IoT Vehicle

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1. Introduction

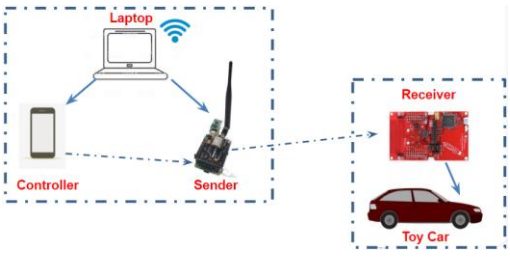
This report tends to basically display our research and implementation of a whole system which could achieve communication between totally different and incompatible wireless protocols. In daily life, we own and use many devices with wire connections. However, these devices cannot communicate with each other as they adopt different wireless protocols, such as Bluetooth, Wi-Fi, Zigbee, Lora. We hope we can make best use of these devices and connect them with each other.

In this project, we try to control a toy car from a mobile phone, sending control signals from a Lora device, which is good at the signal coverage.

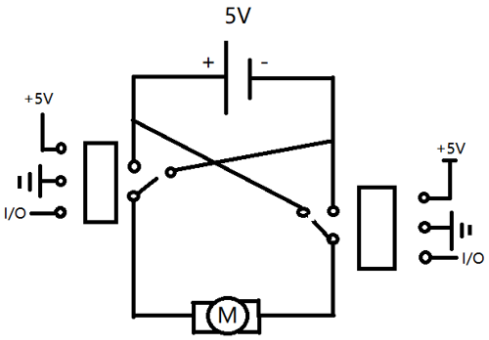
We remodel a toy car and install certain devices on the car to reach our goal. Also, several works are done to polish up our project to make the interaction fancier.

2. Design and Implementation

We searched a lot about the design of the system. Finally, we decide to accomplish the system in these following function modules, including a laptop, an android mobile phone, a sender, a receiver, a toy car.



2.1.1 Hardware part – circuit of the toy car



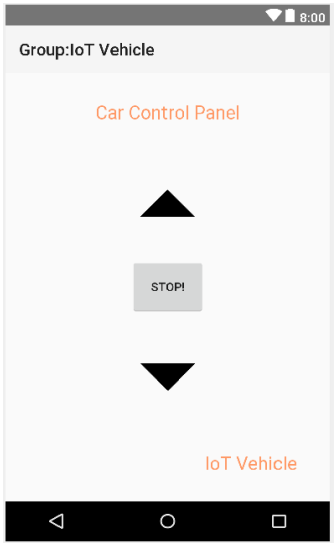
The graph shows the diagram and the basic circuit of the toy car. We use two electric relays to get negative or positive voltage to control the motor.

And in the experiments in the next steps, great instability of the batteries was observed. So we changed the nude batteries into a battery box to make sure the stability of the power supply. And it turned out to be fine. The whole system never choke again.

2.1.2 Software part – Android programming of the control panel of the toy car

To control the car in a user-friendly way, we design an android application, which

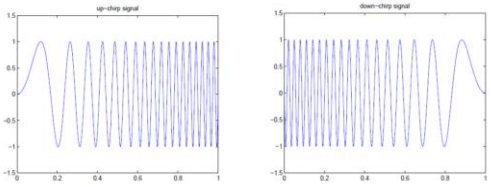
can control the car move forward, backward.. Here is how it looks like:



The arrow is used to control the car, and the button in the center is used to stop the car.

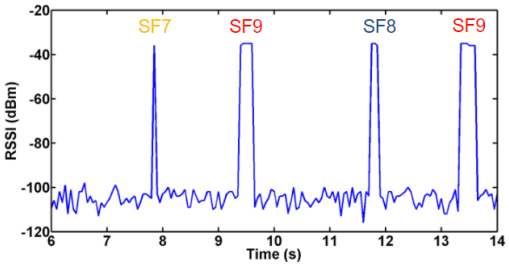
To implement the car control, we use socket interface (both provided by Android and Linux) to send command. A laptop works as an access point and provides a local wireless network. Both the mobile phone and the sender are connected to this network. We choose UDP protocol because it can be more sensitive and low-latency. After receiving the command, the sender transfer the command through Lora signals.

2.2 Lora signal decoding



This is the most challenging part but also the highlight of this project. Lora is a way of manipulating a radio wave to encode information using a chirped, multi-symbol format. These two figures show the Lora's up-chirp and down-chirp radio in time domain. As time goes on, the up-chirp wave will increase the frequency of the sine wave. And the down-chirp wave will decrease the frequency of the sine wave. Actually Lora use the change of the frequency to represent different data.

The cc1310 (the Zigbee device) cannot directly decode the Lora signal. But it can sense the energy strength and duration of the Lora's radio. It decode these signals according to a threshold.



2.3 Car control

After receiving the command, CC1310 transfers the signals to a Raspberry Pi. As the Raspberry Pi can control its pins by the interface provided by Raspberry Pi and to control the relays in the circuit we described in 2.1.1. When the two relays switch to the outside contactors, the motor gets positive voltage and the car moves forward. While the two relays switch to the inside contactors, the motor gets negative voltage and the car moves backward.

3. Conclusion and Evaluation

In this report, we basically fulfilled the implementation of what we originally think about the idea on designing and implementing the combination of the Raspberry Pi, a Zigbee device, a Lora device, a mobile phone and the toy car. To conclude, we successfully achieve cross technology communication between two devices run on different and incompatible wireless protocols, and apply such communication to remotely control a toy car.

4. Acknowledgements

For the whole semester, we would like to thank Professor Mo Sha and TA Di Mu, for their great help and some hints when we face any barriers. We want to thank our classmates as well for their listening and probable advice on improving our data exchange model. Last but not least, great appreciation is given to my teammates about their contribution and devotion to this project.