

SMART DUMPSTERS

Team 24

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Introduction

Objective

Garbage dumpsters have enabled us with a better life of not being able to store the garbage inside our houses. They're everywhere in our daily life, including apartments and cities.

Although big garbage dumpsters have enabled convenience to the residents of the apartment, there are big issues to the conventional use of these dumpsters. These issues are garbage dumpsters overflowing due to people stacking the garbage to the point it overflows, non-residents throwing at the dumpsters without paying any service fees, and inconvenient use of having to open and close heavy lids whenever you throw away.

Smart Dumpsters address all these problems that come with the inconvenient uses of regular dumpsters. First, by installing a sensor where it detects the fullness of dumpsters will enable an automatic locking mechanism that will lock the dumpsters when it's full, and it will let the residents of the dumpster know that they should use another dumpster to throw away the garbage. Second, the locking and unlocking mechanism of the dumpster will enable only the residents who paid for these services to be able to use the dumpsters. Finally, the opening of the lid automatically through the use of a keycard that unlocks and opens the lid will enable any resident to use this dumpster conveniently.

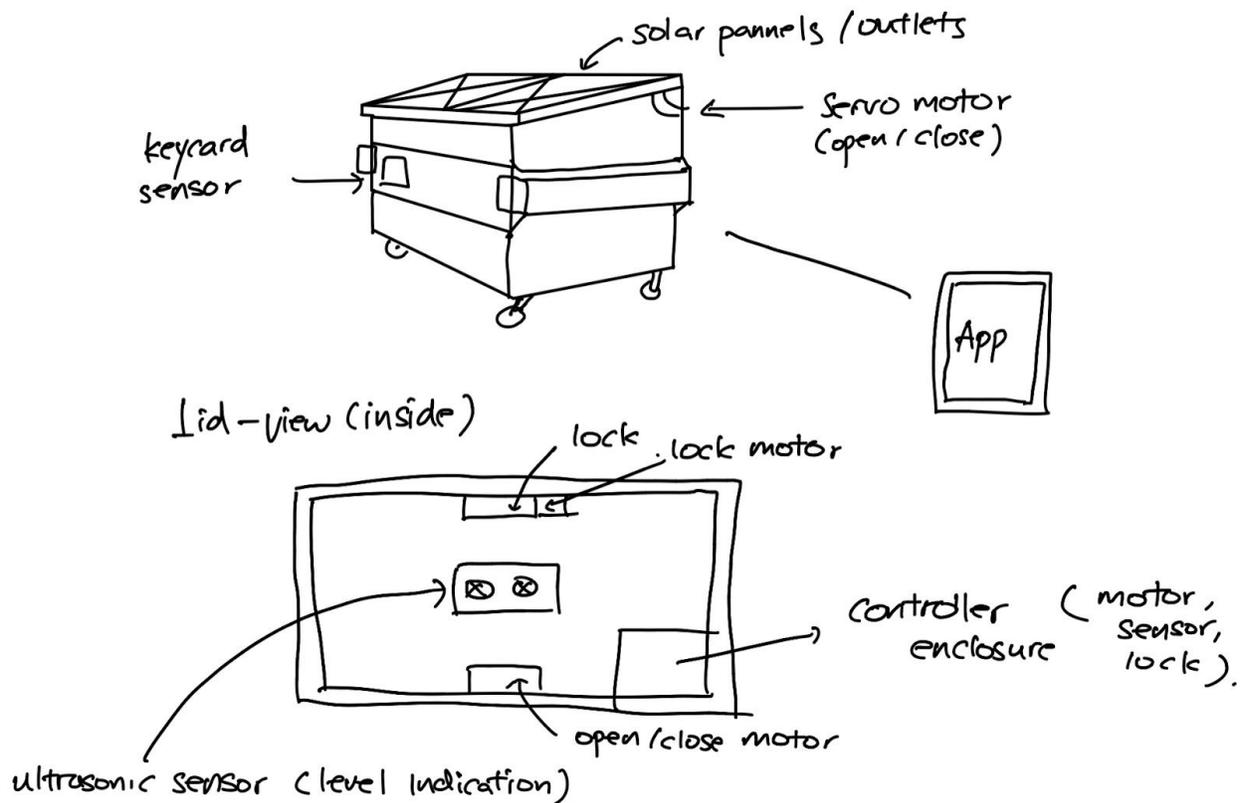
Background

Currently, there has been a big shift in the technology we use to become automatic. The doors that schools use have become electronic to allow people who have disabilities to use it with more convenience and allow access through keycards that enable people to lock and unlock the doors (this can be seen in our very own ece building). The garbage cans we use in our everyday life have become automatic so that it can open with a sensor detecting hand motions.

Likewise, the creation of a smart dumpster will provide the convenience that has never been there before. First, it will allow the people with disabilities that weren't able to throw the garbage by themselves to actually be independent. Not only for the people with disabilities, but also for people who aren't tall enough, such as kids, and not strong enough, such as elderly people, to throw the garbage with more ease. Afterall, the lids for these garbage dumpsters are extremely heavy. Second, the lock and unlock mechanism of the dumpster brings extra level of assurance to people who paid for the service and not worry much about potential overflow of the garbage dumpsters. This will also enable the dumpster companies to not necessarily pick up overflow of

the garbages that are around dumpsters, and easily clean them. Lastly, the app that will notify the residents of which dumpsters are full will let them know when and where they should throw out the garbage.

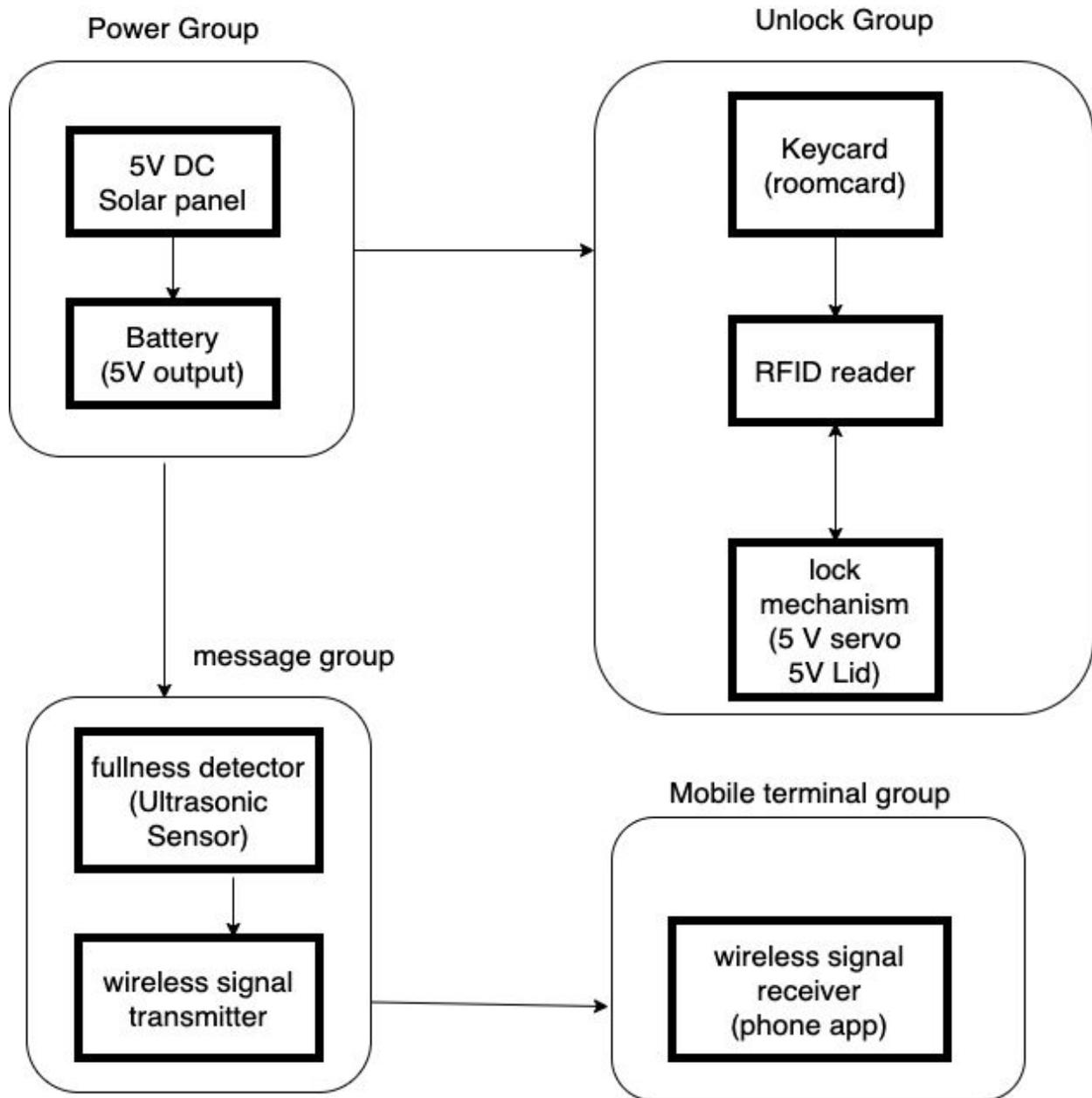
Physical Design



High-level requirements list

1. Sensor that enables when the dumpster is full. This will notify when the dumpster will be locked and notify the app to update the dumpsters as "full".
2. The locking and unlocking mechanism that will be enabled through the use of a keycard. This will also lead to the opening of the lid whenever it's unlocked.
3. Solar panel that will power the dumpsters to be self-sufficient when using the electricity to open up the lid and detect the keycard.

Block diagram



Functional Overview & Block Diagram Requirement

- **Power group**

There are two groups, message group and unlock group, that need electricity. For a prototype, a small version of a giant dumpster, a 5V power source is required for the most parts of the dumpster.

Solar Panel: The power would be supplied from the solar panel which is installed on top of the dumpster and will charge up the battery over time. The power which the solar panel can provide will vary by location as well as the size of the dumpster. For the purpose of the demo, a 5V solar panel will be used to charge up the battery bank.

Battery: The battery will then provide power for the microcontrollers and motors used in other groups. This is the fundamental part of our system, as we would need to supply enough power to last 24/7, a self-sufficient dumpster that will be able to withstand harsh temperatures.

Specifications: For demo purposes,

the solar panel	5V output to battery.
battery	5V output for the rest of the system.

- **Unlock group**

RFID reader: The RFID reader is installed on the dumpster shell to sense and read the RFID electronic tag information and notify the lock and unlock unit to lock/unlock and open/close the dumpster top cover. The RFID reader's range is 33mm, and the electronic tag is a passive RFID electronic tag. It will unlock the dumpster if a registered electronic tag is detected.

Key Card: This will be aligned with the RFID reader. This tag will be able to give information to the RFID reader that the dumpster should be opened automatically.

Lock Mechanism: The unlock and lock unit is used to control the opening and closing of the dumpster top cover. The top cover can be opened and closed by the motor driven servo attached to the lid of the dumpster and it will open automatically after the dumpster is unlocked. The lid will remain open for 20 seconds and if no additional registered tags are detected, the lid will close and the dumpster will be locked.

Specifications: For demo purposes,

keycard	passive RFID electronic tag
RFID reader	Will be controlled by Arduino, uses an input of 3.3V Sense and read the RFID electronic tag, and then notify the servo to unlock dumpster
Lock/unlock servo	Operating Voltage: 5V

	Unlock the dumpster after receive the signal sent from RFID reader
Open/close servo	Operating Voltage: 5V Open/close the dumpster after it is being unlocked.

- **Message group**

The message group, ultrasonic distance measuring unit, is installed on the inside of the top cover of the dumpster and consists of three parts: ultrasonic transmitting unit, ultrasonic receiving unit and signal transmitting unit.

Ultrasonic Sensor: It is used to determine whether the garbage can is full or not through the principle of acoustic reflection, and sends a signal to the reminding device when the dumpster is full. Every time the top cover is closed, the dumpster uses the ultrasonic distance measuring unit on the inside of the top cover to detect whether the dumpster is full or not. If it is full, it sends a signal to the app on the phone through the wireless transmitter.

Wireless Signal Transmitter: This information will be connected along with the wireless signal transmitter to notify the app when the dumpster is full or not. Along with the ultrasonic sensor, this will send information whenever the top cover is closed after the ultrasonic sensor outputs the information, in which it will send the output to the wireless signal receiver (phone app).

Specifications: For demo purposes,

Ultrasonic sensor	Sense the fullness of dumpster and then notify the signal transmitter
Wireless signal transmitter	Send the degree of fullness to the app on user's phone

- **Mobile terminal group**

Wireless Signal Receiver (app): Each dumpster has its own number and signal transmitter, and the software on the phone will use a still map picture to mark the location of each dumpster and the degree of fullness, so the user can know which dumpster to go to throw the trash.

Specifications: For demo purposes,

Phone app	Show the degree of fullness on the still map picture to help user to determine which dumpster is closest with enough space
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- **Risk Analysis**

Arguably, the most important part of this project is to get the battery working. The first thing is to get every component to connect with the battery, which will supply power for the RFID reader, the sensor, and the transmitter to work. The second thing is to get connected well with the solar panel that will supply the power necessary to exist without recharging. The third thing is to condition the battery with protective equipment that will survive harsh temperatures and conditions of the dumpster. If any of this fails, then the whole project is utterly useless. We have to get all three to work in order to have even a chance to make this dumpster work properly.

Another concern is the battery's durability. Because the battery we are going to be using will be exposed to harsh conditions, it would be no surprise if this breaks. Safety is something we have to be concerned with to the uttermost extent, and we will vigorously find ourselves to get the perfect design covers and protective layers to make the battery component of the dumpster as safe as possible.

Ethics and Safety

There will be circuits and wires throughout the dumpster that connect the solar panel to the RFID reader and the ultrasonic sensor. We have to make sure that no matter the content of the garbage that will be inside, whether that would be liquid or solid, it will be able to work functionally. Due to the nature of these dumpsters being in a harsh environment, we have to make sure that it can withstand the harsh temperatures and the potential damages that it might face. Otherwise, the wires might be exposed and electrocute the user.

In order to solve this issue, we will cover the wires that connect with the solar panel to be covered with thick rubber that will be extremely difficult for these wires to be destroyed. Also, the solar panels and the RFID reader will be covered with thick, transparent plastic that will receive sunlight and enable the users to know where to scan the keycard to open the dumpsters.

Another concern is when the lid opens up the dumpster, the speed of the opening might catch some people off guard and injure other people. We have to make sure that the lid opens at an appropriate speed where people can notice the opening of the lid but not too slow to delay the users. Also, putting heavy stuff on top of the lead can lead to mechanical failure that will break the motor and swing the lid in an unpredictable way. To prevent this, we will enable the motor to detect that when the lid is too heavy for the motor to open it up, then it won't force itself to open up the lid.

We will vigorously test our designs so that the end product of our dumpster will be very safe. This will enable us to prevent any potential safety hazards and unforeseen design flaws. We will comply with IEEE code to seek and accept any criticisms and error that comes with the invention. Like mentioned before, we will make sure that our design will be safe, and have its safety to be the top priority in everything we do.