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Development and Power Characterization of an IoT Network for Agricultural Imaging Applications

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Abstract : This paper describes the development and characterization of a prototype IoT network for use with agricultural imaging and monitoring applications. The sensor and gateway nodes are designed using the ESP32 SoC with integrated Bluetooth Low Energy 4.2 and Wi-Fi. A development board, the Arducam IoTai ESP32, is used for prototyping, testing, and power measurements. Google's Firebase is used as the cloud storage site for image data collected by the sensor. The sensor node captures images using the OV2640 2MP camera module and transmits the image data to the gateway via Bluetooth Low Energy. The gateway then uploads the collected images to Firebase via a known nearby Wi-Fi network connection. This image data can then be processed and analyzed by computer vision and machine learning pipelines to assess crop growth or other needs. The sensor node achieves a wireless transmission data throughput of 220kbps while consuming 150mA of current; the sensor sleeps at 162µA. The sensor node device lifetime is estimated to be 682 days on a 6600mAh LiPo battery while acquiring five images per day based on the development board power measurements. This network can be utilized by any application that requires high data rates, low power consumption, short-range communication, and large amounts of data to be transmitted at low-frequency intervals.

Keywords : Bluetooth low energy, ESP32, firebase cloud, IoT, smart farming
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