Drone Detection System using Infrared Cameras and Quantum Machine Learning techniques

BRIEF DESCRIPTION OF THE TECHNOLOGY

INFRARED IMAGES vs CONVENTIONAL IMAGES

Differences between infrared and normal images are many. Infrared images can detect the heat signature of a drone, making it easier to locate and track it. This is because drones generate heat due to their motors and electronics, which emit infrared radiation. Normal images, on the other hand, rely on shape and colour to identify a drone, which can be challenging, especially in night conditions or when the drone is far. However, normal images may be better at identifying drones in crowded areas, as the radiation can help distinguish the drone from other objects.

MACHINE LEARNING VS QUANTUM MACHINE LEARNING

Quantum machine learning is a new field of research that explores the combination of quantum computing and machine learning. While there has been some progress in developing quantum machine learning algorithms, the time and space complexity of these algorithms compared to standard machine learning algorithms is still a new area of research.

Quantum algorithms have proven themselves to be useful by solving complex problems in polynomial time. One famous example is Shor's algorithm which can efficiently prime factorize large numbers. This task was previously not feasible for classical computers. Other examples include Grover's algorithm and the HHL algorithm. An algorithm we have used heavily is the quantum Fourier transform.

The Fourier transform is a fundamental algorithm in signal processing and machine learning. However, the Fourier transform has a high time complexity of $O(n^2)$, but through some modifications we use the Fast Fourier Transform with time complexity of O(nlog(n)). Thus we use quantum Fourier transform to further lower this complexity to O(log(n)), making it much faster. Quantum algorithms also have the advantage of increased parallel computation, which is integrated in the functioning of neural networks.

OVERALL

We can see using infrared images solves practical problems with low light conditions while using Quantum algorithms solves the issue of time. Further because of the speed of quantum algorithms, real-time image processing and detection also have increased viability. Thus we've explored the usage of quantum computing algorithms like quantum Fourier transform to solve practical defence problems by enhancing the speed of computation and parallel computing capabilities.