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User guide bike tracking

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# Required components

* Sim card with NB-IOT
* Arduino MKR NB 1500
* Arduino MKR GPS Shield
* Flask server to receive and show data.

# Wireless technology

We chose to use NB-IoT that makes use of the cellular network. We made this choice because the tracker should be able to send data no matter where it is, and the cellular network covers a large area.

NB-IoT is a low-power wide-area network with a maximum bandwidth of 200kHz (1). The downlink has a speed of up to 127 kbit/s and an uplink speed of up to 159kbit/s with an latency between 1,6 and 10 seconds (1). The connection is half-duplex so it can’t send and receive at the same time and a transmit power of 14/20/ 23 dBm (1). In Europe it usually uses the 800MHz or 900MHz bands and can reach up to 10KM (2).

# Tracker

The bicycle tracker consists of the Arduino MKR NB 1500 with the sim card and Arduino MKR GPS Shield. The sim card is needed for the tracker to connect to the NB-IOT network. The tracker uses the Arduino MKR GPS Shield to get the coordinates of its current location. The Arduino MKR NB 1500 sends the location data to the Flask server with a timestamp.

# Flask webserver

The flask server receives the location data and a timestamp from the bicycle tracker and stores it in a database. On the flask server is a webpage running to view the data from the tracker.

# Frontend

To display the data received from the tracker you can use JavaScript on a web page using the leaflet.js library to display a map with the location of the bike and your own.

An example of the JavaScript is shown on the next page, and you can place a div with the id “map” anywhere on the webpage to display the map.

<script src="https://unpkg.com/leaflet/dist/leaflet.js"></script>

    <script>

        // Coordinates for the bike location

        var bikeLat = 53.2194;

        var bikeLng = 6.5665;

        var bikedate = new Date(2025, 0, 6, 14, 20);

        // Initialize the map and set its view to the bike location

        var map = L.map('map').setView([bikeLat, bikeLng], 13);

        // Add OpenStreetMap tiles to the map

        L.tileLayer('https://{s}.tile.openstreetmap.org/{z}/{x}/{y}.png', {

            attribution: '&copy; <a href="https://www.openstreetmap.org/copyright">OpenStreetMap</a> contributors'

        }).addTo(map);

        // Add a marker for the bike location

        var bikeMarker = L.marker([bikeLat, bikeLng]).addTo(map)

            .bindPopup('Bike (' + bikeLat + ', ' + bikeLng + ')<br>date: ' + bikedate)

            .openPopup();

        // Check if geolocation is supported

        if (navigator.geolocation) {

            // Get the user's current position

            navigator.geolocation.getCurrentPosition(function(position) {

                var userLat = position.coords.latitude;

                var userLng = position.coords.longitude;

                // Add a marker for the user's location

                var userMarker = L.marker([userLat, userLng]).addTo(map)

                    .bindPopup('Your location (' + userLat + ', ' + userLng + ')')

                    .openPopup();

                // Adjust the map view to fit both the bike and user locations

                var bounds = L.latLngBounds([

                    [bikeLat, bikeLng],

                    [userLat, userLng]

                ]);

                map.fitBounds(bounds);

            });

        } else {

            // Alert the user if geolocation is not supported

            alert("Geolocation is not supported by this browser.");

        }

    </script>

# Sources

1. Wikipedia contributors. Narrowband IoT [Internet]. Wikipedia. 2024. Available from: <https://en.wikipedia.org/wiki/Narrowband_IoT>
2. What is Narrowband IoT (NB-IoT): A comprehensive guide [Internet]. A1 Digital. 2024. Available from: https://www.a1.digital/news/what-is-narrowband-iot-a-comprehensive-guide/#:~:text=NB%2DIoT%20frequency%20and%20range,range%20and%20penetrate%20buildings%20better.