**Smart Bicycle Theft Prevention System Documentation**

**Motivation:**

Bicycles are a vital mode of transportation for many, prized for their eco-friendliness, cost-effectiveness, and health benefits. However, the growing popularity of cycling has also led to a rise in bicycle theft, especially in urban areas. Traditional locks and alarms often provide inadequate security, leaving owners anxious about their bike’s safety when left unattended. Our project aims to develop an advanced theft prevention system integrating NFC and LoRa technologies to offer a dual-layer security solution. This system provides local access control through NFC authentication and long-range alert capabilities via LoRa communication, ensuring real-time monitoring and protection even when users are far from their bicycles.

**Why would anyone care if you built it?** Bicycle owners would care because current anti-theft solutions are limited, often relying on mechanical locks or alarms that lack remote monitoring capabilities. This system uses NFC for secure user authentication and LoRa for long-range communication, providing real-time alerts and peace of mind even when users are far from their bicycles. This combination of technologies ensures greater protection and control over bicycle security.

**Who would buy it (if it was a product)?** Potential buyers include:

* **Daily Commuters** who need reliable security for their bicycles while at work or school.
* **Recreational Cyclists** who want to safeguard high-value bikes during outdoor activities.
* **Bike Rental Companies** looking to protect their fleets.
* **Cities and Municipalities** interested in enhancing public bicycle parking security as part of their sustainable transport initiatives.

**What problem does it solve?** The project addresses the shortcomings of traditional bicycle locks and alarms that fail to provide remote monitoring or multi-layered protection. By integrating NFC authentication and LoRa communication, this system ensures only authorized users can unlock the bicycle and allows owners to receive alerts and monitor status from anywhere, adding a crucial layer of security and convenience.

**System Design Overview:**

The system consists of several key components interacting to enhance bicycle security:

1. **nRF52840DK (Main Controller)**: Handles NFC-based user authentication and controls system states (Locked, Unlocked, Alert). It reads NFC tags to verify authorized access and changes the bike's state accordingly.
2. **Heltec WiFi LoRa 32 (V3)**: Facilitates long-range communication, sending alerts to a LoRa gateway or server if unauthorized access or suspicious activity is detected.
3. **nRF52840 Dongle (Optional)**: Acts as a local receiver to send Bluetooth alerts to a smartphone when within proximity.
4. **User Smartphone/Web Server**: Receives real-time notifications via LoRa, displaying the bicycle’s status and any alerts.
5. **NFC Tags**: Used for user authentication, allowing the system to transition from the Locked to Unlocked state.

**System Flow**:

* **Locked State**: The nRF52840DK continuously scans for authorized NFC tags.
* **Unlocked State**: NFC authentication unlocks the system for legitimate users.
* **Alert State**: Triggers if the bike remains unlocked without further authentication, prompting the Heltec board to send alerts.

The figure should depict connections between the nRF52840DK, NFC tags, Heltec board, and user devices through LoRa communication.

**Work Division:**

**1. Shreyas: NFC Integration and Main Controller Programming**

* Tasks: Develop NFC authentication code, implement system states on the nRF52840DK, and handle NFC-to-system integration.
* Deliverables: Functional NFC system, code documentation, and initial test results.

**2. Niraj: LoRa Communication and Alert System Development**

* Tasks: Program the Heltec WiFi LoRa 32 for data transmission, set up LoRa gateway communication, and test alert functionality.
* Deliverables: Working LoRa communication code, LoRa configuration documentation, and alert transmission test reports.

**3. Atchyut: User Interface and Testing Coordination**

* Tasks: Develop a smartphone app or web interface for receiving alerts, set up a basic notification system, and coordinate testing.
* Deliverables: User interface, integration test reports, and testing documentation.