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Solar-Powered IOT-Based Portable Refrigeration Unit

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Abstract—This study presents the design of a dual-powered automated Peltier Effect cooler that transfers heat via the thermoelectric effect. By automatically alternating between two sources—grid electricity and a solar source—according to the sources' availability, this gadget reduces energy use. As a consequence, this unit may be utilized both in distant locations without grid power and in locations with grid electricity. During startup, two Peltier elements are skillfully installed in a heat-chamber to achieve the minimal temperature as quickly as possible. This gadget is an excellent applicant for widespread use and mass manufacture due to its efficient hot straightforward design.

Keywords—solar refrigeration, Peltier effect, cooling and heating module, energy-saving.

1. INTRODUCTION

Traditional freezers are heavy, fixed, and filled with dangerous chemicals. They also depend on the placement of the unit; if the unit is moved slightly, the system might malfunction. A Peltier is a shoe-thin, tiny module that produces the Peltier effect. Peltier module cooling may be a highly time-consuming procedure. Since Peltier components are essentially differential coolers that significantly rely on the outside temperature, the key to reducing cooling time is to extract heat from the hot side as much and as rapidly as possible. [4]

There are several uses for refrigeration, including residential refrigerators, contemporary coolers, and cryogenics. In order to reduce the temperature, one must remove heat rather than add coldness. Work must be done in order to fulfill the second law of thermodynamics. The Peltier effect is used in thermoelectric cooling and refrigeration to create a heat flux at the intersection of two distinct semiconductor material types. The Peltier Plate uses electrical energy to move heat from one side to the other, and the amount used depends on the flow of the current. A Peltier device, Peltier module, or thermoelectric cooler (TEC) are further names for this type of equipment. Despite the fact that cooling is actually the main goal, it will be utilized for both heating and cooling purposes. Even as a temperature controller, it is applicable. The area unit, its immovable parts or current fluid, its long life, protection from leaks, its small size, and its adaptable shape are advantages of a Peltier cooler over a vapor-compression refrigerator. When Peltier's plate is used for cooling, a voltage is supplied across the device, which causes a difference in temperature to develop between the two sides. When the gadget is used as an electrical generator, one side of the apparatus heats up more than the other, increasing the voltage difference. [1]

A voltage difference is created between the two sides of the plate when the device is used as an electrical generator because one facet of the device has a higher temperature than the other facet. This phenomenon is known as the Seebeck effect. Thermoelectric coolers (TEC) combine a heater and a cooler. The mixing of two distinct materials to create hot and cold connectors at their ends makes this conceivable. Electrical voltage or potential is used to produce this effect.

Previous refrigerators featured a variety of disadvantages of their own, such as the use of CFCs in them, lower energy efficiency, or the process of producing electricity. Electricity is primarily reliant on coal-fired power facilities, which initially are extremely detrimental to the environment since they emit household gases that contribute to the environment's hazardous gases. These factors all point to the looming possibility of a worldwide disaster [2]. We have an idea to deal with this issue, which is that we should utilize refrigerators without condensers.

This study proposes an Internet of Things (IoT)-based refrigeration system capable of cooling a specified dimension unit within specified time, accuracy, and cost constraints. This IoT base system is quite inexpensive. The weather parameters of the surroundings will be detected by sensors. All the low power equipment will be powered by a solar battery backup system. With this IoT based refrigeration system, people will have a quick, reliable, and cost-effective way of storing medicines and/or a portable solution to cooling.



Fig. 1. The refrigerator display (left) and the refrigerator back (right)

In Fig. 1, the refrigeration unit is shown along with the Peltier module, which is currently used for heating and cooling within a confined space depending on the data absorbed by the temperature sensor.