Smart Waste Management System

SDG Alignment: Sustainable Cities and Communities (SDG 11)
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The smart waste management system is a promising solution to the challenges of waste management in urban areas. The system has the potential to reduce costs, improve efficiency, increase recycling rates, and reduce environmental impact.

The system would work by using a network of smart bins with sensors to monitor fill levels and provide real-time data to waste management authorities. This data would allow authorities to optimize collection routes and reduce the number of unnecessary trips to empty bins. The system would also include a user-friendly interface for citizens to report waste-related issues and receive notifications on collection schedules and recycling initiatives.

The benefits of the smart waste management system include:

- Reduced costs associated with waste collection and disposal.
- Improved efficiency of waste management operations.
- Increased recycling rates.
- Reduced environmental impact of waste.
- Improved public satisfaction with waste management services.

The implementation plan for the smart waste management system includes the following steps:

1. Develop a prototype of the smart bin system.
2. Conduct field tests of the prototype in Cartagena city.
3. Refine the system based on feedback from field tests.

CONCEPTUAL FRAMEWORK

Human-machine interfaces (HMIs) are the means by which humans interact with machines. They can be as simple as a light switch or as complex as a computer operating system. HMIs are designed to make it easy for humans to control machines and to get information from them. [1]

Tangible user interfaces (TUIs) are a type of HMI that uses physical objects to interact with machines. TUIs can be more intuitive and engaging than traditional HMIs, and they can be used in situations where it is difficult or impossible to use a traditional HMI. [2]

Sensors and actuators are devices that can be used to collect data from the environment and to control machines. Sensors can be used to detect things like temperature, pressure, and motion. Actuators can be used to control things like motors, valves, and lights. [3]

Smart waste management systems use HMIs, TUIs, sensors, and actuators to collect data about waste and to control waste collection and disposal. Smart waste management systems can help to reduce costs, improve efficiency, increase recycling rates, and reduce environmental impact.

PROBLEM STATEMENT

Waste management is a major challenge in urban areas, with costs associated with collection and disposal increasing each year. Traditional waste management systems are inefficient, with collection routes often being suboptimal and waste being disposed of in landfills, which have a negative environmental impact.

Smart waste management systems can help to address these challenges by using a network of smart bins with sensors to monitor fill levels and provide real-time data to waste management authorities. This data can be used to

optimize collection routes, reduce the number of unnecessary trips to empty bins, and increase recycling rates.

Smart waste management systems can also help to reduce the environmental impact of waste by reducing the amount of waste that is sent to landfills.

OBJECTIVES

- Design and implement a network of smart bins with fill-level sensors for efficient waste collection.
- Develop a digital platform for waste management authorities to monitor and analyze data, optimize collection routes, and track recycling efforts.
- Create a user-friendly mobile application for citizens to report waste-related issues, receive notifications, and access information on recycling initiatives.

SOLUTION

This system will use a network of smart bins with sensors to monitor fill levels and provide real-time data to waste management authorities. This data can be used to optimize collection routes, reduce the number of unnecessary trips to empty bins, and increase recycling rates. Smart waste management systems can also help to reduce the environmental impact of waste by reducing the amount of waste that is sent to landfills.

The containers will have a self-sustaining system with solar panels and will be connected to a container controller, this controller will allow information to be sent to the provider's servers. The container controller receives the information by RF in this way manufacturing costs are reduced and a high range can be handled.

CAPABILITIES

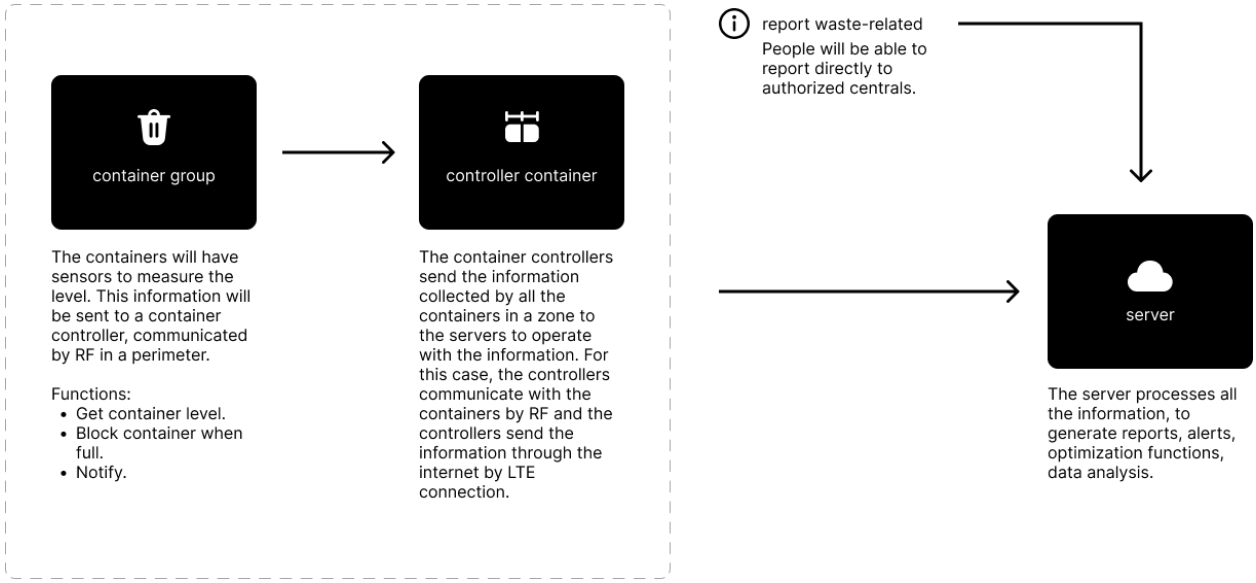
- Monitoring fill levels of smart bins.
- Providing real-time data to waste management authorities.

- Optimizing collection routes.
- Reducing the number of unnecessary trips to empty bins.
- Increasing recycling rates.
- Reducing the environmental impact of waste.
- Improve community care.

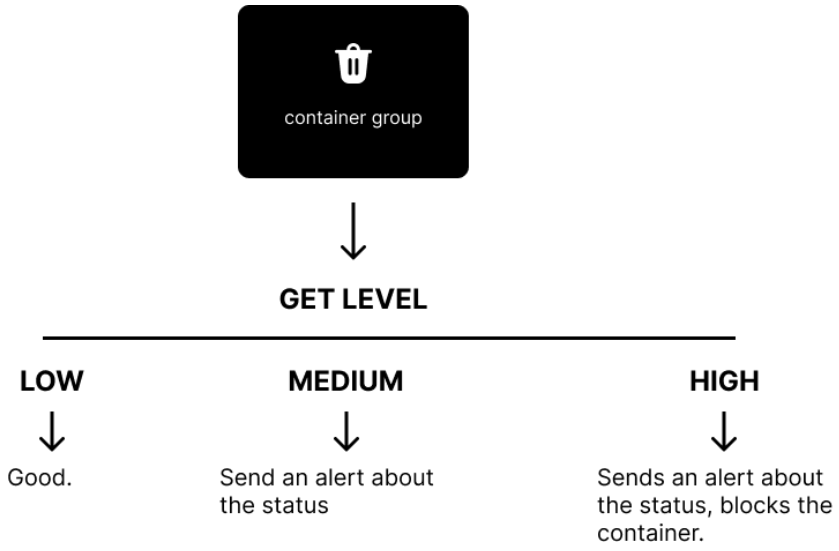
LIMITATIONS

- Control the waste thrown by the community.
- Theft of recyclable resources.

SYSTEM FLOW CHART



CONTAINER GROUP



DEVICE SELECTION FOR CONTAINER

Device	Description
ATmega328P	This device allows you to control and execute all the functions.
RF Transmitter	Allows sending information to container controllers.
HC-SR04	Sensor that will allow me to measure the level.
Electric motors	Open or close the lid.
Lock	Lock the container.
Solar panels	Automatically load the system.
PCB Components	Devices necessary to carry out the assembly such as resistors, etc.

DEVICE SELECTION FOR CONTROLLER CONTAINER

Device	Description
ESP32	This device allows you to control and execute all the functions.
RF Receiver	It allows receiving the information sent by the containers.
LTE	Module that allows communication with the server. This module will be optional as long as the ESP32 has internet access.
PCB Components	Devices necessary to carry out the assembly.

ROLE

All for me.

REFERENCES

[1] *HMI: Human-Machine Interface*. (s. f.). Inductive Automation. https://inductiveautomation.com/resources/article/what-is-hmi

[2] Wikipedia contributors. (2023). Tangible user interface. *Wikipedia*. https://en.wikipedia.org/wiki/Tangible_user_interface

[3] UpKeep. (s. f.). *CMMS, EAM & IIOT software by UpKeep Asset Operations Management | Try Free*. onupkeep. https://www.upkeep.com/learning/sensors-and-actuators-2/