

# BANGKOK PLASTICS WEEK

9–12 October 2023 • Bangkok, Thailand



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# Digital Solutions for Plastic Waste Data Collection & Monitoring

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Global Water & Sanitation Center,  
Asian Institute of Technology



Partner Organizer



in consortium with



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## Presentation Outline

Sharing experience of  
Building Digital Solutions  
under UNEP  
CounterMEASURE project



- CounterMEASURE project was chosen as the showcase solution for SDG14 during the United Nations' SDG Digital Day at the ECOSOC chamber, preceding the SDG Summit, Sep 2023



# Motivation



- Capturing littering stories
- Identifying the sources
- Leakage Data
- Evidence-based decision making

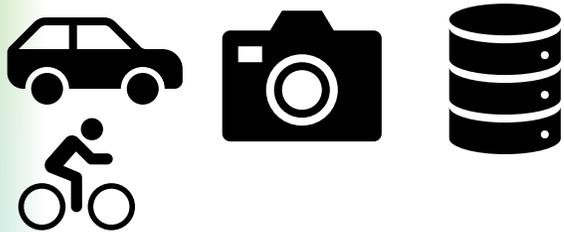
# Digital Solutions for Plastic Litter Monitoring

At city-scale

- Integration of digital technologies
- Open tools, algorithms, platform-based approach
- Scalability with citizens and local authorities



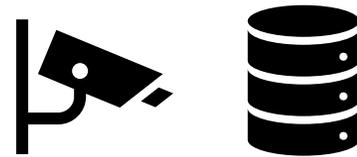
## Road network



Littering  
heatmap  
city-scale

Number  
of objects  
identified

## Canals



Analytics  
of floating  
objects

## Canals & open areas



Plastic litter  
snapshot along  
canals

## Across cities Mobile-app



Analytics of  
collected data  
with geolocation  
by Citizen  
Scientists

# Littering heatmap at city-scale

Remotely executed with partners



Portable Equipment

Basic rules:

1. Keep the camera angle according to the video guide
2. Keep the vehicle max. the speed at 20 km/hr.

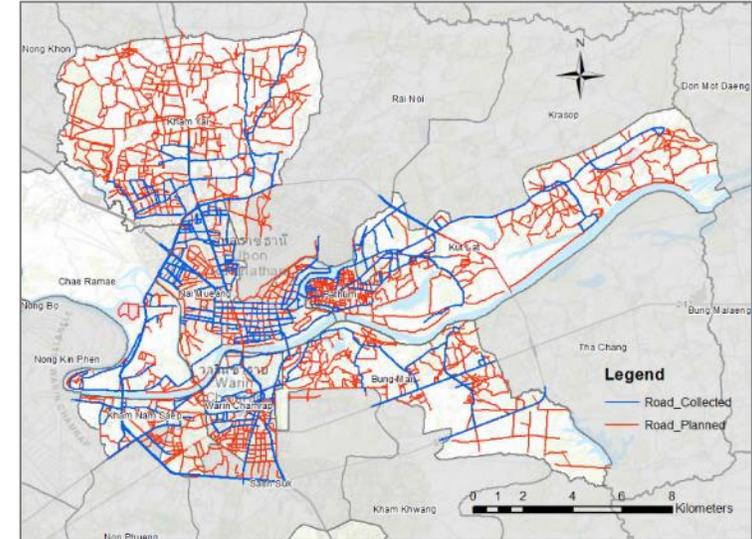


Simple instructions

[https://youtu.be/VA2dlyQ\\_uTo](https://youtu.be/VA2dlyQ_uTo)



Simple installation



Mapping routes



# Littering heatmap at city-scale

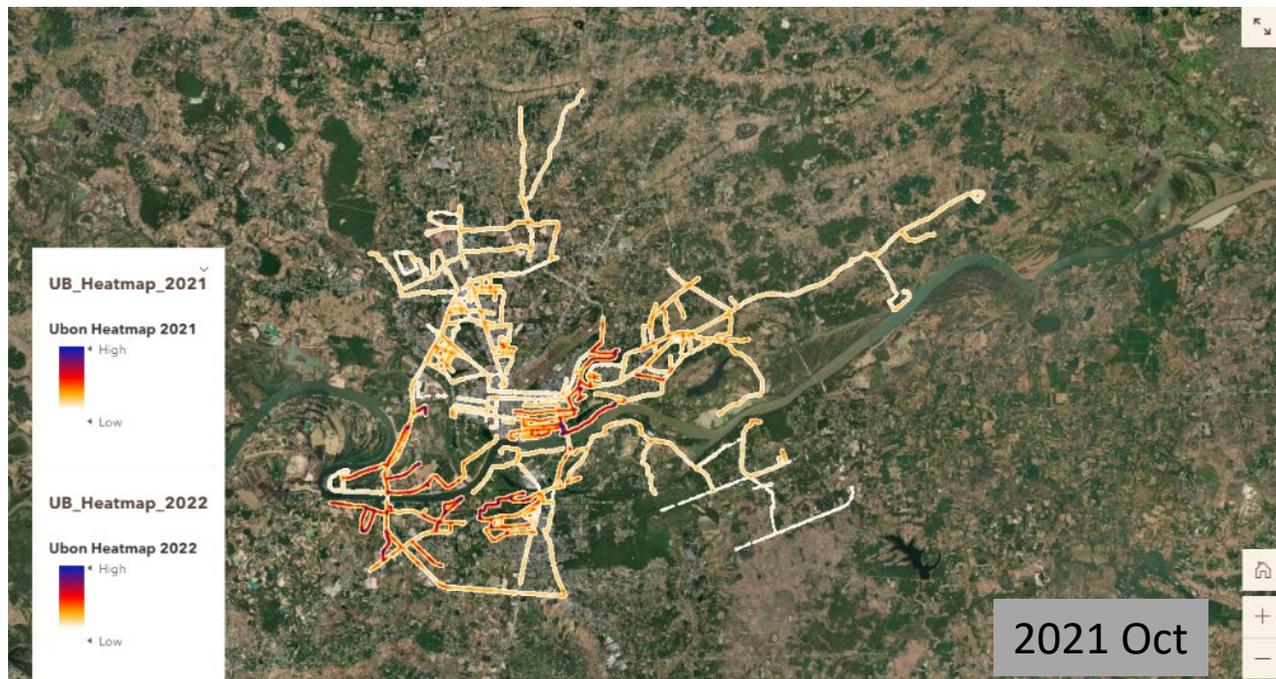
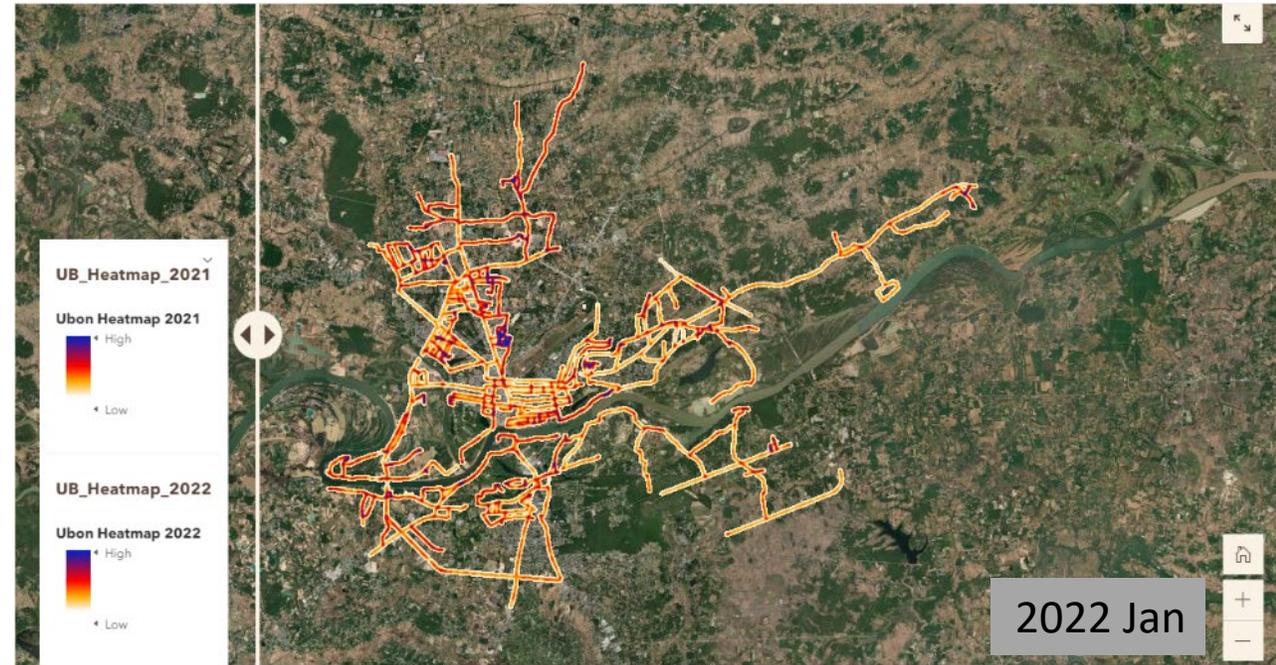
Mapping in Ubon Ratchathani city, Thailand



Litter Prediction along the streets using AI



<https://youtu.be/vKwlo96Tddg>



# Plastic litter detection along the street sides at city scale

Challenges in detection and examples of plastic litter along street side captured from vehicle mounted camera (warped)

**COMPLICATED**

Open-ended problem,  
Complicated nature of  
road-side litter

**SAME**

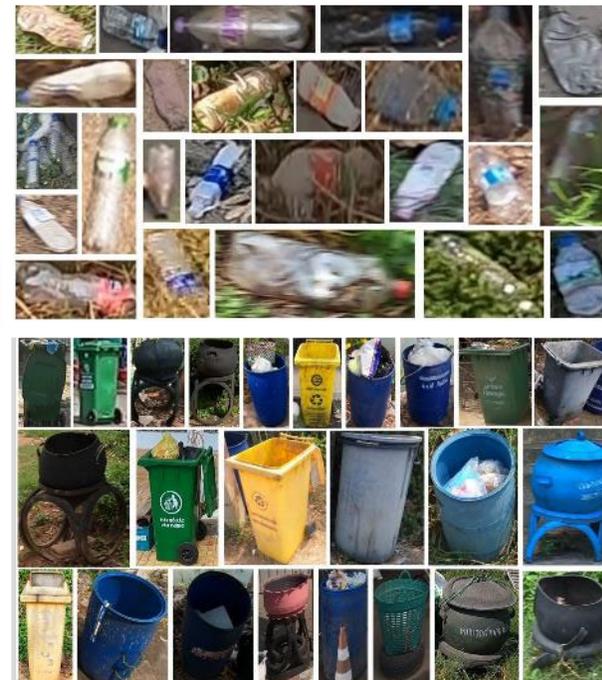
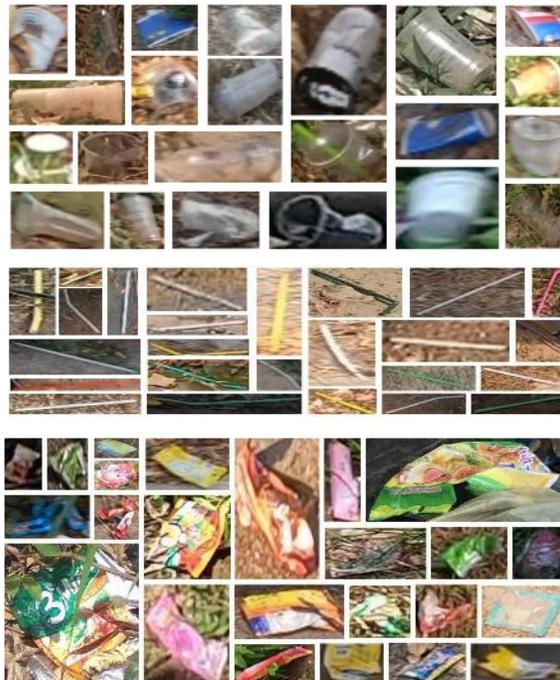
Similarity with non-  
plastic litter objects



Inconsistencies of  
plastic litter/trash  
bins in different cities

**NEW**

Novelty of plastic  
products in the  
market



# Citizen Science Approach

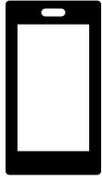
How to overcome the plastic litter identification challenges

Data collection

Citizen Science Approach

Open-source dataset  
& Robust model

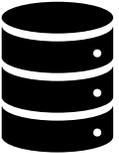
CM-II



CM-II Partners

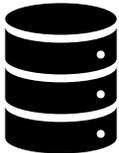


CM-II Data Collection



Roadside data

CM-I



CM-I Mobile App Data (collected)

Citizen Scientists Type 1



1. Upload the images
2. Model Prediction
3. Annotate same image

Citizen Scientists Type 2



1. Model Prediction of random images from collected data
2. Annotate image

Model Predictions

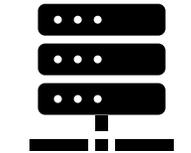


4 labels (Plastics, piles, bins, facemask)

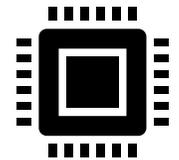
User Inputs



Multiple labels annotation

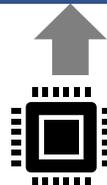


Dataset and annotation

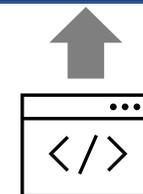


Feasibility of developing a new model

Open-Source Model



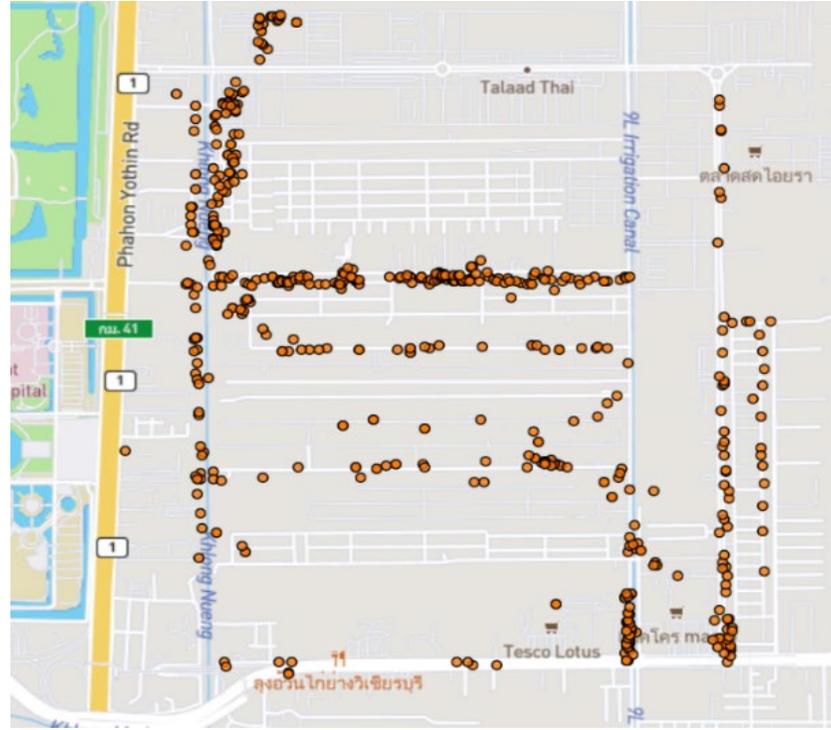
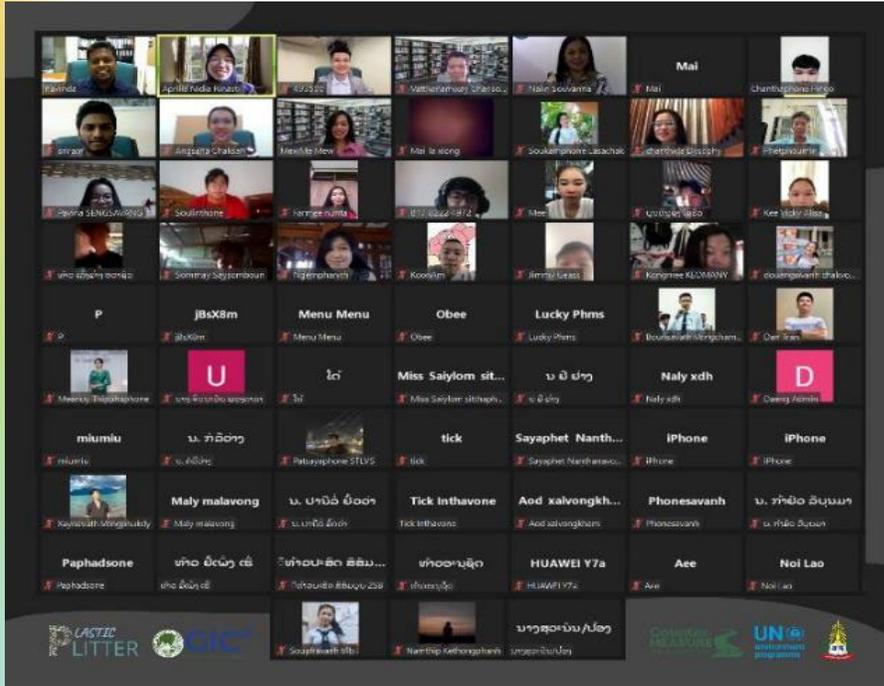
Integrated Platform Development  
Frontend interface + Backend (Coco tool)



# Citizen Science Approach

Is it useful to improve digital tools in monitoring plastics?

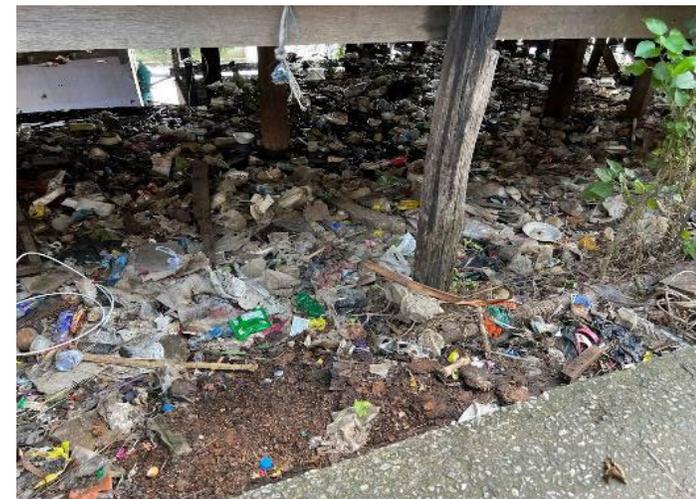
*Integration of citizen science and machine learning approach to shape actions for plastic pollution*



**Citizen Science Interactions**  
**9 Workshops with partnering universities**  
**| over 500 students reached**



**AIT-MPA student: Ms. Pranita Rimal's Research Study**



# How can you map your city with pLitter?

pLitter tool is public and hosted in github: <https://github.com/gicait/pLitter>

gicait / pLitter Public

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

main 9 branches 0 tags

Go to file Add file Code

About

pLitter is a standardized, deep learning friendly dataset and pre-trained model that can be used for detecting plastic litter in streets, road-sides, etc. Additionally, all supplementary codes related to this repository are also published here.

computer-vision deep-learning trash object-detection plastic litter plastic-pollution litter-mapping opensourcedataset

Readme 1 star 4 watching 1 fork

Contributors 6

Languages Python 98.0% JavaScript 2.0%

sriramreddyM street compos cb452a0 12 hours ago 15 commits

File	Content	Last commit
demo	street compos	12 hours ago
gpstools	gps extract	8 days ago
models/automl_edge	load from json	2 months ago
plitterstreet	street compos	12 hours ago
.gitignore	1.0	2 months ago
README.md	load from json	2 months ago
setup.py	street compos	12 hours ago

## plitter-street - Plastic Litter identification along the streets using Vision and AI

pLitter is a standardized, deep learning friendly dataset and pre-trained model that can be used for detecting plastic litter at streets, road sides, and other outdoor areas. Additionally, all supplementary code related to this repository is also published here. *Example video showing plastic litter detection from our model (click on image to see the YouTube video) is shown below.*

plitter\_street\_demo.ipynb

File Edit View Insert Runtime Tools Help All changes saved

+ Code + Text

### 1. Install the tool

Clone the pLitter tool from Github and install it as python packe using pip

```
[1] !git clone https://github.com/gicait/plitter.git
!pip install plitter/.
```

### 2. Select your data

Add your data to colab runtime, here we are downloading a sample data stored on google drive

1 cell hidden

### 3. Import the tool

We need two modules here,

- To convert the video to frames,
- To make predictions on the frames

1 cell hidden

### 4. Convert the street video to frames

3 cells hidden

### 5. Run inference

3 cells hidden

### 6. Plot the stats on the map

```
[10] m = street.draw_street_on_map()
m
```

# pLitter Expansions and Collaborations

How to think about a scalable solution?

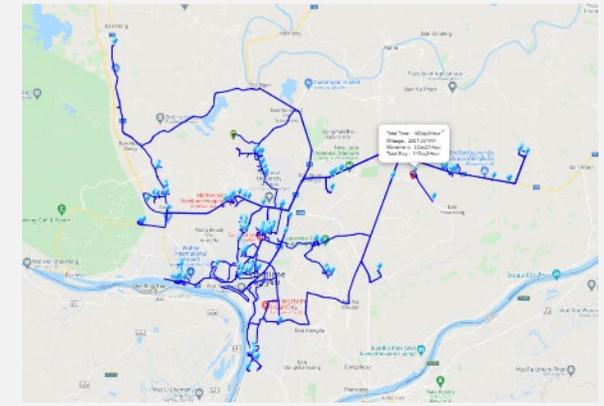
Can we use  with 360 Camera?



Collaboration with AIT SERD-EEM students



## Together CM-Laos Team



Collaboration with Municipality



## Together with IUCN Sri Lanka



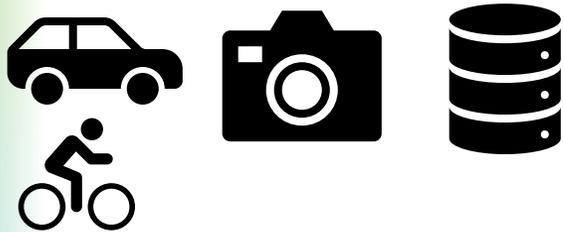
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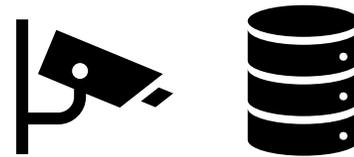
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Analytics  
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## Canals & open areas



Plastic litter  
snapshot along  
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## Across cities Mobile-app



Analytics of  
collected data  
with geolocation  
by Citizen  
Scientists



# CCTV Monitoring in Waterways

Installations and Deployments

**CCTV 01 Chiang Saen, Chiang Rai**



**AC Grid Powered**

**CCTV 02 Chiang Saen, Chiang Rai**



**AC Grid Powered**

**CCTV 03 Ban Kang, Pathum Thani**

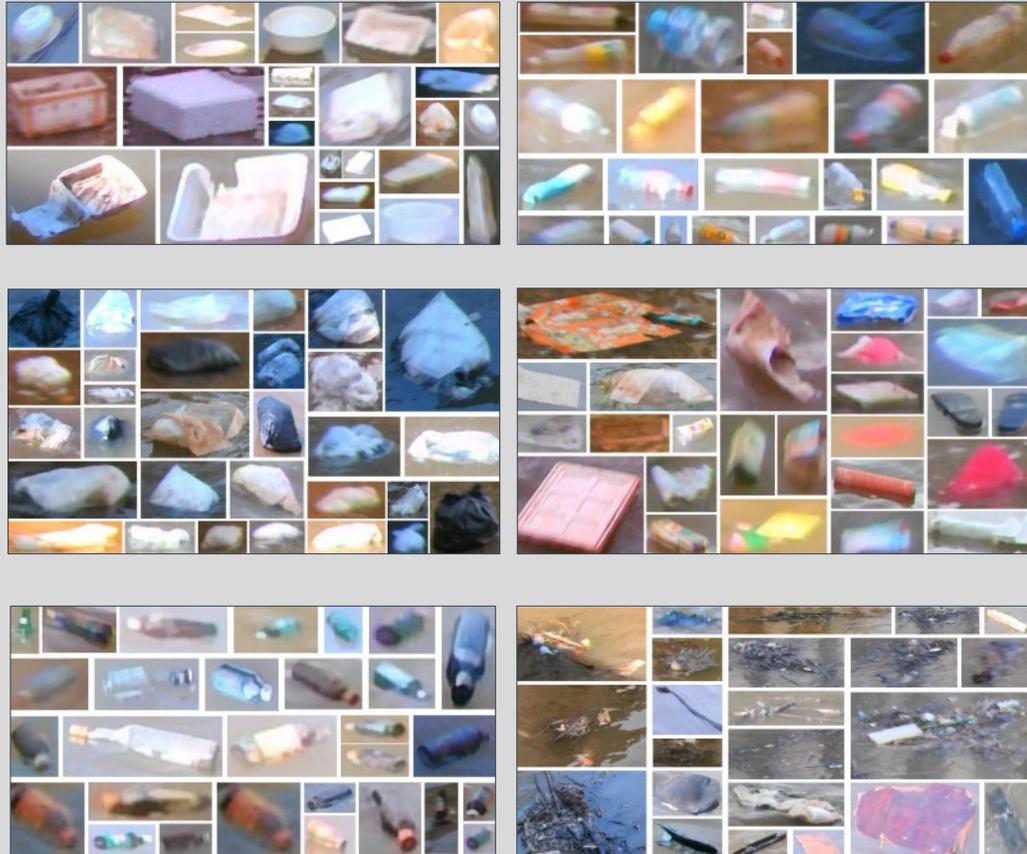


**Solar Powered**

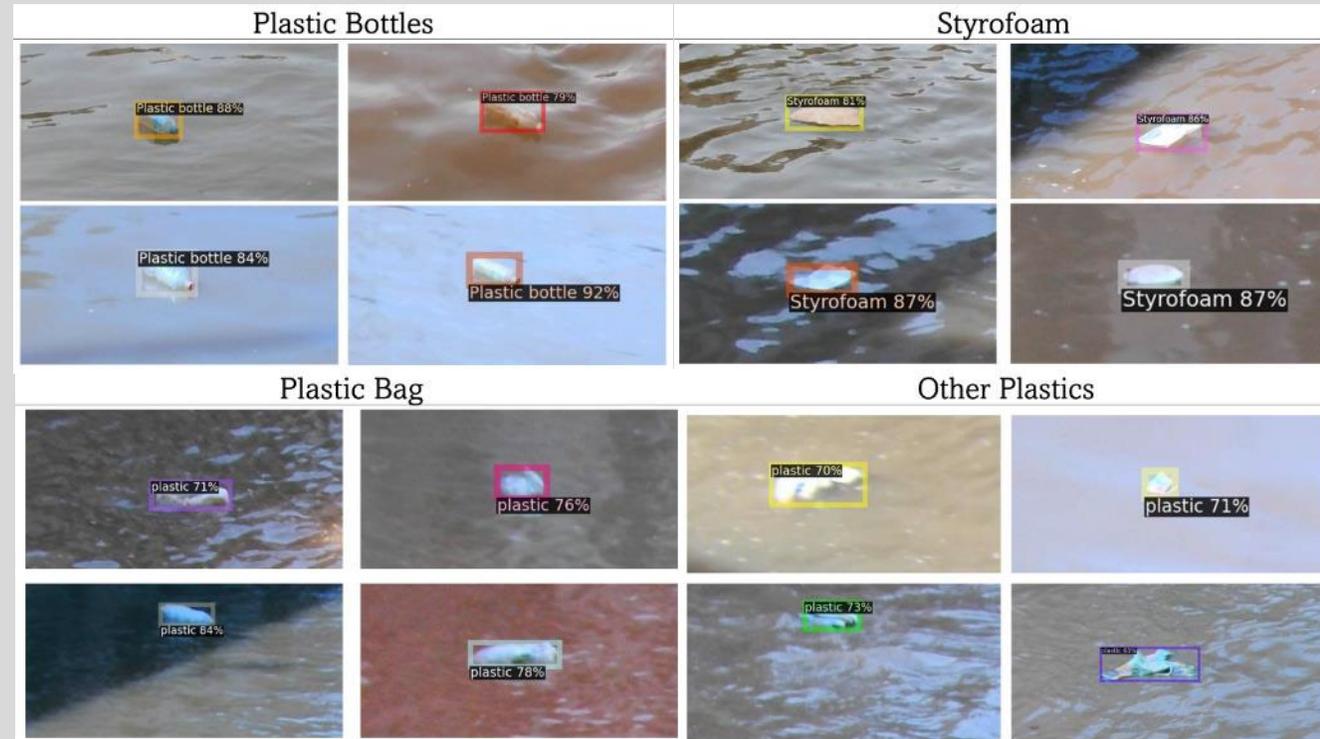
# Plastic litter detection using CCTV

Image annotations and current predictions

## Floating Plastic litter



## Model Predictions



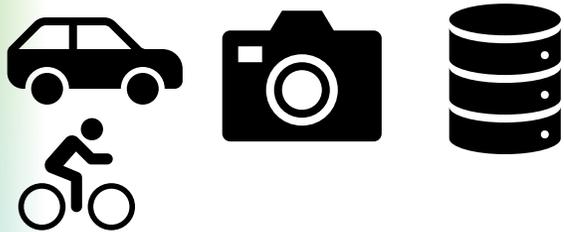
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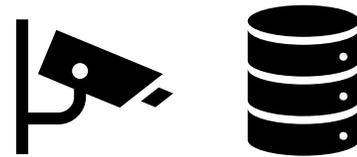
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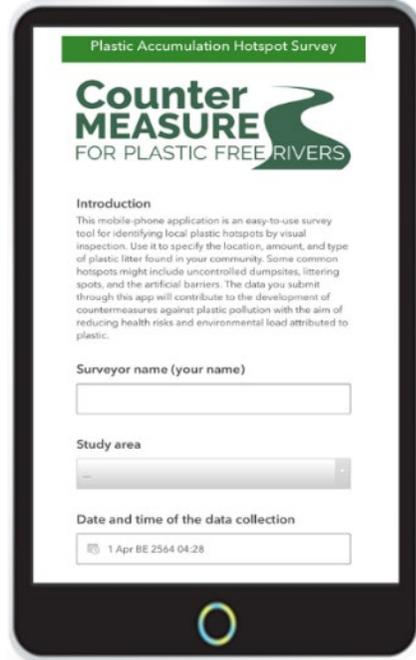
## Across cities Mobile-app



Analytics of  
collected data  
with geolocation  
by Citizen  
Scientists

# Citizen Science Approach for Reporting

Mobile-app based data collection



Artificial barrier



Littering spot

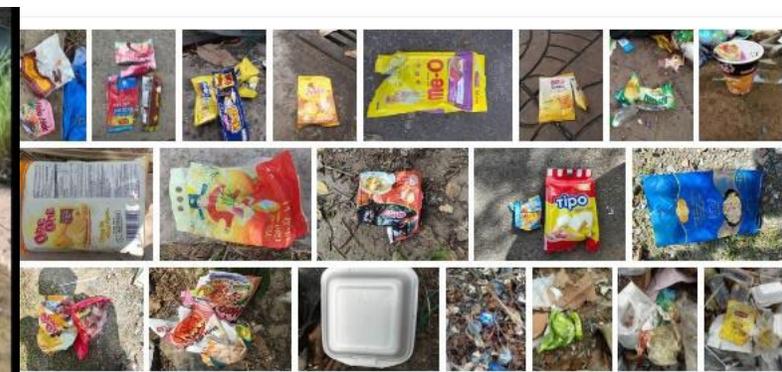


Uncontrol dump

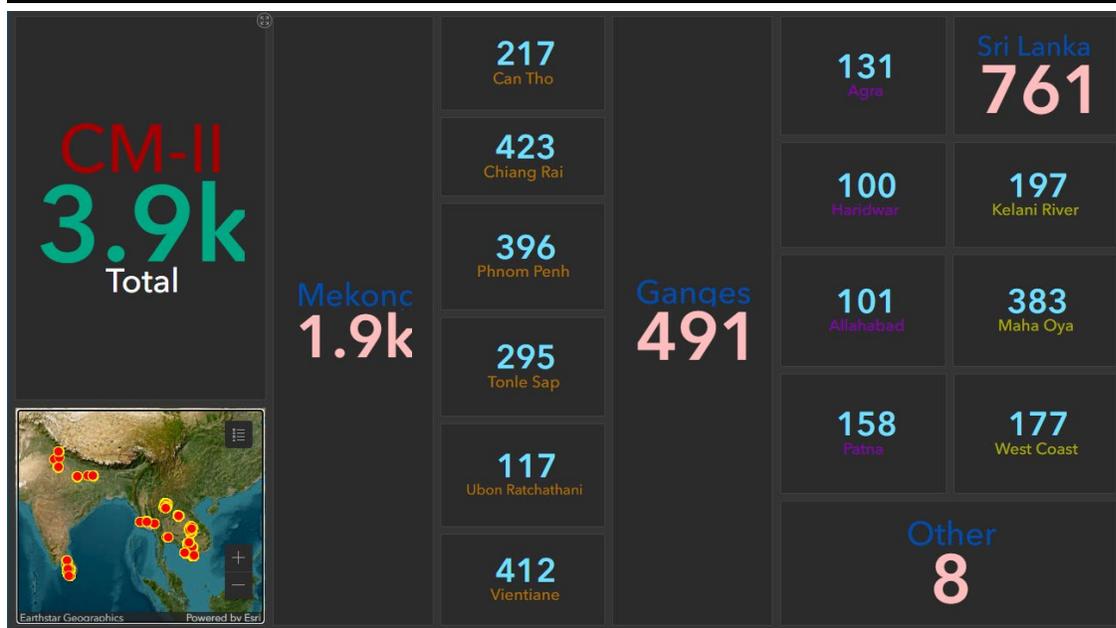
### Our partners

 <p><b>Mae Fah Luang University</b> City: Chiang Rai Contact: Dr. Panate Manomavibool</p> <p>Our team Visit !!</p>	 <p><b>National University of Laos</b> City: Vientiane Contact: Dr. Vatthanamixay Chansomphou</p> <p>Our team Visit !!</p>	 <p><b>Ubonratchathani University</b> City: Ubon Ratchathani Contact: Dr. Pawena Limpiteeprakan</p> <p>Our team Visit !!</p>	 <p><b>Royal University of Phnom Penh</b> City: Phnom Penh, Tonle Sap Contact: Dr. Vin Spoann, Dr. Seng Bandith</p> <p>Our team Visit !!</p>
 <p><b>Can Tho University</b> City: Can Tho Contact: Prof. Vo Quang Minh</p> <p>Our team Visit !!</p>	 <p><b>National Productivity Council</b> Country: India Contact: Dr. Shukla Pal Maltra</p> <p>Our team Visit !!</p>	 <p><b>International Union for Conservation of Nature</b> Country: Sri Lanka Contact: Dinithi Samarathunga</p> <p>Our team Visit !!</p>	 <p><b>The Environmental Education and Recycling Organization</b> Country: Cambodia Contact: Mr. Uch, Rithy</p> <p>Our team Visit !!</p>

The mobile survey link: <https://arcg.is/1LbjqO>



Images: 144



### Vientiane, Laos

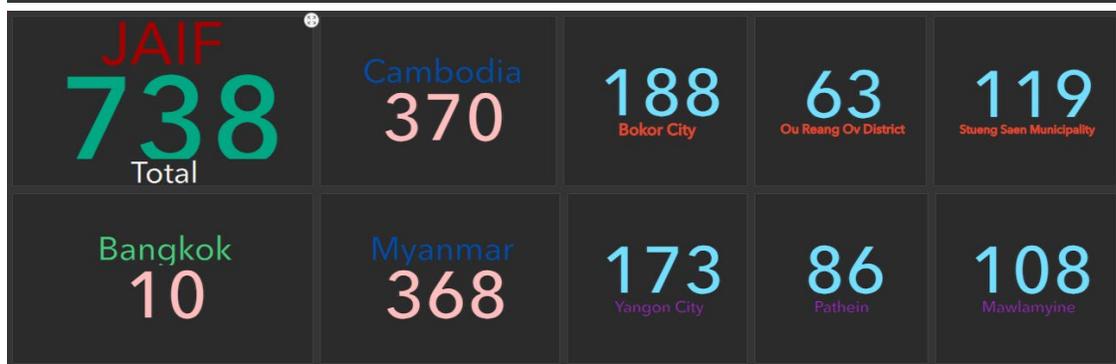
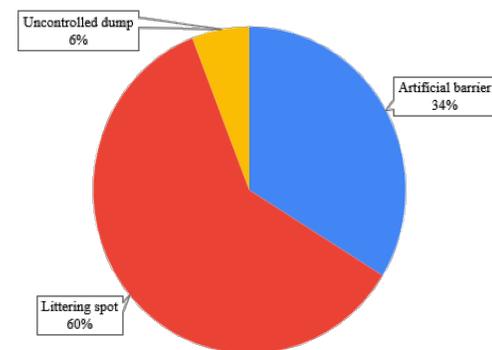
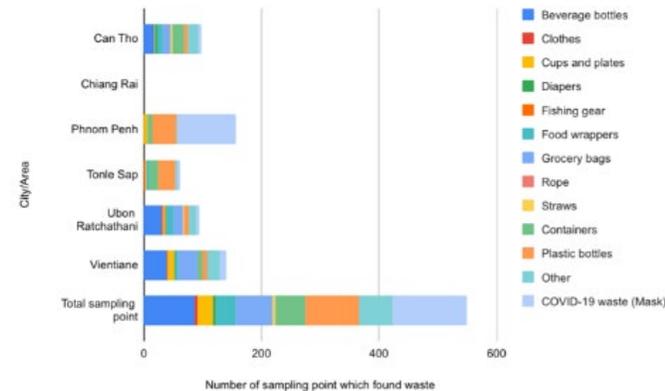


Take a photo of Take out/away container

Gallery



### Phnom Penh, Cambodia



# How Digital Solutions can be used at city level?

## CCTV-based litter monitoring

Location

Country Thailand

Province Chiang Rai

City/Town Chiang Saen

CCTV CCTV 002

DETAILS

**CCTV 002**

Dataset Size  
29,475 images

Lat: 20.2677963  
Lon: 100.0896118

Aug 11, 2022 at 05:36:12 PM

Aug 11, many garbage bags on Mekong River

### How can cannels in cities adapt?

- Analytics of floating plastic items in each channel in a city
- Comparative cleanness among city channels
- Raise citizen awareness with facts
- Identify products of mega companies and get their attention for social responsibility
- Can be utilized for monitoring of garbage accumulation and floating

## YouTube Videos: 1-week in 1-min

pLitter.CCTV02 - Chiang Saen Port - ...

Geoinformatics Center AIT - 10 / 60

0:59 Geoinformatics Center AIT

2022 Aug 10 to Aug 16: 1 week in 1 min

0:23 Geoinformatics Center AIT

11 1:02 Geoinformatics Center AIT

12 1:02 Geoinformatics Center AIT

13 1:00 Geoinformatics Center AIT

14 1:00 Geoinformatics Center AIT

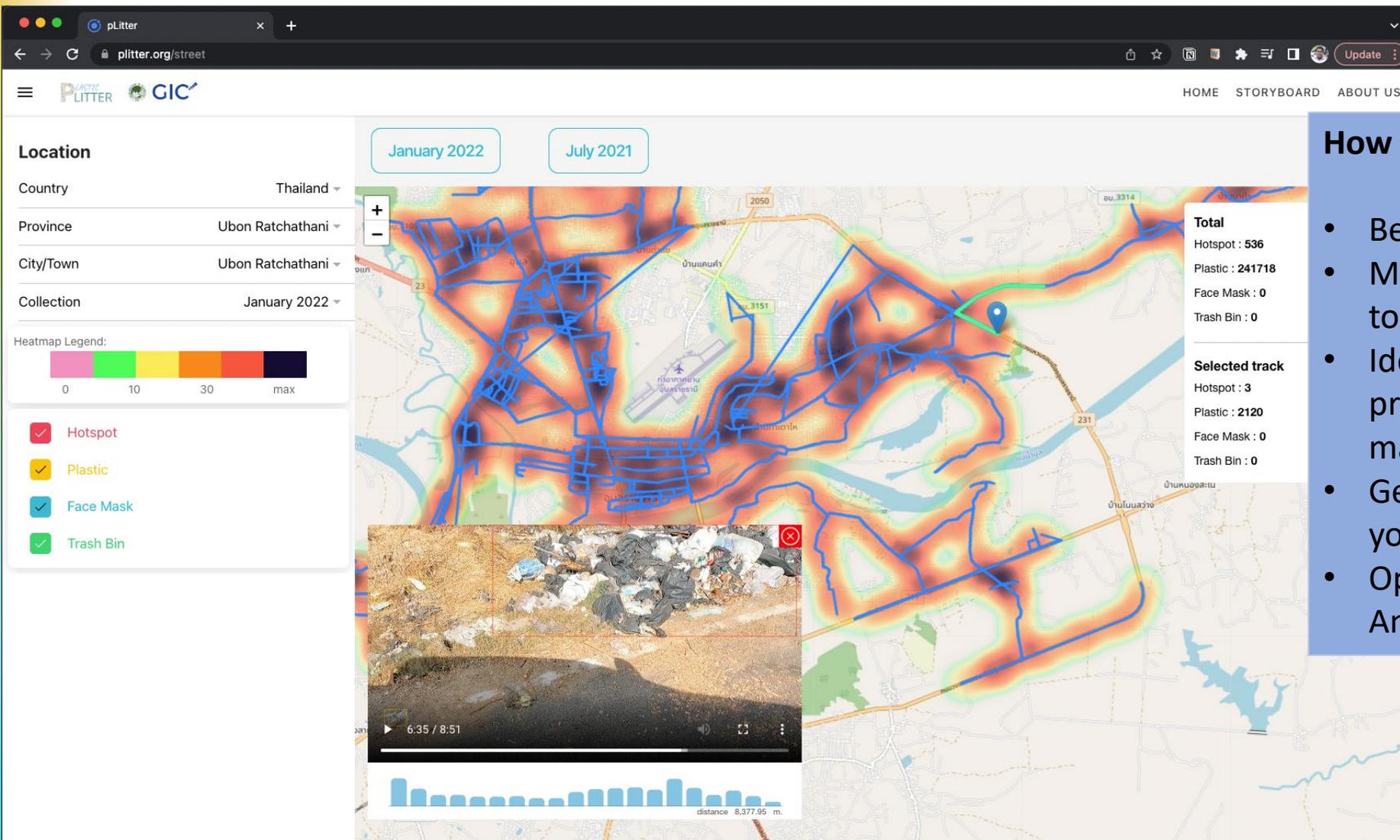
15 1:02 Geoinformatics Center AIT

16 1:02 Geoinformatics Center AIT

<https://www.youtube.com/playlist?list=PLKdGIbtBVuW2Wao2kko7wqdhbGdN7mzEK>

# How Digital Solutions can be used at city level?

## City-scale Litter heatmaps



## How can cities adapt?

- Benchmark litter heatmap every year
- Monitor how city is progressing towards a clean city
- Identify problematic areas and provide effective waste management solutions
- Get city people's attention to trust your story to make city clean
- Open Data | Transparency | Open Analytics will bring people's trust



# THANK YOU!



Collected 233 rubber bands in 30min | 30m stretch of beach during the World cleanup day 2020, Rayong, Thailand with MPA program of AIT

Kavinda Gunasekara

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[www.gwsc.ait.ac.th](http://www.gwsc.ait.ac.th)

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