

Optimization of Pick-up Location and Routing in Waste Management System

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Waste management is a major issue in developing countries, as a result of Growing population migration and rapid urbanization with the targets and indicators of the 6th Sustainable Development Goal.

The methodology utilizes the security game approach to effectively monitor the activities of waste collectors and optimally map the geographical location of waste to the respective collector. The case-study of this proposal is Lagos state, which is the largest city in Nigeria and one of the most populous urban areas in the world.



Problems

- Waste collectors are acting in their own best interest, and are trying to shirk responsibility and not actually go on the pickup routes required of them
- Lagos state have a population of about **21 millions**
- **Limited resources** for waste management
- Generates more than **13,000 tons per day**, with a per capital rate of **1.2 kg per person per day** These have resulted into:
 - the **lapses of waste collectors** reaching **all areas optimally**
 - problem of **waste transportation routing** and **lucid pickup logic**
 - **ineffective scheduling** which does not comply to **frequencies and fair charging fees.**

Proposed Solution

- **Efficient waste transportation routing**
- **Mapping official and unofficial dumpsites.**
- **Spatial labelling of areas based on schedules**
- **Mapping sanitation access**

Collection Stage

Execution Stage

Input

Location Information of Collected Waste

Name of Streets of Collected Waste

Observation Data of Collected waste

Population of the observed area



Descriptive Analysis of Collected Data

Pattern of Waste Collected



Game Theory Model

Pay-off Uncertainty

Street Mapping

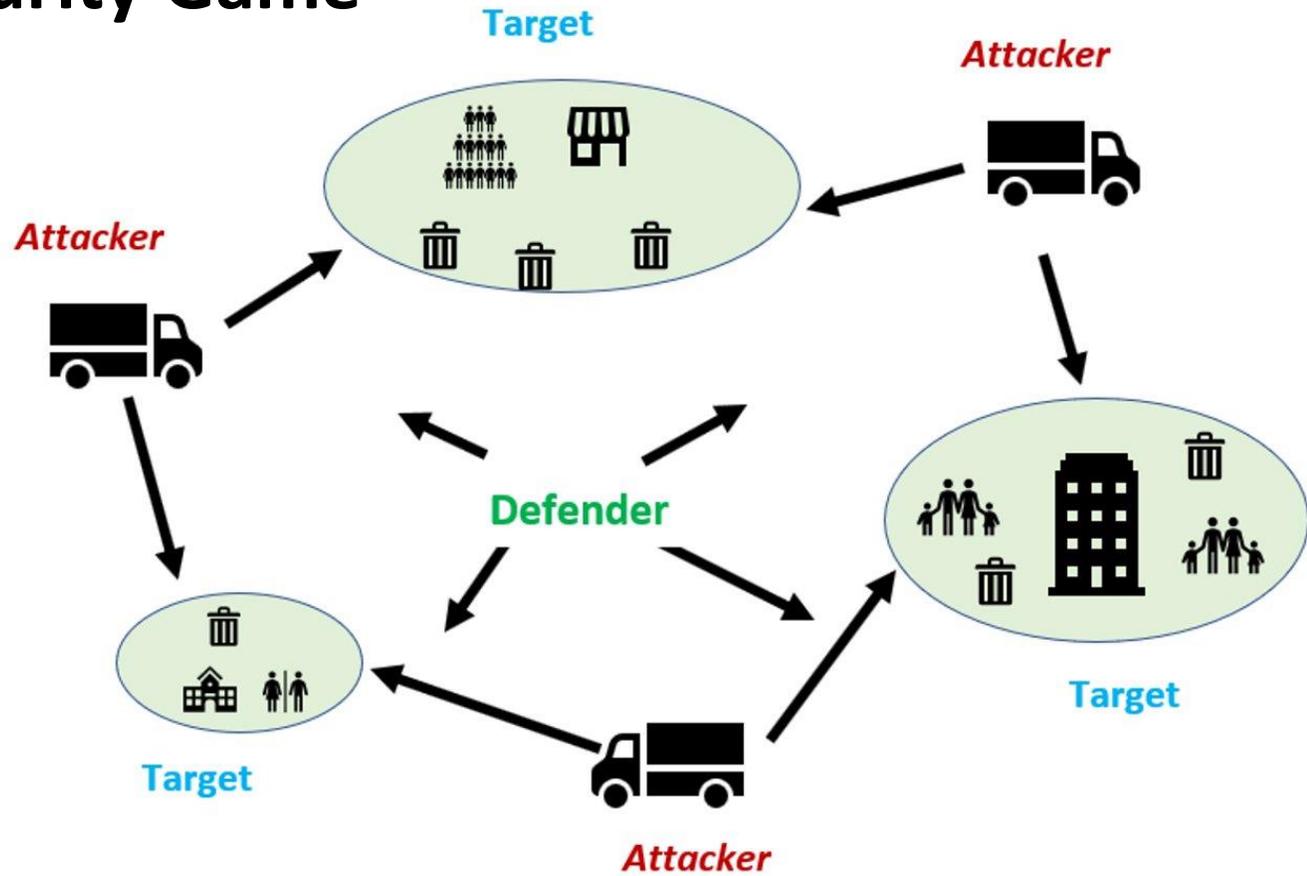
Waste Collectors Behavior Modelling



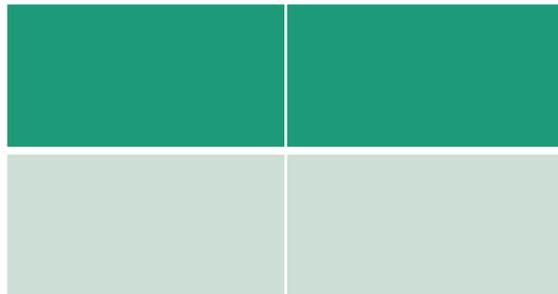
Calculating the Routing strategies

Integrating Arrows/
Blade Theorem

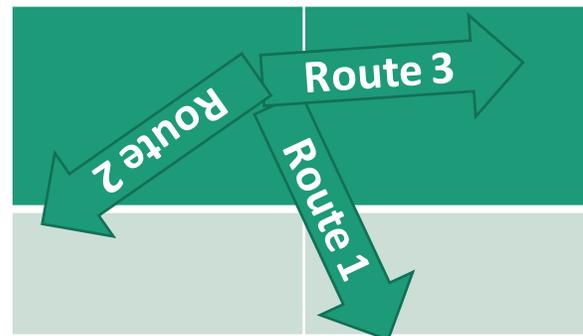
Waste Security Game



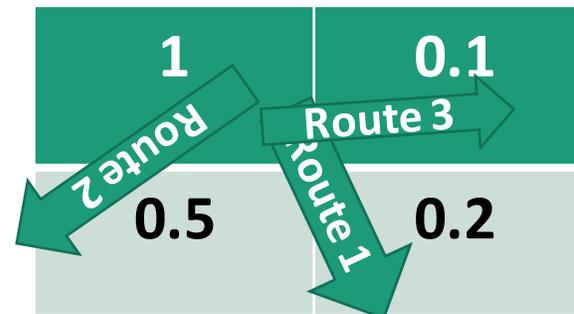
- The "**attacker**" is the agent collecting waste (i.e., the private waste collector or government vendor).
- The "**targets**" are all the locations for which waste is supposed to be collected
- The "**defender**" is the agent that monitors whether disposals were correctly performed.
- Unlike a standard security game, in this model, an 'attack' occurs when the attacker fails to visit a target it was supposed to.
- We want to find an optimal monitoring strategy for the defender."



Waste collection area



Available routes



Mixed Strategies



Payoff