine barrels that he offered to his soldiers in every battle they won. Emperor Nero was always offering chilled food at his concerts. Hundreds of slaves were used to store the natural ice in the vaults of his palace. People continued to use natural ice only as a way to cool their drinks for a long time. With the increasing need for natural ice over time and the great difficulties to get and keep it for a long time, many scientists and researchers began to produce artificial ice. The first of these scientists was the great scientist Michael Faraday (Varday) and Dr William Cullen in 1775 using the theory of discharge for the production of artificial ice, but this experience did not pass the walls of his laboratory. In 1834, an American engineer named Jakob Perkins made the first machine to produce artificial ice, which was very successful in preserving frozen meat and beer. In the thirty years following the manufacture of this machine, many inventors and scientists were interested in manufacturing machines that produce artificial ice, which led to an increase in the number of ice factories in different places in the nineteenth century and spread its use among all classes after it was limited to the rich and elite By the discovery of electricity at the beginning of the 20th century, the industry of cooling and air conditioning has made great progress felt by any human being in our time. So that there is no house at this time without an electric refrigerator or air conditioning device. Recent studies show that buildings occupy the top place in energy usage, counting for 40% of total energy usage in many countries. A large part of the energy used in the buildings is used for fans, air conditioning (HVAC) and heating systems, which counting for up to 50% of the total energy use in the buildings so improve energy efficiency of buildings, especially the improvement of the HVAC system is very important and will have an impact in reducing overall usage For energy. When talking about reducing the

use of energy, which has become an urgent necessity locally, globally and environmentally for the safety of our planet from the harmful effects of carbon dioxide and its impact on the heating of the Earth, we must pay attention to reduce the use of the spent energy on the air conditioning and ventilation systems of buildings and find solutions and systems to reduce the excessive energy usage.

Mobile phones and wearable devices have been integrated with intelligent sensors for temperature and human movement so that we can control the working and living environment in the various climatic conditions of the atmosphere and get appropriate feedback, especially information technology for occupants of public places like factories, companies, institutions and residential buildings through mobile phones and wearable devices, which placed on the human body. this information can be used to adjust air conditioners in advance according to human intentions, which is called intention to cause control. The results showed that the indoor temperature can be controlled accurately with errors below ± 0.1 ° C As the weather conditions for the residents cannot be achieved quickly within 2 minutes, air conditioning compressor must be operated in a timely manner so that it can reach the appropriate weather conditions for the inhabitants of the places before they arrive . This ideal solution is what made us think about the appropriate solutions by using smart devices and wearable devices that can detect the temperature of the person and the type of activity that he exercises, Which helped to set sleep times flexibly and adjust sleep function optimally and maintain human health during sleep. During sleep, it can reduce energy consumption by up to 46.9%. With intelligent air conditioners and smart air conditioners can provide a comfortable environment and achieve the objectives of energy conservation and environmental protection at the same time. In order to become smart air conditioners using communication technology and adjusting air conditioners is not just an idea in the world of IT, smart air conditioners can be combined with an infrared sensor for human position sensors as well as with meteorological networks to obtain weather information abroad. These devices can be worn without affecting human activity from now on. It is expected that the indoor temperature will be controlled efficiently, considering the human comfort and energy used in air conditioners.

Figure 2.5.1 Evolution of air conditioning units

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 3]

Figure 2.5.1 shows the evolution of the air conditioning units (windows unit) and the transition to split unit, which allows control of the external unit or internal unit accurately and also control between them as distinctly in figure 2.5.2.

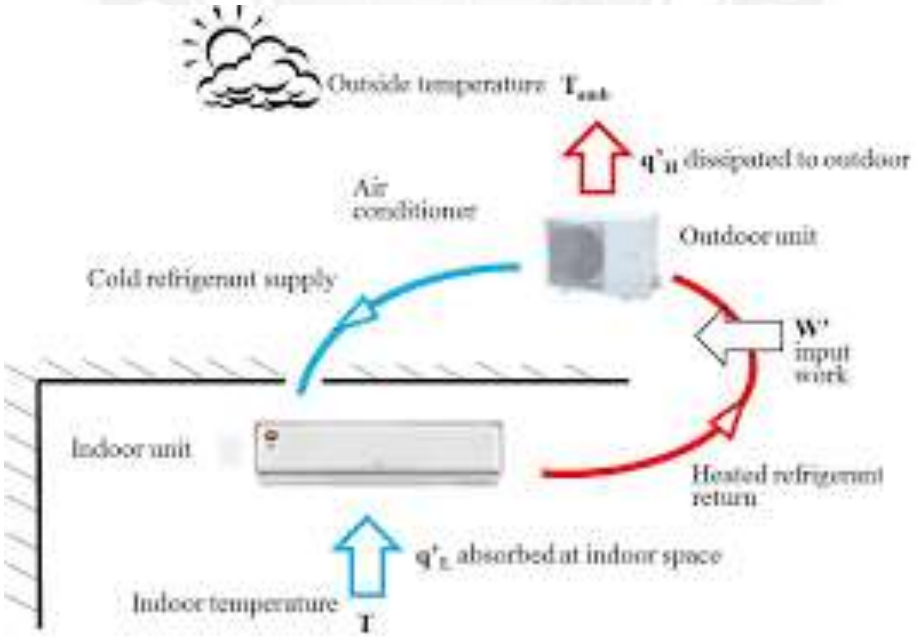

Figure 2.5.2 Refrigerant flow

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 3]

Indoor temperature(T) can be controlled and is related to the work of the internal unit where the air flows through it cross-sided through the propeller as shown in figure 2.5.2. The red line in the figure refers to the coolers of heat absorption from a closed place (q_L)

through the evaporator and dissipating that heat (q_H) to the outside air through the outdoor unit. And the temperature is the controller in the operation unit, we can install the evaporator temperature sensor in the internal unit of the type of air conditioning (Split Unit).

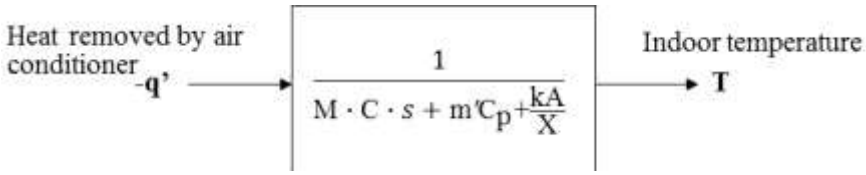

Figure 2.5.3 Open loop transfer function

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 4]

This signal is received by a remote control to control the operation of the unit depending on the temperature changes according to the following box diagram:

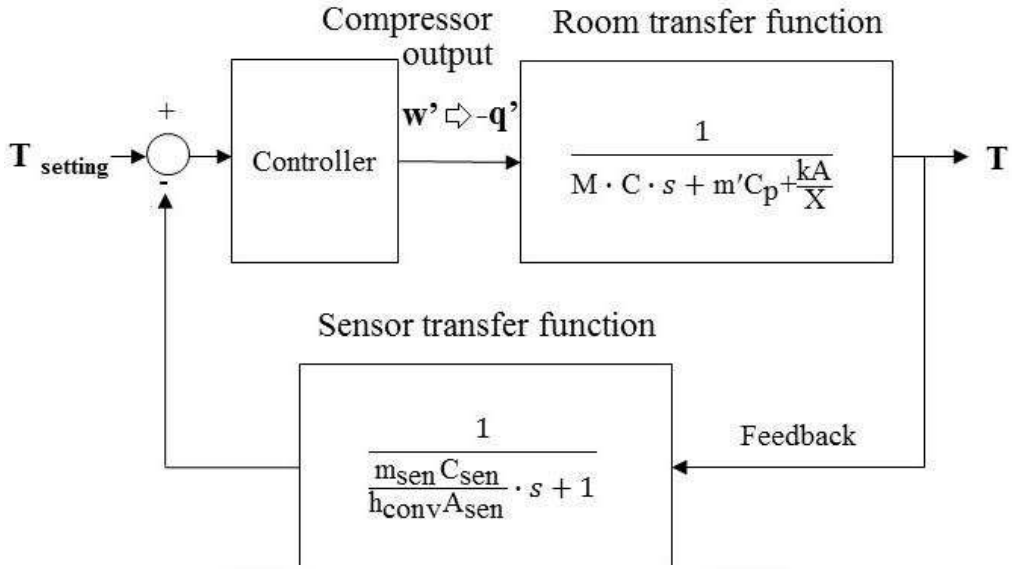

Figure 2.5.4 Closed loop transfer function

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 4]

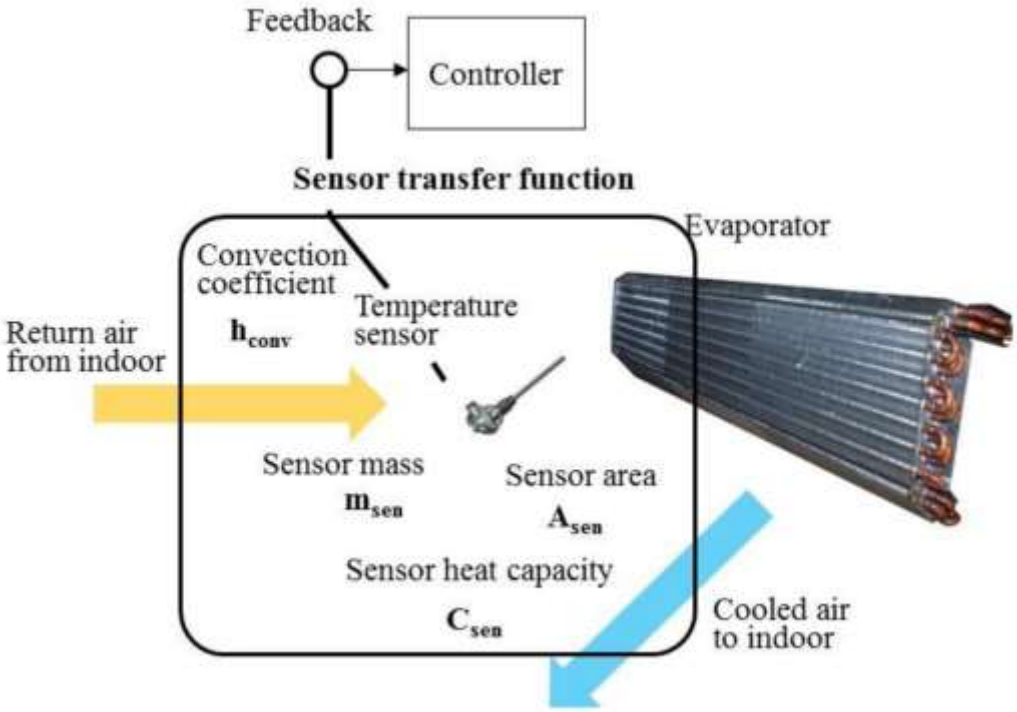

Figure 2.5.5 Sensor based system

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 4]

This is a model of the sensor method and control of the operation of the air conditioners by smart devices that can be personal phones or watch worn around the wrist. Either be controlling the turning on and off the compressor as in the following diagram:

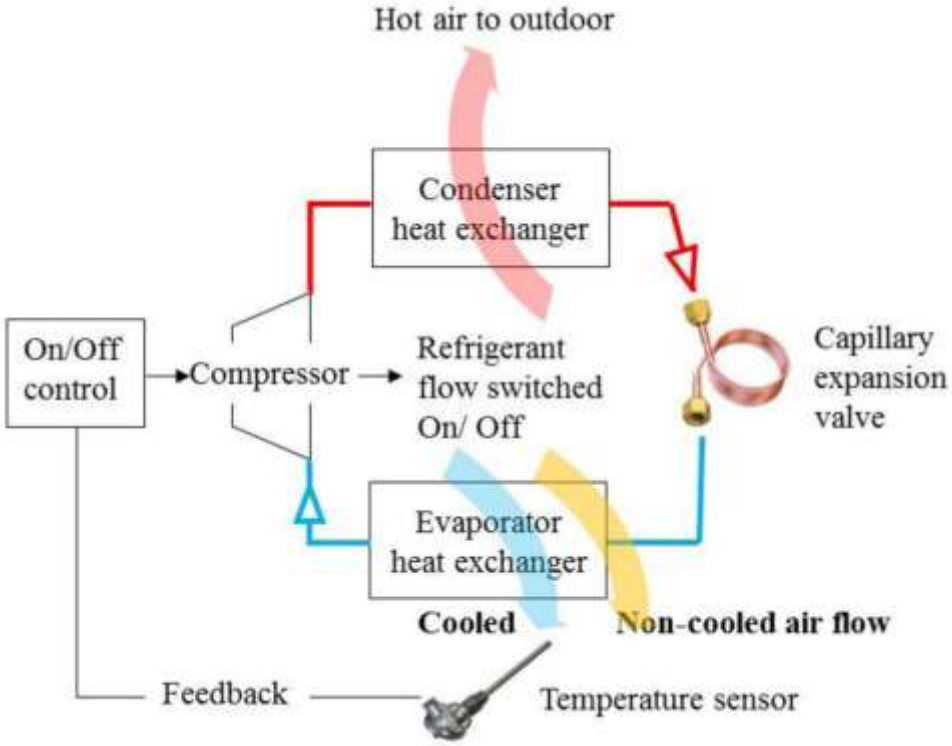

Figure 2.5.6 Capillary expansion valve system

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 4]

Or by changing the flow of coolant by changing the speed of the compressor as shown in figure 2.5.7.

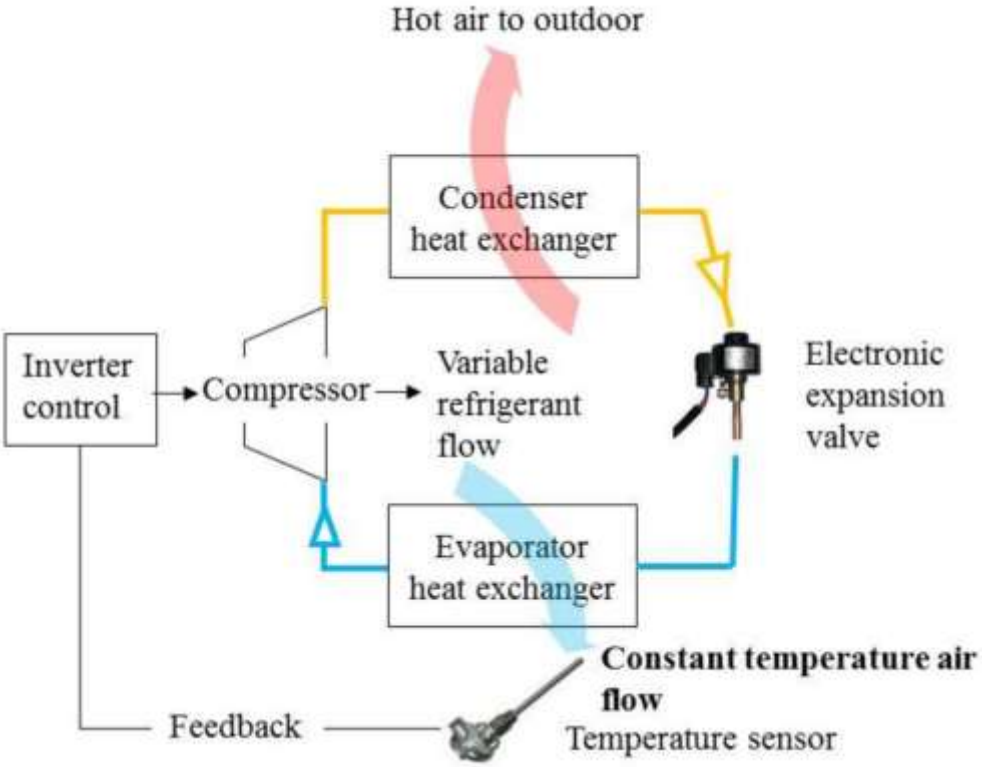

Figure 2.5.7 Electronic expansion valve system

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 4]

Intelligent Control Based on Smart Sensors:

Control depends on quantitative analysis between fixed values and variable values that are monitored by smart sensors, which collect information and send it to smartphones or wearable devices that include:

1. Mobile phones with GPS and the expected time to be in the place to be operated
2. Bracelet can read the situation of the residents of the cooled places, which increases the temperature of the place during sleep to provide energy consumption, so it can control the air conditioner in accordance with the activity of residents. The system uses multiple sensors to achieve intelligent control such as an internal infrared sensor that can detect human position and control airflow. Or mobile phones with GPS and expected personal timetables for movement can be used to detect the occupant position of chilled places as in figure 2.5.8.

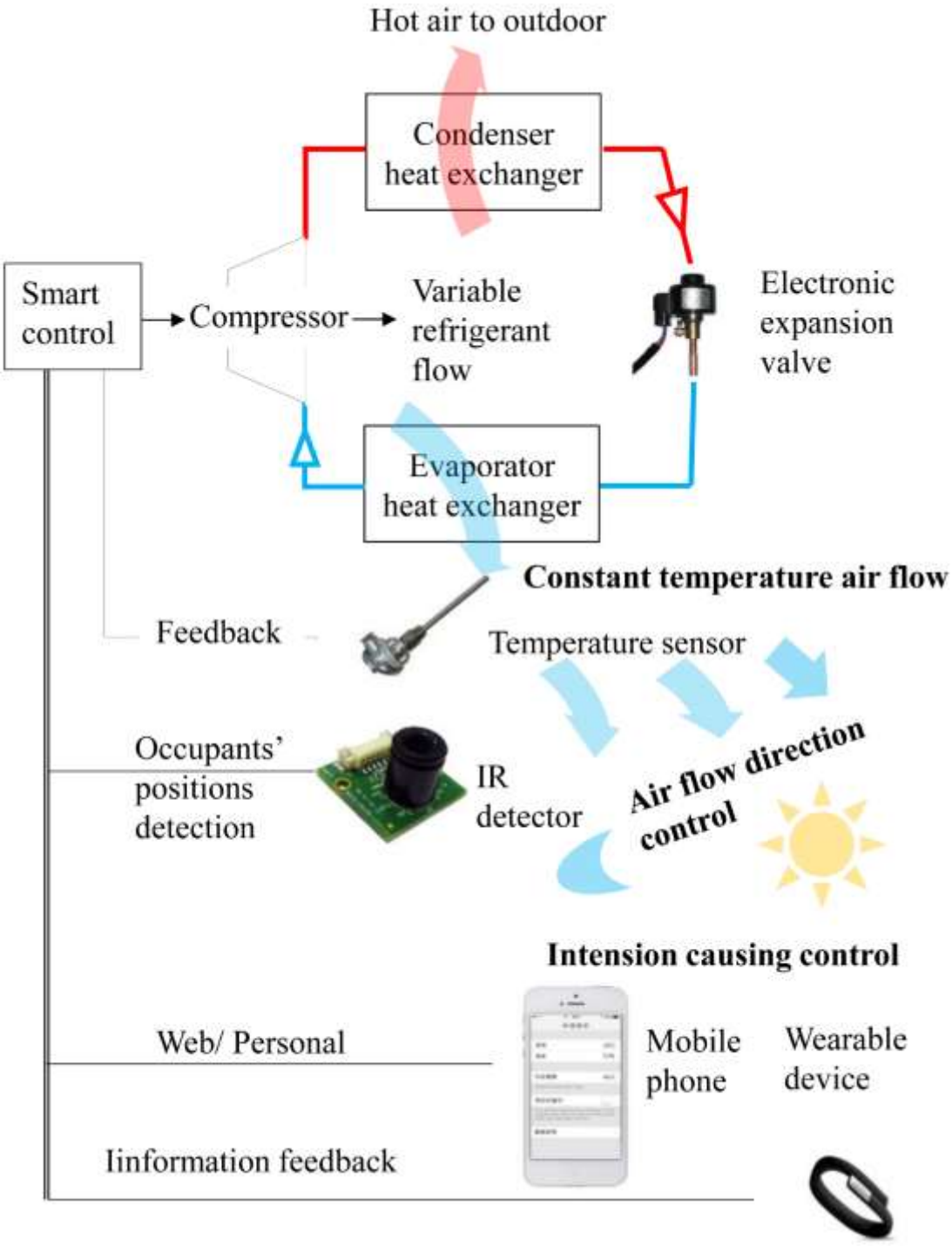

Figure 2.5.8 Smart air-conditioned system

[Source: "International Journal of Scientific & Technology Research" by Nabil Ahmad Moussa, Page: 5]