Clyde:
A User's Guide.

A step-by-step guide on how to use your new desk-cleaning robot.

Cloud 9

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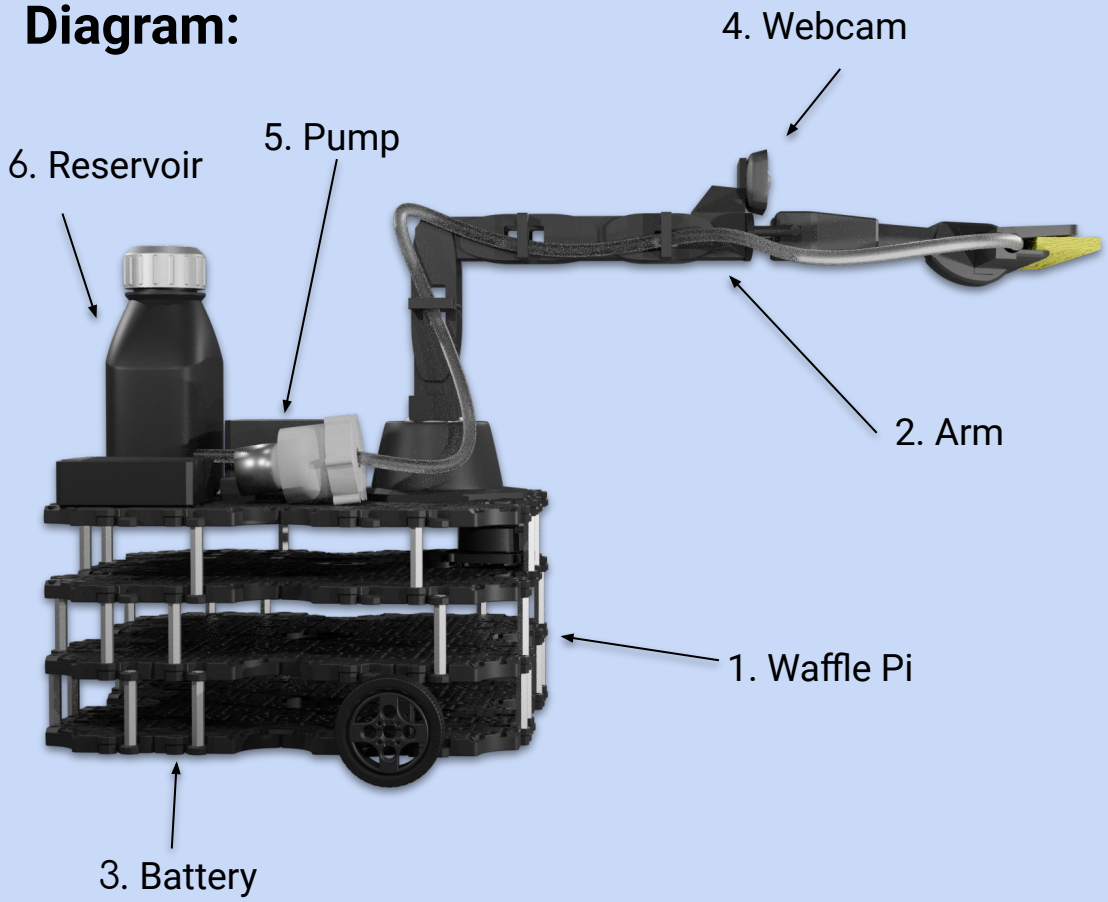
Overview and hardware

Clyde *(**Cl**eaning **Y**our **De**sk)* is an autonomous robot that is designed to help clean desks and tables in high-traffic indoor spaces. It is there to enhance cleaners' capabilities, and ease their workload in a safe and effective manner.

Diagram:



Components:

1. **Waffle Pi Turtlebot**:
   This is the base and core of the robot, providing essential functionality like locomotion, and sensors. It is also home to a Raspberry Pi, ClyDe's "brain".
2. **Pincher x100 Robot arm with cleaning tool**:
   The *Pincher x100* is a versatile arm. Through it the robot performs it's essential cleaning function. At the tip of the arm is our specially-designed cleaning tool, that takes in disinfectant that is pumped up via tubes on the arm.
3. **Battery:**
   The *Zeee 11.1V 8000maH Lipo Battery* is high-capacity, and allows the robot to operate for several hours before needing to charge.
4. **Webcam:**
   The *C270 Logitech USB Webcam* is powerful, yet lightweight enough to be carried on the robot arm. It provides high-resolution pictures that are suitable for QR-code recognition.
5. **Pump:**
   The *6-12V R385 DC Diaphragm Pump* is a lightweight, small, low-volume pump with a lifetime of up to 2500 hours. It is used to pump the robot's disinfectant to the cleaning tool at the tip of the arm.
6. **Reservoir:**
   This contains the disinfectant liquid. Attached on the inside is a non-contact liquid sensor to monitor disinfectant levels.

Essential Information

Normal Operation:

Clyde has a designated area he operates in. After the setup described on page 6, Clyde will move between dirty desks and disinfect them. Desks are marked as dirty when visitors use the Clyde Companion app described on page 7.

Clyde controller:

Clyde comes with a controller that is the primary interface to the system. Through the controller you will see Clyde's battery level, sanitation liquid levels, location and any errors that arise. The controller comes with a power supply and an HDMI cable to connect it to a monitor. Find a permanent location for the controller that's convenient but not accessible to the public. The controller comes with all required software pre-installed. The software includes an interface program that monitors Clyde's current state.

Refilling sanitation liquid:

When sanitation liquid levels are low, Clyde will alert the controller. To refill it, unscrew the cap on the reservoir and refill with liquid to the line marked on the inside.

Turtlebot3 Manual:

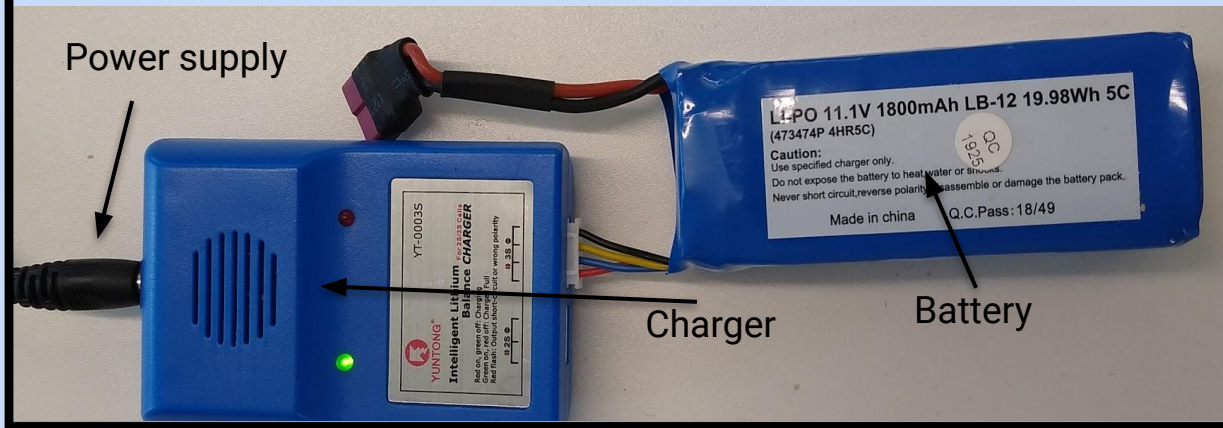
For a comprehensive description about the TurtleBot3 platform and how its core parts are connected, see
https://www.robotis.com/service/download.php?no=750

Charging Clyde

When the system is low on battery, it will return to its home pose and send an alert to the controller. Then, the battery needs to be disconnected from Clyde and connected to the charger and power supply. For detailed charging instructions, see section 2D of the Turtlebot3 manual.

Replacing cleaning sponge

ClyDe's sponges should be replaced each day. They can be washed and reused. ClyDe ships with multiple extra sponges, and more can be bought through our website if needed. Changing them is easy, simply undo the small clamps on either side of the cleaning tool, remove the sponge an insert a fresh one.



The Clyde Controller:

Library Staff

Welcome to Clyde!
This portion of the guide is meant for any library staff that will interact with Clyde.

Installation Guide:

Our technician will handle all set-up for Clyde, so you don't have to worry about it!

On arrival, a technician will be sent by Cloud 9 in order to set up the system. The technician will install a custom computer which can be used to control Clyde. Finally, they will set up the home point for Clyde to return to when an error occurs or once the day is finished, as well as map the library for Clyde to understand.

Operation Guide:

Starting Clyde is a simple four-step process!

1. Make sure the reservoir is full.
2. Make sure the battery is fully charged.
3. Make sure that Clyde is at his 'home' position.
4. Go on the Clyde Controller and click on 'restart clyde'.

With this, Clyde will actively move to any desks marked through the app by visitors and clean them. To see how to fill the reservoir and charge the battery, go to Essential Information.

Constraints

There are notable constraints in the way Clyde can be used, most of them regarding the environment around him. Here are some restrictions on the mapped area that Clyde will work in:

1. Clyde is not capable of passing through doors, and so the area cannot contain any doors. The only exception to this are doors which are guaranteed to be permanently open.
2. Clyde cannot traverse up or down stairs, and so the mapped area cannot have stairs of any kind.
3. Clyde is not programmed to interact with elevators. No elevators can be included in the mapping.
4. Clyde will not clean desks with any objects on them.

In order to interact with Clyde through the Clyde Controller, both devices need to be connected to local WiFi in order to communicate. If this WiFi goes down, Clyde will stop the cleaning procedure and thus needs to be taken back to the home position and restarted.

Technicians

Set up your Clyde!
This portion of the guide is meant for trained technicians. It walks you through setting up Clyde's WiFi, mapping the area, marking desks and making QR codes.

Mapping with Clyde:

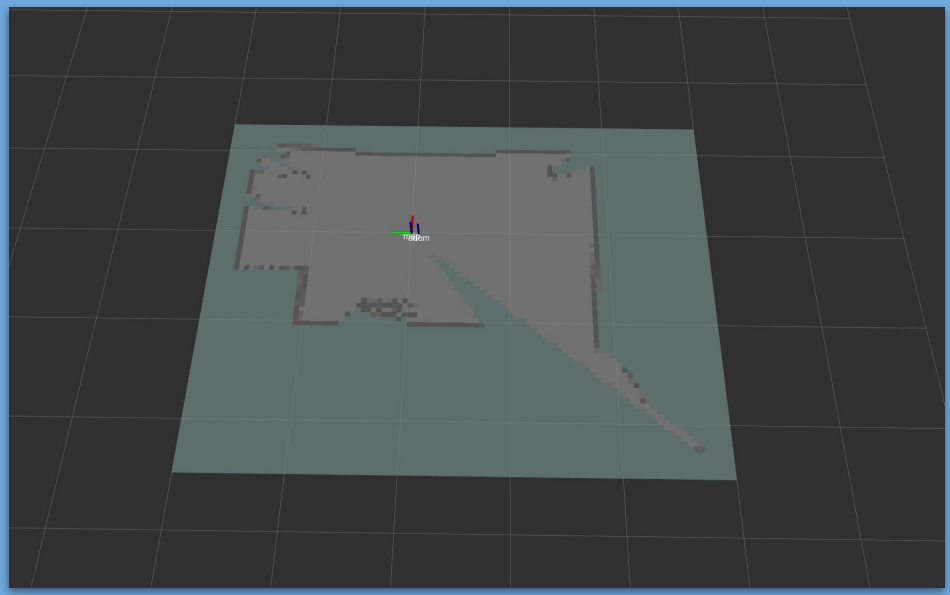
See our tutorial video for more information:
https://youtu.be/JvrAZXzs0NY.

1. Make sure you are performing mapping at a time with low traffic.
2. Connect mouse, keyboard and a monitor to the Controller
3. Place Clyde where it will be charging, facing straight out from the wall. This is the robot's 'home'.
4. Open *Clyde.exe* located on the desktop, and press 'setup'
5. This opens a terminal within Clyde, as well as several windows in the Controller.
    a. RVIZ: displays the map and where the robot thinks it is within it.
    b. Teleop: this terminal is used to control the robot. Familiarize yourself with the controls on a trial run. Make sure you do not drive too quickly or into walls.
    c. QR Code GUI: This window will walk you through the setup process and how to register desks for cleaning. It will also generate QR codes for later use. When noting down tables, make sure to face the table head-on, about 20 cm from it.
6. After noting down all tables, finish mapping the space. The map will be saved and the process is complete. Take the robot back to its base pose.

Setting up WiFi:

1. Connect Clyde's HDMI to a monitor and a keyboard and mouse to it's USB ports.
2. Make sure Clyde is charging or has a charged battery, so it will be tuned on.
3. Log into the system with username and password "ubuntu". Consult the client for password change.
4. Acquire the location's WiFi SSID and password.
5. In Clyde's home folder, run "python3 wifi_setup.py [SSID] [PASSWORD]".
6. Note down the system's IP, which will be printed by the process. Press enter to reboot.
7. In the Controller, plug in devices and monitor.
8. Log in with the same information as step 3. Change this password as well.
9. Connect to the same WiFi using Ubuntu's GUI.

The map below is an example of the cartographer output during the mapping process:

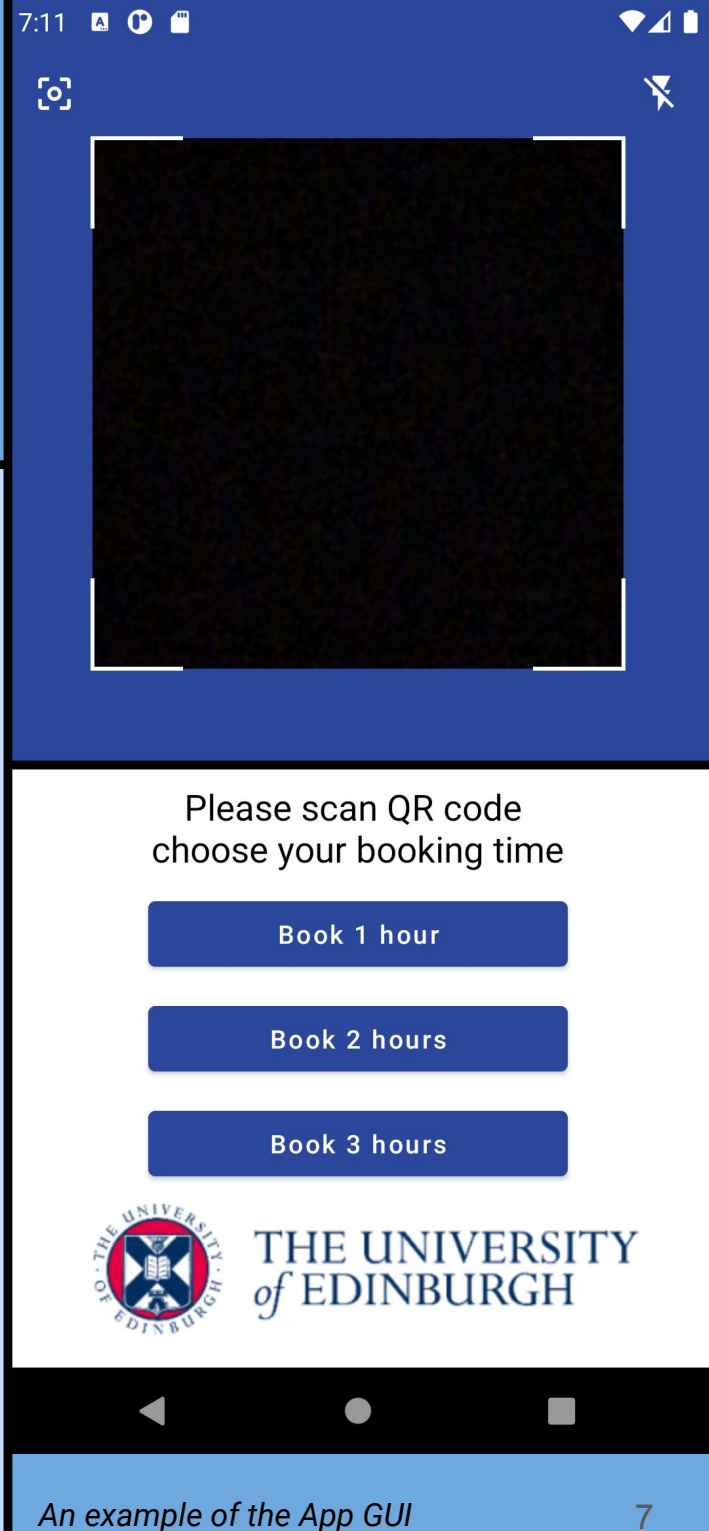


Companion App

Grab a Desk!
The CLYDE app is currently available on any Android phone from the Google Play Store. If you don't have an android phone go to reception and the librarian will help you check in to a desk.

How to find a clean desk with CLYDE at your local library:

a. Find a table in a nice location, and make sure it has a QR code on it!
b. Click on the app and enter the log-on screen, where the logo is attached to the page along with a button which reads "Request". Clicking on this button, will direct you to the QR code scanning interface.
c. When initially opening the QR Code scanning interface, the app will ask for the approval for using the camera on the user's phone. The interface shows "Please scan QR code on desk" as an instruction. Below the instructions there will be two buttons. One is "CHECK IN", the other is "CHECK OUT". The interface will contain a square image which shows the camera live feed. Give the app permission to use the camera in order to perform OR code scanning and Scan the QR code. If the app alerts you that the desk has yet to be cleaned after the last visitor, you should try to find another desk, as CLYDE is on his way to clean that one.
d. When your time slot has expired, simply scan the QR code again and CLYDE will be notified
e. You can exit the app in any of the previous steps. There will be no blocking during the whole process.



An example of the App GUI

Troubleshooting

Is Clyde not working as intended?

We're sorry! This portion of the guide will go over possible issues that may arise and how to resolve them. If your problem with ClyDe remains after checking this section, contact us so we can help resolve it!

Clyde tries his best, but sometimes he needs a helping hand!

There are a few scenarios in which you may need to intervene to help Clyde re-orient himself:

Clyde appears to be stuck!

If Clyde appears to be stuck and will not move due to unforeseen obstacles, simply take Clyde back to his home point. An error should appear on the Clyde Controller requesting for Clyde to be brought home. Then restart him by clicking the "Restart" button in the controller.

Clyde has ran out of battery!

Clyde should return to his 'home' point when he is low on power, but if he is stranded without power, simply bring him back to his home point and charge the battery. See the Essential Information for information on how to charge the battery. A warning should appear on the Clyde Controller when the battery is low.

Clyde has ran out of cleaning liquid!

If Clyde runs out of cleaning liquid, he will return to his home point and a message will be sent to the Clyde Controller requesting the reservoir to be refilled. Simply refill the reservoir as described in Essential Information.

Clyde is disoriented.

Sometimes due to unforeseen circumstances or sensor inputs, clyde can get disorientated. This can be seen by looking at the controller, and seeing that the displayed map, or Clyde's location within it looks wrong. This could be that Clyde's map marker is outside the map, or parts of the map are displayed wrong. Then, Clyde will likely drive in unplanned patterns. In this case take Clyde back to his home point and press the "Restart" button.

Clyde has disinfectant, but nothing is pumped out.

Inspect the liquid tube for any blockers, then detach it using the clamps on the pump and the cleaning tool. Then rinse the tube thougly to remove any blockers. If the problem persists, contact the help centre below.

Contact us!

Still having issues that can't be resolved by this section?
Email us with your problem at: help@cloud9.com.

Do you have feedback or anything else you want to tell us?
Email us with your feedback at: CLYDE@cloud9.com.

Website: https://sdp-09.github.io

Appendix A

Useful links

TurtleBot 3 Waffle Pi Manual	https://www.robotis.com/service/download.php?no=750
Cloud 9 Website	https://sdp-09.github.io/
Cloud 9 Youtube Channel	https://www.youtube.com/channel/UCDa9Jg4bbeeU-FVQ-Rw28ow
ROS2 design document	https://design.ros2.org/
Pincher x100 information	https://www.trossenrobotics.com/pincherx-100-robot-arm.aspx

Appendix B

Reinstalling ClyDe's code(For technicians)

If CLyDe's core ROS2 packages ever need to be reinstalled, please follow these steps.

1. When starting the the CLYDE controller, press "Setup" to open a terminal within ClyDe itself.
2. In the terminal, type "cd dev_ws/src".
3. Delete the ClyDe package by typing "rm -rf ./cloud9_tb.
4. Now, type "git clone https://github.com/SDP-09/cloud9_tb.git".
5. Type "sudo colcon build", using the specific ClyDe's password(decided in setup phase).
6. ClyDe's code has been reinstalled, and can proceed as normal.