Environmental Data Sensing and Monitoring System Using Community-based Private LoRa Network

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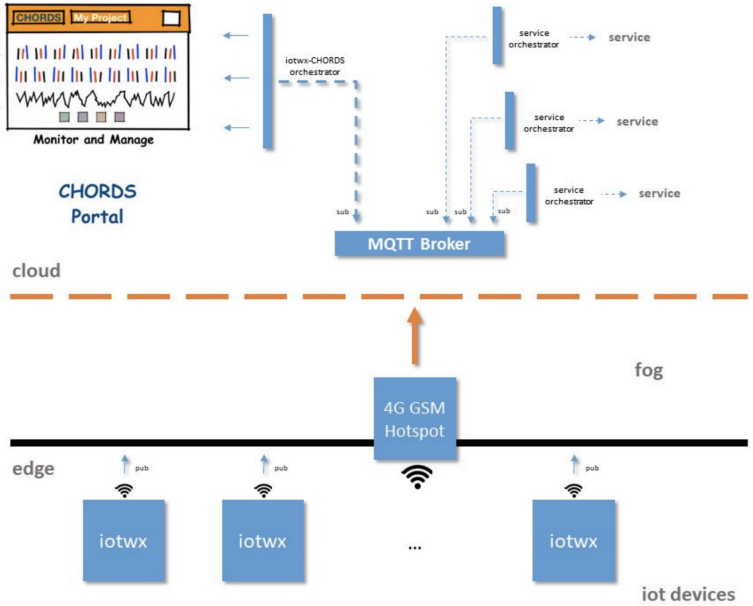
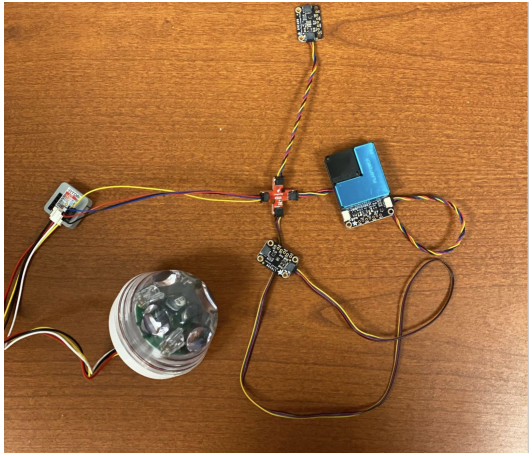
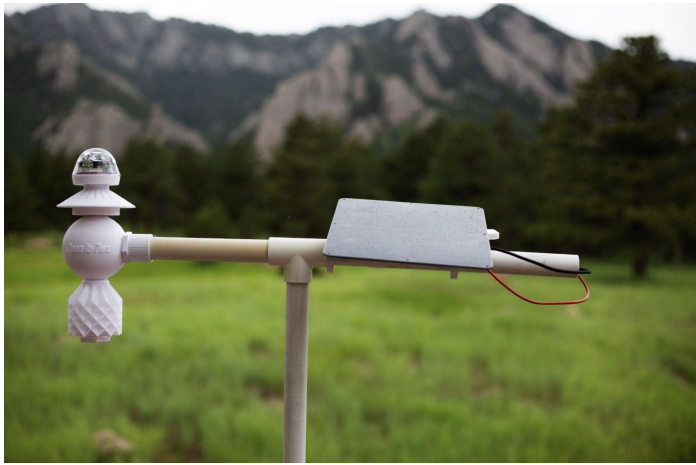
OpenIoTwx v2

- Standalone, cell-based, Weather Station grade, modular, sensor set
- End-to-end Open Source
- 3d printable body
- Easy to assemble electronics
- Created for educational trainings and data equity work







Drawbacks of cellular ecosystem

Location

Remote accessibility not possible

Cost

Cellular plans can often be costly

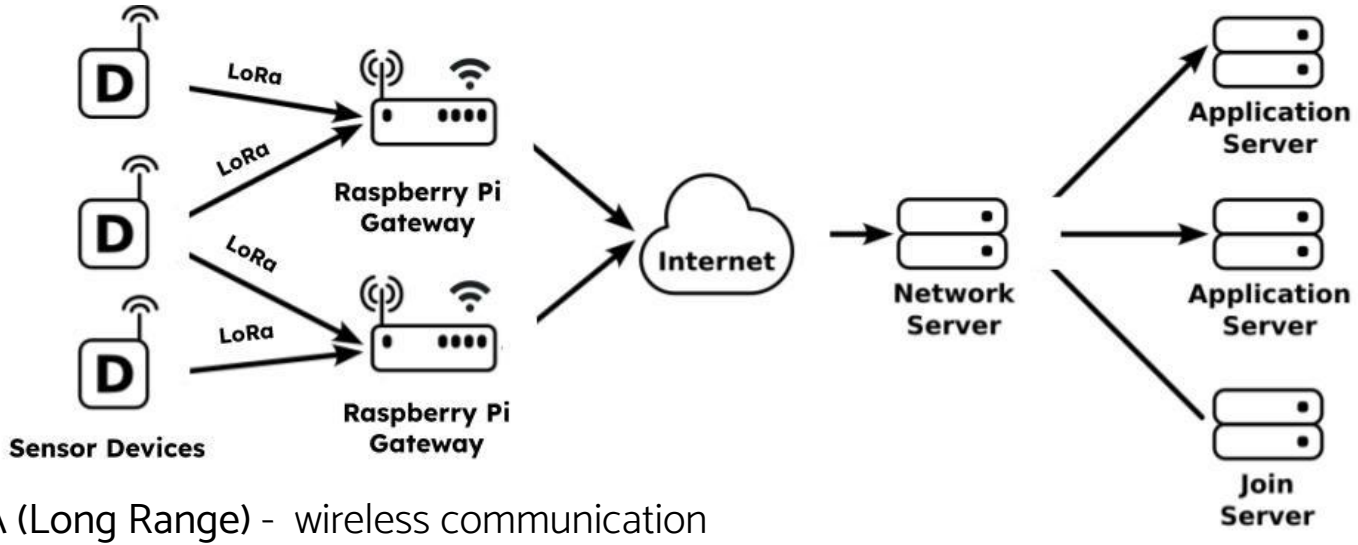
Power

Cellular transmission is power hungry

Unavailability

Cellular system unreliable during breakdowns in disasters

Network Architecture

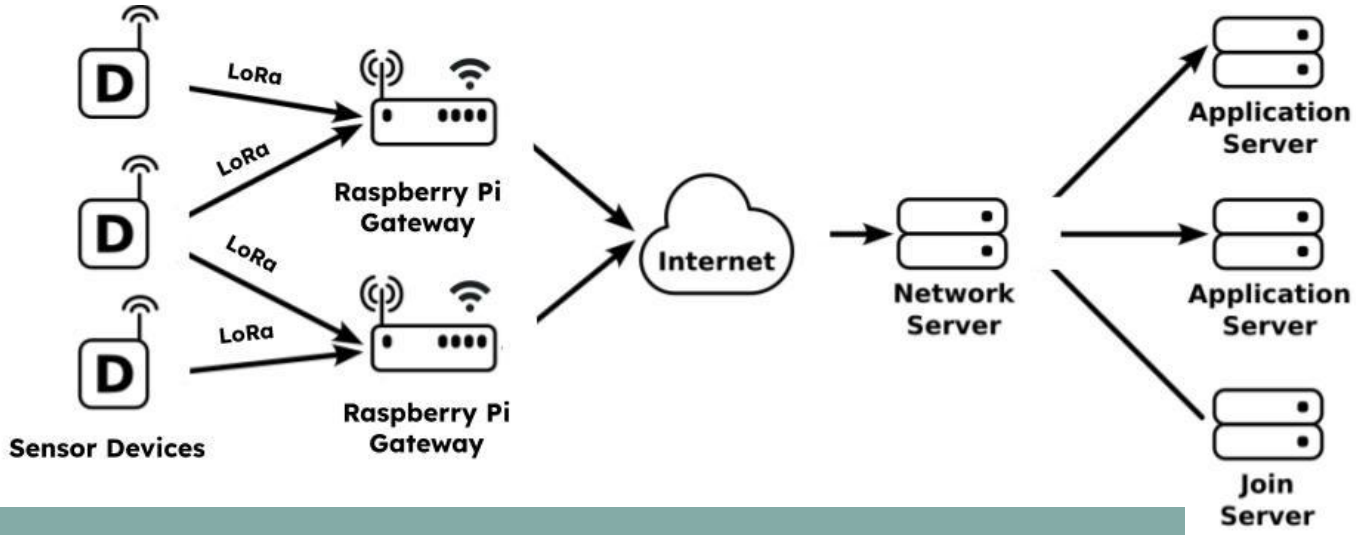


LoRA (Long Range) - wireless communication technology designed for long-range, low-power communication between devices, often used in IoT (Internet of Things) applications.

LoRa frequency bands by region:

- Europe: EU868 (863–870/873 MHz)
- South America: AU915/AS923-1 (915–928 MHz)
- North America: US915 (902–928 MHz)
- Asia: AS923 (915–928 MHz)

Data Protocols



Data Collection

These devices measure and collect weather data. Each sensor node is equipped with LoRa communication capabilities to transmit data wirelessly.

Data Gateway

The Raspberry Pi devices act as local gateways, receiving data from multiple sensor devices via the LoRa network. They then transmit this data over the internet to central servers using MQTT

Data Transmission

This server acts as a central hub, receiving data from various Raspberry Pi gateways and distributing it to multiple application servers.

Use Cases and Motivation

Real time alert system

Real-time alerts for severe weather conditions such as storms, heavy rainfall, or natural events like wildfires

Agricultural Applications

Farmers can use data to optimize irrigation, protect crops from weather, and boost productivity

Environmental Monitorring

Monitoring air quality, UV levels, and environmental factors informs pollution and climate change impact

Comparison

01

Open Source

Open-source hardware and software

02

Flexibility

Not Vendor Locked

03

Cost Savings

No subscription fee , inexpensive equipment

04

Modular

Can add off the shelf products (Cross Vendor)

05

Simplicity

Low skill project

MESHTASTIC

THE THINGS NETWORK

goTenna

DISASTER RADIO

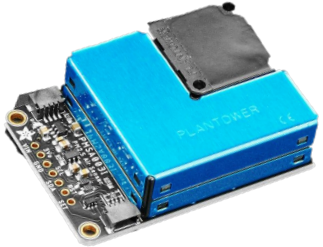
PYMESH LoRa Mesh Network

LILYGO®

HELTEC AUTOMATION

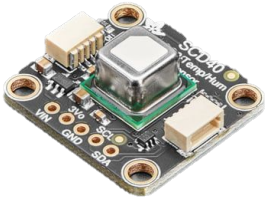
Major Sensors

BME680
Pressure Humidity, Temperature



PMSA003I
Air Quality

LTR390
Ultra Violet



SCD40
Carbon Dioxide

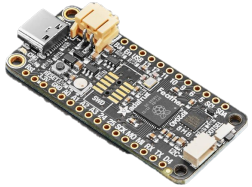
RG15*
Precipitation quantity and rate

RS-CFSFX*
Wind Sensor

Major Electronics

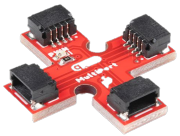
Raspberry Pi

LoRA RFM95W Bonnet



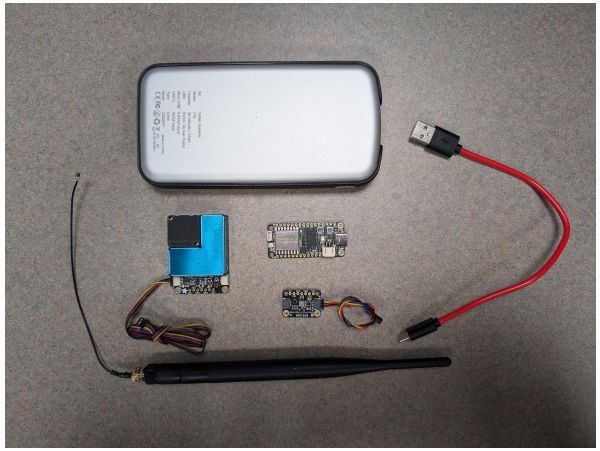
Feather 2040

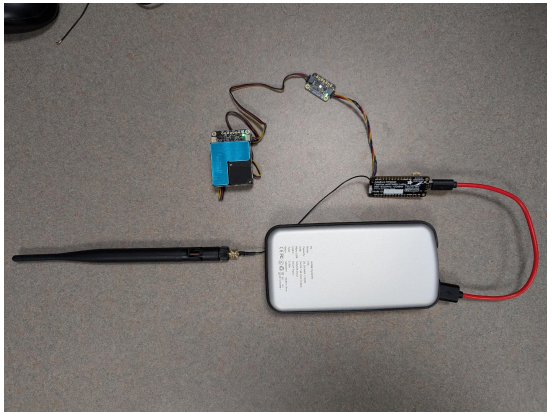
Qwiic Cables

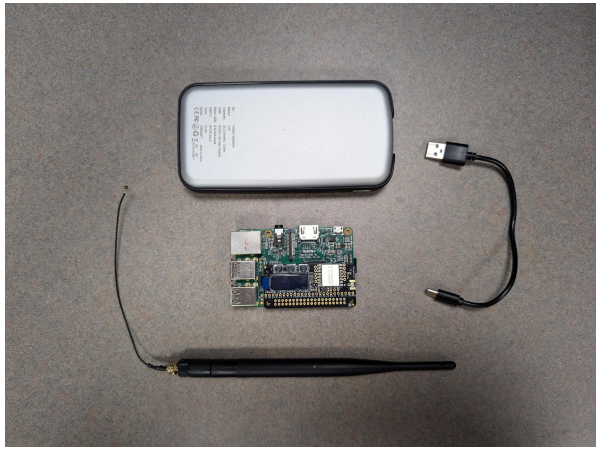


Qwiic Multiport

Assembled setup



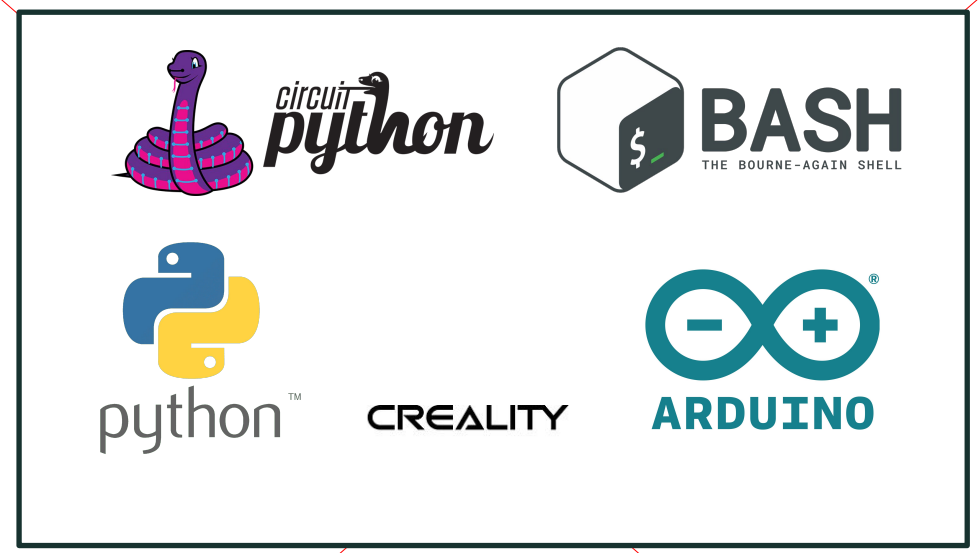




Transmitter Setup

Raspberry Gateway Setup

Software



[Github Repository]

SCAN ME

Range

Standard Range

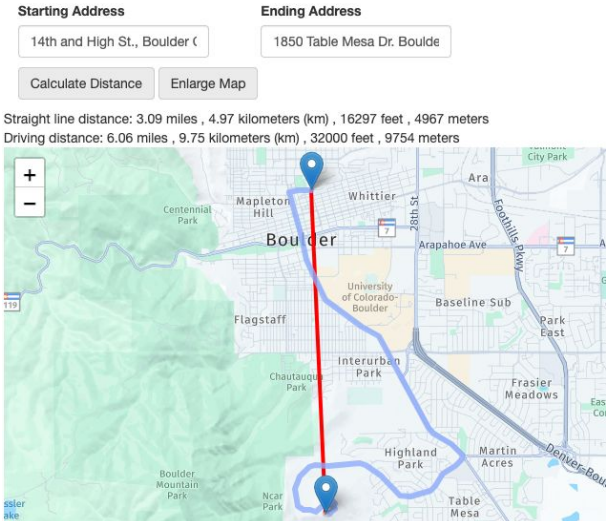
Urban Areas: 3 miles
Rural Areas : 10 miles

Tested Range

Straight line distance: 3.09 miles

Factors Influencing LoRa Range:

- Frequency Bands: License-free sub-gigahertz RF bands (433 MHz, 868 MHz, 915 MHz)
- Antenna Performance: Quality and positioning of antennas impact range
- Environmental Conditions: Physical obstructions (buildings, trees) reduce range, open spaces enhance range
- Transmission Power: Higher power increases range but consumes more energy



Dashboard

SCAN ME

FUTURE Works

- Free and open anemometry solutions
- Reducing LoRA communication deployment costs
- Incorporate Data Encryption for enhance security
- Develop website or openIoTwx for community deployment
- Pursue Edge computing applications and make data AI ready and weather modelling (Chameleon Cloud)
- Publish a paper we're working on

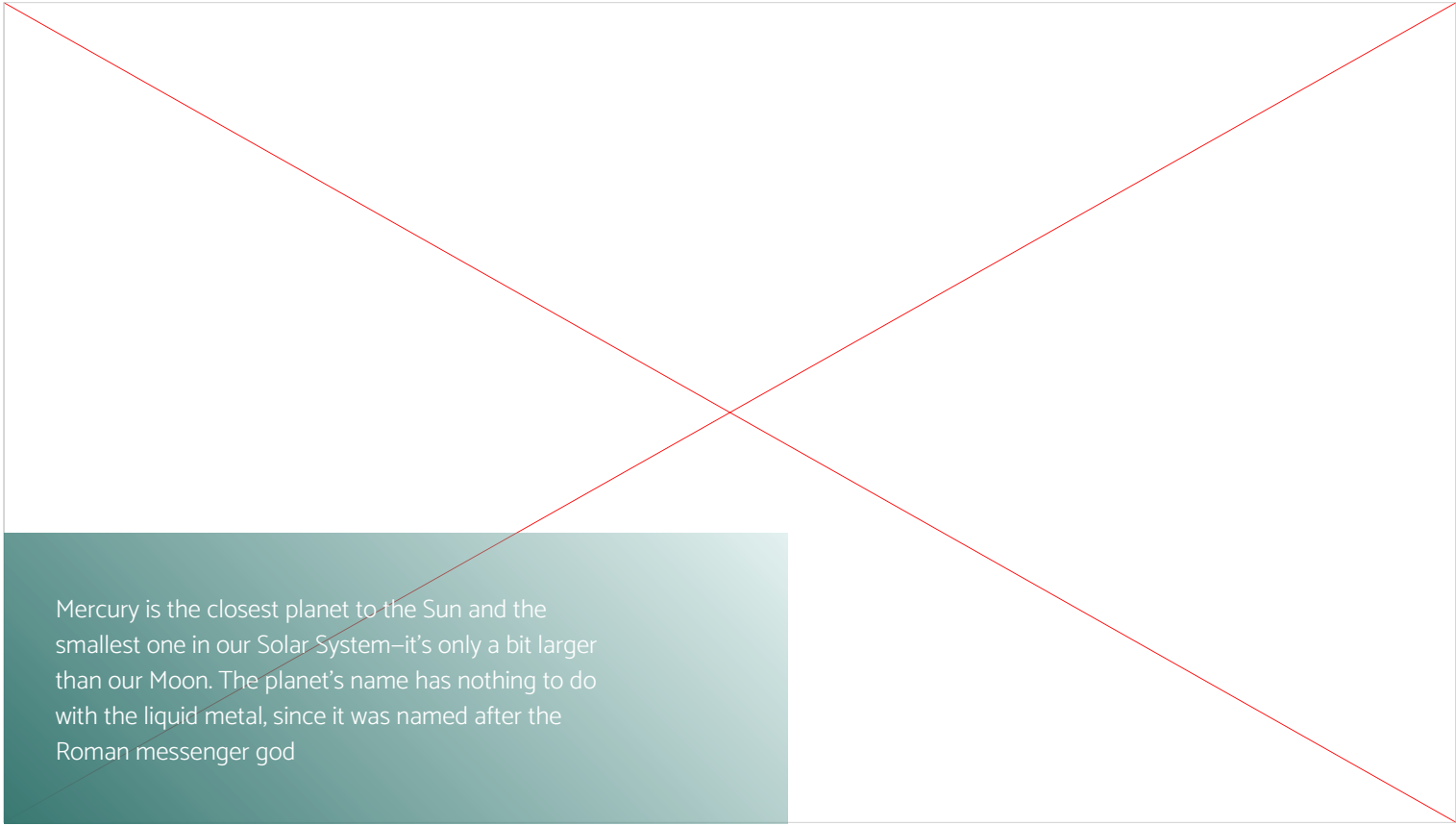
THANK YOU!

- to Agbeli Ameko and Keith Maull for their dedicated mentorship and teaching, which greatly enhanced this project.
- to the administration team and cohort for making this summer unforgettable!

“Here comes the quote. Words full of wisdom that someone important said and can make the reader get inspired.”

—SOMEONE FAMOUS

NOW



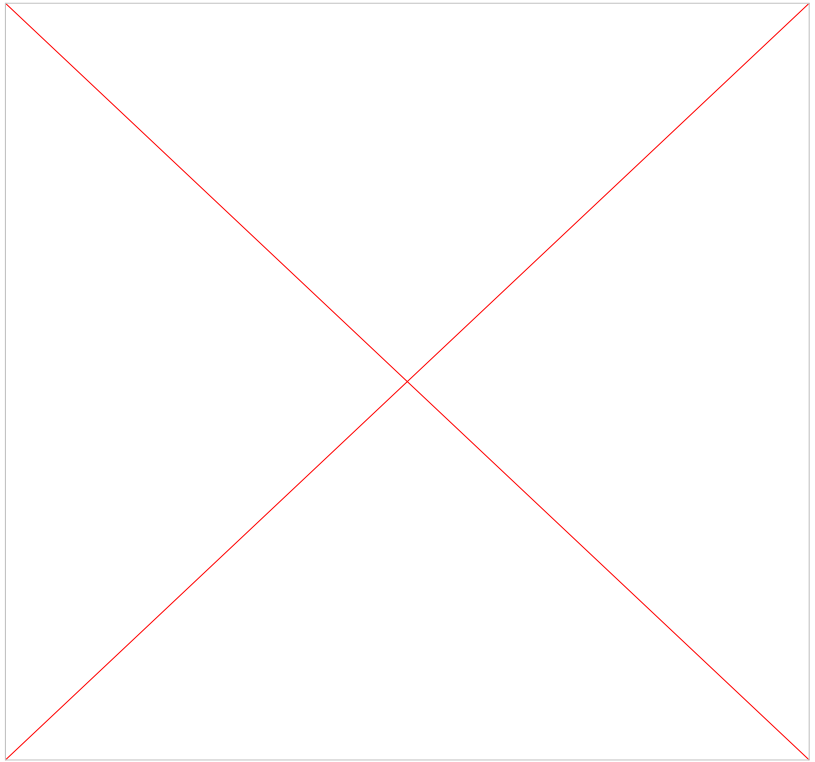
Mercury is the closest planet to the Sun and the smallest one in our Solar System–it's only a bit larger than our Moon. The planet's name has nothing to do with the liquid metal, since it was named after the Roman messenger god

AWESOME WORDS

MAJOR REQUIREMENTS

01

BUDGET



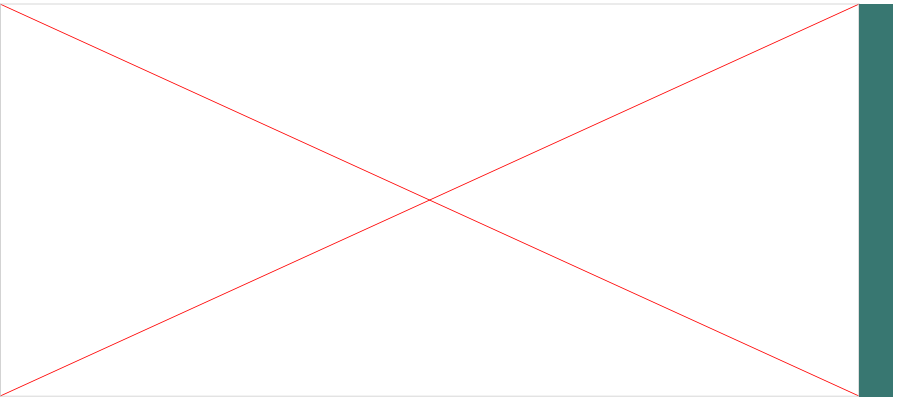
If you want to modify this graph, click on it, follow the link, change the data and replace it

VENUS	30%
MARS	60%
MERCURY	10%

OUR NUMBERS

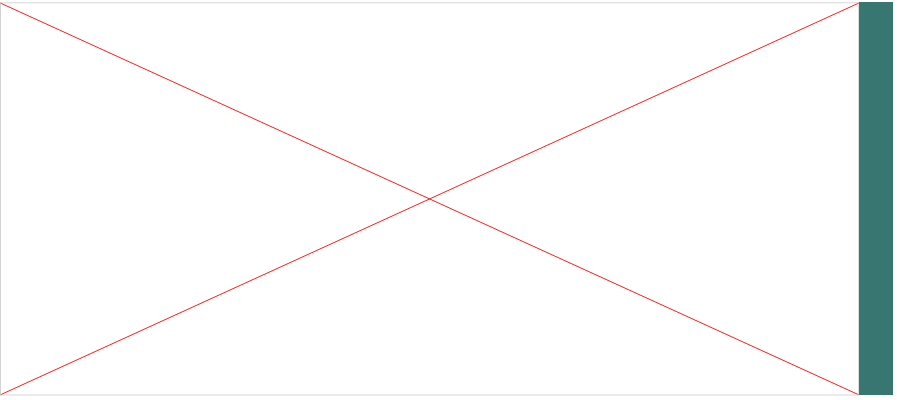
$50,000,000
REVENUE LAST YEAR
2,000
NEW CLIENTS LAST YEAR
75
EMPLOYEES

PROJECT GOALS



GOAL 1

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than our Moon



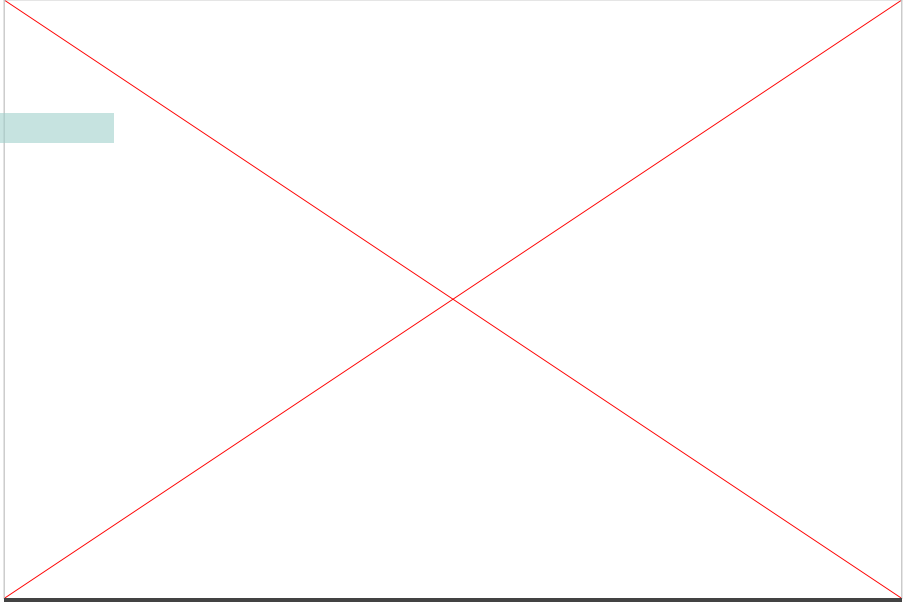
GOAL 2

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury

PREDICTED RESULTS

	VENUS	MARS	MERCURY	JUPITER
AREA 1	50	100	20	30
AREA 2	23	34	45	56
AREA 3	234	45	65	56

SNEAK PEEK



Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than our Moon. The planet's name has nothing to do with the liquid metal, since it was named after the Roman messenger god, Mercury

FUTURE PROJECTS

MERCURY

Mercury is the closest planet to the Sun and the smallest one in the Solar System

MARS

Despite being red, Mars is a cold place, not hot. It's full of iron oxide dust

Venus has a beautiful name and is the second planet from the Sun

VENUS

Saturn is the ringed planet. It's a gas giant, composed mostly of hydrogen and helium

SATURN

TIMELINE

DAY 1
Mercury is the closest planet to the Sun

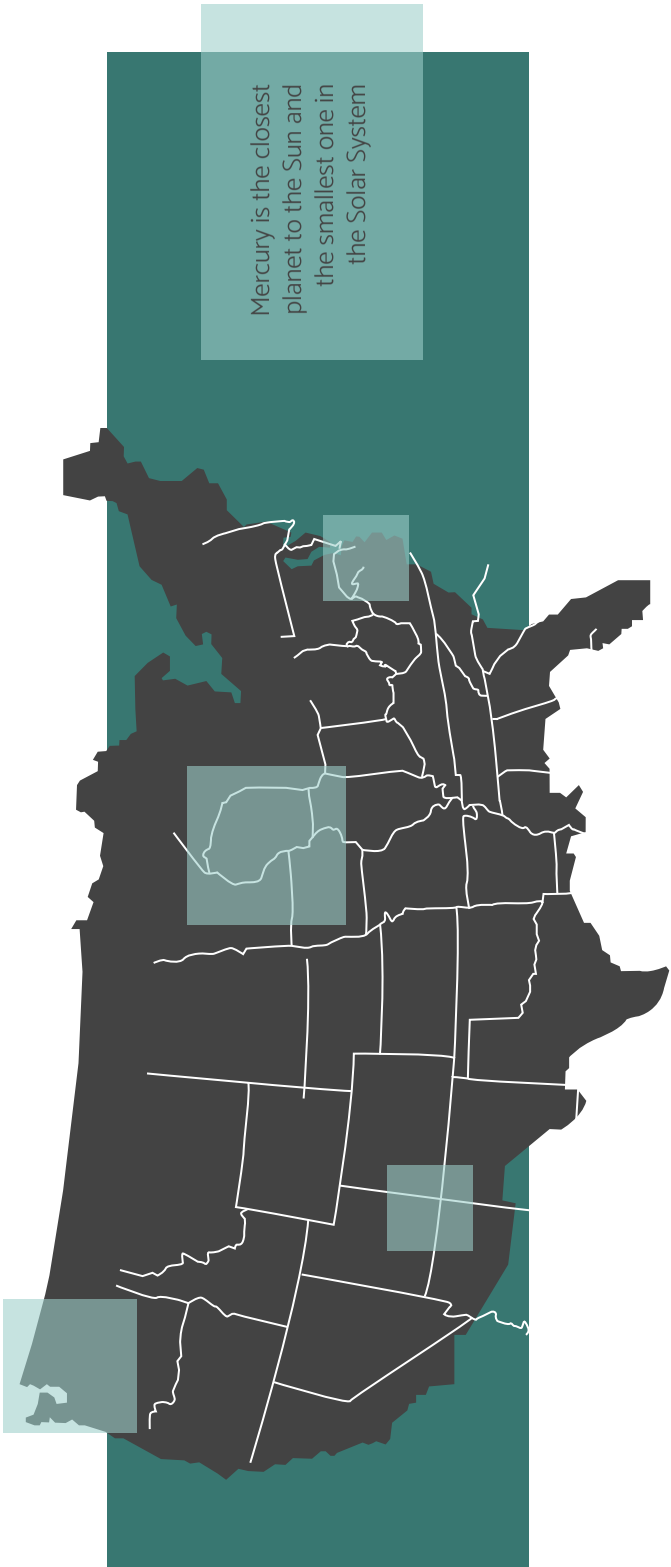
DAY 2
Venus has a beautiful name, but it's terribly hot

DAY 3
Despite being red, Mars is a cold place, not hot

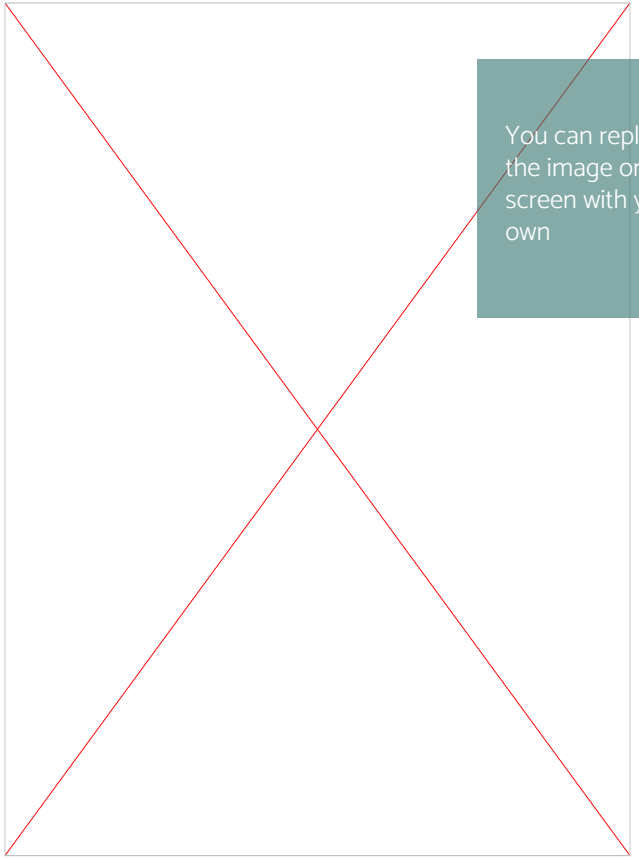
DAY 4
Saturn is composed of hydrogen and helium

DAY 5
Neptune is the farthest planet from the Sun

OUR LOCATIONS



OUR TEAM



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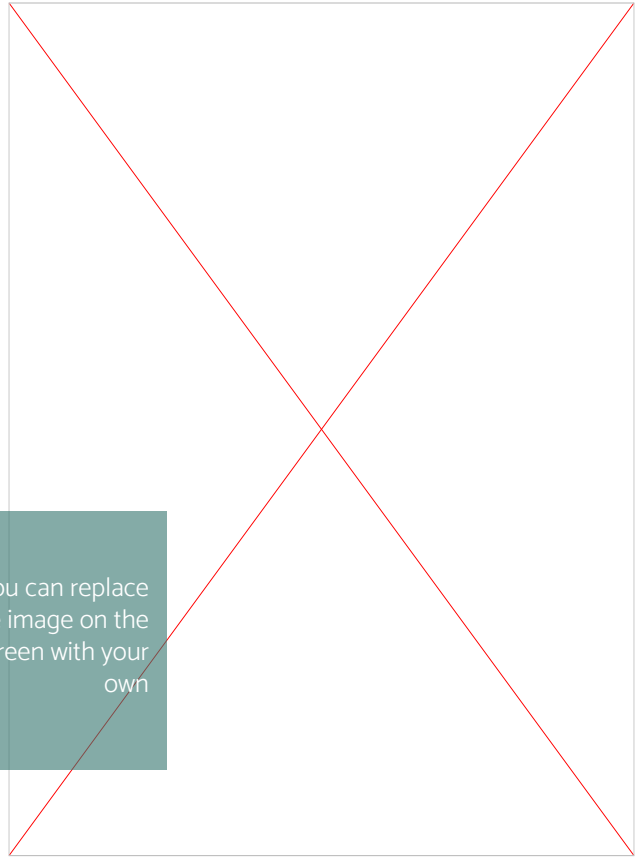

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ALTERNATIVE RESOURCES

Here's an assortment of alternative pictures within the same style of this template.

- Airplane window with sky and sea landscape
- Railway train station long shot
- One way road sign in the city
- Sunset at bay
- Old foot bridge over the river near alesund; norway
- Tropical road with desert background
- Modern woman riding bike in city
- Harbor with boats and blue sea
- City roads at night
- Brooklyn bridge and new york

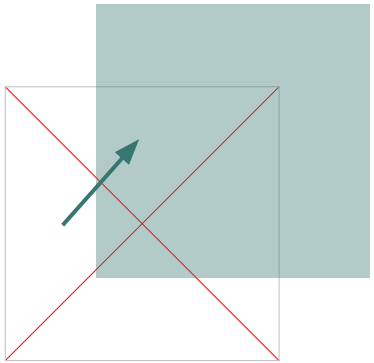
If you want to apply the same filter as the pictures already included in the template, follow these instructions.

In Photoshop:

1. Open the picture in Photoshop.
2. On the Layers panel, click the Create New Adjustment Layer button.
3. Select Photo Filter and click Color.
4. Paste this hex code: #908269
5. Adjust the density to increase or decrease the filter effect.

In Google Slides / PowerPoint:

1. Create a new shape with the same shape as the photo to which you want to apply the filter.
2. Select the color for the filter (#908269) and reduce the opacity until you're happy with the result.
3. If you want to modify the photo, move the filter to a side first.



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- Images created by Freepik

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VECTORS

- Usa map
- Gradient logo with abstract shape

PHOTOS

- Elevated view of road with trees growing in forest
- Foggy weather in city with channel
- American flag on brooklyn bridge in new york
- Brightly illuminated city street
- Blurred traffic lights on street at night
- Road block signs closeup
- Crosswalks in the city closeup
- Manhattan bridge in new york
- Contemporary buildings on waterfront of river
- Brooklyn bridge over east river in new york
- Motion in the city intersection
- Architecture project and tablet mockup
- Railways closeup with blurred background
- Train on railway closeup
- Man in black t-shirt standing in front of railway train
- Portrait of a female architect writing on book at workplace
- Portrait of smiling architect man holding cellphone and hard hat with blueprint at construction site
- Elevated view of straight and curve road in forest

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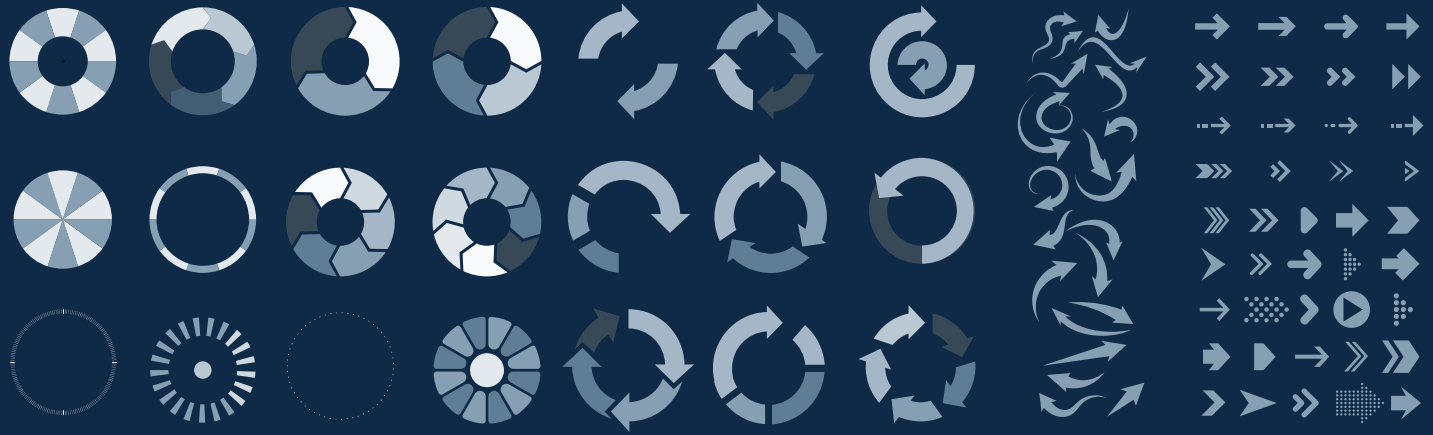

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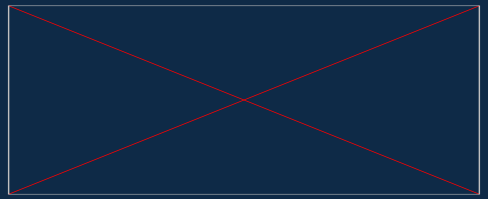
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