SCUTTLE APPLICATIONS GUIDE

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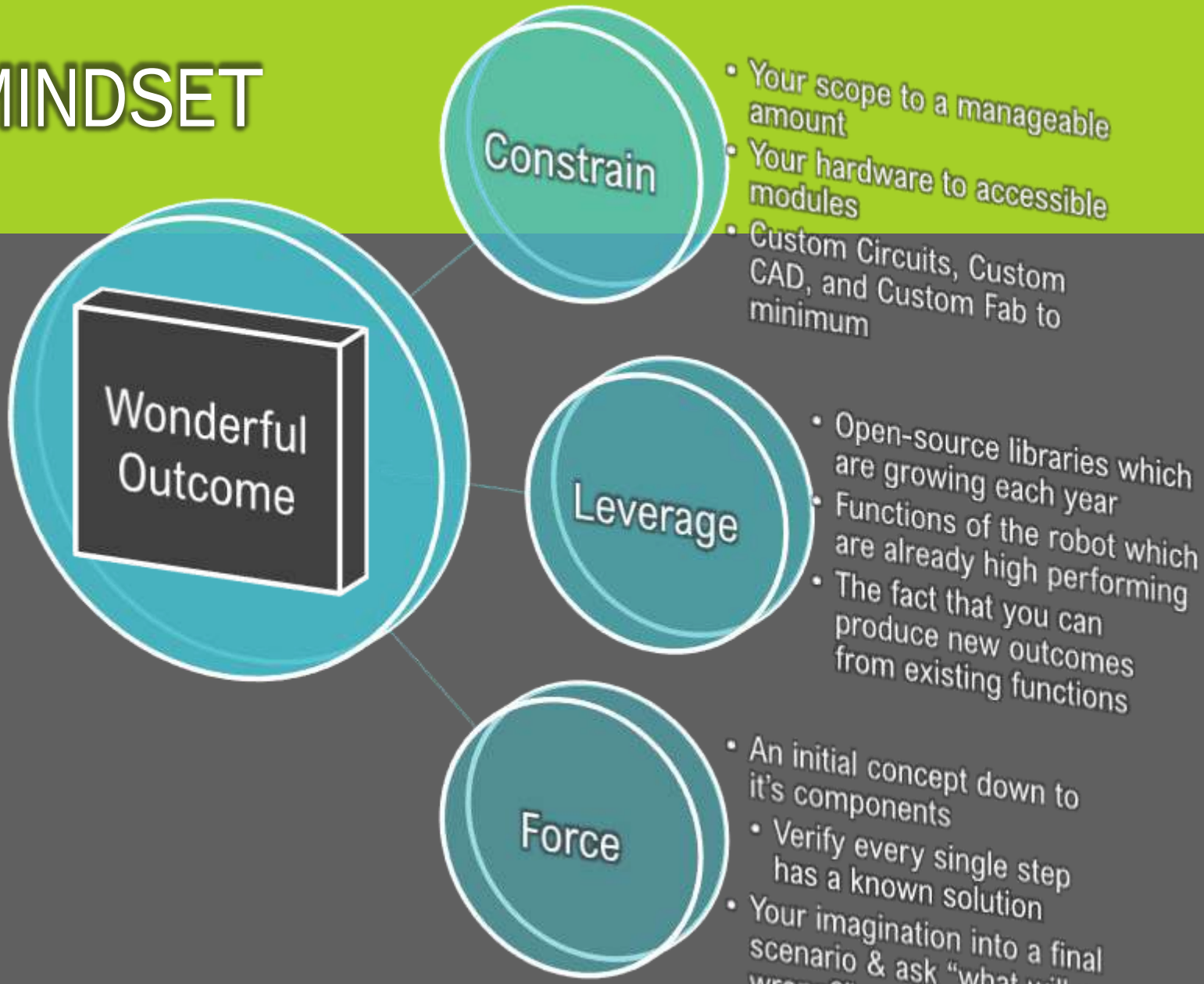
Ever-growing list of easy-to-approach project ideas.

We want your ideas! (not kidding). Submit yours to info@scuttlerobot.org and we will publish for the world.

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.



Applications Guide
SECTION 1

PROJECT TOPICS: HARDWARE BASED

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?

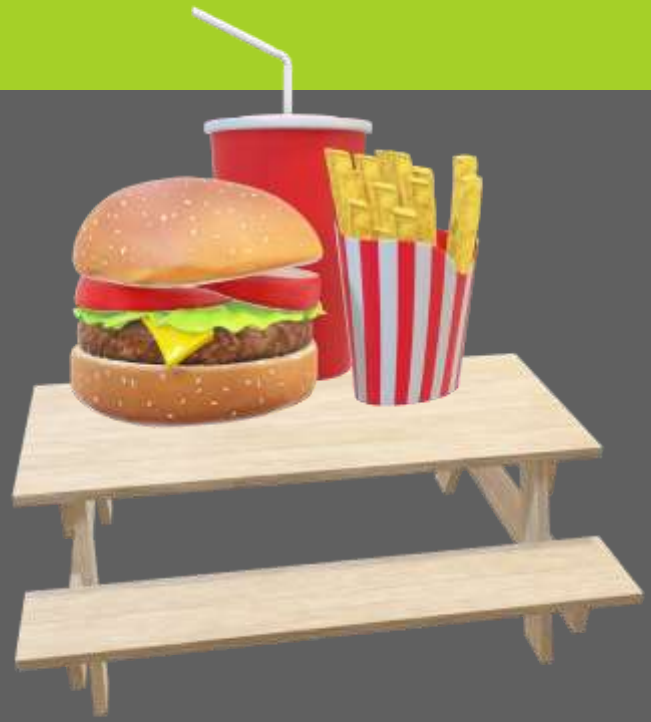
Why it is feasible: SCUTTLE has already shown ability to carry a full size water jug and more. 12v pumps are readily available and powerful enough to lift water at a reasonable rate.

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 it's 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

Problem:

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

Solution:

- Cruise around the court
- Detect balls by color & shape
- Collect them in a basket
- Bring to a designated spot & dump

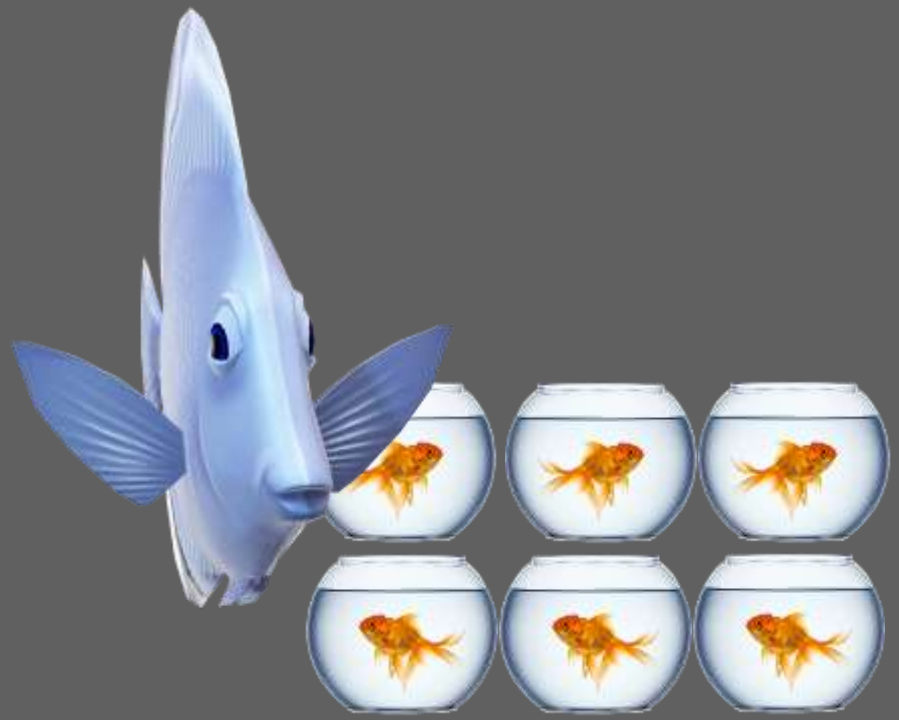
1.8 PET STORE MONITORING

Problem:

- 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

Solution:

- Look after the pet store on holidays to give alerts
- For Dogs: detect barking in kennels
- For Fish: detect dead fish, or sample water
  - pH
  - Temp
  - Salinity
  - Etc
- For birds, reptiles, etc
  - Customize programs for irregular behavior
    - Sounds
    - Violent motion (movement rate)
    - Lack of motion or escape



1.9 HAZARD REPORTING

Problem:

- 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.

Solution:

- Use Lidar to detect hazards to humans in the pathway
  - Cracks in the sidewalk
  - 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.

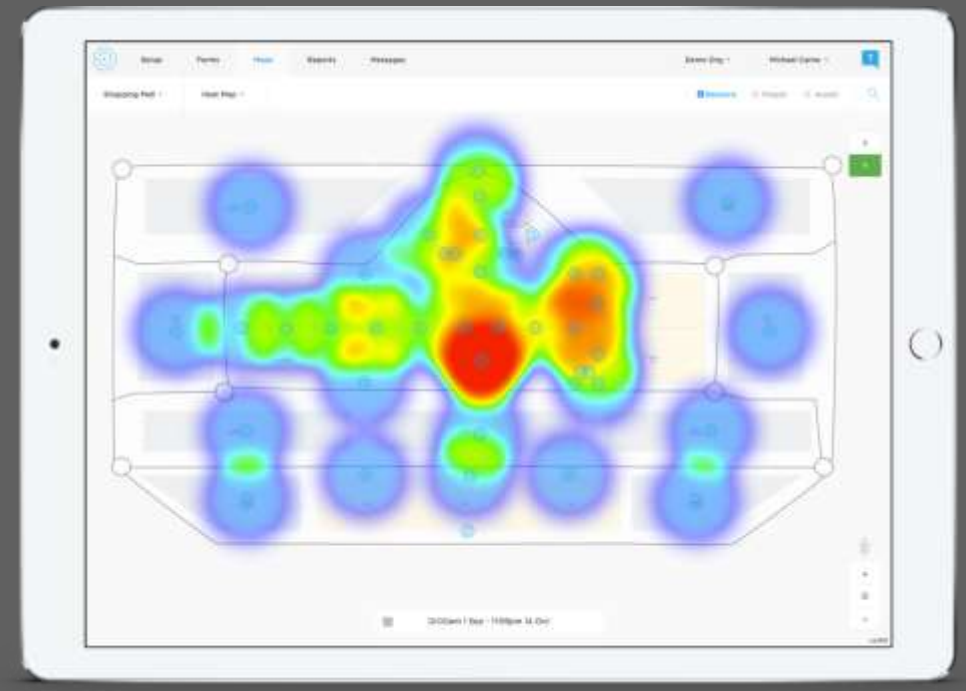
1.10 THERMAL FACILITY AUDIT

Problem:

- 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.

Solution:

- 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)



1.11 FIRE FIGHTING BOT

Problem:

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

Solution:

- Employ a simple 2DOF arm for aiming an extinguishing nozzle.
- Payload: secure 1 or more fire extinguishers
- Optional: use thermal imaging to detect fires.

Example Extinguisher Product (amazon)

1.12 CAMPUS SECURITY ESCORT

- 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.
- SCUTTLE can be equipped with emergency call functions, pathway lights for added safety or an extremely loud siren at the press of a button.
  - Reliable 4G cellular modules are available off-the shelf to give redundant connectivity when wifi may be interrupted.

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1.13 PROFESSIONAL POV PANORAMICS

Problem:

- 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

Solution:

- For taking pictures of malls, churches, riverside properties, etc. it is beneficial to take a new kind of panoramic.
- 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
- Also consider property planning for schools, bus stops, train stations, etc.

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)

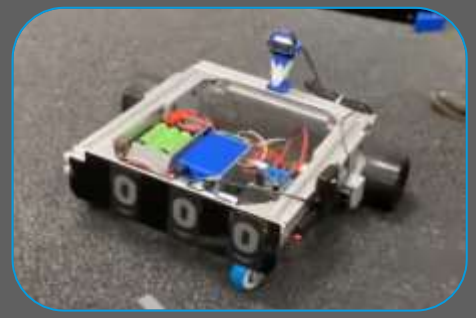
1.15 CHARGING STATION

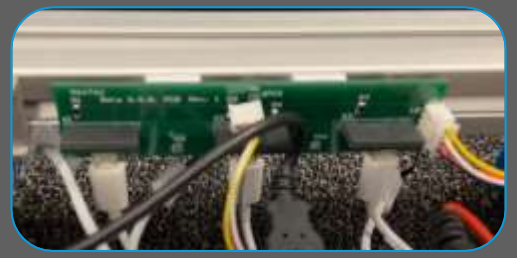
Problem:

- 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

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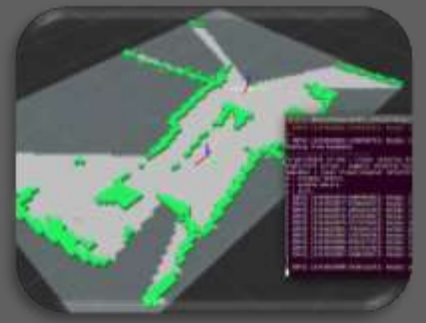
SECTION 2

PROJECT TOPICS: SOFTWARE BASED

Projects that do not require additional actuators

2.1 ENVIRONMENTAL MAP MAKER

- 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.

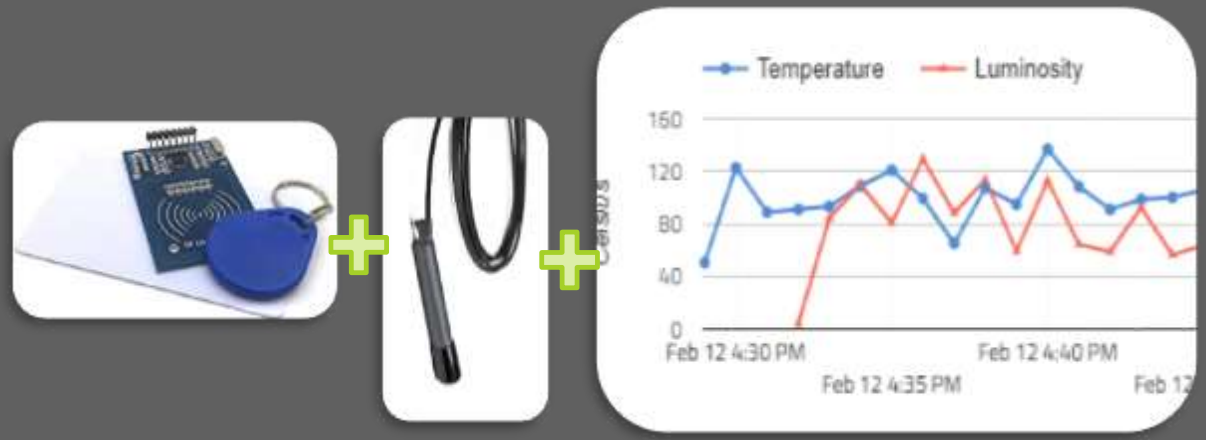


2.2 VISUAL TARGET DISCOVERY

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

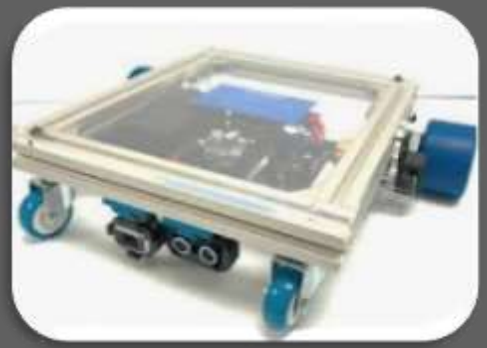
2.3 RFID & SENSOR PAIRING

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



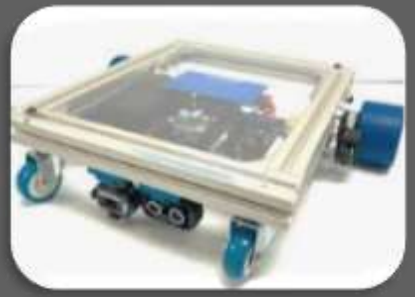
2.5 PARKING ENFORCEMENT

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)

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.

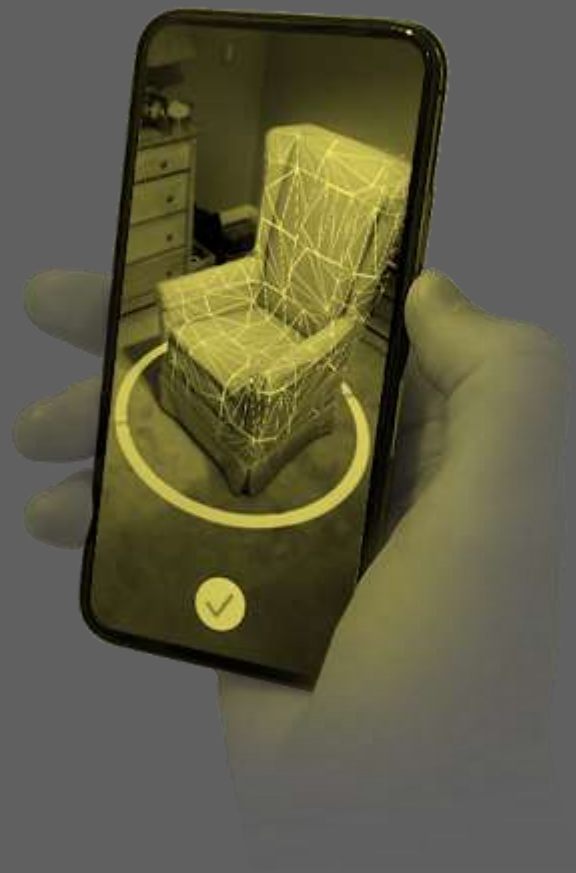
The results of existing 3D capture systems are limited by the photographer's ability to hold the camera:

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

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

Use: this technology could be used:

- 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



2.7 PARKING GARAGE OCCUPANCY

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.

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:

- 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

Carnaval

Oktoberfest

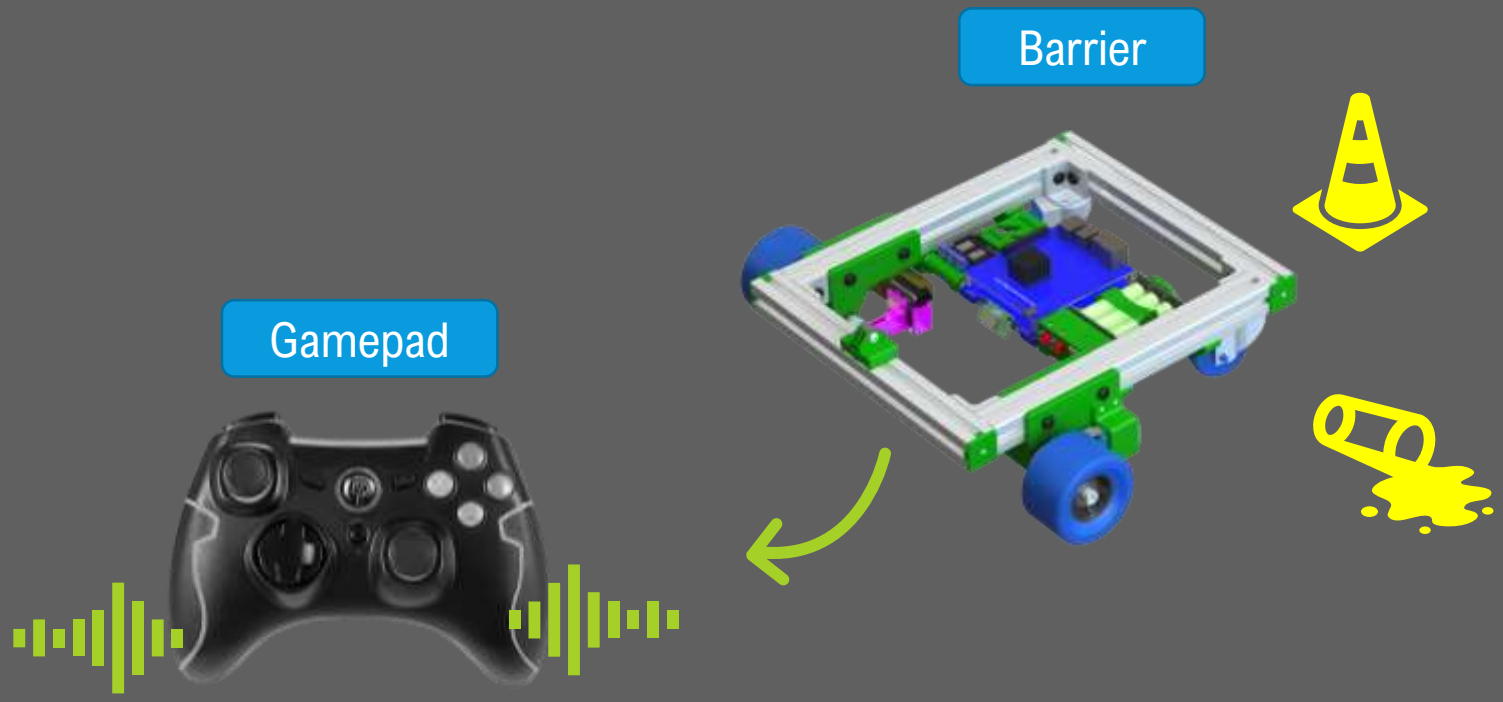
2.9 TACTILE FEEDBACK

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.



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SECTION 3

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.

Submit your ideas to scuttleProject@gmail.com

3.2 HOLOGRAPHIC DISPLAY

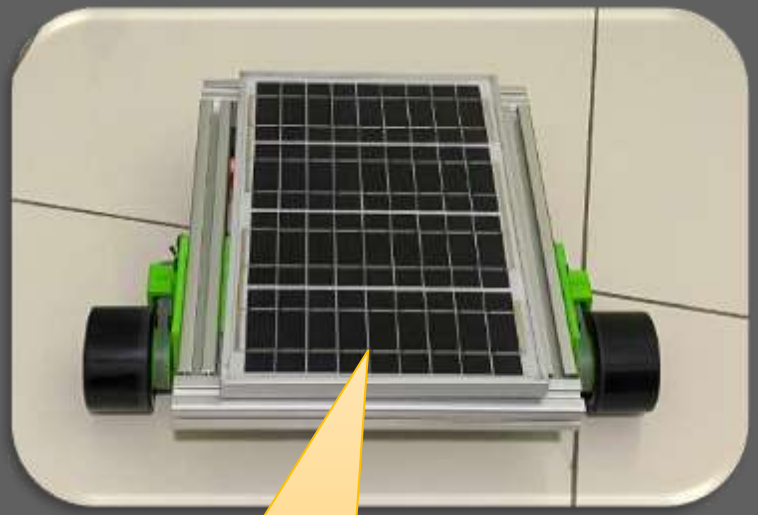
- Mount and integrate a hologram LED wand.
- Use the wand to display important metrics to users.

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

Best Documentation

University Grade Lab

Most Advanced Robots

Best Mechanical Knowledge

Best Cinematography

4.2 HARDWARE ENVIRONMENTS

- SCUTTLE offers ever-expanding CAD library of DIY components (and we want your contributions!)
- 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]