



# Midterm Presentation

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**Team Coyote1**



# CONTENTS



01. Introduction



02. Progress



03. Problem



04. Weekly Plan



01

# Introduction

## 1.1 Team members



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Computer Science and Engineering



**Jaehui Boo**

Dankook University  
Computer Engineering



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Purdue University  
Network Engineering Technology



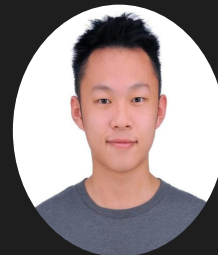
**Hyeongjun Kim**

Daegu Catholic University  
Computer Engineering



**Nayoun Kim**

Woosong University  
Information Technology Convergence



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Purdue University  
Computer & Information Technology



## 1.2 Background



United States  
Department of  
Agriculture

Animal and  
Plant Health  
Inspection  
Service

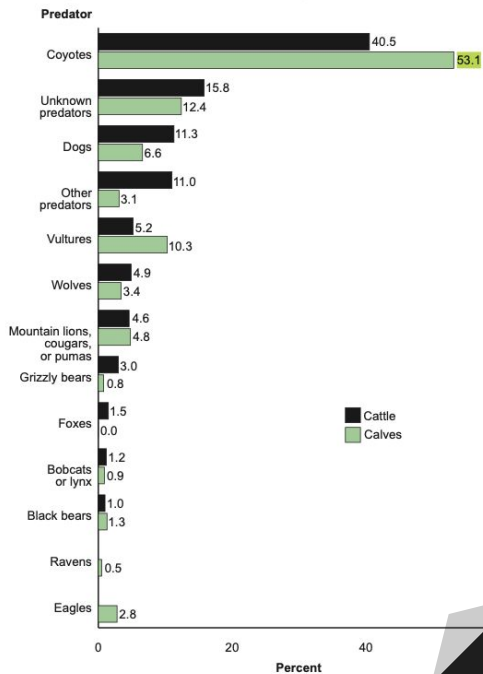
Veterinary  
Services

National  
Animal Health  
Monitoring  
System

December 2017

### Death Loss in U.S. Cattle and Calves Due to Predator and Nonpredator Causes, 2015

Percentage of cattle and calves death loss, by predator



- ✓ Cost-Effective
- ✓ Easy-to-use

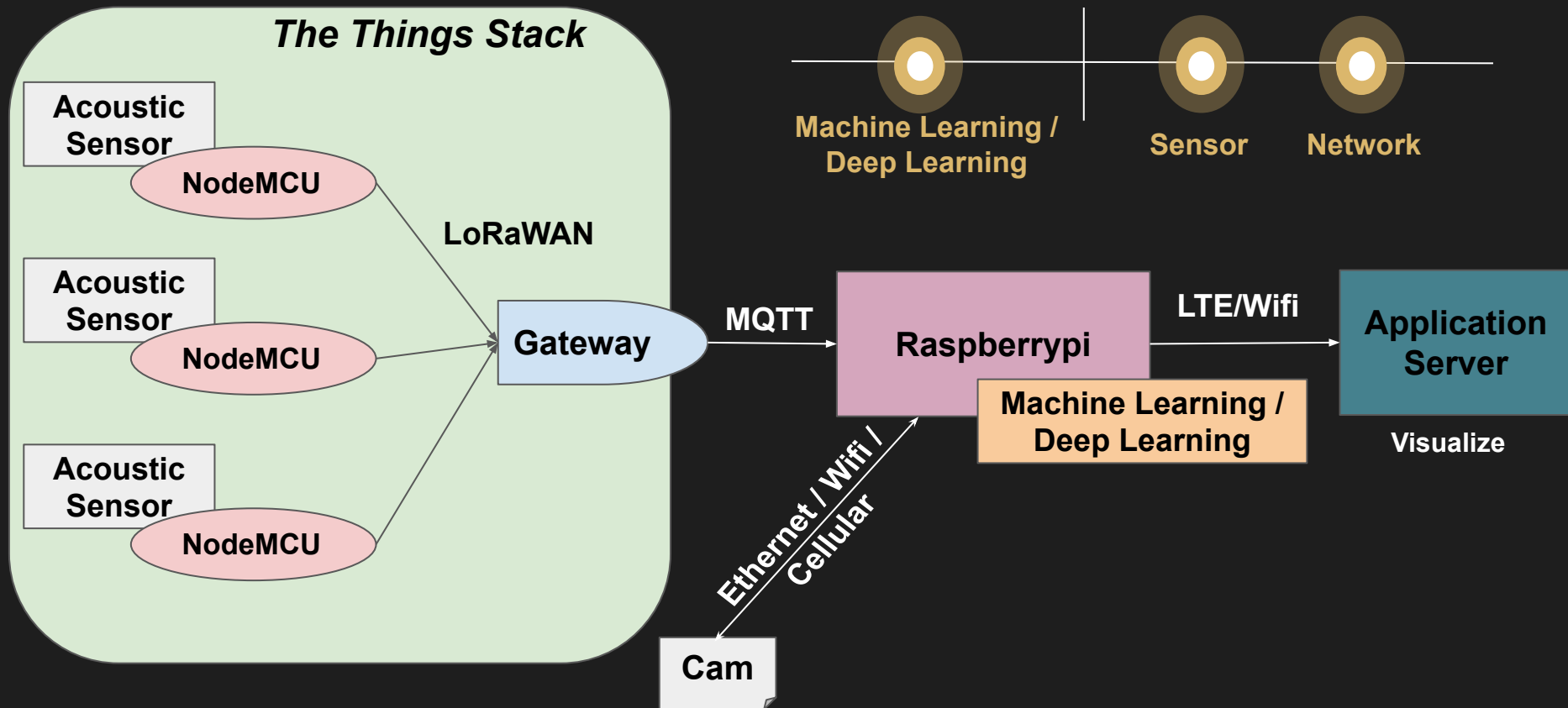


INDIANA



Introduction

## 1.3 Project Architecture





Progress

02

Progress

## 2.1 LoRaWAN



- ✓ **Network server stack**
- ✓ **Open-source components for networks**
- ✓ **Physical layer process of radio modulation**





## 2.1 LoRaWAN



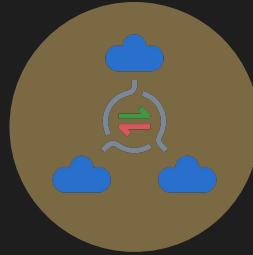
**Low Power  
Consumption**



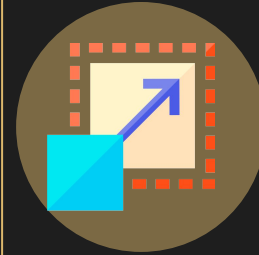
**Years of  
Battery Life**



**Long-distance**



**Multi-usable**



**Scalable**



**Cost-effective**



**Progress**

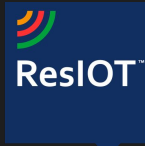
## 2.2 Gateway



To connect the gateway to the ResIoT,  
The program provided by the ResIoT had to be installed on the gateway.

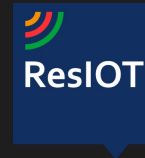
✗ Memory error that the multi-tech gateway lacked storage

✗ When we looked at how much storage was left  
on the mLinux terminal, there was enough storage



Multi-tech gateway

✗ ResIoT did not support the Rak gateway



Rak7249 Gateway



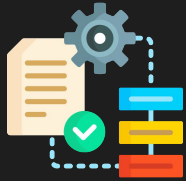
## 2.2 Gateway



### Local Server VS Cloud Server



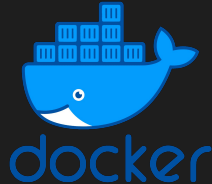
Failed to install it due to unknown errors



configuration files



uploaded



The application server could be created



Connection failed due to an authentication problem

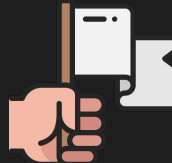


Progress

## 2.2 Gateway



- ✓ The process of building the server went smoothly
- ✓ If clients are connected to the same network, we can access to the application server through the static IP address
- ✗ It was necessary to access the console window to register the gateway, but it was not possible to access the console window
- ✓ Re-created the certificate and tried registering
- ✗ The same authentication problem occurred such as 401 and 404 errors



**multi-tech gateway  
had been previously registered.**



Progress

## 2.2 Gateway



**Decided to turn our attention back to the cloud server.**



An attempt was made to register a different multi-tech gateway with the SENET cloud server.



The multi-tech gateway could not connect to the Internet, so the gateway software provided by SENET could not be installed.



## 2.2 Gateway

Tried to connect the RAK7249 gateway to The Things stack



But it always show disconnected



Debugged the Rak's Internet connection



Connected to The Things Network again,  
the gateway's status said connected-!!



## 2.3 Esp32 – Gateway

### [Esp32]



**Wifi &  
Bluetooth**

Wide Range of  
applications can be  
targeted



**Low-cost &  
Low-power**

Low-cost & Low-power  
system on a chip  
microcontrollers



**Temperature  
range**

Wide operating  
temperature  
(-104°F ~ 221°F)



Progress

## 2.3 Esp32 – Gateway

[Esp32]



Overview Applications Gateways Organizations

Applications > Acoustic Sensors > Live data

Time	Entity ID	Type	Data preview
↑ 05:50:35	eui-70b3d57ed00565be	Forward uplink data message	DevAddr: 26 0C 58 75 <>
↑ 05:50:28	eui-70b3d57ed00565be	Forward uplink data message	DevAddr: 26 0C 58 75 <>
↑ 05:50:20	eui-70b3d57ed00565be	Forward uplink data message	DevAddr: 26 0C 58 75 <>
↑ 05:50:13	eui-70b3d57ed00565be	Forward uplink data message	DevAddr: 26 0C 58 75 <>
↑ 05:50:06	eui-70b3d57ed00565be	Forward uplink data message	DevAddr: 26 0C 58 75 <>

Payload: 07 9F 00 <>

Payload: 07 9F 00 <>

Payload: 08 47 00 <>

Payload: 07 A3 00 <>

Payload: 07 B0 00 <>

Export as JSON

SF9BW125 SNR: 5.25 RSSI: -105

SF9BW125 SNR: 5.5 RSSI: -107

SF9BW125 SNR: -0.5 RSSI: -106

SF9BW125 SNR: 6.5 RSSI: -106

SF9BW125 SNR: 3.25 RSSI: -110

NAM1 Community

Fair use policy applies



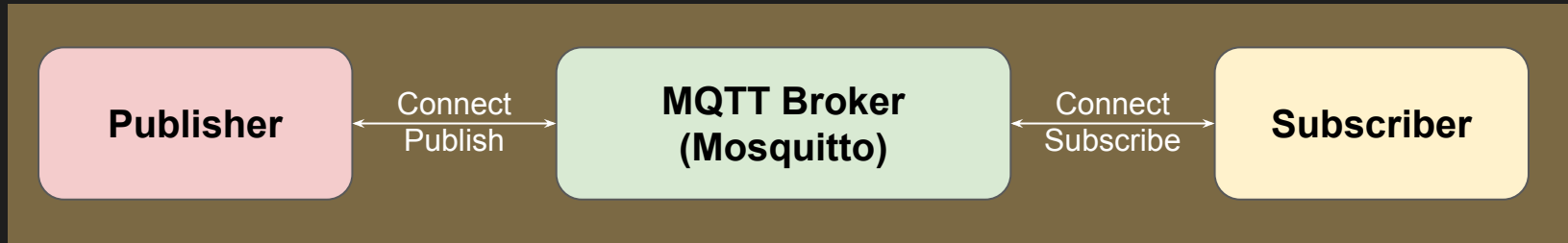
Progress



## 2.4 Gateway – Raspberry pi

### [MQTT]

- ✓ Message Queuing Telemetry Transport
- ✓ Light weight Machine - Machine
- ✓ Minimum power & packet

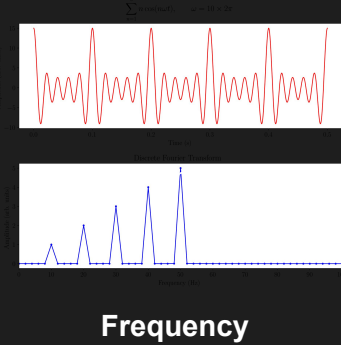
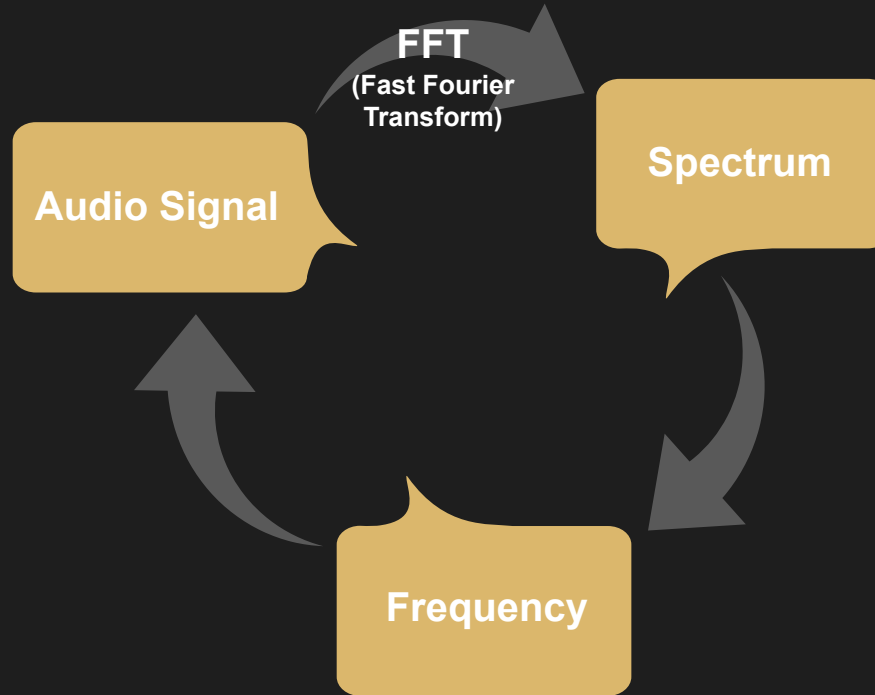


## 2.5 Acoustic Sensor



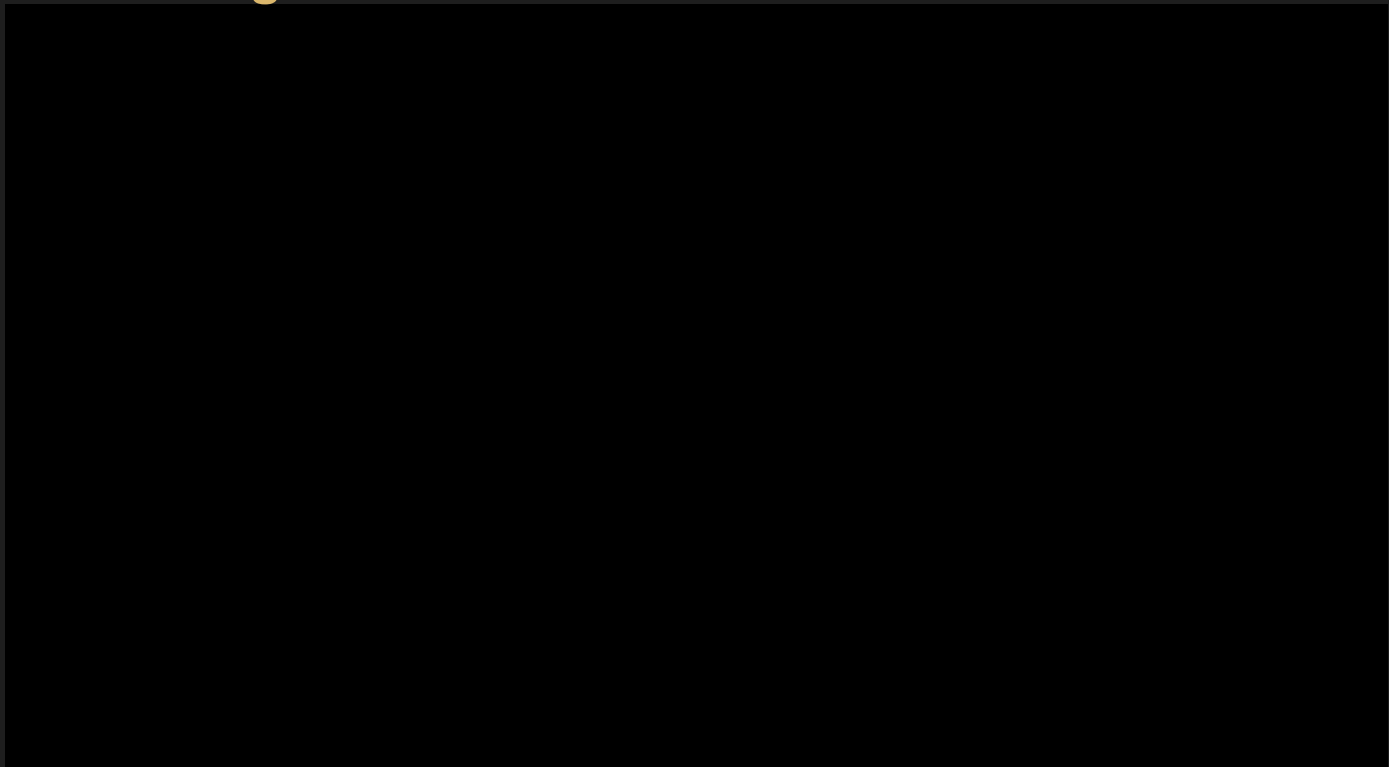
[max4466]

**FFT (Fast Fourier Transform)**  
: an algorithm that computes the discrete Fourier Transform of a sequence, or its inverse.  
Original domain -> Frequency domain



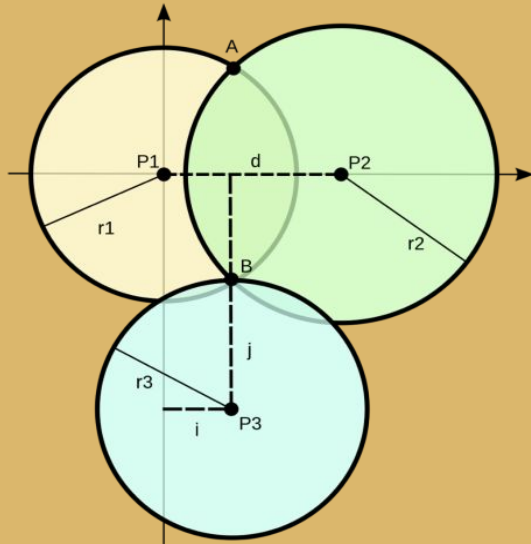
## 2.1 ~ 2.5 Demo Video

### Esp32 — the things stack cloud server — MQTT Broker



## 2.6 Acoustic Localization

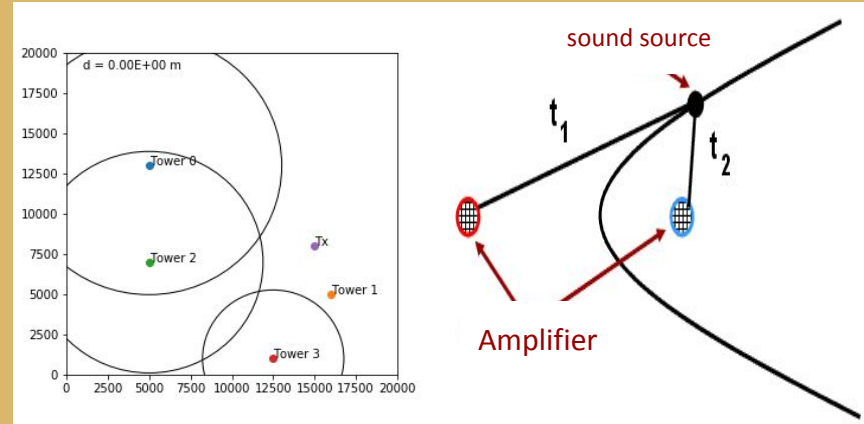
### [Trilateration]



- $r_1, r_2, r_3$ : distance between the source of the sound and three acoustic sensors
- $N$ : the first time when the sound came in

~~$r_1, r_2, r_3$~~

### [Triangulation] - hyperbola



- The process of acoustic localization using forming triangles to the point from known points
- Three hyperbola  $\Rightarrow$  the source of the sound



Problem

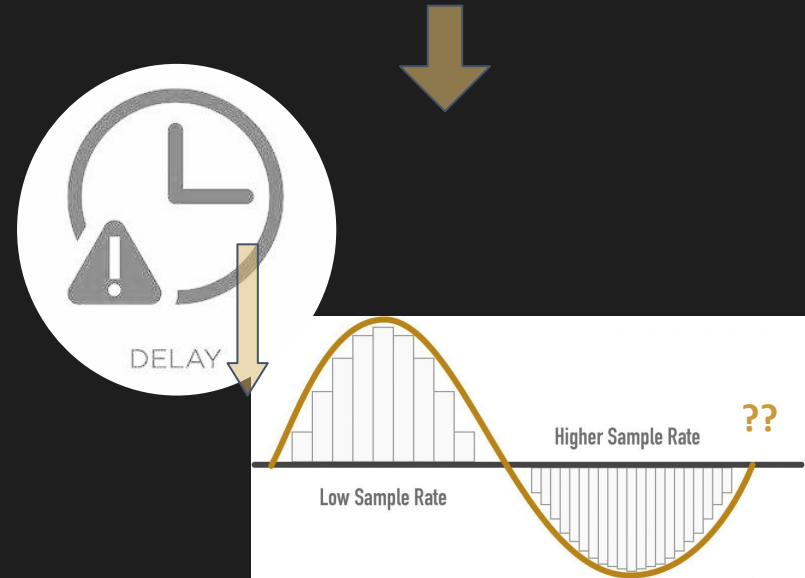
**03**

**Problem**

### 3. Problem



- **Low Power**
- **Low Bit Rate Networking Protocols**





Weekly Plan

04

Weekly Plan

## 4. Weekly Plan

	Sep 4th	Oct 1st	Oct 2nd	Oct 3rd	Oct 4th	Nov 1st	Nov 2nd	Nov 3rd	Nov 4th	Dec 1st	Dec 2nd	Dec 3rd
LoRaWAN Setting ✓												
NodeMCU - Acoustic Sensor Code ✓												
AcousticSensor - GW Connect ✓												
Sound Filtering & Data Compress												
MQTT Connection ✓												
Raspberrypi-MachineLearning												
Camera Sensor Code												
GW - CameraSensor Connect												
Visualization												
Test												
Paper												
PR												





# [References]

- [1] United State Department of Agriculture (USDA)., "Death Loss in U.S. Cattle and Calves Due to Predator and Nonpredator Causes, 2015," in USDA, Dec. 2017. [Online]. Available: <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/monitoring-and-surveillance/nahms/nahms-studies/nahms-studies-table?cat=general>
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- [7] [14] abhilash\_patel. "EasyFFT: Fast Fourier Transform (FFT) for Arduino". Arduino Project Hub. Jul, 12, 2020 [Online]. Available: <https://create.arduino.cc/projecthub/abhilashpatel121/easyfft-fast-fourier-transform-fft-for-arduino-9d2677>





Q&A



**Thank you**