Imagine a scenario when you are about to leave the dorm but you cannot find the keys. You search everywhere in your dorm and feel really frustrated. Because the size of the keys is usually small, it can fit into places like under sofa or bed which make it nearly impossible to find. Several existing commercial products, such as Tile, aims to solve this problem. Tile utilizes GPS technology and low energy Bluetooth to track a block attached to the key or whatever item to be located. The tile can provide audio feedback to alarm the users. We plan to improve this product by providing the user with the key’s exact location, mapped onto a confined space. Since the nature of our solution is about indoor positioning, the solution can be further applied to other fields such as providing accurate positioning or navigation for autonomous vehicles when the traditional GPS-based localization is not accurate.

Our project design is composed of three parts. We will design an RF beacon Transmitter module and Receiver module which detects the Received-Signal-Strength. We will also design a communication module which sends data to some visualization device, such as your mobile phone. The localization algorithm will be running on the microcontroller.
Block Diagram
The frequency of the oscillator is given as:

$$f_{\text{resonant}} = \frac{1}{2\pi \sqrt{L_1 \times C_{\text{tank}}}}$$

(6)

where,

$$C_{\text{tank}} = \frac{C_1 C_2}{C_1 + C_2}$$

(7)

By plugging in the value in the simulation, we get the resonance at 433 Mhz.

Calculations
The S11 showed in the figure is the one-port S-parameter measuring the reflection of the incident signal. A peak is detected at around 436.1MHz, indicating the resonance frequency.

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**Plots**

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**Requirement and Verification**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>RV table for Transmitter</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The matching networks should work within the 3-dB bandwidth of the transmitted signal. The mismatching from ports of different components must be smaller than 10 Ω</td>
<td>1. Simulate and measure the impedance over the bandwidth</td>
<td>2. Attach the antenna used in the receiver on the spectrum analyzer and records the data 10 meters away from the transmitter</td>
</tr>
<tr>
<td>2. The signal transmitted must be detectable 10 meters away with the signal strength greater than -100dBm</td>
<td></td>
<td></td>
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</tbody>
</table>

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Requirements and Verification
4.2 Safety Concerns

In lab environment, the device operates on low-power, DC power source that reduces the risk of electric shocks; however, electrostatic discharge can negatively affect the accuracy of localization results and even damage the chips.

Safety Statements

References


Citations