

I. INTRODUCTION

Fidelity is a measure of the quality of quantum operations or the accuracy of the obtained results in a quantum computing system [1][2]. In this context, fidelity quantifies how well a quantum computer can maintain and reproduce the expected outcomes with minimal errors [3]. Fidelity is typically expressed as a value between 0 and 1, where a value of 1 indicates very low error or high accuracy, while a value approaching 0 indicates higher error rates or less accuracy [1]. The level of errors in a quantum computing system is usually caused by various factors, such as quantum noise, qubit instability, operational errors, and external environmental influences.

Quantum computing is an area of computer science which uses the fundamentals of quantum mechanics to execute computational tasks [2][4][5]. Quantum computing fundamentally differs from classical computing, which operates based on classical bits (0 or 1) as the basic units of information. Instead, in quantum computing, the basic units of information are called qubits (quantum bits), which can exist in a superposition of states and be entangled [6][7].

The unique properties of qubits enable quantum computers to perform computations simultaneously on various possibilities through superposition, allowing for much faster and more efficient information processing compared to classical computers. Additionally, through entanglement, qubits can be quantum-mechanically correlated, so that changes in one qubit can instantaneously affect other qubits, even if they are far apart.

Fidelity is important in quantum computing as it determines how closely the obtained results align with the expected outcomes, and low error rates and high fidelity are essential in maintaining the accuracy and reliability of quantum computations [1][2].

Dynamical decoupling is a technique used in quantum computing and quantum information processing to mitigate the effects of noise and environmental interactions on quantum systems [8][9][10]. The goal of dynamical decoupling is to preserve the coherence and protect the fragile quantum states from decoherence and error accumulation.

In a quantum system, interactions with the environment, such as fluctuations and noise, can cause the quantum states to lose their coherence over time, leading to errors in computations [9][10]. Dynamical decoupling aims to counteract these effects by introducing carefully designed control pulses or sequences of operations [10][11].

Dynamical decoupling enhances fidelity by minimizing the impact of noise, preserving the coherence of quantum states, and suppressing error accumulation [10][11]. By protecting quantum systems from environmental interactions and reducing the effects of decoherence, dynamical decoupling helps to improve the accuracy, reliability, and quality of quantum computations.

Decoherence-free subspace (DFS) in quantum computing refers to a concept aimed at protecting quantum states from the effects of decoherence caused by interactions with the surrounding environment [12][13][14].

This paper is organized as follows. Section II provides the related works and literature reviews. Section III presents the research methodology. Experimental results are discussed in Section IV. Conclusion is given Section V.