



SCUTTLE APPLICATIONS GUIDE

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An ever-growing list of easy-to-approach projects.

We want your ideas! (seriously). Submit yours to
info@scuttlerobot.org and we will publish for the world.

 More
Guides

IDEATION MINDSET



Project ideation is not just a matter of creativity, it's a serious challenge in problem-solving and STRUCTURED brainstorming.

This skill takes years to develop. Here are some ideation guidelines that often make or break a final project demo.



- Your scope to a manageable amount
- Your hardware to accessible modules
- Custom Circuits, Custom CAD, and Custom Fab to minimum

- Open-source libraries which are growing each year
- Functions of the robot which are already high performing
- The fact that you can produce new outcomes from existing functions

- An initial concept down to its components
 - Verify every single step has a known solution
 - Your imagination into a final scenario & ask “what will go wrong?”

SECTION 1: HARDWARE PROJECTS

Projects that require additional actuators

Feasible scope for MVP in less than 6 months

Limited to 1 or 2 actuators

Only actuators & sensors which have open-source libraries already

1.1 ENVIRONMENTAL SAMPLING (GREENHOUSE)

Task:

Environmental measuring – Identify containers and probe for temp/moisture/pH

Why it's Useful:

Currently, readings in these facilities are taken by people walking from point to point. Instead of sampling all regions, companies usually just take a few measurements, leaving the gradients to assumption. More thorough measurements will make more successful operations.

Why it is feasible:

Probes and their associated drivers can easily fit on a scuttle and within power budget. Probing for parameters does not require fine precision of movement so students can achieve this with basic software and materials.



Raft bed hydroponics nursery:
These seedlings will benefit from monitoring of coloration and impacts from pests, or nutrient deficiencies.



1.2 SECURITY ROUTINE

Task:

Security tasks – take photos of designated items & upload.

Why it's useful:

Security guards can't always catch subtle problems. When robots are added, photos can be taken in exact locations from day to day and image processing can run in the cloud to catch someone setting up for a theft.

Why it is feasible:

Camera and RFID technologies have already been tested on SCUTTLE with available examples.





1.3 3D PRINTER FILAMENT HANDLING

Task:

Gather, transport, and load 3d filament spool onto hangers

Why it's useful:

Many machines can nearly run autonomously except for the changing of filament. Filament loading gets the whole print factory one step closer to full autonomy.

Why it's feasible:

Spools are standardized and found in most makerspaces. Low cost actuators don't require additional power supply and have capability to lift or manipulate objects the size of spools.



1.4 MOBILE REFRESHMENTS

Task:

Dispense purified water into cups where people need water.

Why it's useful:

We don't really know. All we know is that highly trained athletes are still getting assistance to drink water so why not help with a robot and spare some effort from the coach?

Why it is feasible:

SCUTTLE has already shown ability to carry a full size water jug and more. 12v pumps are readily available and powerful enough to lift water at a reasonable rate.





1.5 RESTAURANT TABLE DELIVERY

Task:

- Carry trays of food or supplies to designated location.

Why it's useful:

- tray delivery is a longstanding task for people. But since times of COVID-19, we aim to reduce the contact of waiters with dozens of people per hour.

Why it's feasible:

- Trays have a standard and simple form factor. It's just a matter of adding one light actuator to expel a tray when SCUTTLE reaches the destination table.



1.6 INVENTORY LABELING

Task:

Add a portable label printer, identify boxes and label them with the proper information for shipping or contents.

Why it's useful:

Inventory can change rapidly and accurate labeling is a need which exists across many industries.

Why it's feasible:

New printing devices that print wirelessly have been on the market just for a short time. Their usefulness is enhanced when coupled to a machine which knows exactly its speed relative to the box to be printed on.

Example actuator:

- <https://www.searchingc.com.my/products/printpen>



M-brush on amazon:
<https://www.amazon.co.uk/Bluetooth-Printer-Portable-Cicarica-Anywhere/dp/B085VCRVS2>

Youtube example: <https://youtu.be/7Psmlwmv1fc>



1.7 COLLECT TENNIS BALLS

Task:

Collect tennis balls during practice in the court. Cruise around, detect balls by color & shape, collect them in a basket, and deliver them to a designated dump spot.

Why it's Useful:

Practicing tennis (or golf) can be inefficient since someone must collect the balls repeatedly.

Why it's Feasible:

SCUTTLE repo offers computer vision templates that follow colored objects, and round objects are the easiest. This functionality has been demonstrated with Pi, Beagle, Edge AI, and in multiple softwares.



1.8 PET MONITORING

Task:

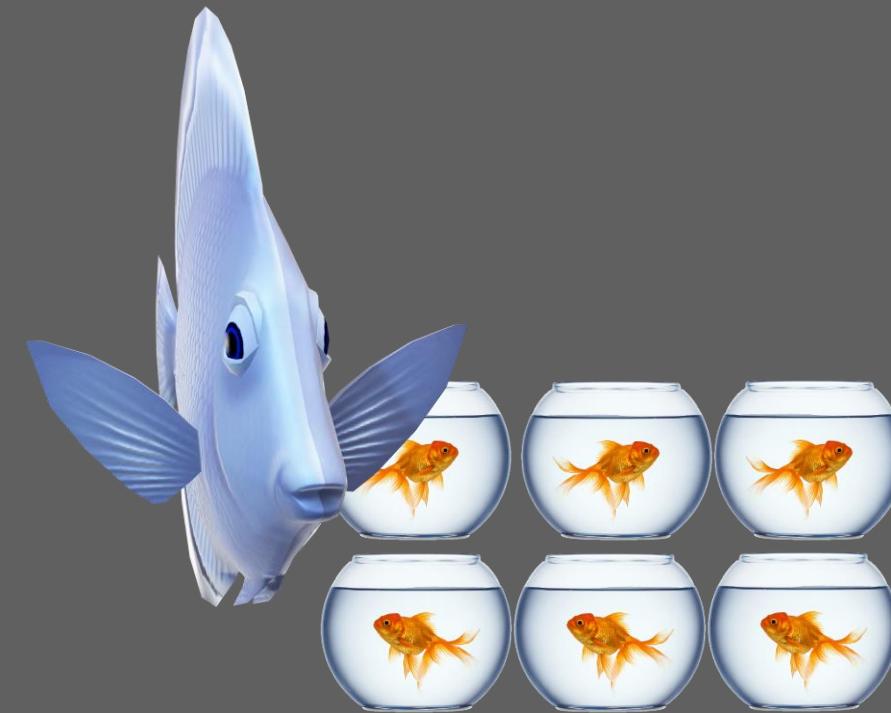
Look after the pet store on holidays to give alerts. For Dogs: detect barking in kennels (audio recognition). For Fish: detect dead fish, or sample water (pH, Temp, Salinity, Etc) for birds, reptiles, etc: Customize programs for irregular behavior by sounds, odd vibrations, or stillness of the animal. (is it dead? Did it escape?)

Why it's Useful:

Many stores carry living or sensitive items which need a very basic human checkup to avoid catastrophic losses. In laboratories in universities, undergrads are forced to show up even on weekends just to look at the creatures.

Why it's Feasible:

Simple handheld probes can be used to achieve environmental measurements on an end-effector. Computer vision with a little creativity can be used to detect discoloration or movement in just a few lines of Python code.





1.9 PATH HAZARD REPORTING

Task:

Use Lidar to detect hazards to humans in the pathway, cracks in the sidewalk, or debris. Take a photo onsite to log the condition. Send the photos instantly to officials by cell carrier. Use GPS coordinates to send a report with photograph to the department who will make a repair or send a technician out for inspection.

Why it's Useful:

Each day, new hazards can show up in parks and public walks due to unexpected events. Trails are often closed after storms due to unknown hazards, until officials can review the condition.

Why it's feasible:

Paths are easy to follow compared with open environments, when programming a mobile robot. Search online for an easy library of AI-based recognition of obstacles.





1.10 THERMAL FACILITY AUDIT

Task:

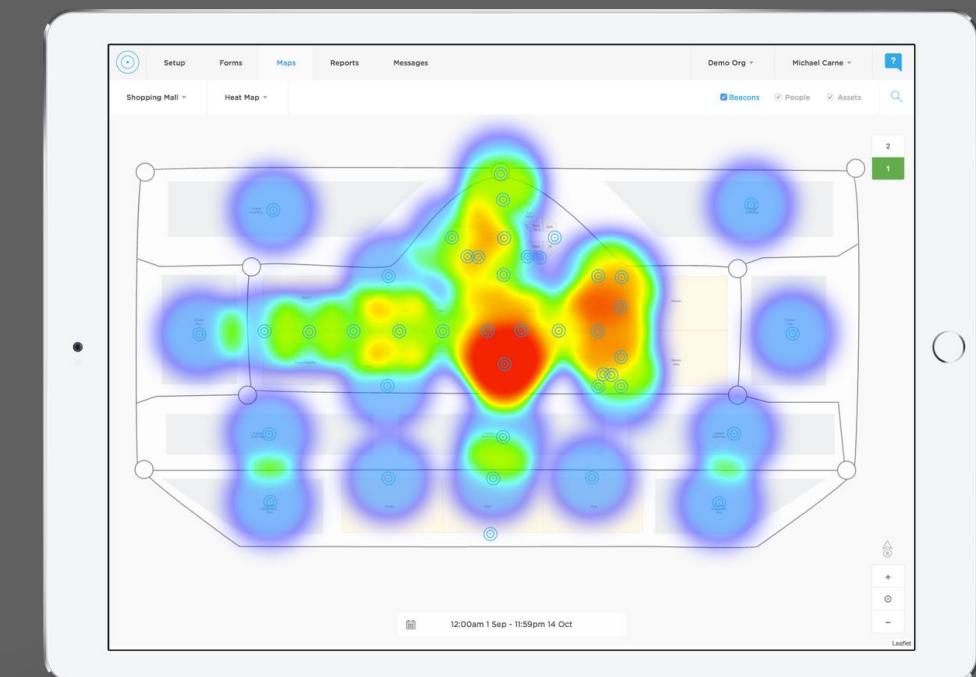
Train SCUTTLE with proper standards to audit buildings for thermal losses. Make a map of a building and take temperature measurements throughout. Detect Windows & sources of airflow. Use an air vane to detect airflow direction. Generate a report on the indoor climate & areas of concern for heat buildup (cooling) and heat loss (heating)

Why it's Useful:

Companies pay huge rates to make energy audits in their facilities. These audits must hire outside vendors because the outside vendors are trained in the necessary standards.

Why it's Feasible:

Just add a sensor to an existing SLAM algorithm.



1.11 FIRE FIGHTING BOT

Task:

Employ a simple 2DOF arm for aiming an extinguishing nozzle. Payload: secure 1 or more fire extinguishers.

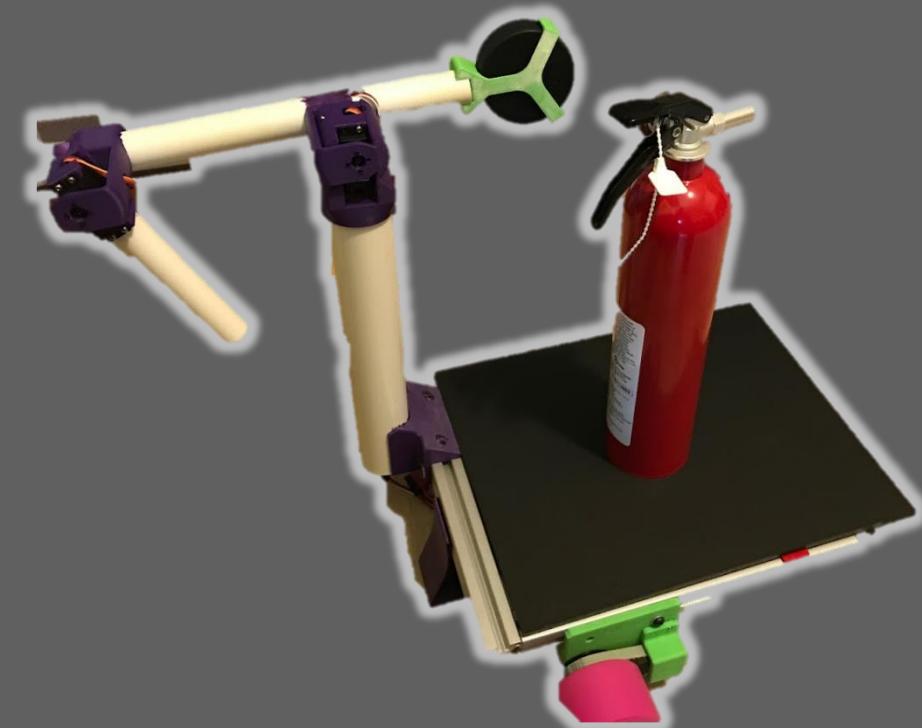
Optional: use thermal imaging to detect fires.

Why it's useful:

Not everyone is capable and ready to manage a fire extinguisher (consider day cares, pets alone at home, or elderly care)

Why it's Feasible:

PROJECT IMPLEMENTATIONS can be found in our [student projects videos](#).



Example Extinguisher
Product (amazon)



1.12 CAMPUS SECURITY ESCORT

Task:

SCUTTLE can be equipped with emergency call functions, pathway lights for added safety or an extremely loud siren at the press of a button.

Why it's useful:

Universities have already identified a need for security during times when someone is alone or in need of help. A mobile security device is just an enhancement over fixed security-call-boxes. Budgets have already been allocated on this kind of infrastructure for many institutions.

Why it's Feasible:

Reliable 4G cellular modules are available off-the shelf to give redundant connectivity when wifi may be interrupted.





1.13 PROFESSIONAL POV PANORAMICS

Task:

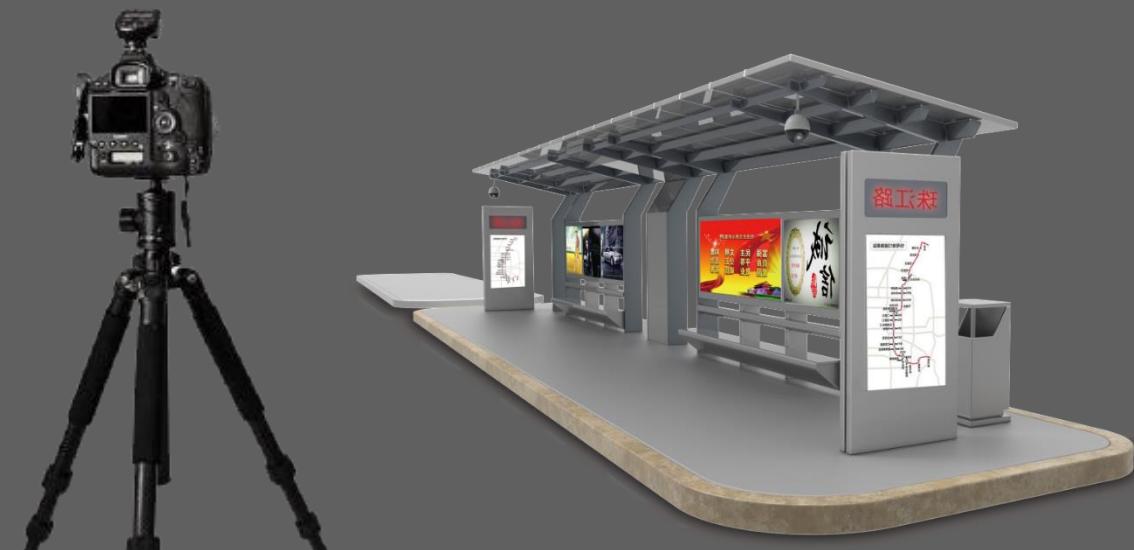
- Execute panoramic photography by utilizing the accurate odometry on SCUTTLE.
- With updates to camera software, professional DSLR cameras can be activated to take a sweeping photo that is tied to the odometry of the wheels.
- Point and shoot: two simple servos can control a laser pointer which the camera person can use to indicate the extremities of a photo, upon which SCUTTLE will execute the image capture. Consider it like a flat-bed scanner but life-size.
- Dimensions and proportions can be more accurately captured for tagging of official measurements

Why it's Useful:

- panoramic photos are limited to single-POV execution, even for wide-spanning scenery.
- The ends of each panoramic lack the pixel density due to their distance from the camera
- Architects and city planners will benefit from improved image capture of schools, bus stops, train stations, etc.
- A new kind of panoramic can be made with a sweeping POV. Panoramic =

Why it's Feasible:

- SCUTTLE can drive in an arc and trigger the camera capture, with distances and curves defined with a simple code.
- Use variables to define the duration, distance traveled, and orientation of the camera.
- Cinematography planning tools are available already as examples.
- For minimal viable execution, SCUTTLE can imitate a hardware track currently on the market.





1.14 HIGH-VALUE VENDING MACHINE

Problem:

- Manufacturing plants are many acres in size, and machinists must drive golf carts to a tools crib to check out expensive components.
- Other spaces like hospitals also carry vending units that require security.
- Automated tool cribs, which already exist, add security and efficiency to the tool check-out process.

Solution:

- To make the process more efficient, we can combine the tool crib with autonomous driving to deliver parts based on an order, or a scanned RFID



Example Mill Bits
Vending Machine

Example Medicine Vending
Unit (Grainger)



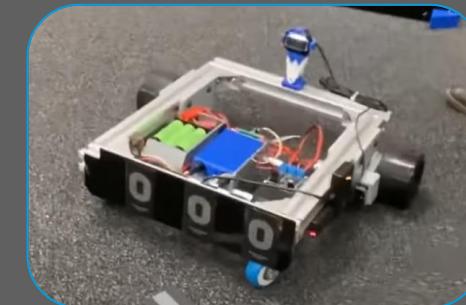
1.15 CHARGING STATION

Problem:

- SCUTTLE has limited runtime unless it can autonomously charge.

Solution:

- Utilize the charging system developed by NexTec Capstone team (2018) and enhance the software so that:
 - docking is fast and reliable
 - multiple robots can share the station
 - battery hardware is neat and easy to use.



Charging Station Design
& Demo Video



1.16 FIRST-AID ROBOT

Task:

- Deliver first aid materials throughout a facility

Why it's useful:

- Replace many cheap first-aid kits with one high-quality first aid kit with mobility.
- Workers no longer need to recall where the first aid kits are stored.
- Speech recognition can be used to indicate the desired item. Imagine “SCUTTLE pass me the scissors and gauze!”

Why it's feasible:

- This concept can add value even with minimal engineering. Simply attach a fully stocked first-aid bin to the robot chassis.



SECTION 2: SOFTWARE PROJECTS

Projects that do not require additional actuators

2.1 ENVIRONMENTAL MAP MAKER

Task:

- Use only the onboard navigation sensors (LIDAR and SONAR)
- Create a map of a room using LIDAR. Implement a remote-control driving and send a command to switch to automatic mode for exploring the room.

Why it's useful:

- many facilities (educational, industrial, personal) need updated maps
- robotic execution can discover changes from blueprints or furniture
- use SCUTTLE when there's a gas leak or other dangerous conditions, instead of a person.

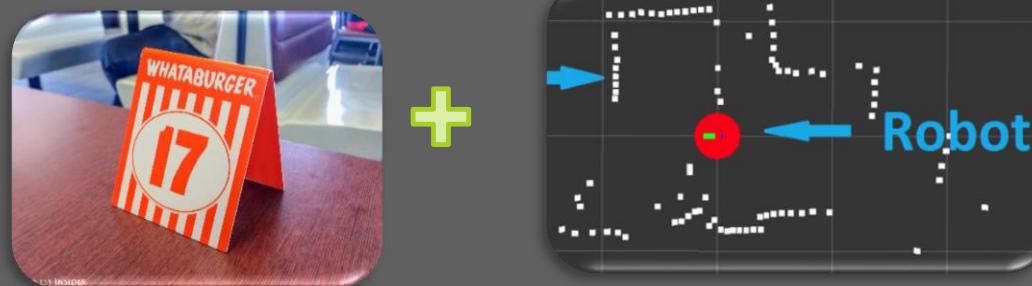
Why it's feasible:

- You can use existing libraries for mapping and integration of low cost or high-fidelity LIDARs.



2.2 VISUAL TARGET DISCOVERY

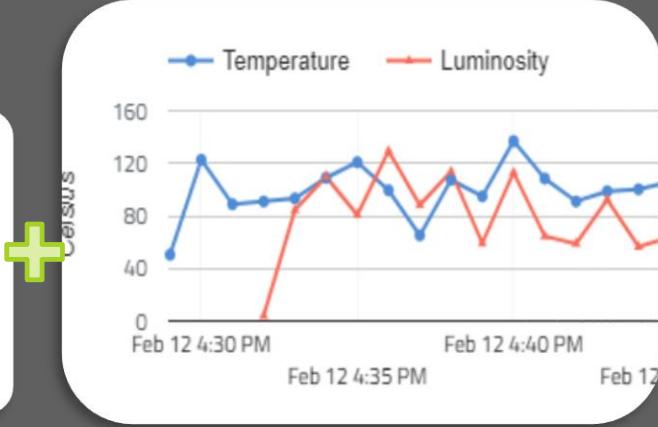
Locate a visual target using machine vision. Collect data about the location of that object and report the data wirelessly.





2.3 RFID & SENSOR PAIRING

Scan multiple RFID tags and report environmental readings to the IOT for each location.



2.4 PAYLOAD IOT WEIGHING SYSTEM

Locate the weight scale, measure the mass of the robot and exchange data with the scale as necessary to report the robot weight to the IOT





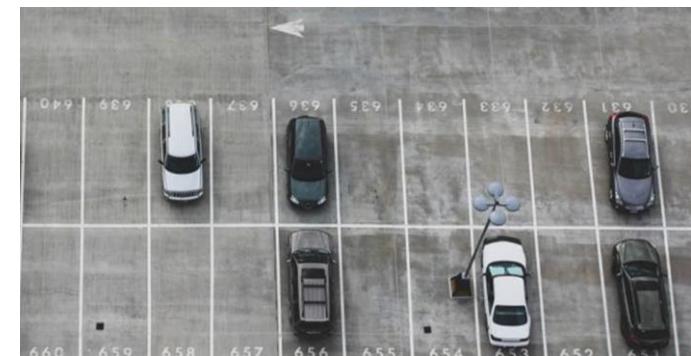
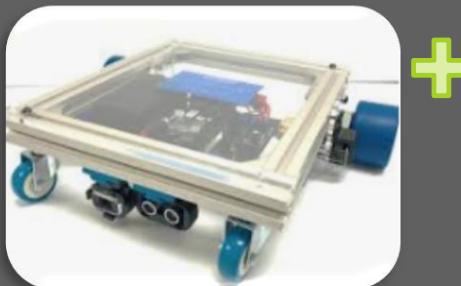
2.5 PARKING ENFORCEMENT

Parking enforcement such as “1-hour parking” is always a gamble because the checking routine is rarely standard.

It's bad for guests who need to gamble if they have an extra 5 minutes and it's bad for enforcers who struggle to keep fairness when they check spots

With no additional hardware, scuttle can be programmed to monitor important parking spots and indicate the status of all spots via web.

During Emergencies, SCUTTLE could even notify officials of empty spots when there is construction or obstructions in fire lanes, etc. This added value can offset the cost of adding robotics to small parking areas where scuttle must lap every 15 minutes or so.



2.6 3D IMAGE CAPTURE (3D SCAN)

Task:

- SCUTTLE can use its precise wheel odometry and internal calculations to drive in a perfect circle around a subject. With a simple bracket, the camera can be mounted at an ideal height.

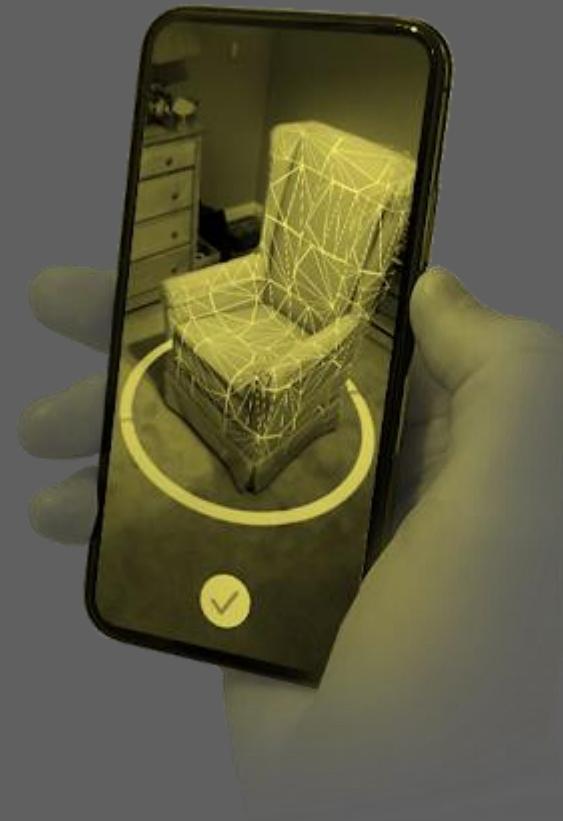
Why it's Useful:

- Capturing 3D images of things outdoors is difficult and poorly executed with current solutions (namely, mobile apps). Several mobile apps render 3D models by circling a subject and taking photos at several angles.
- As for handheld capture systems, the results are limited by the photographer's ability to hold the camera.
- Examples of specific use cases:
 - by insurance companies to evaluate vehicle damage.
 - Make 3D models of your self for a formal dress fitment.
 - Request a quote to have a tree trimmed

Why it's feasible:

Simply using a 2-DOF camera holder, we can orient the camera:

- At a constant height
- Perfectly normal to the centerpoint of the object
- At the proper angular interval requested by the app.





2.7 PARKING GARAGE OCCUPANCY

Task:

Displace the hundreds of occupancy sensors in a large parking garage with SCUTTLEs. Program SCUTTLE to cruise past an array of parking sensors and communicate (over IoT) the status of all of the parking spots.

- How many spots are open?
- Where is the closest open spot?
- How long have spots been occupied?
- Is there an empty spot for extended periods? Maybe there is a shopping cart preventing cars from parking.

Why it's useful:

- Replace expensive infrastructure of conduit, cables, and hundreds of sensors to save cost.
- Allow the system to be adjusted for construction, or changes of designated parking spots simply in software instead of rebuilding hardware.

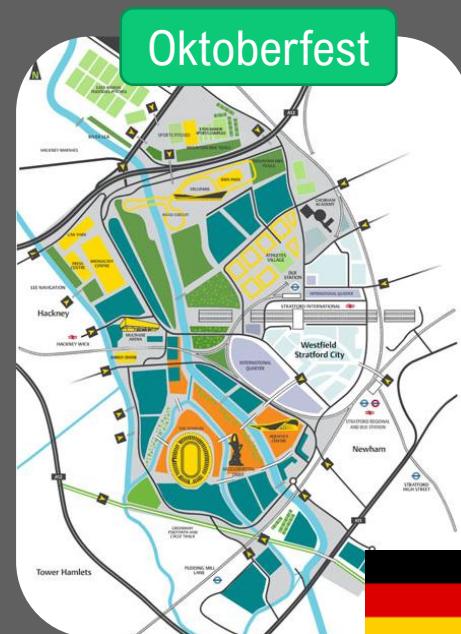


2.8 EVENT GUIDANCE

Problem:

- Everyday navigation is readily handled by mobile phones and google maps, but special events have custom destinations and closed routes.

Solution:



A detailed map of the Oktoberfest site in London, showing the festival grounds, surrounding streets, and landmarks. A green callout box labeled "Oktoberfest" points to the festival area.



A map of Recife, Brazil during Carnaval, showing the coastline and festival locations. A green callout box labeled "Carnaval" points to the festival area. The map includes labels for "SANTO ANTÔNIO" and "BAIRRO DO RECIFE". A Brazilian flag is in the bottom right corner.

- SCUTTLE guides people in festivals and events where temporary structures are in place and google maps has no data.
- County Fair
- Major concerts
- Olympic games
- Oktoberfest, Carnaval

[Applications Guide] © SCUTTLE Robotics LLC

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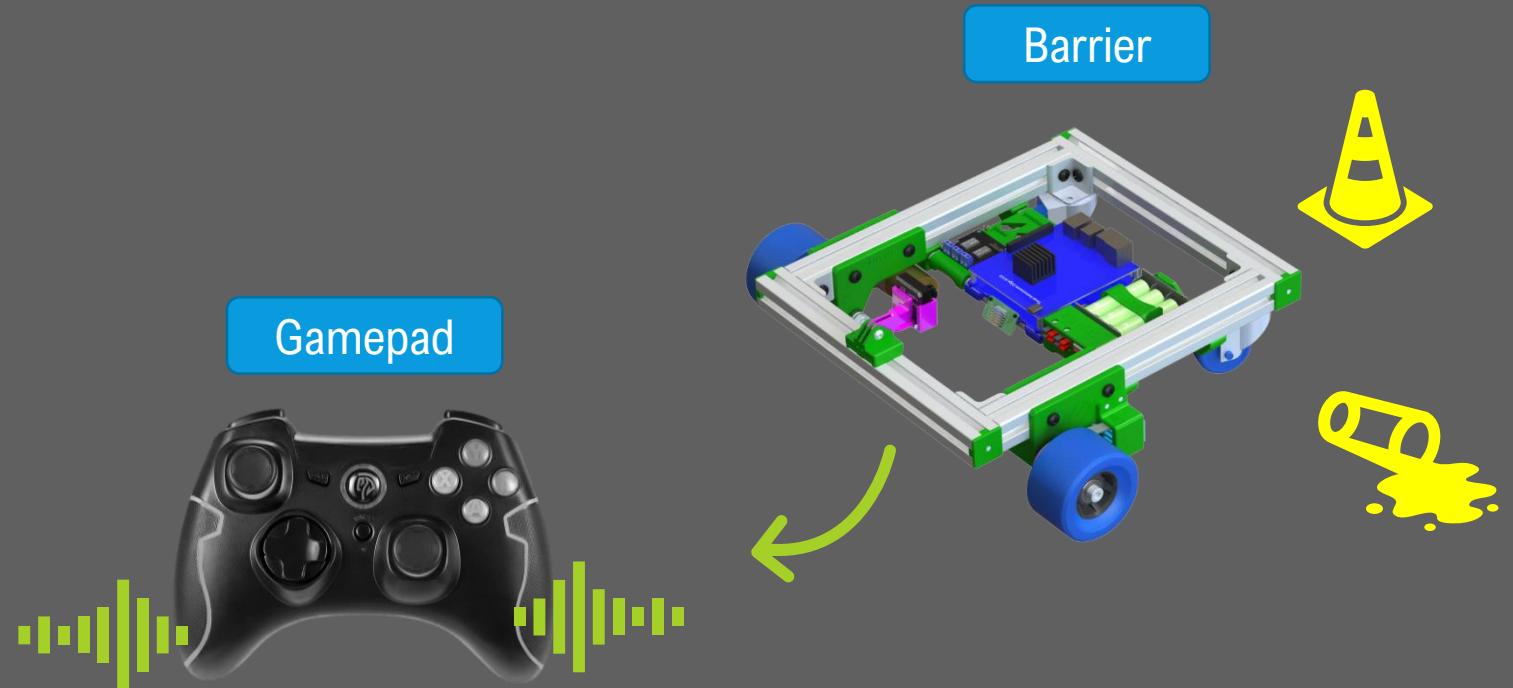
2.9 TACTILE FEEDBACK

Problem:

- Robot drivers need to know if there is an obstacle that SCUTTLE encounters.

Solution:

- Sense obstacles and inform the user via tactile feedback.
- Use a lidar and a “safety bubble” radius, or a distance sensor pointed down to detect edges.



PROJECT TOPICS: FEATURE BASED

These projects add a feature, instead of a full behavior routine



3.1 COMPREHENSIVE TELEMETRY (SELF)

- Design a data structure to hold all major parameters of scuttles
- Design a data structure to carry these parameters for multiple scuttles in a fleet.
- Create a modular NodeRed dashboard with drag-and-drop functionality for new teams to gain awareness of their critical parameters while testing other tasks.





3.2 HOLOGRAPHIC DISPLAY

- Mount and integrate a hologram LED wand.
- Use the wand to display important metrics to users.





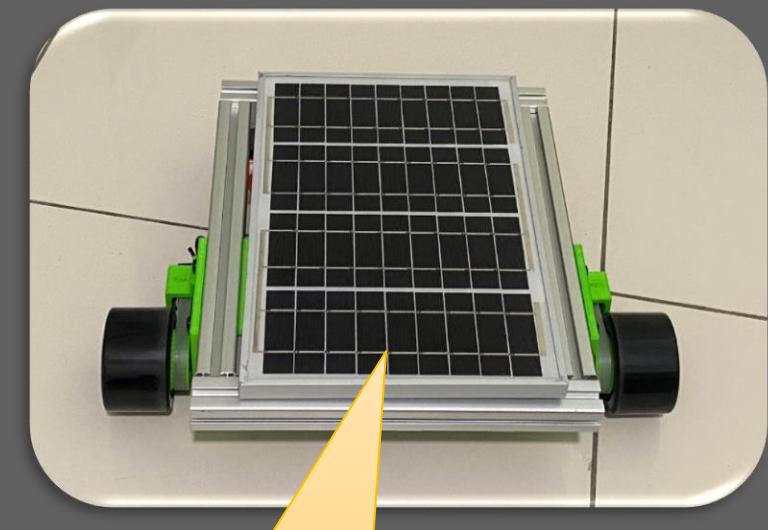
3.3 BATTERY CHARGING SYSTEM

- Option A: Wireless Charging
 - Create a station which is child-safe by adding wireless charging to a dock where SCUTTLE navigates to receive a recharge.
- Option B: Battery changeout station
 - Add more automation to the station itself and allow SCUTTLE's battery to be removed and subsequently replaced.
 - Design a modified battery pack which lends itself to quick recharge.



3.4 SOLAR CHARGING SYSTEM

- Operating as low as 7 watts, the SCUTTLE is a candidate for 100% solar sustainability.
- Make SCUTTLE a long-term outdoor rover by designing a system to recharge the batteries by day and to “sleep” at night.
- If the solar module capacity is increased, it is possible to drive 24 hours per day while charging only for 10



10 Watt Solar Panel
only \$11.50 USD as
of 2020 October

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SECTION 4

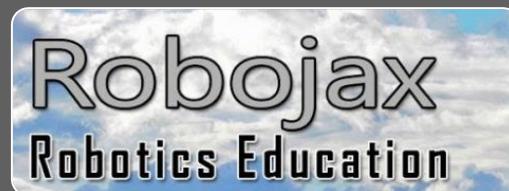
RECOMMENDED REFERENCES

Great Places to Discover Ideas & Designs

4.1 YOUTUBE EDUCATORS

- These exceptional youtubers
 - Frequently share free designs
 - Explain concepts and build simultaneously
 - Generate creative & inspiring projects

Best Array of Components



University Grade Lab



Best Mechanical Knowledge



Best Breadth of Applications

THE
ENGINEERING
MINDSET .COM



Best Documentation



Most Advanced Robots



Best Cinematography





4.2 HARDWARE ENVIRONMENTS

- Standard Photography hardware gives interchangeability with
- Moreover, we want to highlight hardware that is Affordable, Available, and Off-the-shelf in this section to enable users to explore customizations.



SCUTTLE Models Library

4.2.1 Photography Hardware



Quick Release \$16 [\[amazon\]](#)



Field Monitor Holder \$25 [\[amazon\]](#)



1KG Double Ball Swivel \$9 [\[amazon\]](#)



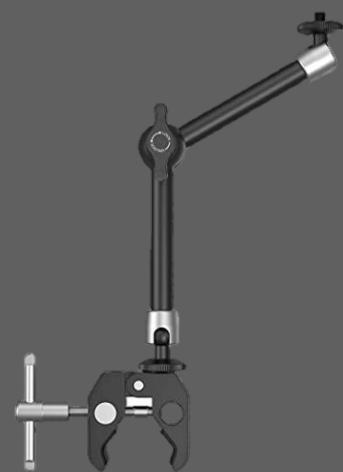
Ball Head 360 \$17 [\[amazon\]](#)

4.2 HARDWARE ENVIRONMENTS

4.2.1 Continued:



Tripod adapter 4-pack [AMAZON](#)



Articulating Arm [AMAZON](#)

Applications Guide
SECTION 5

APPLICATIONS FOR ADDONS

Great Places to Discover Ideas & Designs

USE CASES: ELEVATED TOWER



These kinds of projects will benefit from a robust & easy DIY elevated platform.

- Scan RFID tags at a rack instead of the floor.



LINK to DESIGN

- ▶ Press Elevator buttons



- ▶ Serve Drinks

