A Review on Applications of IoT in Heating, Ventilation, Air Conditioning and its Control

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Abstract - In this review paper it is discussed about how an IoT can be implemented in the refrigeration and air conditioning to save the energy at different climatic problem. We will be discussing about the knowledge of sensor, actuators, and other objects which are connected to Internet and application of IoT. While using IoT in the application it will sense the different parameter like temperature, voltage etc. and maintain the feasible condition in order to save the human time. Now-a-days industries are also using IoT to get the better results. The use of IoT is implemented in industry as well as for household purpose. In this paper, the brief description about the application of IoT in different climatic conditions and how it is beneficial for the human comfort and also how it can reduce the wastage of energy.

Keywords: Applications, Control, HVAC, IoT

I. INTRODUCTION

The study of IoT (Internet of Things) focuses on the knowledge of sensors, actuators, and other objects which are connected to Internet, as connecting the people with the virtual world. IoT will also encourage the number of application latest applications such as environmental monitoring, healthcare, and efficient management of energy in smart homes. Heating, Ventilation and Air Conditioning (HVAC) are the most energy required appliances at the time of power-shiftable loads in home buildings. According to the research, they represent 61% of residential energy consumption in UK and Canada, and 43% in USA [1]. Devices such as TVs, refrigerators, washing machines we use in day-to-day life and are able to communicate with each other that all credit goes to Machine to Machine (M2M) and Internet of Things (IoT) technologies.

HVAC systems are delivering comfort to the humans in their buildings indoor environment, hence, they are having huge demand and their automated development can ease the work of their users [2]. Recently, we have become more and more aware of the concepts of smart city such as smart home, transportation, health, education, energy and smart environment. The concept, "smart home" applications attracts the most demanded applications. IoT is a communication network in which physical objects are linked to each other or rather to larger systems [4]. Most of the IoT devices are developed with sensors to detect and monitor the changes in the surrounding by using the data which is generated by these devices. As per the research by

the CISCO (Commercial and Industrial Security Corporation), the number of things connected to the internet is increasing in remarkable way and it is expected that there will be 50 billion number of IoT connected devices in total up till 2021. An IoT designed system can be useful for checking the internal temperature of the refrigerators used in transportation system [5]. As per the assumption of World Bank, over 85% of population will be situated in the developing countries by the year 2030. This development can lead to the increase in buildings in city area. In this case, artificial system will be dependent to operate buildings, as the number of people spend their time in the buildings will increase. This has led the engineers and the architects to focus on the development of the buildings by considering its thermal comfortability by means of improving the thermal related tools in the buildings and to ease its operation, as over 80% to 90% will spend their most of time in the buildings.

II. APPLICATIONS OF IoT IN HVAC

IoT is the most promising technology machine-to-machine (M2M) or device-to- device (D2D) communication that can transform a conventional system into a smart one that is low cost as well as energy efficient. One of the biggest Muslim societies in the world is Malaysia, followed by a large number of mosques spread in various areas and these mosques are facing maintenance problems especially in energy consumption. Over 500 worshipers are performing prayers, when weather outside is very cold or hot type, it is very difficult task to manage the comfortability for the worshipers. Moreover, providing a comfortable place to worship requires the AC to be switched on continuously which results in wastage of energy during prayer times.

Temperature systems such as smart thermostats such as are used to deal with the following problem. Mosques experience sudden entry of large numbers of users at five specified times throughout the day, and the consumption of energy by the use of the fans in the mosques is in very inefficient way by wastage of energy, with the five daily Islamic prayers. As per this condition, this project is conducted in order to reduce energy consumption in mosque by developing smart mosque temperature control system. The temperature control focuses on reading the temperature

of mosque and then smartly controls fan according to the temperature reading by the application Internet of Things (IoT) technology.

The Arduino Uno controller board will read and process the sensors to operate the fan switch. This process of operating the fan according to the ambient temperature of the mosques will help to reduce power consumption. This smart mosque temperature control can be applied in Malaysia in various mosques to make mosques efficient in energy utilization. Thermal comfort is one of the most essential requirements for the satisfaction of mind and ass well as body. The aim of this project application is to design and develop a circuit that will automatically control the speed of a fan according to switch in the temperature of the surrounding areas. Circuit was constructed with a microcontroller, temperature sensor, and supporting components. The temperature and the fan speed are displayed on the LCD screen. The result of the project showed that the speed of the fan is controlled as per the change in temperature remotely controlled via web browser and Apps [6].

The A/C-R system or vapor compression is designed of four major components.
1. Compressor
2. Evaporator
3. Expansion valve
4. Condenser, which are arranged as shown in Fig. 1.

Scientists have conducted many studies on the development with different angles, which can be shown as
1. Proper air temperature and humidity of the specific area.
2. Improvement of system steady-state performance as well as robustness.
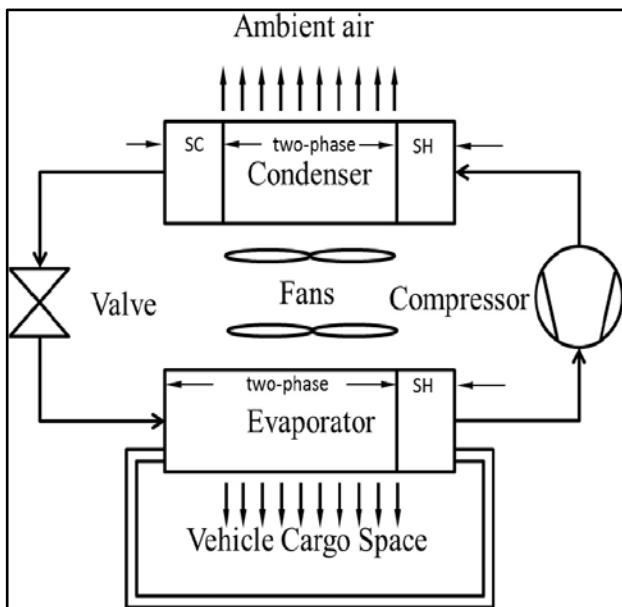3. Reduction of energy consumption.

Fig. 1 Schematic Diagram of A/C System

Initially, turning the switch on/off can result in start or stop the device. But, it is not capable of controlling the temperature according to varying working conditions, such as, the ambient temperature. With the latest application of A/C-R systems in home, vehicles, and industries, a large amount of energy is being utilized. The remarkable growth in the requirement for environment protection and energy conservation is forcing researchers to design green devices with greater energy efficiency. Efficient operation of A/C-R systems can reduce operating cost as well it is not harmful [7].
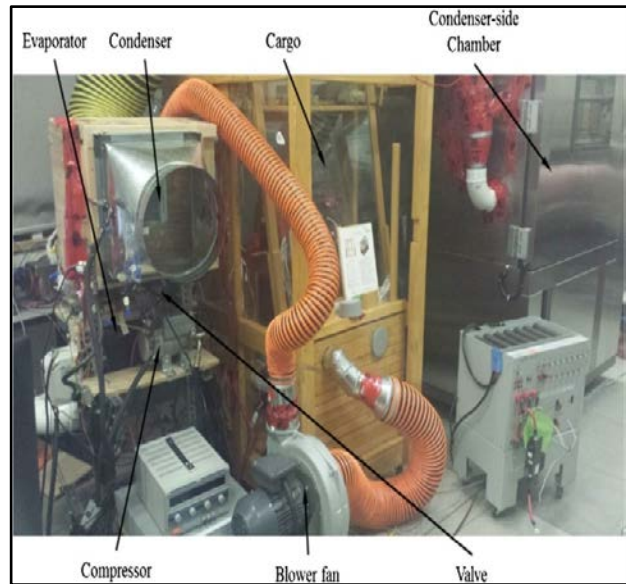

Fig. 2 Experimental setup of automotive A/C-R [7]

III. LITERATURE REVIEW

Hyeonwoo Jang et al., [8] focused on the problem related to building energy management system technology (BEMS). In the building major part of electric consumption used in HVAC system and lighting, It means that its important factor of energy conservation. The main aim of paper it is use of IoT in HVAC and lighting to reduce the consumption of electricity and also can save the energy efficiency. The proposed system operating condition is designed to allow the administrator to setup the system flexibly. The software and hardware system also can use in demonstrated test bed. Power consumption of the test bed was reduced by about 11.2% compared to existing installed system

Raffaele Carli et al., [2] focused on IoT based architecture for module predictive control (MPC) of HVAC system that optimizes the indoor thermal comfort and the energy consumption. Every state has different art and culture. Before using IoT, it is a very important to see HVAC control system and also it general Based structure for the implementation of the HVAC automatic control in real environment. And on other hand define the MPC atomization problem for the effective control of HVAC system. The perfect result shown by easy use of approach and the effectiveness of underlining control algorithm. In

order to comfort system there are various disturbance (such as variation of occupants and the opening of window and door). It's reducing by using IoT and also its increase the Indoor comfort.

B. Padmaja *et al.,* [5] discussed that the uses of IoT. How it can be used effectively in different industries like food, automobile etc. And also in cold storage through IoT we can maintain the different parameter like (temperature, voltage, mean) and many more. IoT can detect more accurately than human. IoT can be more use full in refrigeration industry and food industry for the preservation of food and wine and to maintain the quality and freshness of Products. IoT deals with the data transfer technology in this paper we will find more.

A. M. Ali *et al.,* [4] focused on the IoT used in AC system to produce appropriate thermal comfort in indoor environment by monitoring air temperature by relative humidity inside the temperature in room and office. It has been realized that the most of occupied discomfort is producing from the method of controlling the AC. and also working of AC maximum time effect of occupant health and welfare. Therefore by using IoT based smaller controller with the selected enhanced PMV-based mode because of that AC can create the comfortable environment that can increase the satisfaction about the environment and produce the great words productivity. Also AC system could be improved by using integrating the artificial intelligence element with different type of condition with respect to rooms.

Patil Varsha *et al.,* [9] In this paper it has been discussed that the uses of electricity by the heating and cooling air conditioner is more related to other mechanical devices used to comfort the human. So to reduce the more usage of electricity IoT will be helpful for an example in a room there is only one person and the room is chilled or in a room there are many people and the room is at normal temperature with AC on. So, on both conditions there is a waste of energy. With the use of IoT these problems may be solved. While using IoT in AC's output will be as expected.

IV. RESULT

From the above research it can be stated as the energy requirement is increasing day by day and the requirement of human comfort is increasing rapidly. In order to ease the human comfort the IoT implementation plays an important role in the HVAC so that the energy can also be consumed efficient way and there is less wastage of energy. Luxury of human is also benefited by the implementation of the IoT.

V. CONCLUSION

From the above description it is concluded as, the use of IoT based appliances makes the work easy and it is also mentioned that how the energy consumption can be reduced by the efficient use of IoT in different appliances. By the use of different sensors, actuators, etc. the work is reduced for the betterment of human comfort. And also the use of IoT products the wastage for energy is minimized. In short, we can say that, by the means of use of IoT the human comfort is also increased and the energy consumption is also reduced.

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