2.4GHz JAMMER CIRCUIT

Abstract

With the rapid expansion of wireless technologies and IoT ecosystems, the 2.4GHz ISM band has become increasingly congested, leading to greater sensitivity to interference. Understanding how devices and protocols behave under adverse RF conditions is crucial for building robust, interference-resilient systems. This project explores the design and implementation of a **2.4GHz RF interference generator**, developed using an **ESP32-WROOM-32 microcontroller** and **dual nRF24L01+ transceivers**.

The system functions as a low-cost, customizable, and portable RF noise source capable of operating in two distinct modes: **controlled frequency sweeping** and **random channel hopping**. Both transceivers are configured to transmit continuous RF carrier waves independently over the ESP32's dual SPI interfaces (HSPI and VSPI), effectively covering the 2.4GHz spectrum used by common protocols such as Wi-Fi (IEEE 802.11 b/g/n), Bluetooth, and Zigbee.

To avoid interference with the ESP32's own wireless stack and to maximize RF output performance, **Wi-Fi and Bluetooth functionalities are explicitly disabled** at the system level. Channel hopping and sweep logic are managed through real-time control, triggered by a debounced hardware pushbutton, which switches operational modes on the fly. The system cycles through channels while ensuring that transitions respect regulatory bandwidth limitations. Automatic RF behaviors are supported by the `startConstCarrier()` function, which drives continuous unmodulated carrier emissions for RF stress testing.

The interference generator is particularly valuable in **laboratory environments**, where it can be used to simulate congested RF conditions, evaluate interference handling in IoT networks, analyze signal robustness, or test protocol-level recovery strategies. The device operates within a **shielded and controlled test environment** to comply with radio emission regulations, distinguishing it from unlawful RF jamming tools.

Through this project, advanced concepts such as multi-SPI management, real-time RF control, low-level transceiver configuration, and channel energy distribution were explored. It demonstrates how off-the-shelf components and embedded platforms can be harnessed to build sophisticated RF tools for research, development, and education in wireless communication systems.
