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Task 1: *Value Proposition Canvas*

Pain

- Overloaded trash cans.
- Dirty sidewalks.
- Unoptimized routes for garbage collection.
- Demotivated community.

Gain

- Reducing the number of people littering.
- Increased productivity of garbage collectors.
- Less trash around containers.
- More optimized placement of trash containers.
- Minimizing the chance of getting into the situation when the trash container is full.
- Living in a cleaner area

Customer Job(s)

- Educate/Share awareness
- Sorting trash and recycling at home and outside
- Clean the environment

Products and services

- Tracking the amount of trash
- Sending the status of the trash can to the cloud.
- Locking mechanism for overfilling prevention
- Data analysis system for research and optimization

Gain creators

- Optimized trash locations
- Optimized trash collection paths
- Cleaner areas around trash cans

Pain relievers

- No overloaded trash cans
- The smell is eliminated with closed bins.
- People are driven to maintain the tidiness

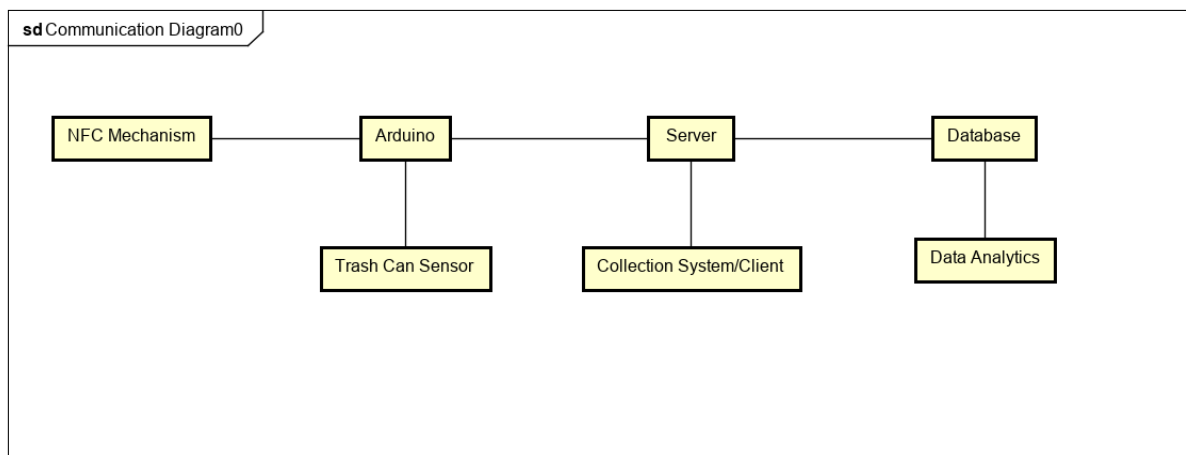
Task 2: *Prototype Description/Documentation*

A retro-reflective sensor (Figure 2) in the trash bin will detect the passing trash falling in the bin. When the emitter and receiver's connection is interrupted for a longer time, this would mean the trash can is full and will be locked/closed until emptied. When this occurs, the Arduino app will send its ID and information to the server, after which the server will be able to notify the garbage collector's system, that there is a full trash can with the specified ID. The trash collection company will now be aware that one of the locations is full. This information may be later used for designing better trash collection paths, optimizing the locations of the trash cans/containers, and extracting data such as the daily trash frequency.

The two mechanisms, that the sensor needs to have for this solution to be operable are an Arduino Ethernet Shield, that connects the Arduino App and Drivers to the internet (which means it can send data to the server), and an actuator component (Figure 3) that can lock the lid of the bin until the garbage collectors unlock the mechanism through an NFC connection. It is important to note, that there are a lot of different types of actuators and the most suitable needs to be chosen.

One of the problems, which needs to be tackled is waterproofing the Sensor and Reflector surfaces, to remove the possibility of the components breaking down due to the liquids being thrown in the bin. One solution could be using a waterproof photoelectric sensor, but the reflector part remains unknown.

The Communication Diagram (Figure 1) of the whole system can be seen below.

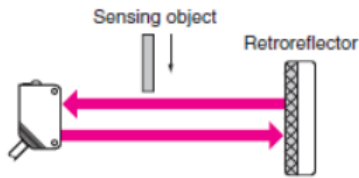


1. Figure

3. Retro-reflective Sensors

Sensing Method

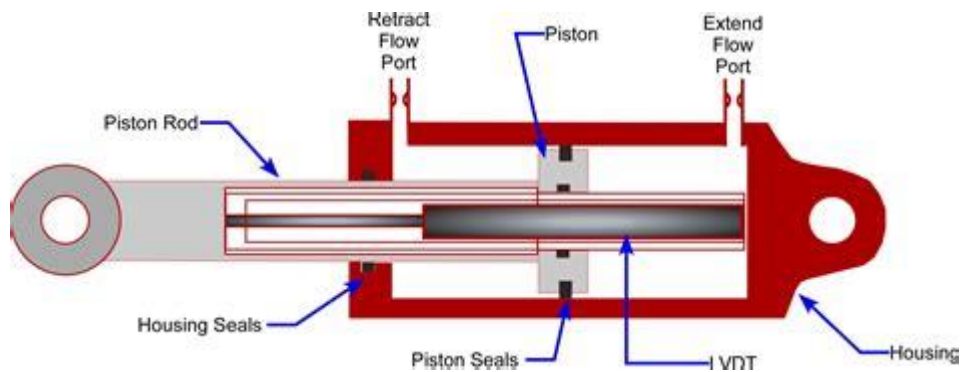
The Emitter and Receiver are installed in the same housing and light from the Emitter is normally reflected back to the Receiver by a Reflector installed on the opposite side. When the sensing object interrupts the light, it reduces the amount of light received. This reduction in light intensity is used to detect the object.



Features

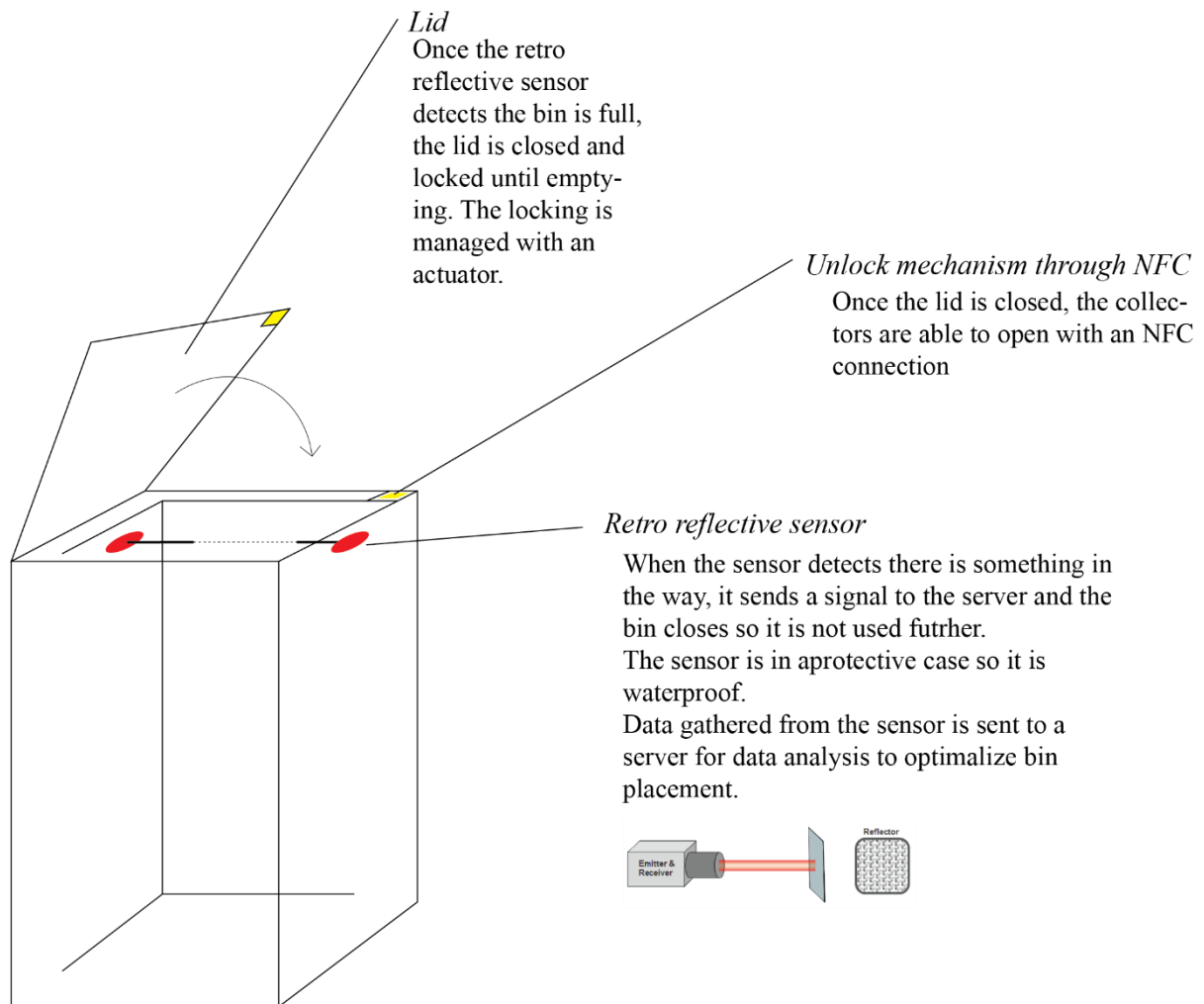
- Sensing distance ranges from several centimeters to several meters.
- Simple wiring and optical axis adjustment (labor saving).
- Operation not greatly affected by the color or angle of sensing objects.
- Light passes through the sensing object twice, making these Sensors suitable for sensing transparent objects.
- Sensing objects with a mirrored finish may not be detected because the amount of light reflected back to the Receiver from such shiny surfaces makes it appear as though no sensing object is present. This problem can be overcome using the MSR function.
- Retro-reflective Sensors have a **dead zone** at close distances.

2. Figure



3. Figure

Prototype:



Sources:

<http://nearfieldcommunication.org/about-nfc.html>

<https://realpars.com/actuator/>

http://www.omron-ap.co.in/service_support/FAQ/FAQ00390/index.asp

<http://senasysphotosensors.com/photoelectric-sensors/retroreflective-sensors>

https://github.com/arduino/Arduino/wiki/_pages

<https://store.arduino.cc/arduino-ethernet-shield-2>