USER GUIDE

ROBOGARDENER

Hi!

Congratulations on your new RoboGardener purchase!
RoboGardener is a high-tech, fully-automated pinecone collecting
robot with accompanying base station and boundary wire.
After setting up your new piece of garden robotic gear, you'll never
have to bend down to pick up pinecones ever again!

RoboGardener works by using advanced image recognition technology
to traverse your garden, seeking out pinecones and rolling them up into
its large collection bay using our clever passive collection mechanism spikes.

By bouncing off of the user-installed boundary wire, the robot will only ever collect
these annoying pieces of garden debris within the desired perimeter of your garden.

In addition to this, RoboGardener's 6 rugged, all-terrain wheels can handle
landscapes of all manner of shapes and sizes, and the in-built 22,000mAh lithium
battery ensures the robot can provide full coverage of your garden and then some!

When the battery is low, RoboGardener autonomously goes back to its base
station, neatly drops off all of its pinecones for removal at your convenience and
recharges for its next mission.

Better yet, all of this functionality is available through our custom web app – so you
can schedule and trigger runs, get stats about your RoboGardener and more – all
from your phone, tablet or laptop.

Great for keeping your
garden debris-free,
always.

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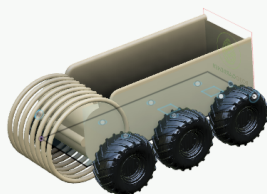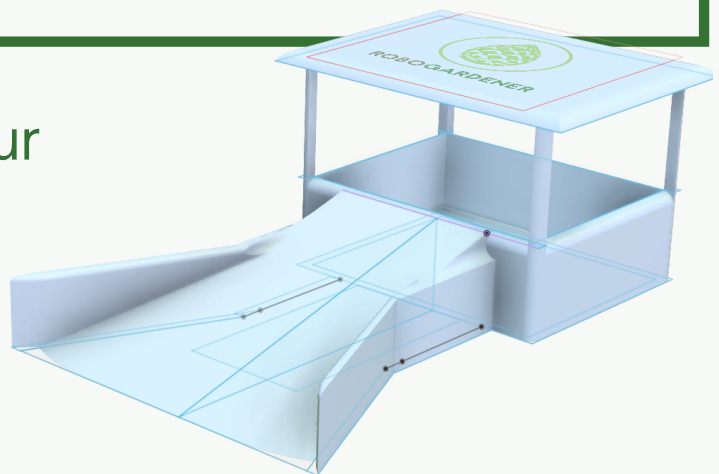
Components Overview

RoboGardener robot

The crux of the system, the RoboGardener robot includes 6 motorised wheels with **rugged tires**, a hard plastic body with a **hinged front door**.

The **collection bay** of the robot articulates up using a solenoid to empty the pinecones into the base station, and it includes draining holes for any water or mulch that may accumulate in the robot.

At the front of the robot there is a cylindrical bar that features a Raspberry Pi **computer with camera module** – forming the basis of our computer vision system and motor control electronics.

Across the footprint of the bottom of the robot there is the **inbuilt battery** that is recharged via the metal contacts on the bottom of the robot. These contacts are covered in a plastic sheaf that is only exposed when it rides up the base station.

The robot is over 15cm off of the ground to allow pinecones to pass underneath it to be caught in the pinecone **collection mechanism** on the back of the robot.

Boundary wire

Used to stop the robot from exceeding your garden's perimeters, the subterranean boundary wire runs out of one side of the base station, around your garden and then into the other side – forming a loop.

This boundary wire is to be lightly buried in your garden as to not harm any of its aesthetics, and as is common with lawn mower robots.
The sensors inside the RoboGardener robot will detect whenever it is near the wire, and the internal control logic will steer it well clear.

RoboGardener base station
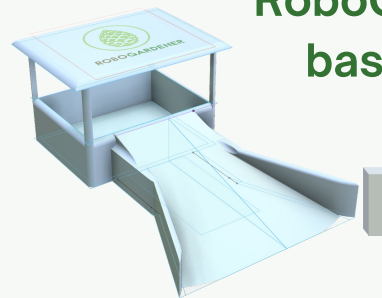
The base station is the home of the RoboGardener robot when it is not performing runs around the garden.

It features a large **storage depot area** – approximately x5 the size of the total capacity of the RoboGardener robot. This is so that when the robot returns to the base station, it can drop off its load of pinecones and return back to duty immediately.
This saves you, the user, from having to empty the robot every time – instead you can empty the base station as and when it gets full!

The base station also features a **funnelled ramp** and small **marker pole** in front of it, to allow the computer vision system on the robot to identify and safely mount the ramp.
Housed inside the ramp are the metal **charging contacts** previously explained.

Out of the back of the base station, the standard **power cable** is run to the nearest garden outdoor socket.

To be stationed near the house, inside the base station is a small **logic board** that receives wireless signals from the User Interface and communicates with the wireless RoboGardener robot.
This provides communication features such as remote monitoring of the battery status of the RoboGardener robot.

Power Cable

Sides are marked with letters for easy connection.
*(See the Setup on page 3 for more details)*

Interface Overview

The interface to the RoboGardener is provided through our **web app**. This has been designed to **work well on all platforms** – whether that is your mobile phone, tablet or laptop computer.

The user interface has many features, from a **secure log-in**, to **commencing a RoboGardener run** of the garden, to **scheduling** the robot to run at certain times and on certain days.

The application even includes **live statistics** such as the current battery level of the robot!

We have designed the UI with **accessibility at the forefront** – that's why you will see clear, contrasting colours and large button interfaces. We are very proud that our work is **WCAG 2.1 AAA compliant**.
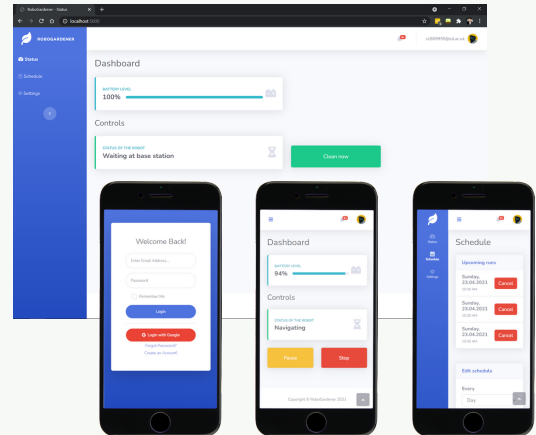
Setup

It's easy. Simply **Plug ang Play!**

1 **Connect to power.**

Position the base station near the house and connect to power.
One side of the power cable (marked A) to the back of the base station (port A), the other (marked B) to your home power supply.

2 **Place the boundary wire.**

Connect the boundary wire cable to the **port B** on the right side of the base station and unwind around the perimeter of the garden. Snip the cable when back at the base station and connect it to **port C** on the left hand side of the station.

3 **Install the marker pole.**

Install the small marker pole **to the right of the base station**.

4 **Place the robot.**

Place robot on the ramp with the **charging point connected** to the metal contacts underneath the robot. The front side with the logo should **face the storage depot** area. Press the **ON button** located at the side of the robot and it should turn on.

5 **Connect to a network.**

When the base station is powered on, the computer inside will be able to be connected to via bluetooth. Use your device. to connect with it and **share your WiFi details**. After this **one-time initial setu**p, the base station will connect to your WiFi network automatically.

6 **Configure the application.**

On your smartphone, go to robogardener.com and create a new account.
Click on **register a new device** and enter device id codes from the **card you received** in the box.
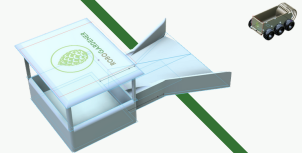
Important constraints

The area entailed by the boundary wire **cannot be greater than 2,000 sq m.**

The base station must be **connected to the internet**.

The robot can only work with the sunlight and **will not work at night**.

The path determined by the boundary wire must be **free of obstacles**.

RoboGardener can connect with **one account only**.

Cleaning process cannot start if **battery level is below 20%**.

Operating the app

The user interface at **robogardener.com** allows you to control your robot and all its functionalities. **Simply log in to the app and...**
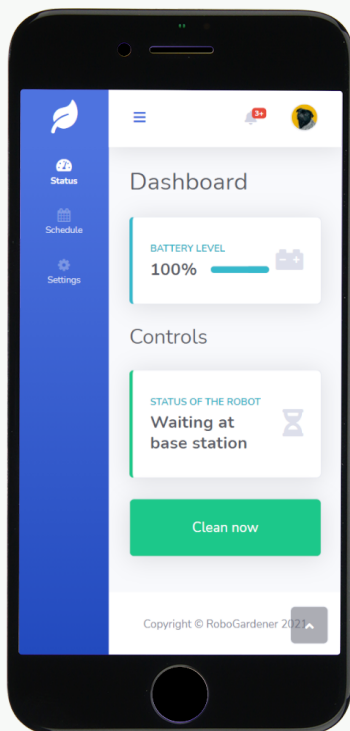

Figure 1

...start a run

The **Status page** *(Fig. 1)* is the first page you will see after logging in. This is your main control centre!

Click on the green **Clean now button** and the robot will start cleaning your garden.

You will see the status of the robot change and the battery charge level will start to decrease.

...control a run

If a cleaning run is **in progress** *(Fig. 2)*, you will see two control options.

Clicking the **yellow Pause button** will tell the robot to stop moving. Click on the **red Stop button** and the robot will to return back to base station.
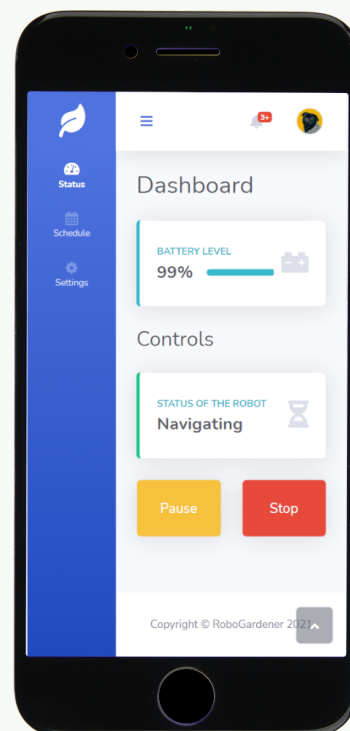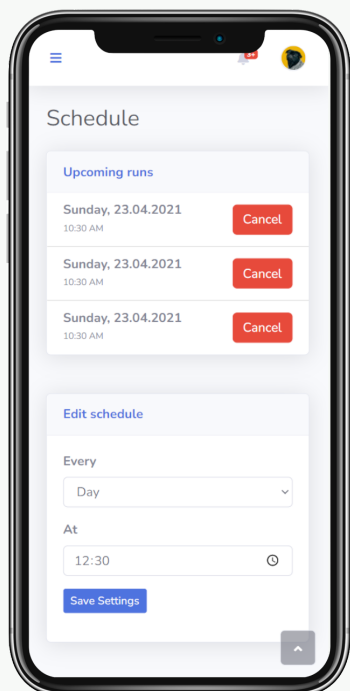

Figure 2

...schedule runs

Having control is cool! But instead of starting the runs manually each time, you can **let the app do it for you!**

In the menu on the left select the **Schedule** tab. (Fig. 3)

In the **Edit schedule** section select your desired frequency, e.g. every day at 12:30, and click on **Save settings**.

You will see your **Upcoming runs** at the top of the page and from now on, RoboGardner will clean your garden automatically.

Figure 3

...change settings

In the left menu select **Settings** tab.

Here *(Fig. 4)*, you may customise your account, i.e. **email** address, **timezone**, and even your profile **picture**!
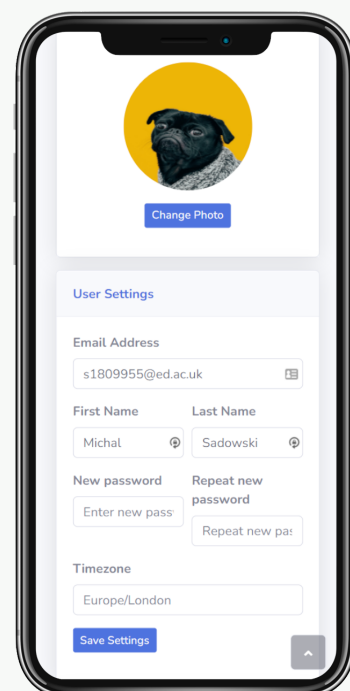

Figure 4

4

Maintenance

We do our best to provide you with a device of best quality. To avoid problems and **keep your robot gardening** you should take care of it.

Battery replacement

The robot will perform best if the maximum capacity of the battery doesn't fall below 80%.
We therefore recommend you **replace it every 2-3 years**. You can order a technician to come and help you **or do it yourself** by purchasing a replacement from our store.
To install a new battery, make sure the robot is not wet. Remove the bottom cover using any Phillips Head, unplug the old battery, install a new one, and reinstall the cover, making sure all the seals are in place. **That's it!**

Cleaning components

Before starting to clean, disconnect the base station from its power source and turn off the robot. Even though we designed the devices to be waterproof, we still recommend taking extra caution when, especially when using high pressure washers.

Troubleshooting

PROBLEM	LIKELY CAUSE	SOLUTION
App displays "Communication with the robot lost." or "Couldn't connect".	The base station has lost its connection with the internet.	Try reconnecting the base station. If the problem persists, strengthen the WiFi signal near the base station.
	The robot or the base station is turned off.	Make sure the base station is properly connected to power. and the robot is not turned off.
App is not responsive.	Computer or mobile device lost its internet connection.	Check your mobile data connection or use a better wi-fi signal.
	An unsupported browser.	Use one of the more popular browsers: Chrome, Safari or Firefox.
RoboGardener crashes into obstacles.	Robot camera lens has dirt on it.	Clean the lens using a wet wipe.
RoboGardener doesn't return to base.	The boundary wire is not properly laid out.	Make sure the boundary wire entails the whole area of the garden you want to traverse.
	Garden area too large.	The maximum garden size is 2,000 sq m. Make sure the area determined with the boundary wire doesn't exceed it.

Customer Helpline

We are delighted that we can offer **comprehensive customer support** to any users of RoboGardener who may need any extra help in setting up their new autonomous friend.
Please reach out to team lead Matt Timmons-Brown with all questions and queries: **s1823424@ed.ac.uk**

Developer instructions

This section is aimed towards any **future developer** who may be working on our Webots project and webpage, such as a group of **Computer Science students** with a similar ability level to us. The installation and local development setup is very straightforward. Our code is available in two **GitHub repositories** within our RoboGardenerTeam GitHub organisation.

Installation

Installing and running the Webots world and controllers.

1. Download and install **Webots**.
2. Download and install **Python 3.8**.
3. Using Python's pip, install **Flask** and **NumPy**
4. Run `git clone https://github.com/RoboGardenerTeam/SystemDesignProject.git` in a terminal to **download the repository**.
5. Launch Webots and **File > Open World...** then select one of the world files.
6. When you **run the simulation**, you should receive the following output in the in-built Webots terminal: `INFO: rest_controller: Starting controller: python -u rest_controller.py`

Installing and running the User Interface website locally.

1. Python 3.8 should be installed from above
2. Using Python's pip, install **requests_ntlm**.
3. Run `git clone https://github.com/RoboGardenerTeam/RoboGardenerWebsite.git` in a terminal to **download the repository**.
4. To **start the server**, run `python3 server.py` in a terminal.
5. You will then be able to see the UI at `http://localhost:5000` in your browser, which will indicate a successful installation.

Reinstallation

Reinstallation is extremely straightforward, you can simply delete the directory and again run the git clone commands above.