Report Date: 09/30/2022
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Summary

Network environment establishment has not been going successfully. All the possible candidates for the network server platform(The Things Stack, Chirpstack, ResIoT, SENET) were not working for different reasons. The team created a local server for The Things Stack and Chirpstack on Docker,[9][12][13] but they had a certificate problem that makes it impossible to register a gateway. This was presumed to be the problem of the RAK7249 gateway itself, since both platforms have the same issue. ResIoT and SENET are a cloud server IoT platform, and The Things Stack also has a free cloud server called The Community Edition. But they did not work either due to unidentified error. For some reason, the RAK gateway could not connect to the network server in all of those platforms. The Things Network Community Edition kept showing disconnected messages, SENET and ResIoT did not support the RAK devices. This was the same with another gateway, Multitech Conduit. With Multitech Conduit, various methods were tried such as factory reset and manual installation of the gateway driver through SSH[4] and serial connection. But it could not connect to any existing platforms.

Professor Anthony Smith recommended to us the paper from his student that succeeded to connect the same gateway(RAK7249, Multitech conduit) to the Chirpstack. Chirpstack had gateway connection problem, but the team decided to try Chirpstack again with the instruction the paper described.[16]

While some teammates worked on network environment establishment, the team seperated and did some other tasks.

First one is writing audio filtering code. Since NodeMCU is executed in C or C++, the code is written in C++. Open source is used to write the code.[6][15] However, it was necessary to study wav file format and Fourier Transform function.[14] Therefore, first job was to make a wav file format class.[8] Using the format, audio data can be changed into object and that makes sound filtering much easier. Conclusively, the detail header information and the frequency of wav file was extracted.

Second one is connecting LoRa board Heltec ESP32 and the sound sensor SEN12642 on to the breadboard and testing basic functions the project needs.[1][2][7][10] Sending and receiving LoRa packets between ESP32 was successful,[11] and making ESP32 to receive sound decibel data from the sound detector was also successful.[3] Combining two codes, ESP32 now can send LoRa packets that contains sound decibel data.

What Coyote Team completed this week:

- Trying to connect LoRaWAN
- Soldered the ESP32, Sound Detector
- Tested the LoRa Module, ESP32 and Sparkfun Sound Detector with Example code
- Writing code of Audio Data Filtering in C++ using Mac
- Building the-things-stack local server
- Research about Coyote Barking and Howling
- Writing paper

Things to do by next week

- Do research and writing about more accurate sound detecting code

- Writing code of wav file compression and decompression in C++
- Put in the code of Audio Data Filtering in NodeMCU
- Trying to connect NodeMCU with LoRaWAN
- Test Sound filtering
- Writing localization algorithm

Problems or challenges:

- Adding the gateway on whichever platform that works(Most problem)
- Having trouble getting acoustic data in C++ using Mac.
- Sparkfun Sound Detector does not provide audio file. (Might need a new kind of sensor)

References

[1] Byron. J. "Sound Detector Hookup Guide" SparkFun. Accessed: Sep, 29, 2022. [Online]. Available: https://learn.sparkfun.com/tutorials/sound-detector-hookup-guide/all

[2] Robot Zero One. "ESP32 Built-in OLED – Heltec WiFi Kit 32" robotzero.one. Sep, 22, 2017. [Online]. Available: https://robotzero.one/heltec-wifi-kit-32/

[3] csdenagama. "Arduino Sound Detection Sensor Project" Arduino Project Hub. Mar, 11, 2021. [Online]. Available: https://create.arduino.cc/projecthub/csdenagama/arduino-sound-detection-sensor-project-5ebd4b

[4] L. Pounder. "How to Use SSH to Connect to Remote Computers Using Windows, Linux or macOS" Tom's Hardware. Jul, 4, 2022. [Online]. Available: https://www.tomshardware.com/how-to/use-ssh-connect-to-remote-computer

[5] B. Mitchell, M. Makagon, M. Jaeger and R. Barrett. (2006). "Information Content of Coyote barks and howls" 2006. [Online] Available: https://www.uvm.edu/~bmitchel/Publications/Mitchell_Information_content.pdf

[6] Adam Stark, "AudioFile: A simple C++ library for reading and writing audio files" Github.com, Jan 15th, 2022 [Online]. Available: https://github.com/adamstark/AudioFile

[7] Markerspaces_com "How To Solder: A Beginner's Guide" Accessed: Sep, 29, 2022. [Online] Available: https://www.makerspaces.com/how-to-solder/

[8] musicg-api "Wav file format" sites.google.com [Online] https://sites.google.com/site/musicgapi/technical-documents/wav-file-format#wavefileheader

[9] ChirpStack "Quickstart Docker Compose" ChirpStack.io Accessed: Sep, 29, 2022. [Online] Available: https://www.chirpstack.io/project/guides/docker-compose/

[10] ShotokuTech "Easy Heltec ESP32 LoRa OLED Setup in the Arduino IDE" Youtube. Dec, 16, 2019. [Online] Available: https://www.youtube.com/watch?v=j-Nz14qaNIw&t=159s

[11] R. Santos. “Installing the ESP32 Board in Arduino IDE (Windows, Mac OS X, Linux)” Random Nerd Tutorials. Accessed: Sep, 29, 2022. [Online] Available: https://randomnerdtutorials.com/installing-the-esp32-board-in-arduino-ide-windows-instructions/

[12] The Things Stack.”command line-interface” Accessed: Sep. 26, 2022. [Online]. Available: https://www.thethingsindustries.com/docs/getting-started/cli/

[13] The Things Network “Installing The Things Stack on Localhost” Youtube. Jan, 20, 2021. [Online] Available: https://www.youtube.com/watch?v=Owm5IUtQTx8

[14] “Properties of sine waves” Nov, 27, 2005 [Online] https://home.cc.umanitoba.ca/~krussll/phonetics/acoustic/sine-properties.html

[15] Hungry Hummingbird. “how to read wav file in C++ Code Example” codegrepper.com comment Accessed: Jun, 26, 2021 [Online] Available: https://www.codegrepper.com/code-examples/cpp/how+to+read+wav+file+in+C%2B%2B

[16] M. Harman, “LoRaWAN Overview & Implementation”, unpublished.