

1. Project Scope

1.1 Project Title *BriSense*: Snap-on IoT Device for Public Waste Disposal Bins to Ensure Cleaner Communities

1.2 Capstone Category & Related Courses: Device & Emerging Media

Relevant Courses

1. Web Programming in JavaScript (Fall 2018)
2. WebGIS: Technologies and Applications (Spring 2019)
3. Big Data, IoT, and Cybersecurity (Spring 2019)
4. Software Testing & Software Driven Development (Fall 2019)
5. User Experience Engineering (Fall 2019)

1.3. Project Goal

In recent years, numerous reports and journalists have been calling out waste management companies and city officials for failure to allocate enough trash cans for lower-income neighborhoods. As a result, among the few trash cans available, they are often full and spilled onto the streets for days past their scheduled dump-date if there even was a schedule to start. Reports from numerous investigations have found that this has resulted in nonchalance toward the environment and others within these communities. Needles, trash, and unhygienic waste litter the streets for blocks. This vicious cycle is very dangerous for such communities because it poses a health risk for lower-income residents in these neighborhoods since diseases and health issues can spread rampantly. In addition to these findings, tourist-heavy areas and wealthier communities have trash cans within walking distance and for at least every other block. These areas have bi-hourly, daily, or short but consistent dumping schedules. Sometimes these trash cans are checked so frequently that some may argue that it's a waste of time for employees and a waste of gas for trucks.

Ultimately, BriSense will be the solution that bridges the gap between city officials, waste management companies, and the respective neighborhood residents. By equipping regular trash cans with intelligent capabilities, it saves the city money from having to replace every single trash can in the city when they can simply take an existing trash can and “snap-on” the IoT

tracking device. The sensors within the IoT device will send a notification back to a central dashboard notifying the relevant operators that the specific trash can needs to be attended to. This solution saves time and money for everyone since it reduces the amount of unnecessary checking and dumping in tourist-heavy and wealthier areas. It allows waste management companies to allocate more time and resources to cleaning and addressing concerns in other parts of the city including the lower-income neighborhoods. When design, development, and pilot test runs are completed, every single city official and waste management company in America should be signing up for this IoT product to be used in every second of their daily operations. It is simply the best way to promote a cleaner, safer, and healthier community for everyone.

1.4. Learning Goals

Skills to be Developed

- Hardware Development with Arduino, Sensors, IoT Gateways
- Software Development for Hardware Products
- Integration Techniques across technologies and platforms

New Technologies/Approaches to be Learned

- IoT Product Development
- Arduino Development with Sensors
- Development in the Blynk Platform (in the event that WebGIS platform does not sync)
- End-to-End Hardware Product Lifecycle from ideation, planning, development, and launch

1.5. Elevator Pitch

BriSense will revolutionize the unchanged decades old operations behind waste management in cities. This will be accomplished by equipping every regular public trash can with IoT Technologies to determine bins/areas that require immediate cleaning. This will truly help clean up America's cities regardless of neighborhood income status.

1.6. Target Audience, Personas & Empathy Maps

This product is for everyone, but serves three types of groups: city officials, waste management operators, and the community. Anyone can fall into any of the three categories, may be one or even all three group types at the same time. Basically, the goal is to have BriSense installed in

every single city in America. However, this project will need to start small and in a pilot city before expanding to other cities. This product will be used by anyone who needs to throw away their trash in a public space and will be used by waste management operators who now have an optimized way of cleaning cities. In this pilot test, I'll target the downtown district of the city where I currently reside in: Oakland, California. According to Point2Homes, the Oakland Downtown district has a population of 4,632 residents. This would be the perfect place to conduct a pilot test for BriSense because the residential population is small compared to the rest of the city (450,000), and receives many daily visitors because due to its proximity to major corporate offices. Additionally, although downtown Oakland tends to have larger population of wealthier residents with white collar jobs, there are still a notable number of areas within the downtown area that don't receive enough trash cleaning attention.

The below statistics were gathered from Point2 (Point2Homes) on residents of Downtown Oakland, CA.

Downtown Oakland Population Demographics

Total Population	4,632
Male Population	2,495
Female Population	2,138
Median Age	37
Citizen US Born	3,145
Citizen not US Born	812
Not Citizen	676

Occupational Employment in Downtown Oakland

White Collar	2,318
Blue Collar	253

Self Employees	276
Private Companies	1,641
Governmental Workers	267
Not for Profit Companies	388

Number of Households in Downtown Oakland

Total Households	2,466
Average People Per Household	2
Family Households	710
Non-family Households	1,756
Households with Children	276
Households without Children	2,190


Median and Average Income in Downtown Oakland

Average Household Income	\$71,418.60
Median Household Income	\$42,375.00
People below Poverty Level	1,105
People above Poverty Level	3,361


Downtown Oakland Education Statistics

No High School	412
Some High School	821
Some College	985
Associate Degree	231
Bachelor's Degree	1,109
Graduate Degree	775


Persona 1 – Oakland Downtown Resident

<i>Freddie Dallas</i>				
		<p><i>Hi everyone! My name is Freddie, and I'm a current Business Development Manager at Pandora! I received my MBA from UCLA after teaching algebra in Boston for 9 years. During my time as a teacher, I felt that it was time for a career change and location change having lived in the Boston Area all my life. When I moved to LA for school, I met my beautiful wife, Andi. We got married shortly after. However, it was during my MBA that I realized that I wanted to try something new and try living abroad. I grew a newfound interest in South Korean culture from my experiences with friends, and the recent explosion of Korean pop culture, etc.</i></p>		
<i>Personal Details</i>				
<ul style="list-style-type: none"> • <i>Age: 45</i> • <i>Sex: M</i> • <i>Citizenship: Citizen</i> • <i>Education: MBA - UCLA, BA, Sociology @ Boston University</i> • <i>Hobbies: Basketball, Soccer, Track & Field, Sailing, Flying</i> • <i>Home Base (Where you live): Oakland, California</i> • <i>Marital Status: Married</i> • <i># of Kids: 2</i> 				
<i>Professional Work Experience</i>				
<p><i>Previous Work Experience</i></p> <ul style="list-style-type: none"> • <i>English Teacher at Boston Public High School (2010 - 2019)</i> <p><i>Current Work Experience</i></p> <ul style="list-style-type: none"> • <i>Business Development Manager at Pandora (Present)</i> 				
<i>Years Lived in Oakland</i>	<i>Favorite Spots in Oakland</i>	<i>Income Level</i>	<i>Life Goal</i>	<i>Frustrations/Pet Peeves</i>
5 Years	Lake Merritt, Oakland Chinatown	\$120,000	Learn 5 new languages	Dirty Streets outside my apartment

Persona 2 – Waste Management Operator

<i>Martin James</i>				
		<p><i>Hello there! My name is Martin, and I've been a proud resident of Oakland for the past 48 years. I couldn't see myself anywhere else in the world. My work hours are pretty flexible and I've been making enough to help sustain my kids who are currently at Oakland High School. I enjoy watching Oakland Sports: Golden State Warriors, Oakland Athletics, Oakland Raiders the past several decades. Despite two of the teams moving, I'll still be a di-hard fan for them. I currently working as a Waste Management operator. Its not the most glamorous job out there, but it pays quite well. A guy gotta do what he gotta do to put food on this table amiright?</i></p>		
<i>Personal Details</i>				
<ul style="list-style-type: none"> • <i>Age: 52</i> • <i>Sex: M</i> • <i>Citizenship: Citizen</i> • <i>Education: High School Diploma, Oakland High School</i> • <i>Hobbies: Basketball, Football, Baseball</i> • <i>Home Base (Where you live): Oakland, California</i> • <i>Marital Status: Married</i> • <i># of Kids: 3</i> 				
<i>Professional Work Experience</i>				
<p><i>Previous Work Experience</i></p> <ul style="list-style-type: none"> • <i>Cashier at Safeway (2000 – 2010)</i> • <i>Train Driver at Bart (2010 – 2014)</i> <p><i>Current Work Experience</i></p> <ul style="list-style-type: none"> • <i>Operator at Waste Management (2014 – Present)</i> 				
<i>Years Lived in Oakland</i>	<i>Favorite Spots in Oakland</i>	<i>Income Level</i>	<i>Life Goal</i>	<i>Frustrations/Pet Peeves</i>
48 Years	Oakland Hills	\$87,000	Put my kids through college	Rude people who think they are all that.

Persona 3 – City Official / City of Oakland Planning Director

<i>Robert Gomez</i>				
		<p><i>Hello! My name is Robert, and I'm the Planning Director for the City of Oakland. All new developments, renovations, and public upgrades go through me and my office. I'm excited to help turn Oakland into the city to be in the 21st century. I'm looking into innovative new ways to help clean up the city, make our cities safer, but to also use technology to make our lives more convenient! If you have suggestions on what we can do to make Oakland better than San Francisco, please email me at Robert.Gomez@oakland.com.</i></p>		
<i>Personal Details</i>				
<ul style="list-style-type: none"> • <i>Age: 39</i> • <i>Sex: M</i> • <i>Citizenship: Citizen</i> • <i>Education: BA Sociology @ UC Davis, MS Urban Planning @ UC Berkeley</i> • <i>Hobbies: Basketball, Football, Baseball</i> • <i>Home Base (Where you live): Oakland, California</i> • <i>Marital Status: Married</i> • <i># of Kids:2</i> 				
<i>Professional Work Experience</i>				
<p><i>Previous Work Experience</i></p> <ul style="list-style-type: none"> • <i>Community Manager at OpenSpaces (2000 – 2005)</i> • <i>Oakland Council Member (2007 – 2017)</i> • <i>Oakland Mayor Candidate (2017 – 2018)</i> <p><i>Current Work Experience</i></p> <ul style="list-style-type: none"> • <i>Oakland Planning Director (2018 – Present)</i> 				
<i>Years Lived in Oakland</i>	<i>Favorite Spots in Oakland</i>	<i>Income Level</i>	<i>Life Goal</i>	<i>Frustrations/Pet Peeves</i>
22 Years	Oakland Hills, Jack London Square	\$122,000	Become Mayor of Oakland then Governor of California	Damaged public spaces

Empathy Map – Is Oakland a clean city?

Persona 1 – Freddie Dallas

Says	Thinks
<ul style="list-style-type: none"> • What do you think? • Obviously, it’s no Beverly Hills, but overall city cleanliness is aight. • There are parts that are kinda nasty, but for the most part it seems ok 	<ul style="list-style-type: none"> • Ehh... its ok
Does	Feels
<ul style="list-style-type: none"> • Throws out trash in the BriSense bins without much thought • Carries out his regular life with his family without much thought about the city operations 	<ul style="list-style-type: none"> • Indifferent

Persona 2 – Martin James

Says	Thinks
<ul style="list-style-type: none"> • I’ve been serving the city of Oakland’s Waste Management activities for a strong 5 years • I’ve done the best I can, but there is more work to be done. • At this point, I don’t know what else I should be doing to help. I already have to wait up extra early and work extended hours to make these dump truck runs 	<ul style="list-style-type: none"> • What should I say? What if I get fired from my job for saying it’s still hella dirty? • This city is actually quite nasty, and why should I be responsible for how it looks. • I only do what is within my paygrade
Does	Feels
<ul style="list-style-type: none"> • Proceeds with doing his dump truck routines of emptying out cans on his scheduled route • Does only what is within his paygrade 	<ul style="list-style-type: none"> • Indifferent • Anxious • Fatigued

Persona 3 – Robert Gomez

Says	Thinks
<ul style="list-style-type: none"> • At least its cleaner than San Francisco • It still needs improvements, but its not bad • Do you have suggestions on how to improve city processes/operations? 	<ul style="list-style-type: none"> • Whats the politically correct answer to say? What if I get fired from my job for saying its still hella dirty? • After all, its my job to ensure that the city is seeing overall improvements

<ul style="list-style-type: none"> • Overall, it's gotten a lot cleaner since I've taken office 	<ul style="list-style-type: none"> • Should I criticize something I'm in charge of?
Does	Feels
<ul style="list-style-type: none"> • Looks around to see how the city cleanliness is looking • Picks up trash on the sidewalk if he passes by it • Asks friends and family what they think of Oakland as a city. 	<ul style="list-style-type: none"> • Anxious • Proudful • Unsure of who to trust • Fear • Inadequate

1.7. Metrics, Rubric and User Survey

In order to ensure that my project is successful, it must meet the metrics and rubric outlined below. Per the rubric, in this project, anything deemed a 5 in any category is very successful, 4 is successful, 2-3 is average, and 1 is unsuccessful.

Metrics

1. The BriSense system will be able to pinpoint the general location of the disposal bin with at least a 70% accuracy rate out of 10 attempts.
2. The BriSense system will be able to generate a notification to the central dashboard regarding a full trash can with an 80% accuracy rate out of 10 attempts.
3. The central dashboard will receive all notifications from the BriSense system with an 80% accuracy rate out of 10 attempts.
4. The snap-on casing and functionality of BriSense works on at least 5 different looking trash cans.
5. All monthly milestones are completed by the assigned deadline to ensure that the product is on-track throughout the Capstone Project.

Capstone Rubric

BriSense would ultimately be deemed successful based on the below self-developed rubric. Percentages will be determined by a final test consisting of 10 demonstrations for the sensor, GPS, and dashboard functionalities. The durability of BriSense's outer shell will be tested against potential natural and weather considerations as deemed appropriate to ensure "snap-on" capabilities remain intact.

BriSense Capstone Rubric					
Milestones Deliverables Completed on Time	1 - None or one out of the five milestones were submitted on time.	2 - Two out of five milestones were submitted on time with the necessary work and deliverables.	3 - Three out of five milestones were submitted on time with the necessary work and deliverables.	4 - Four out of five milestones were submitted on time with quality work and deliverables.	5 - All five milestones were submitted on time with quality work and deliverables.
Sensor Functionality Works	1 - BriSense sensor doesn't work, but the attempt has been made to build it.	2 - BriSense sensor records when the disposal bin is full with an accuracy of at least a 60% success rate	3 - BriSense sensor records when the disposal bin is full with an accuracy of at least a 70% success rate	4 - BriSense sensor records when the disposal bin is full and will achieve moderate accuracy with at least an 80% success rate	5 - BriSense sensor accurately records when the disposal bin is full with at least a 90% success rate.
GPS Functionality Works	1 - BriSense GPS doesn't work, but the attempt has been made to build it.	2 - BriSense GPS pinpoints location of disposal bin with at least a 50% success rate.	3 - BriSense GPS pinpoints location of disposal bin with at least a 60% success rate.	4 - BriSense GPS pinpoints location of disposal bin with at least a 70% success rate.	5 - BriSense GPS pinpoints location of disposal bin with at least an 80% success rate.
Dashboard Receives Data Functionality	1 - BriSense Dashboard doesn't work, but the attempt has been made to build it.	2 - BriSense Dashboard receives location data and sensor data with at least a 60% success rate.	3 - BriSense Dashboard receives location data and sensor data with at least a 70% success rate.	4 - BriSense Dashboard receives location data and sensor data with at least an 80% success rate.	5 - BriSense Dashboard receives location data and sensor data with at least a 90% success rate.
Product Outer Shell Complete	1 - Snap-on casing and functionality doesn't work.	2 - Snap-on casing and functionality is built and works on at least 2 different trash cans	3 - Snap-on casing and functionality is built and works on at least 3 different trash cans	4 - Snap-on casing and functionality is built and works on at least 4 different trash cans	5 - Snap-on casing and functionality is built and works on at least 5 different trash cans
Overall Product	1 - The product is not prototype ready.	2 - Overall, the product is a prototype that requires some major tweaks before demoing to public.	3 - Overall, the product is a prototype that requires some moderate tweaks before demoing to public.	4 - Overall, the product is a prototype that requires some minor tweaks, but is good to go.	5 - Overall, the product is a prototype ready to be demoed to early stage investors.

User Survey

1. Does BriSense notify you when the trash can is full?
2. Has there been any false alarms about a full trash can?
3. Does the Snap-On device on the BriSense stay put through general weather conditions (e.g. rain, sun, regular winds, etc.)?

4. Does the BriSense protect the inner hardware components from weathering and water leakage?
5. Does the GPS accurately pinpoint the relative location of the trash bin?
6. Does the dashboard accurately reflect the full status of the trash can?
7. Is the dashboard capable of monitoring one more than BriSense system?
8. Was the BriSense system easy to install?
9. How likely would you recommend this product to another user?
10. What feedback do you have for improvement of the BriSense system?

2. Competitor Review & Analysis

Zunch Labs Smart Trash Sensor

Link: <https://www.zunchlabs.com/iot-products/smart-trash-sensor/>

Zunch Labs is a company that produces an extended line-up of different types of commercial IoT hardware that can be integrated into a full system as a separate part. This product is a component of a future product with many capabilities ONLY if the end-user can hire engineers capable of developing the required dashboard and algorithms, then perform the holistic systematic integration.

Pros	Cons
<ul style="list-style-type: none"> • LoRaWAN module to transmit trash can statuses via appropriate servers • Batteries are capable of lasting 5+ years due to its low consumption power algorithm and build • Waste management operators CAN monitor the status of each bin and build out a resource work plan for its workers 	<ul style="list-style-type: none"> • Because Zunch Lab produces a multitude of IoT parts, they do not have an end-to-end system tailored for the end user (commercial or residential) • Their sensors are not equipped with a “snap-on” functionality, resulting in the potential need for skilled technicians or complex user manuals. • Product line-up doesn’t include end-user dashboard + route plan mapping. Will result in extra configurations and engineering to build this integration with external dashboards/route planning algorithm.

Compology**Link:** <https://compology.com/>

Compology is a camera-integrated monitoring system for industrial disposal bins. Compology's cameras are "rugged" and built to withstand weather conditions and construction debris. They also provide comprehensive high-resolution viewing ability of trash cans through their application platform. These products are equipped with a GPS to enable ease of tracking when on the move.

Pros	Cons
<ul style="list-style-type: none"> • "Rugged" dumpster cameras capable of handling a wide range of weather conditions + potential impact with heavy trash • High resolution images viewable from anywhere at anytime • GPS tracking of camera • Viewable mobile app/dashboard 	<ul style="list-style-type: none"> • Because Compology is camera-based, it requires the user to actively check the disposal bins to determine trash capacity • This can be inconvenient and is often limited to commercial usage for large heavy-duty bins. • Lighting may also be a concern since these systems are often installed outdoors making it difficult to see the trash capacity in the dark.

Bin-E**Link:** <http://bine.world/>

Bin-E is a disposal bin that utilizes AI to identify the type of recycled product being disposed, then sorts it appropriately within the bin. The bin is also equipped with a compression mechanism to flatten out the disposed items to provide extra space for further dumping. The recycle bin only separates by glass, plastic, paper, and metal. When the bin is full, a notification will be sent to the appropriate operators notifying them that the Bin-E is now full. Because Bin-E is a large commercial and office-place disposal bin which contains complex internal software and hardware, specialized technicians will be required to install and setup. Because this bin is very large, it is primarily built for the commercial consumer and does not address concerns at the neighborhood level.

Pros	Cons
<ul style="list-style-type: none"> • AI-Based Trash Can with waste recognition • Internal trash can sort by glass, plastic, paper, metal • Compression capabilities to enable a fuller trash can • Sensors with consistent monitors on trash capacity • When trash is full, a notification is sent out to Waste Management Operators • Outer touchscreen on bit to inform user of bin fill levels. 	<ul style="list-style-type: none"> • Fit for only large office/commercial sites • Built with complex internal software and hardware. Requires specialized technicians install and setup. • Expensive and doesn't address business need for the public, especially those in lower-income areas • Very large, requires a lot of space

Comparison Review & Competitor Matrix

Ultimately, there are a couple startups that sprung up to address America's trash disposal problems. However, while these startups all address individual of problems, there is no waste management solution that is a "one size fits all" in the market. However, that will change with the launch of BriSense. Zunch is a sensor with many configuration possibilities, but is intended for those interested in building out a side project. Compology and Bin-E address industrial and commercial issues. However, there isn't a solution that addresses problems within the general public. BriSense is a low-cost solution that doesn't require replacement of current trash bins, is durable, and uses IoT to connect with an end-user Operator Dashboard.

<i>Features</i>	Zunch Labs Smart Trash Sensor	Compology	Bin-E	BriSense
Snap-On	✓ Limited Ability	✓		✓
GPS-Tracking		✓	✓	✓
Waste Management Operator Dashboard		✓	✓ Limited Ability	✓
Distance Sensors	✓		✓	✓
Minimal Configurations/Installation		✓		✓
Full Capacity Notifications	✓ Requires Configuration		✓	✓
Low Cost Per Bin	✓ Extensive Configuration May Drastically Increase Costs	✓		✓
Available for All Three Uses: Public, Commercial, Private				✓
Durability		✓	✓	✓
Powered by IoT Technologies	✓	✓	✓	✓

3. Technology Requirements

Ultrasonic Sensors: ELEGOO HC-SR04 Ultrasonic Module Distance Sensor – This is a sensor device that measures the distance between the sensor itself and the trash in the disposal bin. When the sensor head emits a wave that is reflected, that is what is used to measure the distance before having the microprocessor send out the notification if appropriate.

- **Related Course:** CSCI E-11: Big Data, IoT, Cybersecurity
- **Alternative Technologies:** SONAR, Camera

- **Reason:** The reason why Ultrasonic Sensors would be better, is because these sensors are generally more affordable and is generally used over terrain. SONAR is often used underwater, and cost more. My competitors use Cameras to view the “fullness” of their bin, but this defeats the purpose of a dashboard that provides notifications when a bin is actually full.
- **How it’ll be Used:** As mentioned above, this is a sensor device that measures the distance between the sensor itself and the trash in the disposal bin.

Micro-Controller: Arduino Nano 33 IoT – An Arduino is an “open source electronic prototyping platform” used for building applications that have limited and repeated use of one capability. The micro-controller is ultimately the “brain” tool that handles and processes the data.

- **Related Course:** CSCI E-11: Big Data, IoT, Cybersecurity
- **Alternative Technologies:** Raspberry Pi
- **Reason:** Raspberry Pi’s are mini-versions of regular computers, capable of a wide range of activities. However, Arduinos are smaller computers that run one program at a time reputedly. In this case, Arduinos are a better choice since it’ll be in charge of checking the trash can capacity and send the notification out when full, and that’s it! Its usage is very limited and that’s all I require of the micro-controller. With a Raspberry Pi, it’s a very powerful tool for the limited needs in this specific project.
- **How it’ll be Used:** – As mentioned above, the Arduino is essentially the “brain” of the system that enables the notification to be sent out and received by the WebGIS operations dashboard. This system also enables and simplifies the process of connecting the IoT system to the internet.

WebGIS Operations Dashboard - WebGIS is an advanced mapping tool that specifically enables us to track IoT products/sensors/cameras in real-time on its commercial industry-standard operations dashboard.

- **Related Course:** CSCI E-8 WebGIS: Technologies and Applications
- **Alternative Technologies:** Blynk IoT Platform, In-house dashboard.
- **Reason:** Other competitors would use in-house dashboards because it generally has more customization capabilities when built-in house. However, the perks of using existing

commercial grade technologies is that they've been accepted by industry standards, get consistent upgrades, and generally have a sound security system. If the WebGIS platform becomes a barrier due to enterprise costs and trial limitations, the Blynk IoT Platform will be used as an alternative dashboard. Blynk is a platform that provides customizable apps, a private cloud, device management, and analytics for all IoT devices.

- **How It'll be Used:** This tool will be used as the central dashboard for receiving notifications and mapping out where the trash cans are that need emptying.

GPS Module - This device generally connects with a micro-processor such as an Arduino, and to provide location tracking for the final project build. GPS modules are generally able to receive information from satellites and provide the exact pinpointed location of an object.

- **Related Course:** CSCI E-11: Big Data, IoT, Cybersecurity
- **Alternative Technologies:** N/A
- **Reason:** GPS Modules are a common industry grade tool for projects and industry products. There aren't any other alternative and affordable technologies that integrate seamlessly with Arduinos the way a GPS module does.
- **How it'll be Used:** This device will enable location tracking for all the public trash cans that have a BriSense device, and provide data that gets mapped to WebGIS

4. Developer Manual / Design Workflow / Product Design / Methods

Product Component Line-Up

BriSense Component Line-up



Sensors are constantly monitoring disposal bin capacity. Once full, a notification is sent to the appropriate operators.



When the "full" notification is sent, it also provides a GPS location of where the disposal bin is located in the City.



Waste Management operators monitor a comprehensive dashboard that collects all the data received from the BriSense.

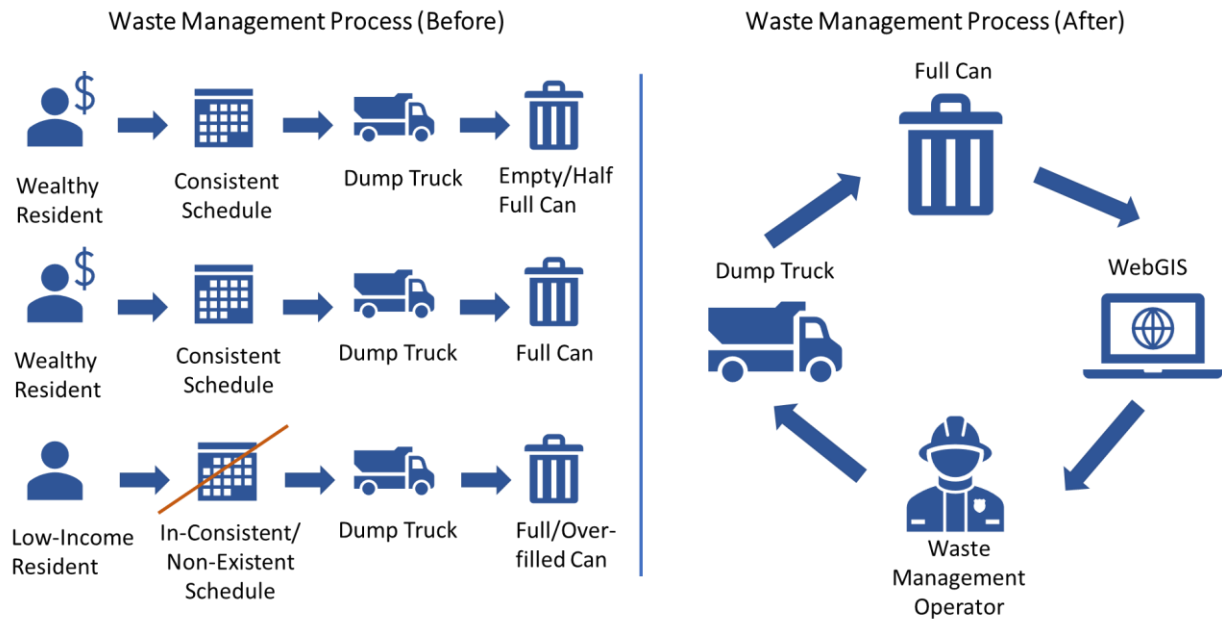
How the Product Will be Build

1. Purchase and gather all the hardware components (Arduino, Sensors, etc.) and Software products (WebGIS), plastic box material required for casing

Technology + General Components List	
<ul style="list-style-type: none"> • ELEGOO HC-SR04 Ultrasonic Module Distance Sensor • Arduino Nano 33 IoT • WebGIS Operations Dashboard • GPS Module 	<ul style="list-style-type: none"> • Trash Cans for Testing • Plastic box • Drills/Art Supplies • AA Batteries for Arduino Board • Blynk Platform (Back-up Option to WebGIS)

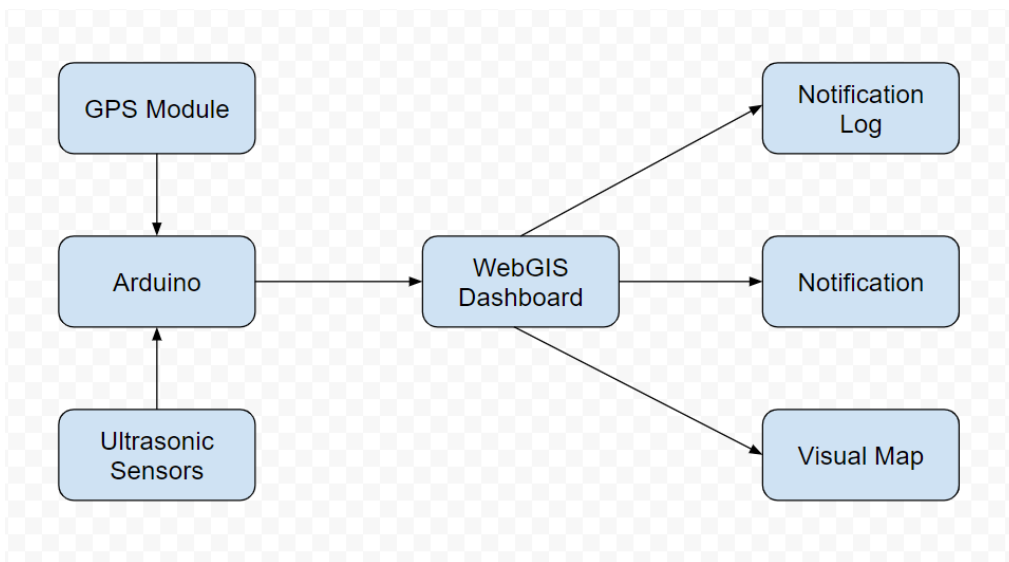
2. Install Necessary Libraries
3. Assemble the Circuitry to enable the sensors and board
4. Assemble the box casing and Snap-On features
5. Configure the Operations Dashboard on the WebGIS System
6. Program the Arduino board, sensors, GPS module
7. Sync the Dashboard + Arduino Board
8. Testing

How BriSense Works



The BriSense system consists of both hardware and software components. This is blended with art, design, and construction engineering to build a snap-on device to house the BriSense hardware components. Every part will contribute to enable BriSense’s mission of optimizing the way trash is disposed of in cities. The Arduino will act as the brain power for the system that’ll transmit “full capacity” notifications to the WebGIS dashboard for the user to see. The Ultrasonic sensors will be monitoring the trash capacity and the GPS module will provide the Arduino with real-time location settings. For this prototype, it’ll be built with a plastic box, that’ll be constructed to include a universal snap-on feature to accommodate most trash cans.

Product Architecture



5. User Journey/User Manual

There are two types of users for the BriSense product.

- There are regular civilians who throw out trash in a BriSense equipped trash bin. Besides that, they will have no other interaction with the system.
- The second type of user are the Waste Management Operators who simply log onto the WebGIS operations dashboard, and can view a map of all the trash cans in a city. Notifications will appear on a dashboard with the location when a trash can is full.

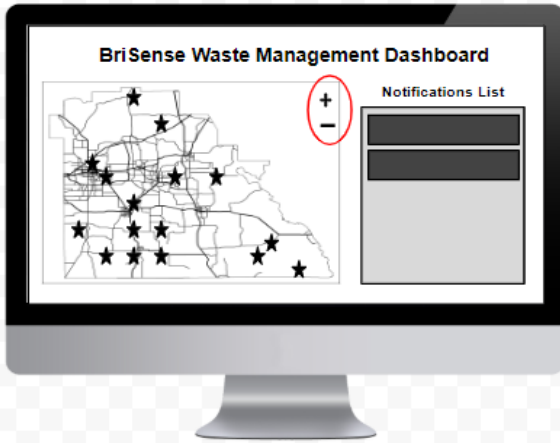
BriSense Screen Views



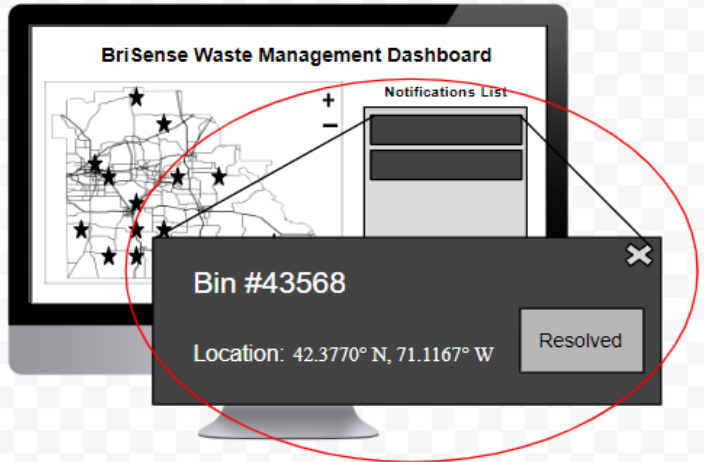
1. The Waste Management Operator is able to login into his account and access the BriSense dashboard.



2. The Waste Management Operator is able to view a map of all the BriSense trash bins in the area



3. He is able to zoom in and out of the map to see the specific location of the bins



4. Operator is able to view all incoming notification requests on the Notifications List. When clicking into a request, the user is able to view the coordinates of the bin and mark it as resolved after its been emptied.

BriSense Tasks & Instructions

Waste Management Operator Persona: Eric

- **Receiving Full Trash Bin Notification**
 1. Eric logs into BriSense by providing his user credentials and password
 2. Eric sees all incoming full-trash bin notifications on his dashboard

- **View Trash Bin Locations**
 1. Eric logs into BriSense by providing his user credentials and password
 2. Eric selects the map view
 3. Eric zooms in and out of the map view to see detailed locations of a trash bin at the street level
 4. Eric selects a bin on his map and can see the bin # and exact location coordinates

- **View Full Trash Bin Log**
 1. Eric logs into BriSense by providing his user credentials and password
 2. Eric views the log of full-trash bin notifications in the view on the right of the screen
 3. Eric selects a bin on the log and to see the bin # and exact location coordinates
 4. Eric resolves the bin case after a team is deployed to that location for trash emptying

6. Workplan and Milestones

I will know that I'm on track to finish this project on time so long that I'm able to meet the deliverable deadlines. If a deadline is unable to be met, I will make sure this is communicated to my project advisor a long with a plan for making sure the deliverable will be completed and an alternative is proposed. It'll be critical for me to have constant communication with my advisor on project progress.

Tentative Development & Deliverable Schedule

Milestone #1. Complete Build for Hardware

Tentative Deadline: February 14, 2020

Description: This milestone will be for gathering all the necessary equipment and completing the rough build of the IoT product.

Milestone #2. Complete Sensor Testing + Geo-Location Tracking Functionality

Tentative Deadline: March 13, 2020

Description: By this milestone, all the Arduino programming will have been completed, and all the sensors are working correctly.

Milestone #3. Complete Program to Feed Data to WebGIS

Tentative Deadline: April 17, 2020

Description: By this milestone, all the data collected from the IoT Device will feed into the WebGIS Operations Dashboard.

Milestone #4. Integrated Product Testing

Tentative Deadline: May 8, 2020

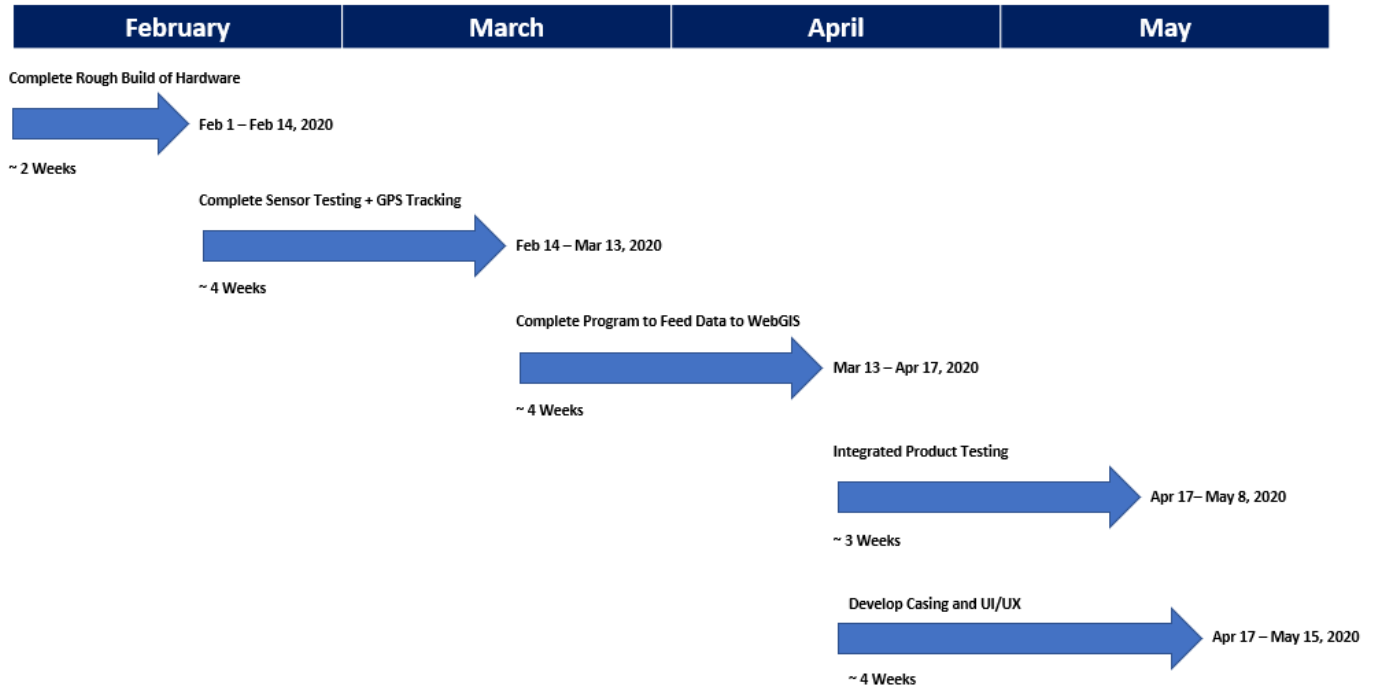
Description: By this milestone, the product will have completed all thorough hardware and software testing. Patches or necessary fixes will be completed and updated in the final presentation project material.

Milestone #5. Develop Casing and UI/UX on Final Product

Tentative Deadline: May 15, 2020

Description: By this milestone, all the UI/UX on the product is complete and the “snap-on” casing for the product is complete.

Gaant Chart Timeline



7. References

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