CHAPTER I INTRODUCTION

1.1 Background

Refrigeration technology has a vital role in people's lives, and one is a refrigeration chamber that can be used to store fruits, vegetables, and drinks. However, the current circulating cooling chambers still use freon, containing dangerous chemicals, namely chlorofluorocarbon (CFC).

The use of CFC damages the ozone layer, causing leaks because the viscosity of the refrigerant is very low, so it easily flows through small gaps. This system is also heavier because the system construction is designed to withstand high-pressure (Mirmanto and Wirawan, 2021). Apart from that, this cooling system is noisy. Utilizing the Peltier effect in the thermoelectric cooler (TEC) is an innovative way to create a cooling chamber that is more eco-friendly.

Cooling chambers can be powered using electricity, but electricity has become a problem in recent years due to the need for conventional energy sources. So, energy is needed that can be used over a long period without depleting the source. A photovoltaic system was developed to solve this issue by converting the sun source into electrical energy in a cooling chamber (Kumar Sah, Kumar, Kumar Ram, & Pratap Singh, 2018).

Ebong et al. (2022) created a tool, a portable and energy-saving refrigerator for vaccine preservation in medical centers in remote areas where electricity supply is limited. The device uses the cold side of the TEC 12706 peltier as a cooling component and a solar panel component as an electricity source. Ebong et al. use two units of TEC 12706 Peltier and solar panels with a capacity of 12 V 50 Wp and an accumulator with a capacity of 12V 50 Ah. This tool has dimensions of (20 x 15 x 20) cm with a capacity of 6 liter and can reduce the temperature from 28°C to 5°C within 1 hour. However, the temperature of the hot side of the TEC 12706 Peltier increased drastically within 15 minutes of operation. Hence, Ebong et al. suggested that the system be operated using a fan cooler installed on the hot side of the TEC 12706 module so that the module is not damaged and the coefficient of performance (COP) of this research value was successfully increased from 0.6 (in literature) to 0.7 by reducing excessive energy consumption.

Manik et al. (2019) recently created a tool to maintain the freshness of fruit and vegetables, namely a solar-powered cooling system using 4 units of TEC 12706 Peltier, a 12 V 10 A Solar Charge Controller, two units of 12 V 100 Wp solar panels, and batteries used to store energy electricity to power on the fan cooler and Peltier components with 12 V 70 Ah. During the three day test, the minimum temperature obtained was 17.324°C for vegetables and fruits. Test results show that the Peltier cooling system can maintain the freshness of vegetables and fruit. The maximum COP of the system is 0.0670, while the minimum COP is 0.0428. Manik et al. (2019) suggest that accumulator capacity needs to be considered in future research because it affects the performance of the Peltier cooling module.

Suryadi and Firmansyah (2020) created an environmentally friendly cold chamber using the TEC 12706 Peltier component as the cooling component, but this research still uses a conventional electricity source. The conclusion obtained from the test results on this tool from three experiments with different loads was that the highest temperature reduction percentage was 11.28% in the second test for a water volume of 200 mL. In contrast, the lowest temperature reduction was 5.07% in the first test with a water volume of 100 mL.

Based on studies and recommendations from earlier researchers, this research was conducted using two units of TEC 12706 Peltier as cooling components, a 50 Wp solar panel as a component that can convert sunlight into a source of electric current, a 12 V 33 Ah accumulator as energy storage, 4 fan coolers for controlling the temperature in the chamber, and can be monitored remotely using Blynk.

1.2 Research Objectives and Benefits

This research aims to create a portable environmentally friendly cooling chamber, such as campsites or remote areas with limited electricity supply and monitored remotely using the Blynk application on a smartphone.

1.3 Research Scope and Limitations

The following are the scope and limitations of the research used in this research:

1. The size of the cooling chamber is (26x17x10) cm.
2. The left side is the cooling chamber, while on the right side, there is the accumulator. At the top of the system, there is a solar panel with a capacity of 50 Wp and below it, there is a Solar Charge Controller, as well as a trolley and wheels so that the tool is easy to move.

3. The sensor used in this tool is the DHT22 sensor, NodeMCU ESP 8266 CH340G microcontroller.
4. The actuators are two TEC 12706 Peltier modules and four 12 V 0.15 A fan cooler units.
5. The accumulator used in the research was an SMT Power Deep Cycle 12 V 33 Ah dry accumulator.
6. Solar Charge Controller PWM 12/24 V 40 A
7. The temperature and humidity results will be displayed via the smartphone Blynk application.
8. The refrigerator can reduce the temperature from 30°C to 15°C within 2 hours.