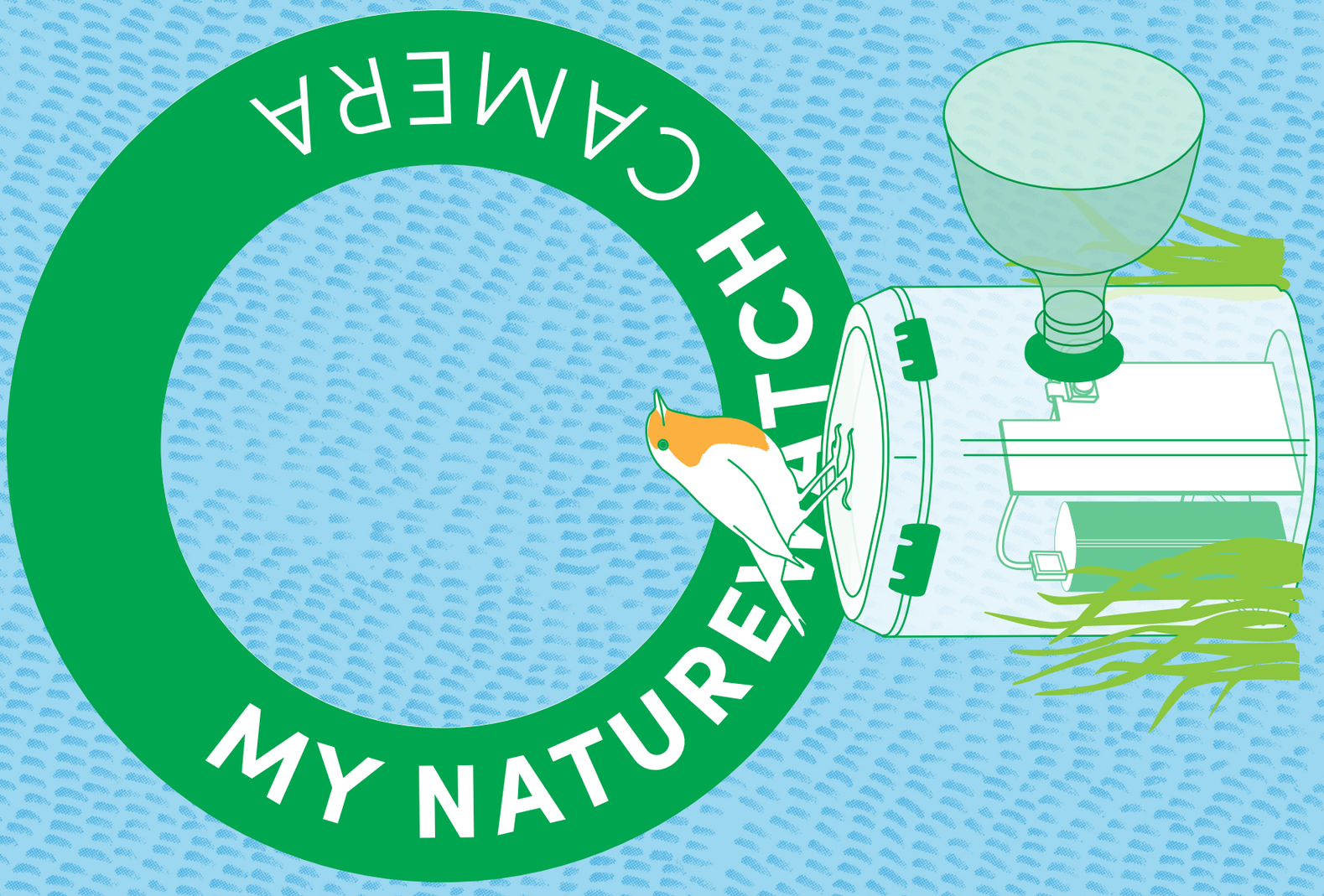

MY NATUREWATCH CAMERA

MY NATURE WATCH CAMERA

My Naturewatch Camera
The My Naturewatch project team at the Interaction Research Studio are Bill Gaver, Andy Boucher, Dean Brown, Naho Matsuda, Jen Molinera, Liliana Ovalle, Andy Sheen & Mike Vanis. At the Royal College of Art the Design Products team is led by Dr Rob Phillips, Amina Abbas-Nazari, Beki Gowing & Dr Rosie Anderson. Special thanks to Jamie Dunning & Chris Howard.
www.mynaturewatch.net

Edited and Designed by the My Naturewatch project team
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My Naturewatch Camera

Goldsmiths UNIVERSITY OF LONDON

Royal College of Art

EPSRC Engineering and Physical Sciences Research Council

Introduction

My Naturewatch Camera is designed to take pictures of wildlife automatically.

Left outside to view a birdfeeder, or an animal trail, or some bait, it will wait patiently until it sees movement, and then capture images of the birds and animals that venture nearby.

Cameras like these are known as ‘trail cams’ or ‘wildlife cameras’, and many versions are sold commercially. The vast majority are used by hunters in search of game, or animal stewards interested in the health of local populations. Utilitarian devices, they often take bleached, low-resolution pictures that look like the output of security cameras.

My Naturewatch Camera, in contrast, uses a high quality colour camera that can return aesthetically striking images and videos. That’s because it is designed to go beyond utilitarian animal tracking, to encourage us to enjoy the beauty and personality of the wild creatures that live among us.

Left: My Naturewatch Camera in use.
Above: A robin and squirrels captured with the camera.

Above: Constructing the My Naturewatch Camera with household materials.
Top right: Camera parts.
Middle right: An assembled camera.
Bottom right: The camera interface on a smartphone.

Anybody can make their own My Naturewatch Camera.

A 'self-build product', the camera is constructed from a few inexpensive and readily available parts. It can be put together in around an hour by following online instructions and installing software available at the My Naturewatch website. With a casing made from simple household materials like food storage containers or leftover plastic bottles, the camera is robust enough to use outdoors even in bad weather.

Once it is working, the camera is controlled from a smartphone, tablet or computer using a webpage that it creates. That means you don't need to touch the camera to start and stop image capture, to adjust its settings, or download and delete photos. It is remarkably versatile and simple to use, often while looking out at the garden from inside one's home.

Inexpensive, good quality, and easy to make and use, My Naturewatch Camera makes informal wildlife photography available to everybody.

BBC Springwatch, a popular nature-focused television series, featured My Naturewatch Camera in an episode that aired in the Spring of 2018.

Several million people saw the episode live, on catch-up TV, and on the BBC 'best of Springwatch' website, and tens of thousands visited mynaturewatch.net to find out more.

Other people engaged with making and using the camera at workshops held in nature reserves, schools, and museums around the UK. Still others discovered the project via leaflets they found in stands at restaurants, hotels and cultural attractions, alongside advertisements for amusement parks and zipline rides. More found the cameras on social media, or while searching the web.

Over time, thousands of people have made their own My Naturewatch cameras. Young and old, technically experienced and complete novices, fanatic wildlife lovers or merely curious, all have been enabled to build their own computational product and use it to explore local nature.

In fact, many have gone beyond our instructions to develop their own housings and adapt them to different situations and interests – to take pictures of hedgehogs, for instance, or bees, or a buzzard's nest.

Some makers have gone even further by forming groups and teaching others how to make and use the cameras. For instance, a researcher from the University of Sussex recruited teachers from nearby schools and taught them how to teach their pupils to make cameras. Others have contributed software features that have been incorporated into new versions of the camera firmware, for instance to make saving and deleting pictures more convenient, or to alert makers when the camera module is not installed correctly. Through efforts like these, My Naturewatch Camera has on taken on a life of its own, attracting new makers without the involvement of the original design team.

Left and above: Chris Packham, Bill Gaver and a robin during filming of the My Naturewatch segment of Springwatch 2018.

My Naturewatch Camera is the result of a collaborative design research project between the Interaction Research Studio and RCA Design Products, with the BBC Natural History Unit as a project partner. The process of creating the camera involved a great deal of experimentation with design and technology as well as engagement with people and animals, and we describe My Naturewatch as a research project in a series of appendices at the end of this book.

In the body of the book, we simply want to celebrate what happens when you make a good quality, affordable and easy to use wildlife camera available for people to make themselves. We hope you'll agree the results speak for themselves.

Photo credit: Elisabeth Bierhaus

Libby Miller
Robin
Posted on Twitter

yodatheoak
Mouse
Posted to the My Naturewatch Forum

RobT
Fox
Posted to the My Naturewatch Forum

Mr Chaz
Hedgehog
Posted to the My Naturewatch Forum

Elisabeth Bierhaus
Blackbird, european greenfinch and house sparrow
Posted on Instagram

Elisabeth Bierhaus
Two european goldfinches
Posted on Instagram

Elisabeth Bierhaus
Blue tit
Posted on Instagram

Elisabeth Bierhaus
Young blackbird
Posted on Instagram

Peegee99
Bird bath
Posted to Twitter

Peegee99
Bird bath
Posted to Twitter

Peegee99
Bird bath
Posted to Twitter

Peegee99
Bird bath
Posted to Twitter

Benjamin Grice, aged 8
Deer
Posted to Twitter

Benjamin Grice, aged 8
Pheasant
Posted to Twitter

Malcolm Gibbons
Sparrowhawk
Posted on Twitter

Malcolm Gibbons
Sparrowhawk
Posted on Twitter

Libby Miller
Blue tit bathing
Posted on Twitter

Libby Miller
Blue tit bathing
Posted on Twitter

The Design Museum workshop participant
Red fox

The Design Museum workshop participant
Red fox

The Design Museum workshop participant
Swan and seagulls

The Design Museum workshop participant
Swans, seagulls, coots and duck

Kevin, Depot Cinema workshop
Long-tailed tits

Paul, workshop participant
Grey squirrel

Lucy, The Durrell Trust
White stork

John & Arthur, workshop participants
Jackdaw

Kevin, Depot Cinema workshop
Young seagull

Kevin, Depot Cinema workshop
Young seagull with parent

Kevin, Depot Cinema workshop
Young seagull

Kevin, Depot Cinema workshop
Young seagull

Malcolm Gibbons
Fox
Posted to Twitter

Malcolm Gibbons
Badger
Posted to Twitter

Malcolm Gibbons
Badger
Posted to Twitter

Malcolm Gibbons
Badger
Posted to Twitter

My Naturewatch Team
Mouse
Taken during testing of the infrared camera

Mr Chaz
Hedgehog
Posted to the My Naturewatch Forum

RobT
Fox
Posted to the My Naturewatch Forum

RobT
Fox
Posted to the My Naturewatch Forum

nounandnumber
Porcupine
Posted to the My Naturewatch Forum

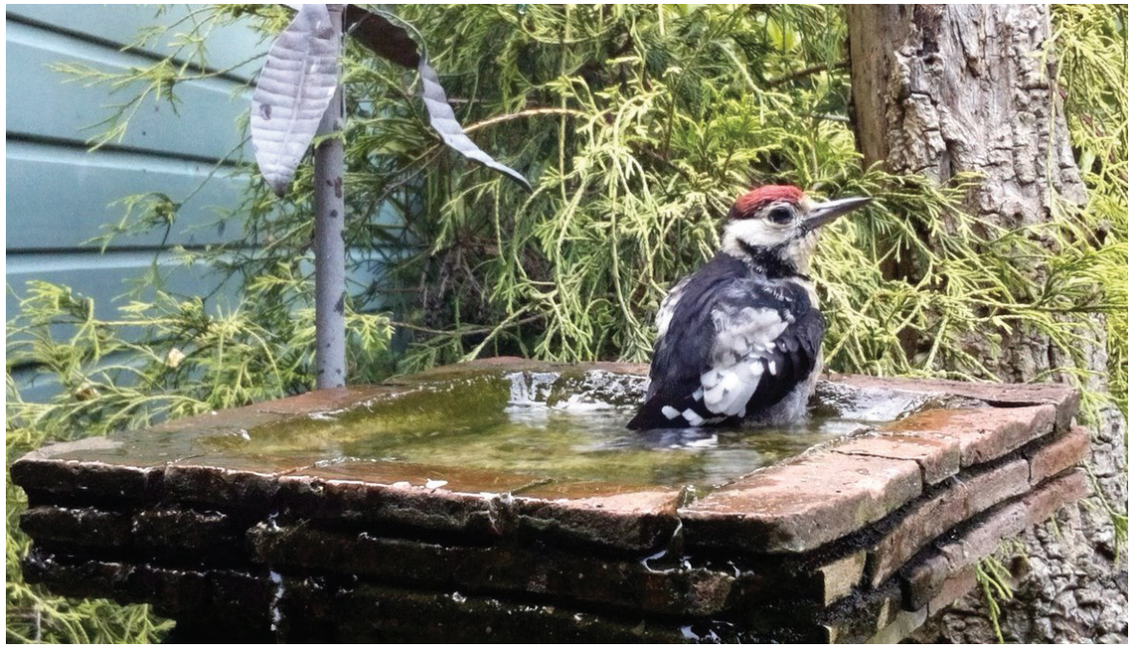
nounandnumber
Porcupine
Posted to the My Naturewatch Forum

Lucy, The Durrell Trust
Stork

My Naturewatch Team
Coal tit
Taken during testing of the software's custom exposure settings

Camera set-up, Wakehurst National Trust workshop

Camera set-up, Wakehurst National Trust workshop



ISpaceCab / CoopersCustomRings
Woodpecker
Posted on Instagram

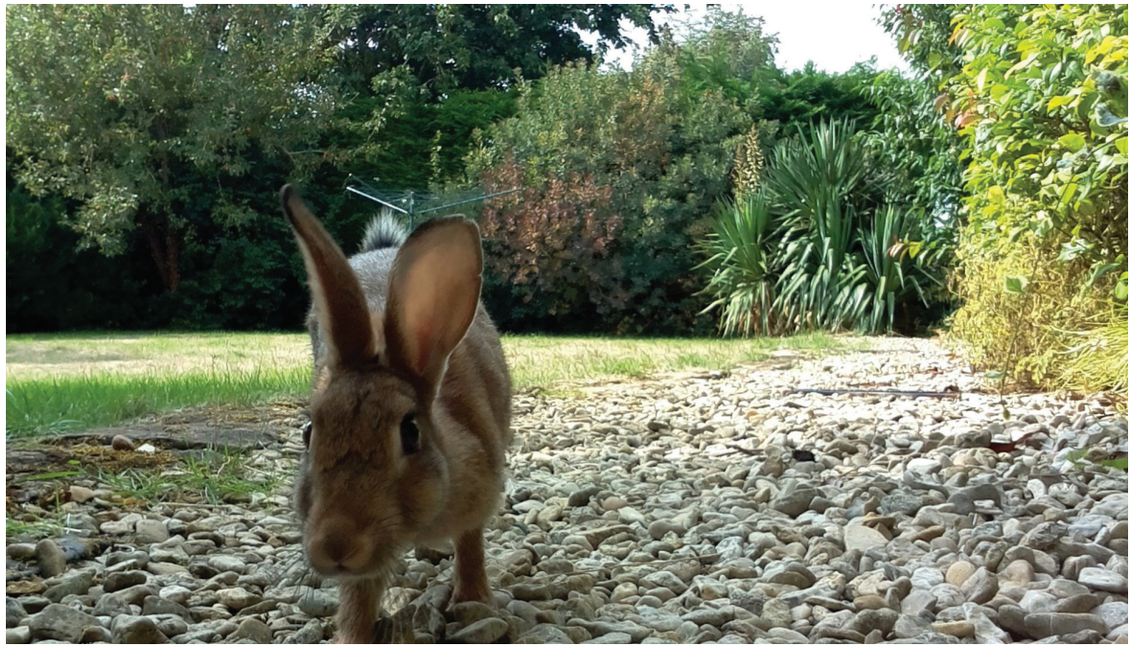
ISpaceCab / CoopersCustomRings
Blackbird
Posted on Instagram

Dave B
Bank vole
Posted to the My Naturewatch Forum

Dave B
Blackbird
Posted to the My Naturewatch Forum

Matthew Beach, Phytology, Bethnal Green Nature Reserve
Bee

Matthew Beach, Phytology, Bethnal Green Nature Reserve
Bee

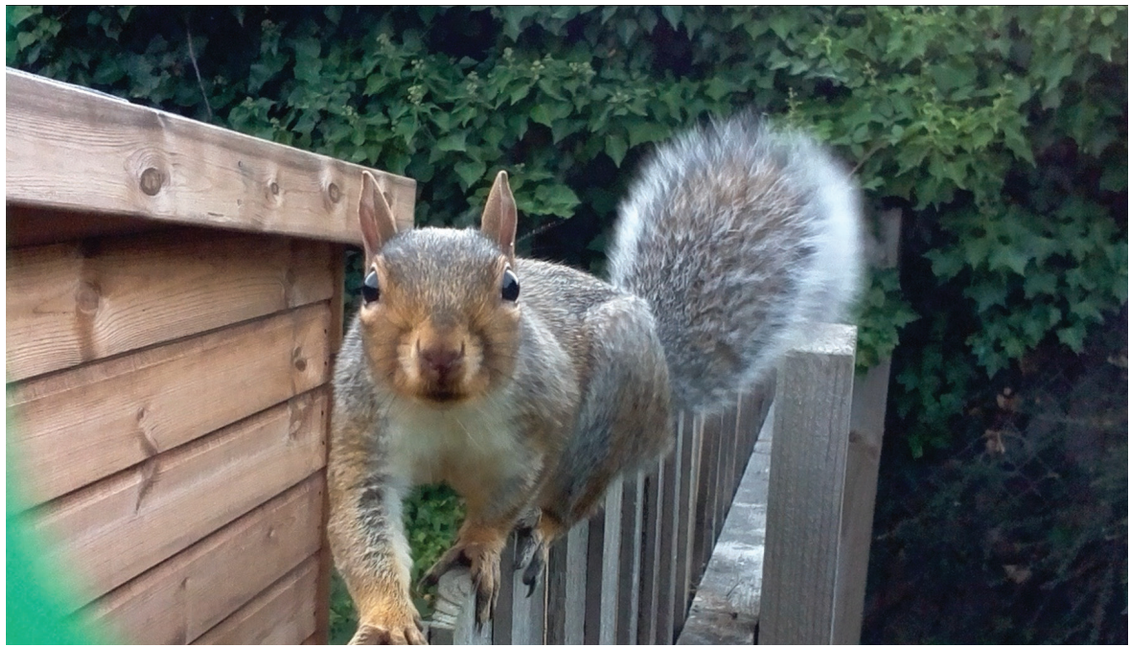


Carole
Rabbit (or hare)
Posted to the My Naturewatch Forum

DBCloggy
Crow
Posted to the My Naturewatch Forum

Ricko352
Jackdaw
Posted to the My Naturewatch Forum

johnjohnston
Seagull & hungry friends
Posted to the My Naturewatch Forum



MisterW
Squirrel
Posted to the My Naturewatch Forum

Ricko352
Squirrel
Posted to the My Naturewatch Forum

StuartP
Great spotted woodpecker
Posted to the My Naturewatch Forum

StuartP
Great spotted woodpecker
Posted to the My Naturewatch Forum

Wildlifekate
Robin
Posted to the My Naturewatch Forum

MikeInWigan
In flight
Posted to the My Naturewatch Forum

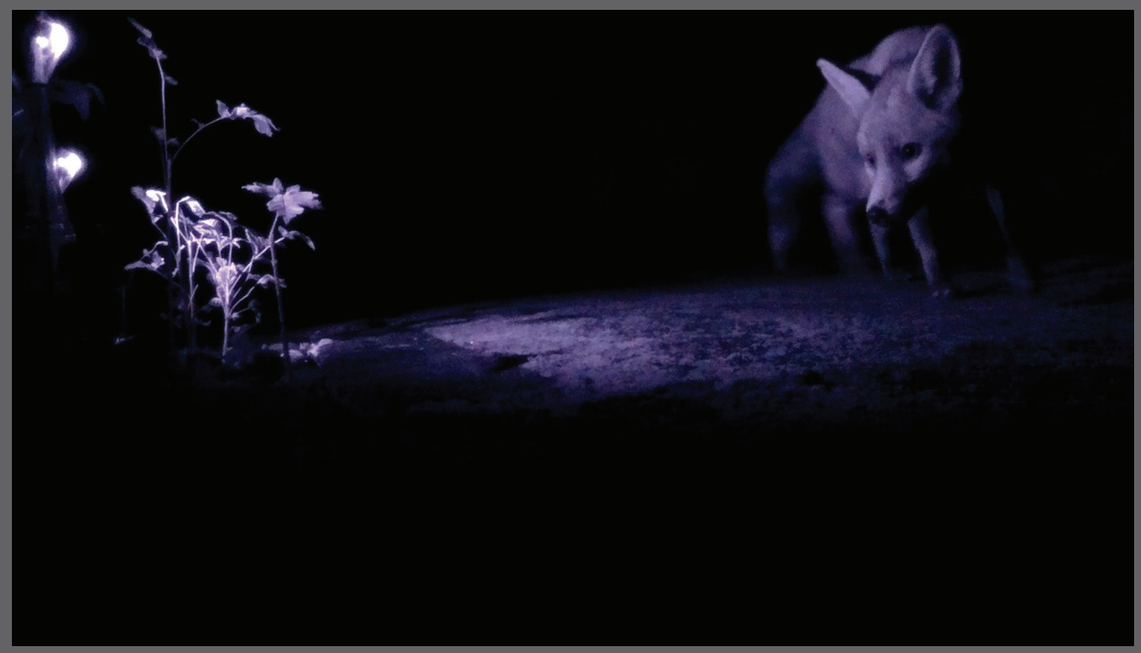
tbanack
Feeding time
Posted to the My Naturewatch Forum

tbanack
Feeding time
Posted to the My Naturewatch Forum

Photo credit: Elisabeth Bierhaus





My Naturewatch Team
Fox
Taken during testing of the infrared camera

"I set your camera up in front of the bird box when I went to work, came back and had a look at the pictures and then saw the cat, pictures of it creeping along the roof and then stepping down onto the top of the bird box and trying to fish the birds out from inside the bird box... fortunately it was unsuccessful".

"Then two days later they fledged, because I caught them on the camera again."

Jackie
Posted to the My Naturewatch Forum

RobT
Camera set-up
Posted to the My Naturewatch Forum

RobT
Inquisitive visitor
Posted to the My Naturewatch Forum

hc25036
Hedgehog camera box
Posted to the My Naturewatch Forum

StuartP
Camera on a tripod
Posted to the My Naturewatch Forum

NatureWatcher123
Infrared camera set-up
Posted to the My Naturewatch Forum

Appendices

Photo credit: Elisabeth Bierhaus

MY NATUREWATCH RESEARCH PROJECT

Rob Phillips, the Bee Lab, Citizen Science

Camera monitoring unit, on-site at BBC Springwatch in 2017.

My Naturewatch was a design-led research project to investigate whether we could attract large numbers of people to engage with digital making and local wildlife by releasing 'self-build' products. A collaboration between the Interaction Research Studio and members of Design Products at the Royal College of Art (RCA), it was conceived from the start around involvement with the BBC's Springwatch programme. Achieving the project thus meant coordinating the interests of our three diverse groups as we engaged in a research process lasting about three years and involving a great deal of experimentation with design and technology as well as engagement with people and animals.

One of the primary outcomes of the project is My Naturewatch Camera, a self-build 'wildlife camera' that takes pictures when it sees movement, and which people can build for themselves. In the main body of this book, we document some of the thousands of images that people have captured with their My Naturewatch Cameras, as well as the ways people customized their cameras to their own circumstances.

In these appendices, we discuss the work as a research project, using pictures as well as words to give a sense of the experience of developing the My Naturewatch Camera. We start with the background to the proposal and the formation of our relationship with the BBC's Natural History Unit (who produce Springwatch), then describe the conceptual, technical and design development of the camera before describing some of the lessons we learned from the research. Along the way, we include reflections about the project from diverse points of view, both to complement our main narrative and to illustrate how projects like this one raise a myriad of issues and produce a multiplicity of learnings.

Background: Forming a Project

The My Naturewatch project had its genesis in a meeting between Rob Phillips from the RCA with Andy Boucher and Bill Gaver from the Interaction Research Studio to discuss possible collaboration. Phillips had recently completed his PhD research, in which he worked with beekeepers to develop Bee Lab kits that they could assemble and use to monitor factors such as beehive weight and temperature that are important for assessing hive health. He was keen to continue investigating how research practice could be used in a form of collaborative design with non-academic participants to support environmental sustainability.

Boucher and Gaver, meanwhile, had been pursuing a programme of research investigating how their research products could be produced for large-scale audiences. After an original focus on batch production, which culminated in a field trial of over 100 'Datacatchers' in the greater London area, they had turned their attention to self-build products as a method for replicating designs without having to fund their construction. They saw potential for a collaboration with Phillips to help develop this programme, as well as an opportunity to explore their interests in nature and wildlife.

Guided primarily by a nebulous desire to work together, overlaps between ongoing research, and a large range of other potential shared interests, our conversation drifted widely as we explored possible projects we might pursue. None seemed quite right until one of us suggested that we partner with a television series to promote self-build, nature-related devices that we would design.

BBC Springwatch seemed like a perfect choice for collaboration.

At the time, we knew Springwatch, by reputation and as viewers, to be a magazine-style television show focusing on wildlife and nature in the UK. Produced by the BBC Natural History Unit, the group behind such blockbuster series as Planet Earth and Blue Planet, Springwatch has aired since 2005, with its success leading to spin-offs including Autumnwatch and Winterwatch as well as a great deal of online activity.

During Springwatch's intense three-week run, the team establishes a mobile studio on its chosen site, usually a nature reserve or farm, consisting of some twenty mobile homes containing studios, workshops, offices, and a canteen. Miles of fibre optic cable are strung to high-quality cameras located on site, with their feeds leading to a studio with a large matrix of TV monitors which are overseen by a team whose job it is to extract compelling footage of wildlife activities – feeding, mating, rearing young, and (best, we were told by one member) killing or being killed. The team arranges these into stories that are strung together with live narration by an on-air team, and particularly Chris Packham, the well-known lead presenter of the show. Local footage is enlivened by features filmed elsewhere, on-site guests, and various activities such as the release of weather balloons onsite. The results appear on several shows daily, and further content is available via the BBC 'red button' service as well as online. The result is an entertaining and informative glimpse into the UK's wildlife that is viewed by upwards of 2 million viewers daily.

What we had in mind was a self-build, computational product that people could make and use at home to experience local wildlife in ways similar to those shown on Springwatch. Not only would this localize engagements with wildlife for viewers, helping them appreciate that wildlife can be found in their backyards as well as in remote wildlife refuges, and engage them with digital making, encouraging them to understand and 'own' digital technologies rather than passively consuming them, but the one-to-many broadcasting model of television would potentially be complemented by a many-to-one model as people shared the results of their activities with the BBC.

Making Friends at the BBC

Though we didn't entirely realise it at the time, working with the BBC was a matter of coordinating two very different rhythms (see Appendix 2 for a different account). Work for the Springwatch team

was seasonal, starting to ramp up a couple of months before the next series, picking up pace as they started filming features, and reaching fever pitch during the programme itself, much of which is filmed live. After the series was over, the team would disband for a time to work on other projects, before slowly forming again in preparation for the next series. Our work was slower and steadier, as we prepared a funding proposal over several months, waited several months longer while it was reviewed, and then started to steadily develop ideas and designs within the project. So it was that, when we originally contacted them, they agreed to write a letter of support for the project, only to have forgotten about it completely when it was funded. Even after we started work, it seemed that every time we would visit to check in about our progress, the context was somehow different, and enthusiasm for our work waxed and waned. Small wonder – while we were patiently focused on developing work for this single project, they were going through complete cycles of programme-making within a changing institutional context and with shifting personnel.

Fortunately, we managed to negotiate our different tempos through goodwill and a mutual curiosity, which was supported by the nature of our relationship. For us, having external research funding meant we could pursue the project independently, without needing approval for every step we took. For them, it meant that they had no responsibility for the project and could decline to use our designs or even meet with us if our work wasn't relevant for their current concerns – and if it was, we made clear they could use it for free. This lack of dependencies, combined with the possibility of mutual benefit, served the project well. If it made our position as researchers risky, we consoled ourselves by thinking that our design work was worthwhile whether or not it appeared on Springwatch. Neither of us could fail the other – and that meant not only that we could meet as equals, but that we could play around with ideas together.

My Naturewatch as Research

The story of the My Naturewatch project is scattered through this book and its appendices. It was a long and eventful three years, so we only allude briefly to some of the activities and events that made up the project, not to mention the spin-offs it engendered (water cams, puffin sunglasses, urban animal habitats…). All the clues to a full account of the My Naturewatch Camera are here, but the interested reader may have to hunt vigilantly to collect them all. For a more traditional, though somewhat incomplete, account see http://research.gold.ac.uk/id/eprint/25284/.

For now, it is worth reflecting briefly on My Naturewatch as an example of research. In many ways, the project does not resemble the cliché of scientific research as a disciplined and exacting practice of controlled hypothesis testing. Instead, it embodies a form of design-led research, in which the skills of design practitioners are brought to bear on situations chosen for their potential relevance to topical research issues. The logic is that, once appropriate situations are found, sufficiently mindful design practice is bound to uncover new insights and understandings relevant for those research issues, without having to change its nature to emulate more traditional research.

For this project, that meant that once we shaped its basic premise – designing self-build devices to complement Springwatch – to be relevant to our broad interests in sustainability, digital making, and self-build products as a methodology for large scale studies, we could pursue the project on its own terms without thinking too much about whether what we were doing was research. Because the situation we chose reflected the logic of the design issues we were interested in, we could pursue the project according to the logic of the situation.

Pursuing design-led research in this way has a couple of implications for how it proceeds and the nature of its results. First, it is emergent in the sense that what happens is not entirely planned or predictable but unfolds over time. To be sure, for this project what actually happened – we designed a wildlife camera that people built after seeing it on Springwatch – appears entirely congruent with what we set out to do at the outset. But it needn't have been, and it felt far from inevitable at the time. For instance, at the outset of the project we had no intention of designing a wildlife camera. On the contrary, we entertained a great many other ideas with our friends at the Natural History Unit (see Appendix 2) before settling on the camera as being most accessible and easiest to appropriate for viewers. Similarly, there was no guarantee the camera would be featured on Springwatch. Even after filming, we were warned that it would depend on what else they had available, and it was only a matter of fortune (they hadn't been able to film some planned features because of an unusually cold Spring) that they ended up airing the My Naturewatch feature. At each step of the way, the circumstances we found changed, either for external reasons or due to the repercussions of our previous design moves, and we responded as best we could. If we had responded differently, the project would have spun out in a different direction – not towards failure, necessarily, but towards a different set of outcomes that would have seemed as inevitable as these. In sum, the process was far from the planned and controlled set of experiments we associate with scientific research, and more like an improvised dance with the world. This, we suggest, gives the project a kind of life and immediacy that made it a pleasure to be part of and, we hope, to encounter.

Second, design-led research tends to produce heterogeneous results, in the sense that they are not only varied but of different kinds. Unlike controlled scientific experiments, we don't just answer the questions we know to ask at the outset, but instead discover new questions and gain new insights as the project emerges and we negotiate changing circumstances. In this project, for instance, we learned that motivating large numbers of people to make and use a self-build product, and thus to engage both with digital making and with local wildlife, required a configuration of functionality, media coverage, accessibility, low cost, clarity and much else besides – all factors that became clear in the doing. And we learned many other things as well – about the rhythm of television production, for instance, or the importance of the 'editorial line' that guides the narrative of a show. We learned about the behaviour of Pi cameras and animals, the properties of materials and the effects of weather, the expectations people bring to digital making projects and the motivations of component suppliers, and much more as well.

The unpredictability of emergence and heterogeneity of learning that characterises projects like this one make them difficult to report adequately in traditional academic genres. The typical approach is to strip away these complications and focus on a narrative and subset of results that are most relevant for the research community. After all, for the designers involved, the full scale of learning is maintained in the experience they can bring to new projects. For other design researchers, however, such a solution seems unsatisfactory. Not only do 'cleaned up' accounts fail to pass on all the things we learn, but in misrepresenting the process and outcomes of design-led research they risk constraining how it can be pursued in the future.

And so it is that we offer this book: a messy, detailed, only partially narrativized glimpse into the making of My Naturewatch Camera. We don't pretend that this embodies a solution to the difficulties of reporting design-led research, but at least it acknowledges them. Perhaps more importantly, we hope it will give readers a hint of the excitement, inspiration and optimism that the My Naturewatch project gave us.

Elisabeth Bierhaus, Robin, posted on Instagram.

Working Outside the (Telly) Box

Chris Howard
Series Producer, Springwatch 2018

Collaboration

I like to think I'm a collaborator at heart. I like spotting connections between people, pulling ideas from different sources and marrying them all up in different ways. I like to see what happens when things collide.

Working for the BBC's Natural History Unit, collaborations became my unofficial thing. Whenever an unusual project cropped up or a CV full of skills that didn't really fit came in, they often got sent to me to work out what to do with them.

Sometimes they went nowhere and never would. Sometimes there was something there but the timing was wrong. And sometimes everything came together, and magic things happened.

This was one of those times.

Making friends.

Even so, it took a while for us to hit it off.

For a simple TV producer like myself, receiving an email from a team made up of clever people from Goldsmiths and the RCA, working on a project funded by the Engineering and Physical Science Research Council, was kind of, well, daunting.

It sounded serious. It sounded like I'd really have to focus to understand it. It sounded like, well, a lot of work.

And that's where a lot of these things fall down. Collaboration is tiring. You have to work at them, find the common ground and convince others that the collision might make something beautiful.

More often than not, it's easier to just say no and save yourself the hassle - but something in the approach by Bill and the team made me think that this might be worth it – so we decided to meet and thrash it out. And right enough, there was something there.

True, I had no idea what it was, but I loved their enthusiasm, I loved their knowledge of the show and what we were trying to do, and I love their madcap (to me) way of thinking.

And let's be honest, I also loved that they were fully funded and offering me a no-risk opportunity to give something new a try. Springwatch is a content hungry production – requiring somewhere in the region of 40 short films a year just to stay afloat - not to mention all the things we need to fill time in the live shows too...

We *always* need new ideas. So, for this TV producer, we'd moved from daunting to music to my ears really rather quickly.

Your design workbooks are my pitch documents

The first part of the process was familiar, but altogether different at the same time.

In TV we are constantly selling ideas - and use what we call pitch documents to help us do it. I would take these 'glossy' documents to London to sell my big picture vision to my BBC overlords. I'd pitch where Springwatch should be based for the next year, what the overarching vision for each series was, and what the long-term future would hold.

At the same time, my team of producers and researchers would be pitching ideas to me. Thoughts about the kind of short films they wanted to make that year, what the presenters would do during the live shows, and what hand-made props we would force the newer people on the team to make with no time and entirely the wrong tools.

It's common parlance to claim that there is no such thing as a bad idea in these documents – but honestly, that's bollocks. I certainly wouldn't take my wildest ideas to my bosses, as even getting a twenty-minute slot takes weeks of effort. And much as I tried to encourage and commission some proper left-field ideas from my team every year (sometimes successfully, such as a Blade Runner parody which was set in the near future and featuring the last hedgehog left in the UK – "Quite an experience to live in fear, isn't it?"), I bet they were holding back too.

Instead, we refine everything, narrow it down and include perhaps 2 or 3 reasonably well-honed and focussed ideas in pitch documents, for every one that we hope might pass the grade.

So when we got the 'design workbook' from the Goldsmiths/RCA team I expected it would be similar. I was expecting maybe 10-15 ideas in total, some that they obviously favoured and a few more left-field ideas to keep things interesting.

But apparently that isn't how design workbooks work. We were presented with a free-wheeling, free-forming and free-associating pack of around 70 (seventy!) ideas, from which one final project was going to emerge.

It was an eye-opener to say the least. Some of the ideas made me laugh (The Snail Tracer App) and many made me think (The Perception Filter). Some were ethically dubious (Fight Club: setting up an arena for robins to fight themselves in mirrors [and just to say everyone knew they were dubious – but even that didn't count them out as valid concepts at this stage]) and many of them practically impossible – at least to my closed little mind.

But every single one made me stop and consider things a different way, and had at least one nugget of genius/madness/truth embedded in it.

Out of seventy ideas there wasn't a `bad' idea in there – for once the maxim was true.

The design workbook was like a pitch document in many ways but for one crucial difference – it has all the fun, interesting stuff left in

Refining the concept to something beautiful... and useful.

Of course, from there we had to find a single idea that would work for both of us.

We had a lot of discussion about what would actually work biologically. We needed to find something that would be useful enough to us as a production that putting it on TV would be natural and not forced. And we were both very, very keen that it should be accessible to, and of a benefit for, as many of our audience as possible.

There are more than enough exclusive clubs, snooty attitudes and high-priced gadgets in the wildlife world – and if we were going to do this collaboration, we were all determined that it should be the opposite of that.

With all that in mind – Bill and the team refined the ideas (through several new layers of equally brilliant workbooks) and came up with the final products that they describe in the rest of this book and which I won't waste time describing again here.

In doing so they took elements from across the whole unimaginable breadth of the original workbooks and made something much more collaborative and interesting than I would've imagined – teaching me many lessons in collaborative working along the way.

We collaborated to make some great TV, with Chris Packham getting heavily involved with the project and very passionate about the products we made (a very choosy collaborator, believe me).

We collaborated with scientists to develop ways of tracking and interacting with wildlife (RFID Feeders) that allowed scientists to learn new things and develop new, more cost-effective techniques to study and help British wildlife.

And most importantly we collaborated to make something (My Naturewatch cameras) that allowed our audience to engage in a deeper and more meaningful way with the natural world – as evidenced by their feedback on the cameras they had made at home.

And ultimately, that was always the point for me. The collaboration between us and the Goldsmiths/RCA team was never about just that - it was also about a unique and ongoing collaboration we have with our audience too.

If Springwatch is anything, it is an ongoing collaboration between the team and the audience – a deep and trusting bond that has taken years to build and is vital to the success of the shows. That means that when we collaborate with others, they're collaborating with the audience too – and any success in that part of the show should be measured by what the audience thinks.

If we work with someone else, the audience needs to like them too. And they did, because they told us, and showed us, and sent us their clips.

Magic did happen.

Chris Howard, Bill Gaver and Chris Packham on site at Goldsmiths.
Photo Credit: Rob Phillips

Bill Gaver, Chris Packham and film crew on site at Goldsmiths.
Photo Credit: Rob Phillips

CAMERA DESIGN & DEVELOPMENT

Intro

Developing the My Naturewatch Camera was a careful balancing act of considering ease of build, cost, accessibility and usability. Key to developing the camera, though, was software development. It would have been relatively simple to make a camera similar to commercial camera traps. Instead, we wanted to push the software as far as possible to create a simple yet fulfilling experience that connects people with nature in their garden. The My Naturewatch Camera software evolved and improved based on user feedback. We received ideas, reports of bugs, and even code contributions from keen wildlife enthusiasts. Here we outline the journey of the My Naturewatch Camera design and in particular, the development of the software: from early tests and failed attempts to launching the camera and its adoption by a wide variety of makers.

Testing off-the-shelf camera parts

We started investigating how we could make a self-build wildlife camera by buying commercial camera traps and deploying them in our homes. The cameras we tested were between £80 and £200, with varying levels of sophistication and build quality. These cameras have a few common features: they are waterproof, they can switch between photography and video, they run on batteries, and they can capture content in low light with infrared lights. Within the case, they have a small screen for previewing what the camera sees, buttons for changing settings like sensitivity and quality, and a micro SD card for storing content. The case is usually rugged, with external features for mounting the camera, and a rubber seal to prevent water from getting into the electronics.

All the cameras in our tests, and most camera traps in general, use a passive infrared sensor (PIR) to detect movement in front of the camera. These sensors are generally effective at sensing animal movement, but they suffer from false positives, especially when they are hit by direct sunlight. Sometimes, the video recording would start as the animal was already leaving the shot, catching only a small part of the action. Retrieving photos and videos from the cameras proved tricky, requiring that the camera setup be disturbed and the case unmounted, and involving a search through hundreds of false positives to find a handful of images with animals.

Left: Initial testing of a commercially available camera trap. These are often optimised for animal tracking, rather than the quality of the image. In addition, their PIR sensors were particularly poor at identifying movements of small garden birds.

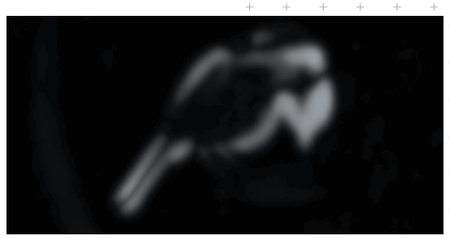
Below: Testing computer-vision frame differencing as a trigger event. The bottom image shows the result of subtracting an average of recent images from the incoming image (top). Areas that haven't changed are dark, areas that have changed are light. The camera is triggered when it detects changes that are not too small, nor too big.

Setting up and framing the camera proved very difficult, since the camera preview screen was inside the waterproof case. All the camera traps in our tests featured infrared lights to illuminate night scenes. Because the lights were positioned directly next to the lens, they produced a "mugshot" effect giving animals glowing eyes and unflattering lighting.

We identified three categories of features that we could improve technically: camera setup, movement detection, and price. Seeing a preview of what the camera sees should be possible without having to open up the camera, so that people can frame their photos more accurately. Retrieving photos should be easier, without needing to open up the case to see if any animals have been detected. Movement detection should be more accurate to reduce false positives and be less susceptible to sunlight changes. Finally, the overall cost of the camera should be much lower to make it accessible to everyone willing to spend around £35 and a few hours putting a camera together.

Imagining a cheap, easy to make DIY wildlife camera

Testing with commercial cameras was invaluable, allowing us to find lots of room for improvement. We started imagining a cheap, easy to make self-build camera trap that improves the experience of capturing photos of local wildlife. Technically, we thought we could improve the experience by rethinking how the camera detects motion, how people can access the photos, and how it can be assembled from off-the-shelf parts.

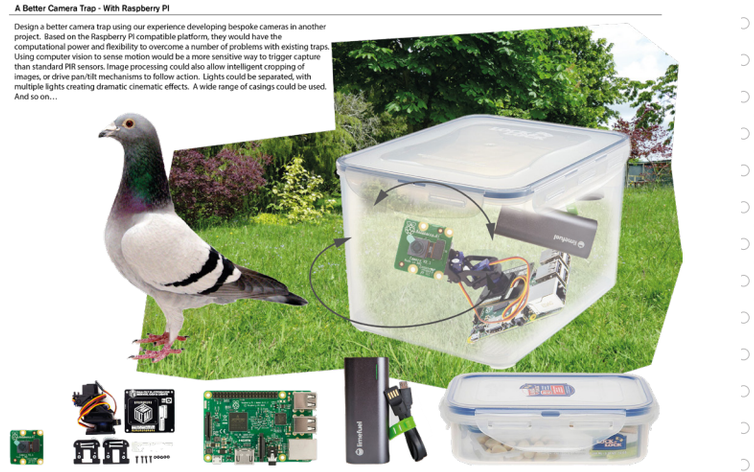


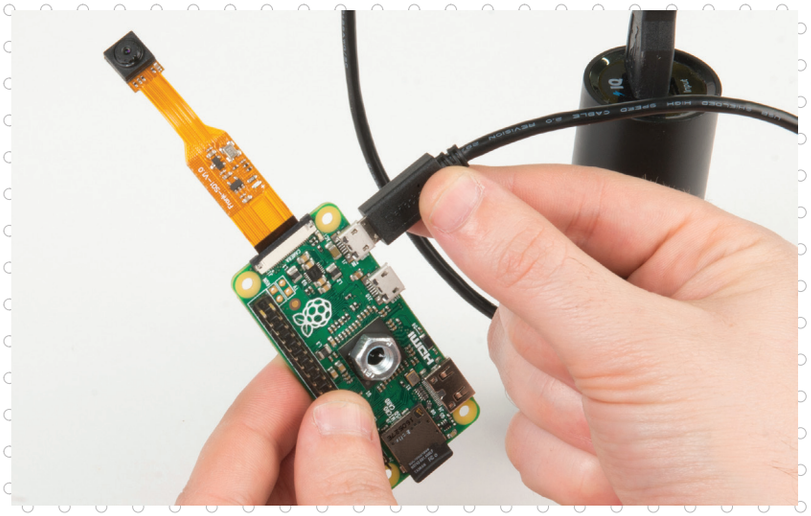
We started developing computer vision to sense animal motion, removing the additional cost of an external sensor and simplifying the wiring of the camera. Looking for change in the image also allows the software to be more nuanced with what is considered as a trigger event. By looking

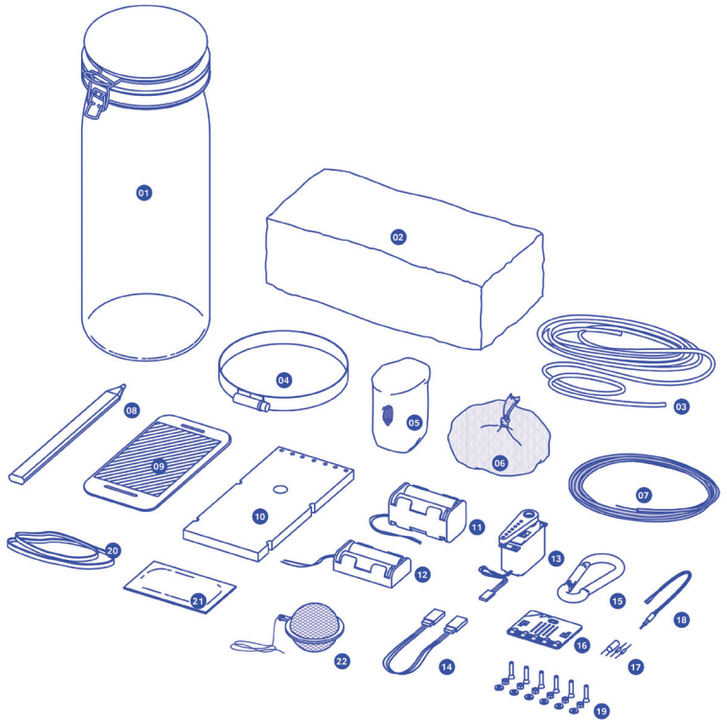
Top: ‘Design Workbooks’ are a method the design team uses in which hundreds of design propositions are gathered to explore situations and design possibilities. The image shows My Naturewatch workbooks 1, 2 & 3 that were presented to the BBC (as recounted by Chris Howard in Appendix 2).

Middle: A workbook proposal outlining a self-build wildlife camera housed within everyday household containers, such as food storage container.

Bottom: The heart of the My Naturewatch Camera kit features low-cost off-the-shelf electronic parts, comprising a Raspberry Pi Zero, Pi Zero camera module, SD card and battery pack. The bolt functions as a cheap, ad-hoc heatsink in early versions of the design.







Top: The Watercam is a design for an underwater camera that can be line-lowered into rivers, canals or ponds, and which featured in the London Design Festival 2017 exhibition ‘Water’. Housed in a Kilner jar, the Watercam contains a smartphone running a rudimentary vision tracking application that records videos if it detects movement, such as a passing fish (or old boot). Coupled with the phone is a servo-operated pendulum that knocks the side of the jar when a video is captured, thus tugging on the line.

Bottom: A poster for the Watercam containing a parts list and a web link to building instructions. These were distributed during the ‘Water’ exhibition for visitors to take and try at home and was our first attempt at distributing a design for a self-build camera. It is unclear, however, whether anybody else built one.

Watercam

01 Clip top glass jar
02 Brick
03 Rope
04 Jubilee clip
05 Plasticine
06 Bag of rice
07 Coaxial cable
08 Carpenter pencil
09 Phone
10 Wood support
11 Battery holder 6v 4 x AA
12 micro:bit battery holder
13 Servo motor
14 Servo extension lead
15 Carabiner
16 micro:bit
17 2 x resistors, 1 x electrolytic capacitor
18 Audio jack cable
19 M3 nuts and bolts
20 Elastic bands
21 Sugru
22 Tea ball infuser

Interaction Research Studio

There are hundreds of waterways in London, from garden ponds to the Thames, each one an intriguing environment worth exploring. Watercam is designed to let anyone take a look. Easy to make at home using readily available materials and a smartphone, it relies on a highly evolved technology for creating watertight enclosures — the clip-top jar — to protect its contents. We have been developing DIY technologies such as these, in part via a collaboration with a well-known natural history television series, as an alternative to commercial distribution for spreading ideas and opportunities.

Find the instructions here: **interactionresearchstudio.net/water**

Below: We built several prototype cameras based on various technologies (such as the smartphone-based Watercam) before deciding on using the Raspberry Pi Zero as the platform. Another variation used a Raspberry Pi 3B camera that we developed in another project, housed inside a transparent acrylic sphere in an experiment to create new and semi-random points of view. The results were good (see opposite page), but the battery life on the Pi 3B was poor, to say the least.

at the difference between video frames, we can build an average of the environment over time and sort change based on size. If a very small portion of the video stream changes, we can guess that a few leaves are moving in the background, which should not trigger a photo. Similarly, if the entire image is different from one frame to the next, it is safe to say that the entire camera was moved, or the light changed. Any other size in between can be considered an animal passing by. This "acceptable" size range is also something that people could tweak, if they decide they are looking for a particular size of animal.

Initial tests for the computer vision algorithm were developed using a handful of platforms including Open Frameworks, Arduino and Python, so that each could be assessed for its accessibility and usability. These languages were chosen based on being free, open source platforms that already have a large number of active users, with many active online forums to help with user issues and updates. We decided to develop the detection software using Python, due to its large user base using Raspberry Pi as a hardware platform, and also because Python makes it relatively simple to develop and understand computer vision program using its maintained library addons for OpenCV. Although other languages may be able to achieve the same results with higher processing efficiency, Python requires relatively few lines of code to create computer vision programs. We hoped this would be easier for users without extensive knowledge of computer vision to understand how the software is developed, making it more accessible for them to contribute with bug fixes and new features.

Our first decision was to choose which hardware platform would be most suitable for the project. When assessing this, we wanted to make sure it met requirements from a computational power perspective, but also accessibility and affordability. With this in mind, we decided to settle for the newly released Pi Zero W, due to its price point, form factor and processing power. Raspberry Pis can interface with cheap camera modules and have enough computing power to capture photos and videos. They are powered through a USB connection, allowing them to be run from a cheap power bank. Other platforms such as ArduCam and OpenMV were tested, but were either more expensive, lacked processing power or were less widely available than the Pi Zero W.

First Software Prototype

Our first prototype consisted of the absolute minimum we needed in order to put a Raspberry Pi camera outside and see if it could capture photos when it sees motion. We developed a Python script that opens a connection with the camera module and looks for change in the picture by differencing frames. The script also ran a local server on the Raspberry Pi, which served a website showing a preview of the camera, and a few buttons to start a session and change the sensitivity. Instead of connecting the Raspberry Pi to a WiFi router, we enabled it to host its own WiFi hotspot. By connecting to the hotspot and opening the camera's website, we could control the camera remotely without touching the setup.

We waterproofed our first testing setup by putting it in a jam jar with a tightly screwed lid. The Raspberry Pi was powered by a large rechargeable power bank, normally used to charge phones on the go. Capturing photos of wildlife with this setup immediately felt different from the commercial camera traps. Framing the scene and deciding what should be in the photo was easily done through the live preview on the web app. Checking if the camera took any photos and saving photos to another device without disturbing the setup was incredibly useful.

The first version of the software performed computer vision operations to detect motion on a 420 pixel-wide stream. This was far from ideal, since the photos were not high resolution enough to be used as nature photographs. After much research and study of the Raspberry Pi camera documentation, we discovered that it should be possible to split the camera port across two resolutions. Eventually, we set up two streams - a 320 by 180 pixel "computer vision" stream and a 1920 by 1080 "photo" stream. Having those two streams open simultaneously meant that the software could run motion detection in a low resolution stream, and take photos with the high-quality stream. Running motion detection with such a low resolution stream was also beneficial for saving computing power and therefore extending battery life.

When testing a night vision version of the Raspberry Pi camera with the same software, we realised that the exposure and white balance was inconsistent. This made night-time photos look washed out, wildly varying in quality from one capture to the next. We worked on a feature so that exposure could be set to manual and locked to a particular shutter speed. This made exposure more consistent across night-time sessions and even proved useful in daytime photography. Whilst testing, we had a particularly beautiful session with a white background visited by a few birds.

Above & Below: A fox and a squirrel captured with the spherical camera described on the opposite page. Although the images were optically distorted by the acrylic sphere, the angles and closeness to wildlife afforded by the size and shape of this prototype pointed to the potential of a self-build camera.

Top: An early design for the My Naturewatch Camera housed the electronics in a ziplock food bag. This bag was brilliant for waterproofing for a low cost, but not so great for setting up and framing images, and no matter the quality of the bag, the images that were taken with this prototype were always slightly distorted.

Middle: From the start, we were keen to build a night vision camera that would allow the infrared lamps to be positioned separately from the camera lens to allow us to create more cinematic lighting effects. The result of early experiments is shown on pages 74 & 75, but here we built a box habitat with a mouse hole and integrated infrared camera and top-mounted infrared lamps. The result can be seen on the opposite page.

Bottom: Testing the adjustable white balance settings in software, on the Goldsmiths campus with an outdoor studio set-up.

Top: Testing the focal range of the standard Raspberry Pi Zero camera in our studio, using a mug and a robin ornament.

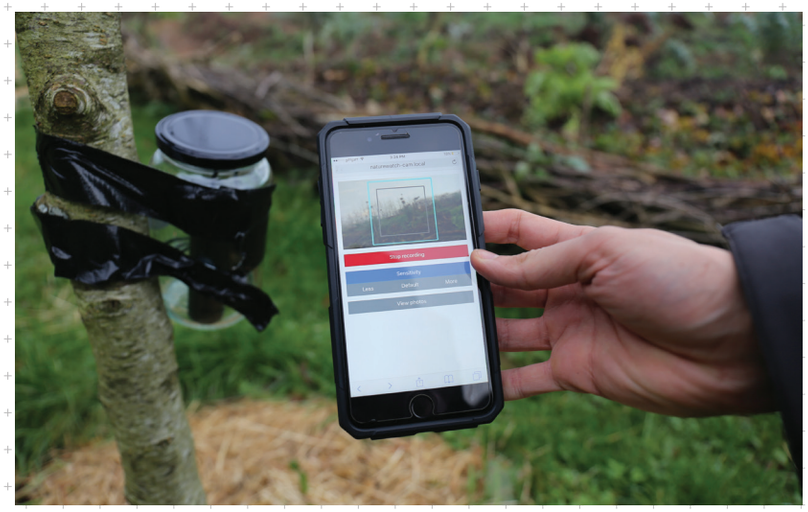
Middle: A mouse in its house, illuminated by an overhead infrared lamp. Incidentally, the box habitat was the perfect environment for capturing 100% of wildlife activity with zero false positives from moving branches etc, allowing the computer vision sensitivity to be set on maximum. Footage from this box habitat also includes a spider spinning a web and a slug slowly moving from right to left, and then climbing the wall!

Bottom: A robin with attitude, in the outdoor studio. White balance tests are going well.

Top: As we developed the software, we began testing the camera at workshops, inviting participants to build and try a camera themselves. At this stage, we were pursuing designs for housings that could be constructed with no tools from everyday household materials. Here, a workshop participant builds a camera in an instant coffee jar.

Middle: A workshop at the Railway Land Wildlife Trust, Lewes. Here we are testing a camera built by a participant, demonstrating how to begin the camera capture using the software interface on a smartphone.

Bottom: A jam jar and a bird box set, built during a workshop at Schumacher College, Totnes.



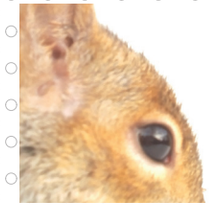
Top: The live feed of the My Naturewatch Camera interface viewed on a smartphone.

Middle: The infrared night vision camera housed within a bucket, placing the bucket upside down (but propped up slightly) produced great images of insects and worms.

Bottom: A jar-based camera deployment with an adjustable arm, constructed from timber and rope, allowing for flexible positioning and framing.

Right: More white balance and focusing tests in the outdoor studio.

Below: A solution to an overheating problem posted by Ricko352 to the My Naturewatch Forum, that uses a small fan to cool the Raspberry Pi Zero.

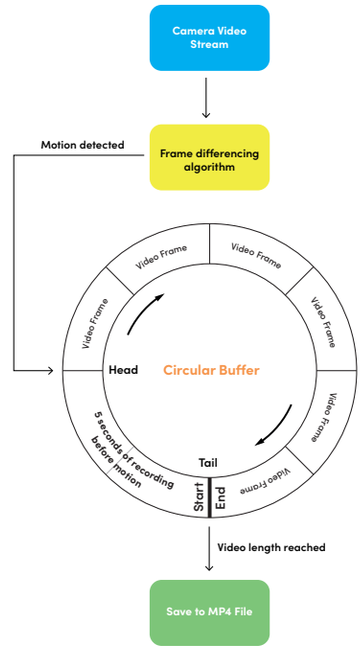


Software Launch

In May 2018, the software was officially launched alongside our My Naturewatch Forum and the instructions for building the camera. The forum was set up to allow users to share photos from their camera setups, but also act as a first port of call for any user issues with the hardware and software. The original software release was offered as a direct link to a ZIP package hosted on a Goldsmiths, University of London server. We were able to track this link to monitor the traffic and usage, giving us an indication of how many users had downloaded the software and presumably attempted to build a camera. These metrics were useful to track any influxes in new users, which ultimately led to a delayed increase in forum usage.

Within a few months of the forum launch, the user traffic steadily increased. Due to the forum being a platform for engagement and troubleshooting, we began to notice a variety of users with varying technical experiences sharing their journeys with the camera. The forum was originally split into sections for sharing photos, sharing custom setups, suggesting new software features, and sharing software and hardware issues. We noticed users would often post in more than one of the types of forum sections, with some users engaging with the forum to solve technical issues and ending with posting their results from their finished working setups.

After a few months, the forum traffic increased, with new posts and dozens of new users daily. It became apparent that a selection of users were having similar issues with certain factors of the hardware and software design. The first was issues with overheating. This was due to a variety of factors, including insufficient heat dissipation and the use of cameras in direct sunlight during a particularly warm summer for the UK. We resolved these issues by suggesting the use of a small heatsink, instead of the DIY approach of using aluminium bolts as we previously suggested. Another was related to a hardware specific bug in a batch of manufactured Pi Zero W boards. This caused the boards to underpower themselves, causing the software to crash. The solution we provided was to edit a file within the SD card. Once the forum was updated with instructions on how to identify and fix these, we noticed a decrease in forum posts relating to these issues.



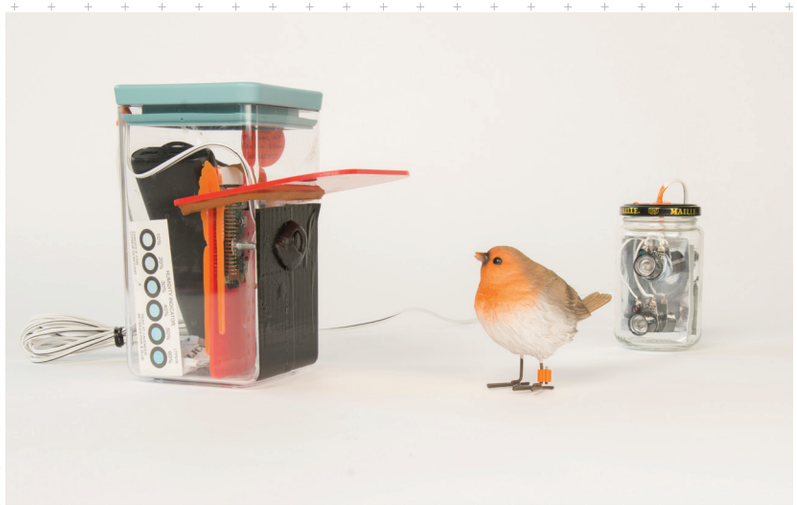
V1.0

Two years after the original software release, thousands of user downloads, and a multitude of software feature requests, we released version 1.0 of the software. Features included a new user interface, exposure and ISO controls for the image capture, and video recording using a circular buffer. In order to accommodate all of these new features, we redesigned the software architecture from the ground up. Server-side functions were moved over to Flask, an open-source Python server framework. The new web interface was made with React, allowing for dynamic changes on the interface and for battery saving features like pausing the live preview.

Video recording was one of the most requested features through the forum community and workshop feedback. Circular buffering is a common function in security cameras, in which a set length of video is constantly buffered. When the camera trap is triggered by motion, the video file will start with a set amount of footage prior to the motion trigger. This works well for the My Naturewatch Camera software, since the footage will include the animal entering the frame. We added the circular buffer functionality after reflecting on our initial examination into commercial camera trap setups with video functionality, which suggested that they often miss this initial part of the action.

The video functionality uses the same frame differencing algorithm as the photo capture to detect the movement, but instead, it creates a 15 second 1080p video recording, in which the first 5 seconds of the recording is recorded footage prior to the movement detection.

Above left: A diagram describing the circular video buffer of the later versions of the My Naturewatch Camera software.



Top: Tools and components in our studio, used to build a camera from a plastic takeaway food container.

Middle: A camera housing made entirely from a plastic drinks bottle.

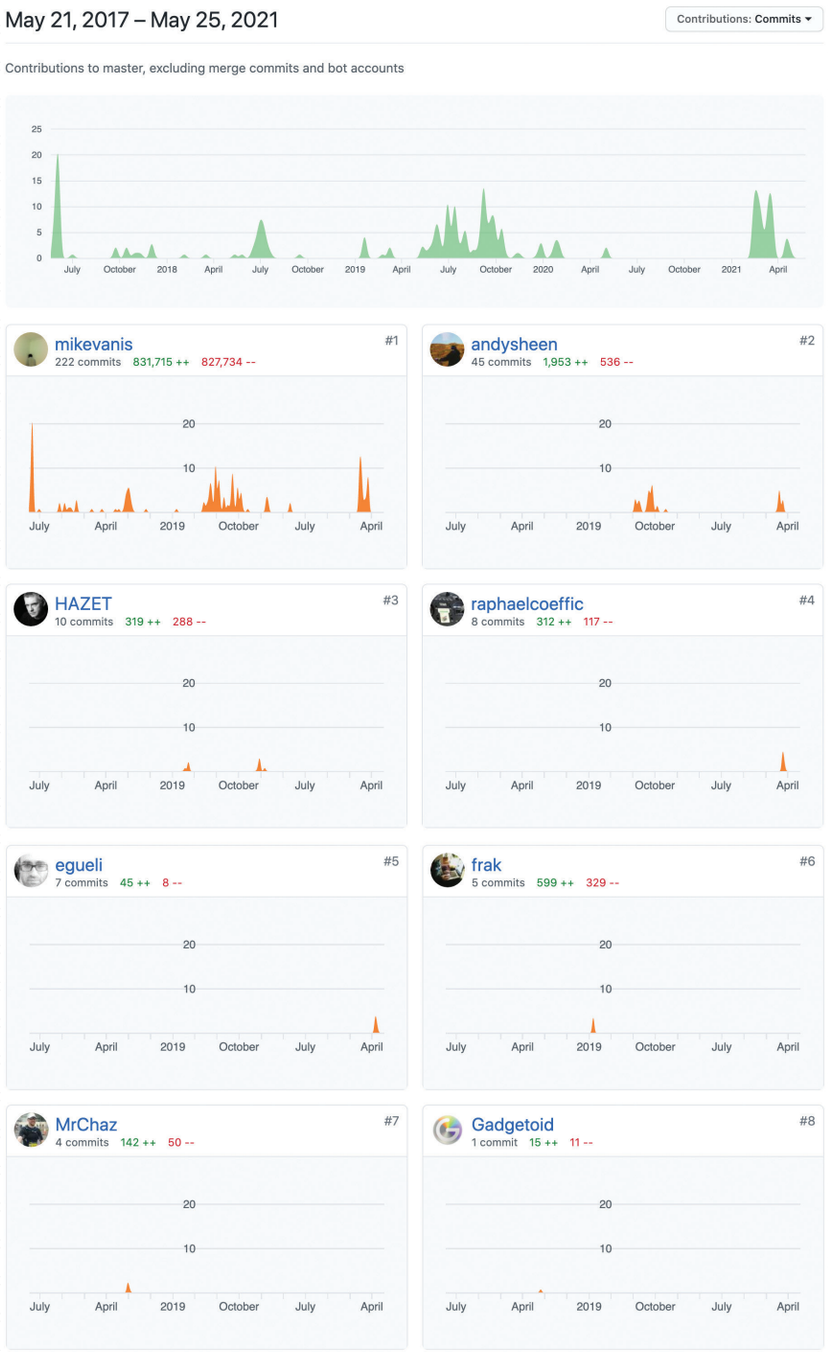
Bottom: One of our first food storage container cameras, using a plastic brim to protect the lens from rain. This version is the infrared camera with separate battery-powered infrared lamps that we used to capture the fox images on pages 74 & 75.

Top: The spring/summer collection camouflage.

Middle: Infrared night vision camera housed within a standard takeaway container with a soup container lens and camouflage self-sticking bandage.

Bottom: An autumn/ winter camouflage My Naturewatch Camera out in the wild.

Right: This page of contribution activity from the software development and version control platform, GitHub, shows how the code was modified from the first public release. Some users contributed improvements that were merged into the main branch, while others maintained their own copies of the codebase with features that they developed for their own personal use.



Programming and designing for open source

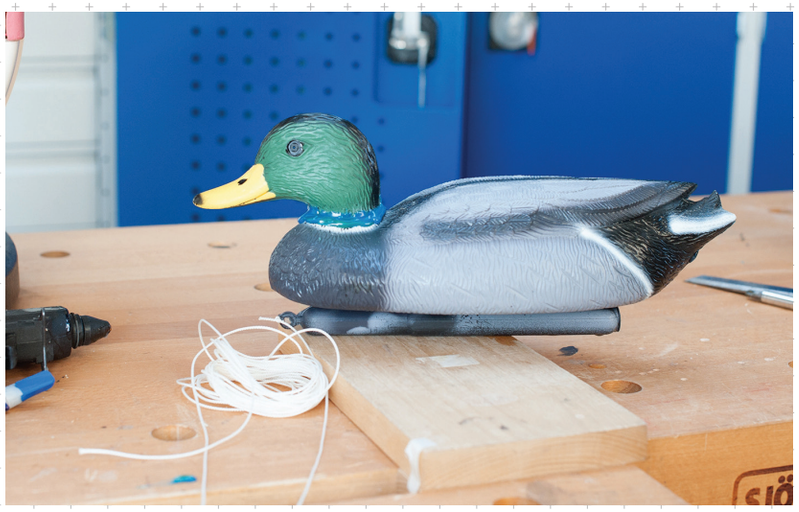
When we started outlining the process for developing the My Naturewatch Camera, we decided to make all aspects of the software readily accessible and easily modified by users, without the need for permission from the My Naturewatch team. For this, we decided to license the software under a GNU General Public License, giving people the freedom to use the software in both commercial and noncommercial projects. Although this is generally seen as standard practice in the maker world, especially for projects using Raspberry Pi, we wanted to make sure the software was developed in a way that actively encouraged participation in its development, from fixing bugs to working on new features. With this ethos of user participation already at the centre of the project, we made decisions that promote collaborative software development.

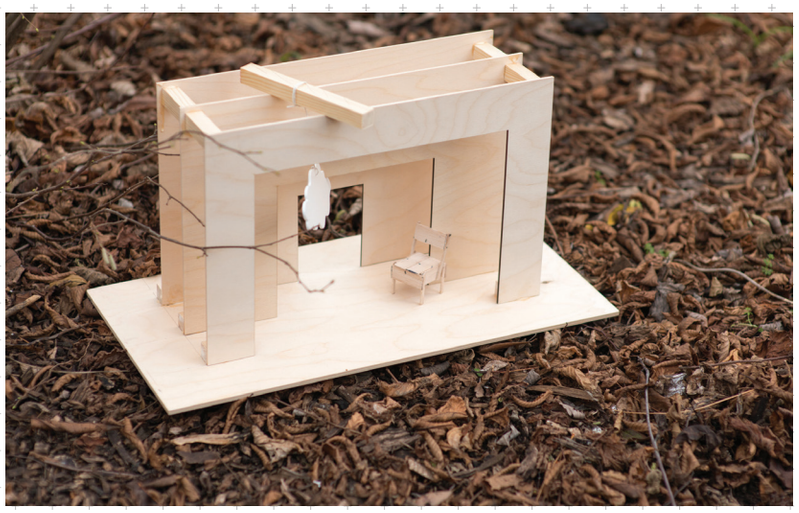
Hosting the source code on Github quickly helped technically-minded users engage with the software development. Github is a widely used software development tool that allows anybody to host software repositories online, allowing multiple developers to collaborate on the same codebase. In My Naturewatch Camera releases prior to 1.0, Github was used to track development progress, help identify software bugs and contribute new functionality and fixes to the software. Using Github as a software development tool made it easy for users to contribute major or minor changes to the project and for them to be tested and verified by the Naturewatch team.

With the release of My Naturewatch Camera v1.0, we introduced additional Github development tools, such as Github Actions - a continuous integration tool that allows for software to be compiled and verified in the cloud. With the help of CustomPiOS by guysoft*, the My Naturewatch Camera software automatically compiles a new version of the Raspberry Pi Image every time a commit is made to the software's main branch, making it easier for contributors to test software changes before committing. This makes software updates simpler for our team and volunteers to deploy. My Naturewatch Camera v1.0 also includes a template for users to report software issues. By providing a set of questions to be answered and tests to be done when posting an issue or creating a pull request, user contributions can be assessed much more efficiently by both the My Naturewatch team and active contributors, streamlining software updates.

We have had a number of contributions by users over the past year, including both bug fixes and new features, with users helping with general maintenance alongside the My Naturewatch team. This includes a feature to zip and download multiple videos or photos, timelapse photography, and general optimisations. The project will continue to be open to new updates and developments from users after the research project has ended, handing over maintenance of the codebase to the community.

*github.com/guysoft/CustomPiOS





Top: A My Naturewatch Camera inside a floating plastic duck, ready for its maiden voyage. Note that the camera is housed inside the duck's eye, for the full espionage effect.

Middle: A wildlife theatre featuring an Enzo Mari Autoprogettazione model chair.

Bottom: A birdbath and camera setup on campus at Goldsmiths.

Top: Duck cam meets duck in Folkestone Gardens.

Middle: A robin and a great tit tread the boards in the wildlife theatre.

Bottom: Robin based trouble at the birdbath.

Top: Takeaway boat cam photographed from ashore.

Middle: Infrared Night Camera Spotlight almost ready for action.

Bottom: The mobile studio with a hungry visitor.

Top: Seagulls circling the Takeaway boat cam.

Middle: An urban fox as seen from the Infrared Night Camera with remote spotlighting.

Bottom: Dinner for two in the mobile studio.

Importance of Citizen Scientists

Jamie Dunning

Ornithology, the study of birds, is a science inherently open to everybody. As I type these words at a desk in an empty university post-grad office, I can hear song thrush singing somewhere beyond the open window. When I submit that data point (my single, singing song thrush) to one of the various recording apps, bird news channels or other, local data repositories, it doesn't tell us very much about song thrush ecology. That is to say, anything more than the information I provided (a bird, some basic behaviour, a time and a place). However, when our single song thrush is compiled with equivalent data, data from other places (..through other open windows, from car parks, gardens, parks and nature reserves) or with different time stamps – a differing space time to ours, now – then patterns begin to emerge.

With these new data, we can see that song thrush declined sharply between ~1970 and ~1990, and although the population in the UK has increased slightly, in 2018 it was still ~50% less than it was in 1967. Now, armed with a population trend, we can begin to unravel the drivers of that decline. Have we changed the way we manage the land we share with song thrush? But also, are the song thrush of 2018 doing the same things that song thrush did in 1967? Do they nest in the same places? Have the threats to their survival changed?

The study of ornithology has for a long time been at the forefront of utilising 'citizen' scientists to answer these questions which ultimately inform the way we conserve our wild spaces for the future. These questions though can only be answered with information, and single singing song thrush heard through open office windows (... or robins on garden fences, Manx shearwater from battered harbour walls, nightingale singing from ancient oak woodland in the middle of the night etc. etc.) are the individual units that make answering those questions possible.

So, with that in mind, it is perhaps not an over-exaggeration to suggest that losing our collective connection with wild spaces is one of the greatest threats to its long-term conservation. How do we begin to measure change in song thrush populations if we forget what they sound like ?

The challenge then, alongside science, is to engage conservationists of the future, and to make sure that those wild spaces (whether they are a week's hike into the wilds of Scotland, or under a log in a public garden in north west London) are accessible to everybody. For that we need to step outside of the science and work with creative industries, with designers and makers, to come up with new, accessible and affordable ways to engage with the world around us.

Jamie Dunning and Andy Sheen ringing garden birds.
Photo Credit: Rob Phillips

After a long day of trying to capture a robin, Jamie came back the next day and we finally caught a Robin - Apollo - and tagged it with an RFID bird ring.
Photo Credit: Jamie Dunning

Sunglasses for Puffins

Dean Brown

Protective 'sunglasses' for puffins created by the Interaction Research Studio have helped scientists demonstrate that the birds' bills 'glow' in ultraviolet light.

The unique eyewear was designed and produced by the Studio for an international project led by researchers at the University of Nottingham working with scientists in the US and Canada.

The project set out to investigate photoluminescence in the bill of the Atlantic puffin (Fratercula arctica). This phenomenon was first observed in puffins that had died of natural causes but in order to understand it the scientists had to shine ultraviolet (UV) light on the bills of live birds. With animal welfare at the heart of the project, this meant finding a way to protect the birds' eyes from potentially damaging UV light sources and the answer was to develop opaque puffin-friendly eyewear or puffin 'sunglasses'.

The development of the sunglasses was a purely user-driven design process – the unusual thing was that the user in this case was a puffin.

The initial prototypes were born from discussions with ornithologist and environmental consultant Jamie Dunning, and visiting resarcher at the Interaction Research Studio, through his involvement with the My Naturewatch project. Jamie provided the Goldsmiths team with scenarios of how the eyewear would be used and important puffin metrics.

The Interaction Research Studio investigated different forms, sizes, materials and wearing concepts that prioritised the comfort of the bird and outdoor use. In-studio fabrication and batch production facilities meant the team were able to laser cut a variety of mock-ups that could be quickly tested. They fitted their initial ideas on deceased specimen puffins to ensure that the designs were completely suitable before creating their ready-to-wear range for live puffins.

Jamie Dunning, who was undertaking research at Nottingham's School of Life Sciences for his master's degree when he made the discovery, said: "At this stage, we aren't really sure why puffins need this trait. However, we wonder if they can detect it [in each other] and if so, we suspect that it is linked to sexual signalling.

Photoluminescence in the bill of the Atlantic Puffin Fratercula arctica'

Prototypes, experiments and the final Sunglasses (top right of image)

We will be working on these questions in the future as well as looking at a range of other equally exciting possibilities. For example the glowing trait could still be linked to a visual signal, but rather than the omitted light, it could be the light which is absorbed which might create a contrasting region on the bill to match the black and white plumage. Otherwise, there could be some clue in the way that puffins develop their ornamental bill plate, which is developed seasonally in the spring before they arrive back at the breeding grounds."

Squirrels

Bill Gaver

According to the Red Queen Hypothesis, species must evolve and adapt because their competitors are evolving and adapting to compete with them. It is named for the Red Queen in Lewis Carroll's Through the Looking Glass, who explains to Alice: "Now, here, you see, it takes all the running you can do, to keep in the same place."

Whatever its status in Evolutionary Biology, the Red Queen hypothesis is a pretty apt description of my attempts to keep my birdfeeder safe from the local squirrel[1]. I evolve a deterrent; it adapts to overcome it. I evolve a new one; it adapts again. It's an endless race – and it's becoming clear I'll never win it.

I hung the feeder on a longer line and moved its site entirely, but it didn't take the squirrel long to get to it. I arranged a dozen pointed strands of wire into a crown for the top of the feeder, but the squirrel just seemed to enjoy the challenge of picking its way around them. I even mixed cayenne pepper with the seed after reading that squirrels dislike it, but birds don't mind — but my squirrel seems to enjoy spicy food.

Inspiration struck while brooding about the problem in the dead of night. I cut the bottom off a large plastic bottle and suspended it from a Slinky© children's toy so that when a squirrel climbed on it would lower to block the feeder's ports. That worked well enough that I had fantasies of patenting it and becoming independently wealthy.

Then the squirrel figured out how to hang upside down from a hind paw until it could prop one forepaw on the feeder's perch, and while in this stressed and precarious position, use its other forepaw to gently raise the bottle enough to feed. Watching from our kitchen window, I had to admit a grudging admiration for the squirrel's tenacity.

After that, I decided that I didn't mind the squirrel eating from the feeder. After all, it's a beautiful wild creature too, just like the birds. Even if it's a fat grey American one. Fat grey Americans deserve respect too. Or so I tell my children.

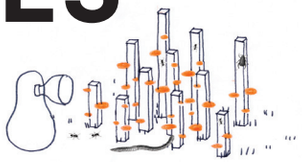
But the squirrel is a pig. I can tell when it's been around because it can empty half the feeder in a morning. This offends me. I don't begrudge the cost – bird seed is notoriously cheap – but I don't like having to fill the feeder constantly when I know that it's just going to be emptied an hour later by an impudent little overdressed rat who is laughing at me.

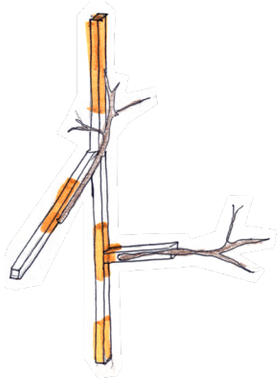
So the race continues. My latest attempt – a plastic bowl hung to form an overhang over the feeder – didn't even slow my opponent down. I'll keep trying though. Until I succeed, however, I know one thing to be true: Where there are bird feeders, there are bound to be squirrels.

1 There are probably several, but I tend to individualise the conflict.

Left - Right, Top - Bottom: Squirrel by Libby Miller, Squirrel by Dave B, Squirrel by My Naturewatch team, Squirrel by Ricko352, Squirrel by Jo, Squirrel by Stewart L, Squirrel by Peegee, Squirrel by My Naturewatch team, Squirrel by Libby Miller, Squirrel by The Design Museum workshop participant.

NATURE SCENES





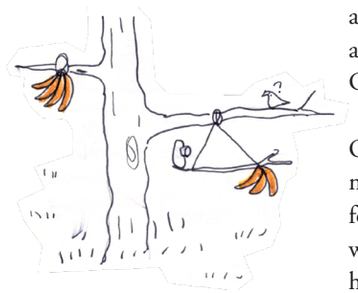
The Interaction Research Studio were approached by Jane Withers Studio to take part in Brompton Design District during London Design Festival 2019.

Responding to the theme of Biotopia the studio created Nature Scenes - environments for wildlife that served complementary roles for animals and humans alike. Each featured a My Naturewatch wildlife camera to document the goings on of animal inhabitants when humans weren't watching.

From an animal perspective, the installations offered welcoming environments, acting as shelters, feeding stations and watering points where various species could mingle. The DIY structures were built with natural materials that would feel familiar to animals, serving as shelter for some, and food for others.

From a human audience perspective, these spaces were small scale 'sets' or 'still lifes' which acknowledge that the natural world and the human world are intertwined. Natural materials were interspersed with touches of the human-made to emphasize the entanglement of people and other animals in urban settings such as Brompton.

Coinciding with the Nature Scenes installation in the Alexander Square gardens the Studio also created a wildlife themed occupation at the nearby Hour Glass Pub, reinterpreting pub paraphernalia with an animal twist, as well as a scenography within the White Post Gallery, an exhibition plinth on Thurloe Street.



Overall, Nature Scenes highlights that the city is already home to many creatures beyond humans – from rats to peregrine falcons, foxes to mice, native plants to nematodes. The first step towards welcoming them is to be sensitive to the fact that they're already here.

www.mynaturewatch.net/nature-scenes

NATURE SCENES

Top: A prototype of a ground level Nature Scene installation, featuring a My Naturewatch Camera.

Bottom: Food sources and bird boxes, made from branches, timber, dried gourd, dried orange peel and custom made fat balls, cast from 3D printed moulds.

Top: A mobile habitat and camera set-up suspended from a tree.

Middle: The gourd photostudio nestled in the undergrowth. Photography by @ studiostagg / Andy Stagg for Brompton Design District.

Bottom: A ground dwelling made using oak timber, stone and a dried gourd.

Top: A sighting of a Eurasian Jay.

Middle: A Mayfly feasting on a fatball.

Bottom: A grey Squirrel occupies a low level habitat.

Top: Above the bar, at The Hour Glass pub: a diorama of birds, squirrels and foxes dwell amongst DIY MyNaturewatch Cameras.

Middle: Footage of local wildlife, taken in the adjacent gardens, is broadcast on the pub TV.

Bottom:
My Naturewatch branded beer mats.

Top & Bottom:
White Post Gallery, an exhibition plinth on Thurloe Street, South Kensington.

Bottom: Photography by @studiostagg / Andy Stagg for Brompton Design District.

Engagement(s)² as Material

Dr Rob Phillips

The National Co-ordinating Centre for Public Engagement, (publicengagement.ac.uk), defines public engagement, as encompassing activities that cultural institutions produce to engage outside establishments. The My Naturewatch project enabled people to actively engage, informing community agency within the context of their surrounding gardens, public greenspace and wildlife. The project developed (through practice), how to co-ordinate, include, listen, design and deploy *Active Engagement(s)*. Currently, we are in an *age of transition*, where activities can evolve our cultures, through designed engagement(s). Citizen 'active engagements' are common practice in museology, creating lasting impacts on visitors, taking experiences outside cultural institutions, into their homes and lives.

These design elements combine driving new opportunities re-forming traditional 'passive' public engagement. I perceive 'active engagements' as a 'material' typology that can provide agency to communities. The My Naturewatch (NW) project achieved embedded buy-in from participants, creating *Empowered Citizens*. It also informed new methodological approaches and digital/physical design properties, worthy of future exploration, within design and interaction practice. **Engagement(s)²** are materials, crossing trans-disciplinary domains, providing people agency beyond, designed experiences. This essay reports on insights, framing, positioning and lessons raised throughout engagement workshops, led by the Design Products + Futures team at the Royal College of Art.

Keywords; Design, Creative Practice, Engagement, Sustainability

Introduction

Sprawling cities (Hayhow DB, 2019), funding reductions (Burke, et al. 2018) and extended working hours (Ganster, et al. 2018) have transformed our relationship with wildlife (Lumber, et al. 2017) and natural systems. We are distanced from protecting / connecting with our surroundings by an "othering" of nature (Uggla, Y and Olausson U, 2012). Our traditional nature relationship(s) were defined by food (Uhlmann, et al. 2018), forest, fuel (Cincinelli, et al. 2019), seasonality and self-sufficiency (Kelobonye, et al. 2019). Sustainable Design (SD) practice currently foregrounds consequences of traditional relationships and systems. Whilst SD indirectly engages with *implicit* ecological benefit, it is often pre-occupied with symptoms of production and consumption within paradigms of economic growth. SD rarely *explicitly* undertakes design(s) intent on propagating bio-diversity or interrogating our consumer role as 'ecological citizens'. The NW project used Open Design, a means to broadcast and engage, where and how people can re-appropriate design material(s).

Open Design (OD) is a "catchall term for various on-and-offline design and making activities, used to describe a design process that allows for (is open to) the participation of anybody (novice or professional) in the collaborative development of something" (Tooze et al., 2014). OD democratises access to construction information in a post-industrial world, presenting opportunities for communities to sustainably respond to bespoke needs. OD, or distributed design, is an outcome of two global trends: the maker movement and the digitisation of the design discipline, resulting in stakeholders having more agency over items they make, repair, use and adapt.

There is a link between Open Design and sustainability, that affects the way we ponder materials, and our impact on the natural world that surrounds us. National parks encourage public engagement, however "biologists [comment] that protected areas are not playgrounds": wildlife "parks are assets for tourism, but not tourism assets" (Buckley, 2009). I argue for designing with nature to actively preserve and propagate, informing people's actions. Society's current rise in "nature deficit disorder" draws attention to negative health effects from people spending less time in nature (Louv, 2008). *A Measure of Nature Connectedness* documents the "size and suddenness of the drop-in levels of nature connectedness from [ages] 10-15", something that generationally we can address, through exciting and inclusive engagements (Lumber, et al., 2017). In the UK over the past 4 years there has been a "220% increase in artificial grass sales impacting surrounding domestic wildlife" and biodiversity (Laville, 2018). Garden bio-diversity is plummeting (Guardian, 2019), presenting a "hyper-reality, substantially divorced from surrounding natural ecosystems" (Cannon, 1992).

> *"Closing the gap between human civilization and wild nature will require a set of values strong enough not only to protect endangered species and conserve energy but also to reshape health care, education, and whole cities, to conserve but also to generate new natural habitat–in effect, to regreen the earth"* (Louv, 2021).

Ecological Citizenship

There is widespread recognition of the importance of "direct interactions between people and nature, particularly for human health and wellbeing, but also for the future of biodiversity because of the impacts on people's attitudes and behaviour towards nature" (Soga & Gaston, 2020). Community Ecology is focused squarely on "understanding Earth's biodiversity, including generations in maintenance and the diversity of life" (Mittelbach & McGill, 2019). I believe there is a direct link between nature, communities and their citizens. Citizenship, is defined as "living in a

particular area or town and behaving in a way that other people who live there expect of you" (Dictionary, 2006). This definition is top down, due to someone else's ideals. I believe this should be more open, democratic and inclusive, enabling people to action. *Citizen Designer*, advocates for Human Centred Design, "develop[ing] solutions based on direct interaction with actual individuals, user-centred design relates to consumers" (Heller & Vienne, 2003).

> *"Human-centrism permeates design to this day. When left unquestioned, this human-centrism tends to address human needs at the expense of other life forms. Designers are often unaware of this disparity, embedded as we are in a society that does not hold humans in intimate connection with nature and does not value all beings equally"* (Pierre & Tham, 2019).

Ecological Citizenship "presents a normative account of how citizens should conduct their lives, reducing their environmental impact" (Wolf, *et al.*, 2009). Ecological Citizenship's "principal virtue is justice", but it also leaves the question *whom is responsible for it?* And *how should it function and or be designed?* (Wolf *et al.*, 2009). These large-scale challenges are; complex, socially responsible design spaces. The author advocates for 'Ecological Citizenship', transcending consumerism, undertaking challenges, impacting culture, enacting sustainable change, intervening in cultural habits and empowering resilience. One example of 'Ecological Citizenship' is voluntourism. In 2019 infamous nature retreat, the Faroe Islands, closed their doors and jetties to reduce the impacts of tourism on wildlife, conserving landmarks and habitats. Visit Faroe Islands reported, within 24 hours of registration opening for 100 voluntourism places, 5,886 people applied to spend April 2020 working. The author sees 'social citizenship' as inspirational but inaccessible to all.

A more local Ecological Citizenship example is "citizen shepherds", where Sussex Wildlife Trust recruited local dog walkers and trained them how to evaluate livestock's condition (at a distance) (Blencowe, 2013). This mutually aligned participants daily activities with a higher purpose, without requiring extra time or intervention. Ecological Citizenship, should be embedded within communities large and small, urban and suburban from all social classes and not something that should be forced, but encouraged. This should not be viewed akin to 'eat your greens and you will grow up strong', but an indication that the act of engagement has contexts, ramifications and outputs. It should be embraced as actions individuals, communities and organisations can take to improve their surroundings where possible and appropriate. To build sustainment, design proposals should be embedded "within the diverse array of communities in affluent societies is the social connectivity that binds us together rather than divides us. The present [agendas are] not harnessing this connectivity, but the future should" (Cutter, 2019).

My Naturewatch Context

Through collaboration(s) with experts and grassroots communities, the My Naturewatch project fosters 'active community engagement': downloaded 4,000 times, estimated 2,500+ cameras constructed, 26 workshops (run by the research team) with another 20 sessions (and counting by the day), run independently of research team by conservation, civic or cultural institutions / organisations… that we know of, with users well outside researcher's comprehension. The known audiences we have engaged include: old aged pensioners, teenagers, school children, citizen scientists, museum volunteers, museum directors, families, conservation experts, technology experts, museum visitors, technology novices, bird watchers, online audiences, cinema goers, conservation projects, communities, MP's, NGO's, animal hospitals, cultural institutions, infant schools, broadcasters, woodpecker societies, camera clubs, social media audiences and more.

Designing for Active Engagement

Public engagement can often be seen as a 'bolt-on', a dissemination activity, and often a passive rather than an active process. Open Design enables design to move beyond professional realms as designing "has to be made present as an activity that extends well beyond the rubric of designers" (Fry, 2010). Engagements are intent on enabling participants to transition beyond consequence mitigation to active activities. The UK Research and Innovation (UKRI) "believe that research and innovation should be responsive to the knowledge, priorities and values of society and open to participation by people from all backgrounds" (UKRI, 2020). In their 2019 report, they highlight two concerns: "nurture a future generation passionate about research and innovation, [and] listen to public concerns and aspirations" (UKRI, 2020). We are proposing these can be co-created with audiences, and be integrated into designed engagements (UKRI, 2020). This design space is interesting as it takes design practice into public spaces, homes, and the communities it is intent on engaging with. Culturally we are disconnected with material value, repairing (Schmid, 2019), and underestimate the damage of extracted natural resources used in products, creating [a] loss of 'consumption perspective' (Young & Rosner, 2019). The materials within Active Engagement require rethinking. They are not solely digital and/or traditional: wood, metal, plastic. They are embedded systems, ticket machines, cultural institutions, digital bus stop signage, maker spaces, distributed materials, off-the-shelf parts, builders' merchants, catalogues, festivals, community spaces, vending machines, recycle stores, service stations, leaflet displays, accessible resources, local non-government organisations, community resources, tourist offices, downloadable plans, broadcasters, social media, WhatsApp groups, radio stations, paper tear and share signs, digital resources etc.

The benefit in providing agency to groups is almost like a new form of democracy and/or empowerment. Citizen "engagement is not only a basic element of democratic systems, but it is also crucial for other elements of democratic systems" (Dasandi & Taylor, 2018). Public "disengagement with democracy can provide fertile ground for populism", i.e., serendipitous research through design, helps explore new and rich territories (Dasandi & Taylor, 2018). The definition of a material is "information or ideas for use in creating a book or work" (Dasandi & Taylor, 2018). We think Engagements should be treated in the same way, as they can manifest deep impacts (Dictionary, 2006). Engagements have different scales and levels of engagement,

from DIY movements and people creating their own technologies, through to simple garden observation. Citizens have a major role to play in addressing the challenges to a sustainable future. For example, "Doing It Together" Science (DITOs) implements many innovative participatory events across Europe, focussing on the active involvement of citizens in two critical areas: the cutting-edge topic of bio design and the pressing area of environmental monitoring" (Hackalay, 2018). Whilst there are challenges for how we engage the natural world, there are also challenges in how we engage each other in it.

This **Engagement(s)²** as material agenda, forms a trajectory for a blending of disciplines and in time the most powerful social relations that we will utilise, in which to enact the biggest changes towards reaching a sustainable planet. Engaging Design: "showcases creative material, models and methods for transformative action. Sustainability is arguably a human construct born from a necessity to reengage with our relationship to a range of issues" associated with our biosphere dependency (Phillips & Gant, 2020).

Design-led Frame

In *Research into Art and Design*, Frayling identifies three approaches: Research into Design, Research for Art and Design and Research Through Design (Frayling, 1994). Our agenda falls into Research Through Design as the process of including stakeholders and communities can often yield mixed results. The act of including people within the design process is traditionally Human Centred Design. This has taken many forms; Participatory Design, Co-design, User Centred Design and more, with each process having different subtleties and nuances making them unique. However, the main point of difference is that this process is 'intent on actively engaging audiences' and driving objectives informing their agency. The emergence of *Society Centred Design* forms strong principles: design for sustainable development, confronting uncertainty, working with co-pilots for the common good, re-distributing the power of tech, ensuring fair and just oversight, designing for people's rights, creating patterns for public value, empowering collective agency, earning trust and putting care first (societycentered.design). As a discipline Planet Centred Design refocuses our attentions.

> *"Our planet is threatened by human activity, propagating a human centric worldview is no longer adequate. The anthropocentric worldview unavoidably follows unsustainable development and to sustain life on earth. Human centric approaches are weak with regard to agency. I use the term [agency] exclusively for a person acting on behalf of other parties, non-humans and environments. Agency in design becomes ever more important, to include secondary users, affected bystanders or non-users, or non-human beings affected by design interventions"* (Sevaldson, 2018).

Sevaldson highlights systems thinking approaches to proposed solutions and over time build resilience by using discursive methods. We need to surpass Human Centred design principles and centre ourselves around the environment, the wildlife, materials, impact etc. The ED approach values serendipity through engagement, building a research through design approach.

> *"Empower[ing] local people: any design action that rearranges places and relationships is an exercise of power. A good test for sensitivity of a design proposal is whether is enables people to increase control over their own territory and resources [i.e., reciprocity]. The principle of reciprocity: anyone who takes from the commons has to contribute from the commons"* (Thackara, 2015).

In totality, Thackara sees grassroots and bottom-up opportunities as form of citizenship and form of human rights, which is the material language of Engagement. These two principles are paramount as they proliferate agency and a notion of collaboration, no matter how small. We "must end this obsession with perpetual growth, change is most likely to happen when people reconnect – with each other, and with the biosphere – in rich, real-world contexts" (Thackara, 2015). We are living at a time of transition from Human to Planet centred design and engage communities within that challenge. We still need to understand challenges within context by and for communities, whilst moving beyond sustainability to empower sustainment.

Engagement as Activity: an activity, initiative or event

The Urban Barley Field (LasnaVILJAmägi)
Estonian design/agricultural installation, encouraged locals to change their neighbourhood. The grassroots crowdfunded project was built and cut by volunteers. Harvested crops were gifted to funders; with some laboratory tested, calculating the areas pollution levels. The "project inspired locals and authorities to enliven the traffic channel with 38 flowerbeds" (Press, 2020). The impacts were encouraging local government into funding pilots for urban food in the area, a rich area for design.

Engagement as System: complex relationships between people, institutions, ideas, places etc

30 days wild
Annually in June, thousands of people participate in the Wildlife Trusts nature challenge, 30 Days Wild. By participating in one "wild thing a day throughout the whole month: for your health, wellbeing and for the planet in 30 simple, fun and exciting Random Acts of Wildness" (The Wildlife Trusts, 2018). These examples are tied into specific locations, times, networks and are interconnected by stakeholders, interdependencies and systems.

Engagement as Relationship: the idea of a relationship between two parties

Public Lab Balloon mapping
Balloon mapping is a low-cost way to take aerial photos using a camera, attached to a balloon, on a spool of string "from a few hundred feet up all the way to over 4,000 feet in the air" (Warren Jeffrey Yoo, 2012). Both examples form a link between users, makers, communities and collected data, the relationship becomes intertwined relying on all parties. Both examples contribute toward 'Engagement as Material' as they both form a relationship between communities, methods and take engagements into people's homes.

Engagement as Process: processes of research or knowledge-to-action

Zooniverse
A citizen science platform that enables everyone to take part in real cutting-edge research in many fields across the sciences, humanities, and more. The Zooniverse creates opportunities for you to unlock answers and contribute to real discoveries (Zooniverse, 2013). These examples include opening a dialogue between parties, within a tight process that transfers knowledge-to-action.

Engagement as Affect: A final configuration

The My Naturewatch (NW) Project
The My Naturewatch camera can be adapted by novice or expert and provide unity across communities. It contributes to **Engagement²** by going beyond participation as it is open to public response and enables others to build their own resource at low economic cost.

My Naturewatch Active Engagement

I view engagement as a material that requires contextual knowledge in its use and ethical deployment. The design team have engaged with national design and nature organisations to enhance their approaches to participation including workshops and public facing digital 'making' events at various institutions. These include The Design Museum, The Victoria & Albert Museum, The National Trust, The Wildlife Trusts, Kew Gardens, The Durrell Trust (who used the NW toolkit to monitor the reintroduction Storks to the United Kingdom), Suffolk Wildlife Trust, Bedford Wildlife Trust, The Knepp Estate (The UK's first and world-leading rewilding project), Ouse & Adur Rivers Trust (introducing a new river course way), Frog life, 'Eco Young & Engaged Summit', Doncaster Library (running open tech workshops for the first time) and Coder Dojo's. Research presentations were given at NASA Florida, Disney World, Priestman Goode, Smart Design London & New York, Richmond University, Kingston University, The Design Museum.

The recorded impacts (to date) include: participants changing their landscape architecture and adding ponds to encourage wildlife, OAP's and grandparents stating they felt "reskilled" (after workshops), feeling reconnected with nature, transforming leading design museum outreach teams' approach to sustainability.

The project is being used as Sussex University's outreach for their ecology department's work with schools and is being used by leading conservation organisations. The Durrell Trust use the tool to engage teenagers with the natural world: an initiative central to their strategy for engagement in 2020-2021, and something that would never have happened without the My Naturewatch project. An audience produced a cinema trailer running for one month over the 2019 Easter Holidays showing before every film in an independent cinema. Through the 39 workshops and engagement activities, participants: learnt 'gateway technology skills' that build confidence and translate into a wider platform, learn more about their surrounding wildlife, and develop an interest in the outdoor world.

> *"This project has allowed me to look at things in a completely different way in my tiny little garden", "It's opened my eyes, that experience of not only going to the Design Museum, but going around Holland Park, and then going back home, taking photographs. But it just opened my eyes to something that I hadn't actually experienced before. So, that is of great value to a very old man. Because I'm 83, you see"* (NW Workshop participant).

A retired town planner in his early eighties was explicit that it was the ability to combine his interests in a way that felt intuitively exciting and right to him, that first persuaded him to get involved:

> *"I think it's the package. I think it's an interesting package. It was not only a workshop to make a camera. It was more than that. It was how to use that, and introduce another interest, you know, at the same time"* (NW Workshop participant).

After following their behaviour with the camera, another participant came to see this "problem" behaviour as a natural attempt to survive in an urban environment, one as valid as her own strategies for living in that space.

> *"I've come to some sort of acceptance of the foxes and the squirrels, and I've adapted my behaviour to accommodate their lifestyle, to protect my plants, and things like that. I used the plastic orange nets off fruit to cover the [bulbs]… if I can, to peg out and stop the squirrels digging…"* (NW Workshop participant).

We have also witnessed community groups and participants develop new social relationships through their engagement with the project in urban environments that previously felt more disconnected with nature. Participants have landscaped their gardens to encourage wildlife. People have realised that there is no wildlife on their housing estate. Conservation broadcasters shared new content. People shared content from live wildlife festivals and participant content has been used internationally.

The project has been designed to nurture relationships with communities through opensource technologies, without relying solely on researchers. The toolkit can be accessed by schools and experts and parts can be purchased economically online. This has led to a training scheme where project staff imparted knowledge to leading organisations so they could in turn train others. The demographics of people that the project has impacted on range from 6 – 83 with a vast array of backgrounds, technophobes to techno geeks, wildlife activists to people who are just buying bird feeders. The bigger picture of the project is about creating engagement with the outdoor world, through technologies that people can construct on their kitchen table without specialist tools or knowledge. The key organisations in these endeavours have been The Design Museum, The Durrell Trust and The Wildlife Trusts.

A participant was drawn to My Naturewatch cameras because he felt strongly that a change in perspective could reveal things we ignored, or things we take for granted, and the natural world was at risk of this as much as the built environment:

> *"People don't use their eyes. They tend to look either horizontally or down, but never look up. […] That, I think, was the interesting aspect. That, in fact, by doing the photography, one might well see things that, with the normal naked eye, just sitting at your window [you would not]"* (NW Workshop participant).

A retired woman in her seventies with little pre-existing knowledge of either the natural world or the technology involved, considered making the camera to be integral to the purpose of her involvement:

> *Interviewer: What is it, do you think, about the fact that you did a workshop making one that's different to, say, going and buying one? Participant: "Oh, gosh, the world. Absolutely the world. […] To make a thing, that was amazing"* (NW Workshop participant).

Wider more strategic impacts have included organisations and created an embedded legacy for the project including; The Wildlife Trusts, The National Trust, The Durrell Trust, The Knepp Estate and many more organisations within 'nature'.

> *"My NatureWatch is playing a central role in helping us develop the 2021-2031 strategy for a Wilder Future". We are using the My Naturewatch project as an impactful case study that we are building off to build our future strategy, without the My Naturewatch project we would not be thinking like this and or encouraging the use of technological approaches within our means. Whilst this project has started by building an opportunity within #30dayswild (our leading engagement programme) it is enabling us to transform and inform our thinking from a public led opportunity"* (Director for Campaigning & Policy, The Wildlife Trusts).

The overarching findings are inter-woven throughout this entire book, academic publications, workshops and a plethora of material that could not been included here due to print restrictions. The conclusion is based on all of the deployments, designed engagements, interactions with users, serendipitous engagements. The findings are conclusive, the My Naturewatch project has provided agency, adaptability, empowerment, repairable research tools and been open / inclusive to as many parties possible.

I believe in providing agency to groups, as a new form of democratic empowerment. Citizen "engagement is not only a basic element of democratic systems, but it is also crucial for other elements of democratic systems" (Dasandi & Taylor, 2018). Public "disengagement with democracy can provide fertile ground for populism", i.e., serendipitous research through design, helps explore new, rich territories (Dasandi & Taylor, 2018). Engagements have different scales and level of engagement from DIY movements and people creating their own technologies, through to garden observation. Whilst there are challenges for how we engage the natural world, there are also challenges in how we engage each other within it. In Designing in Dark Times: An Arendtian Lexicon, a contemporary critique on design concludes that we must;

> *"support the new generation of designers, not only in employing solid craftmanship and technology skills but also to collaborate, empathize, and bring design capacities to the whole of society, they may take on roles of responsible designers with the ability to help collaboratively shape conditions for human existence"* (Tassinari & Staszowski, 2020).

with the public and stakeholders, we are compelled to design for humans and communities, not scenarios and personas. I believe that 'engagement' will be an important force to enact sustainable transitions and to develop a new paradigm of arts and design practice. To this end the numerous versions of how we might engage with things and others deserve to be explored. The intention highlights the need for producing art & design research with appropriate communities whilst acknowledging the criticality to imbed outputs, enacting change and producing impactful alternatives.

> *"We must celebrate the joy of nature, share her wonders with children, scrutinise the policies of shallow politicians, invest our savings in schemes that improve our environment, not those that fund environmental destruction, while upholding the laws that protect our wildlife. It is essential to understand that our lives are connected to every living lifeform"* (Mears, 2021).

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Live workshop in the Victoria & Albert Museum, London.
Photo Credit: James McCauley Photography.

Camouflage of a NW camera, by a participant at the 'Training the Trainers' event.
Photo Credit: James McCauley Photography.

"Made by Me" families workshop at Wakehurst Place.
Photo Credit: James McCauley Photography.

Collaborative camera deployments with The Design Museum and Holland Park Ecology Centre as part of an over 60's tech group, run over 1 month to re-skill, review and reconnect locals to their wildlife.
Photo Credit: Dr Rob Phillips.

Training the Trainers event, imparting insight, knowledge and lessons to over 16 wildlife organisations. *Photo Credit: James McCauley Photography.*

Work with Kew Gardens Wakehurst place site. *Photo Credit: James McCauley Photography.*

Work with Kew Gardens Wakehurst place site, running open family workshops, building collaborative building and cross-generational interactions.
Photo Credit: James McCauley Photography.

Trials and deployments with The Natural History Museum staff, pre-Covid-19, to instigate staff-led activities with their visitors.
Photo Credit James McCauley Photography.

Family workshops at Wakehurst place, opening up live participation and activities in working cultural institutional locations. *Photo Credit: James McCauley Photography.*

Deployment in the Natural History Museum as part of engagement training for staff. *Photo Credit: James McCauley Photography.*

Working with the Knepp Estate and the White Stork Project. Helping their volunteers to use the cameras to monitor their stork enclosure to successfully understand movements and habits. *Photo Credit: Lucy Groves, White Stork Project.*

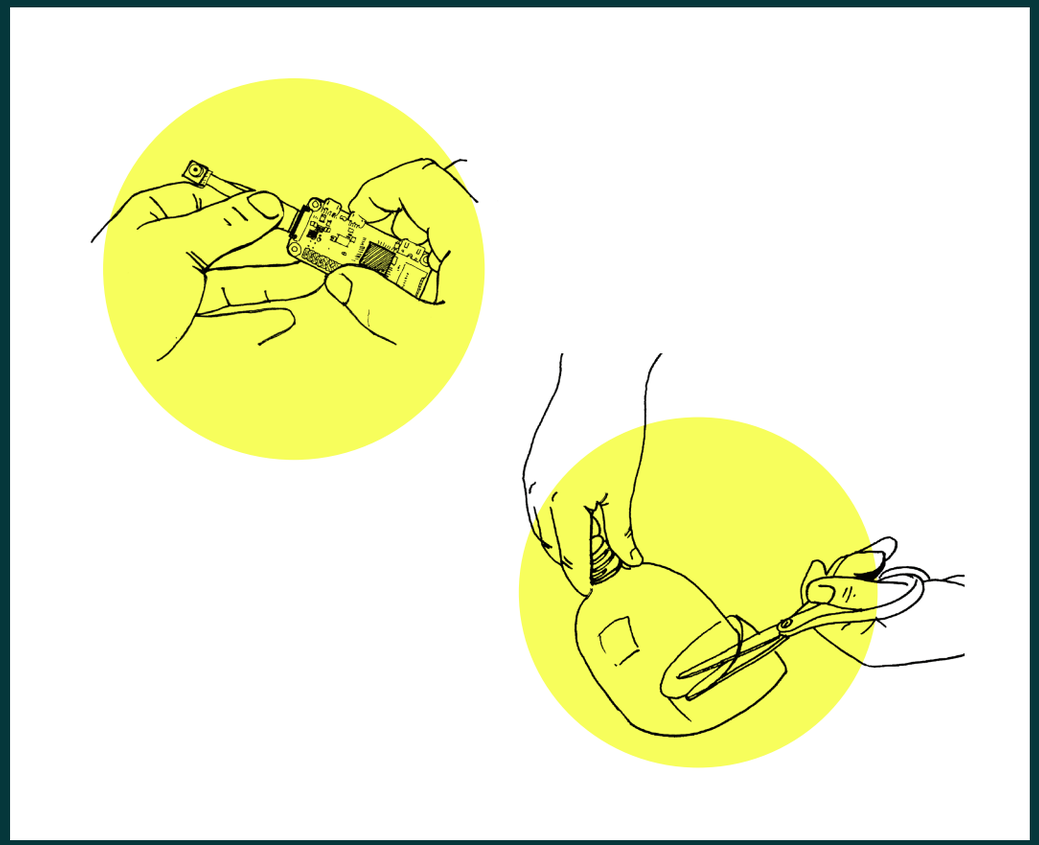
The team worked with The White Stork project, which is located on the infamous Knepp Estate and is part of The Durrell Trust. The White Stork Project is led by a pioneering partnership of private landowners and nature conservation organisations, who are working together to restore a population of at least 50 breeding pairs in southern England by 2030 through a phased release programme over the next five years. The My Naturewatch project enabled volunteers to log flightless storks' tag numbers, checking their health, location and behaviours. *Photo Credit: Lucy Groves.*

The project produced a 3 minute community trailer that was played in the independant cinema, *The Depot Lewes*, over Easter 2019. The trailer was collaborativley shot and edited, reaching an audience of over 15,000 people.

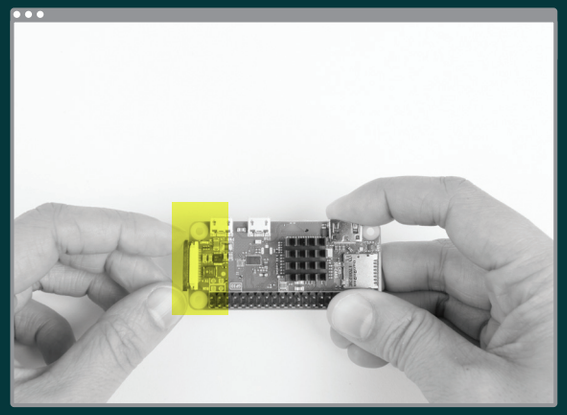
INSTRUCTIONS

There are five stages to making a My Naturewatch Camera. Here we show selected steps; for complete instructions visit mynaturewatch.net/make

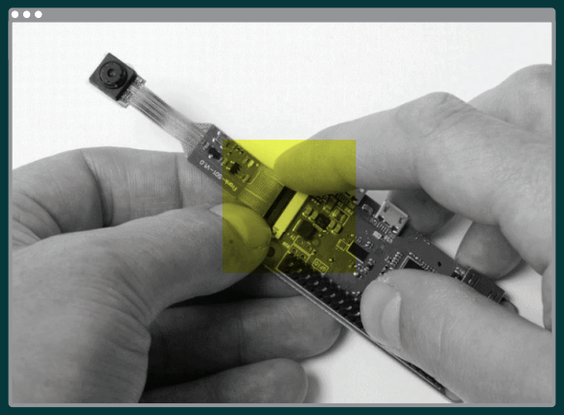
Download the Software. The camera software needs to be installed on the SD card from the Internet. The Raspberry Pi Zero will read the software from the SD card to become a My Naturewatch Camera. **Assemble the Electronics**. Here you will attach the camera to the Pi Zero. It's a little fiddly, but with patience you'll manage. **Test Your Camera.** Now you can power up the camera and see if it works. **Make the Camera Housing**. Assuming you have a working camera, it's time to make a weather-resistant case for it. **Assemble the Camera.** Finally, you're ready to fix the camera inside the housing and try it out!



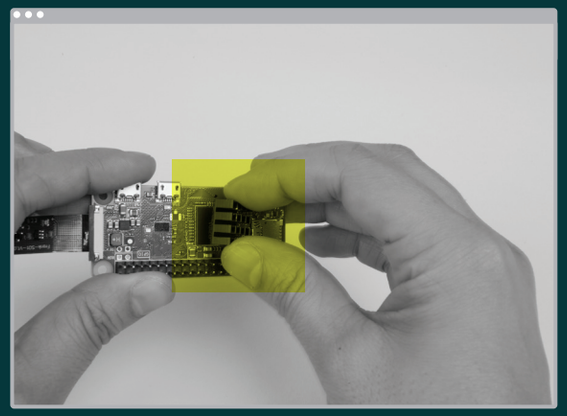
The whole process should only take 60 - 90 minutes.



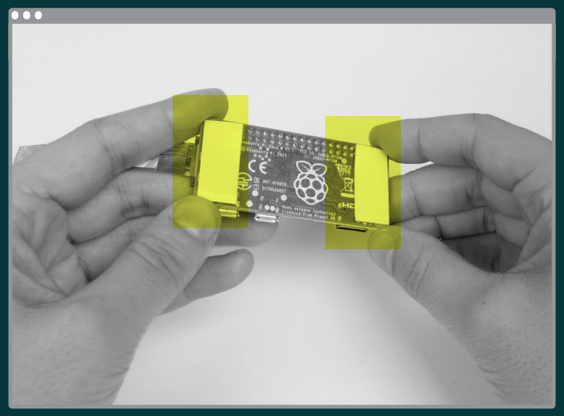
To attach the camera module to the Pi Zero: unclip the black locking strip away from the white camera connector on the Pi Zero - it should move outwards by 1mm and feel loose.



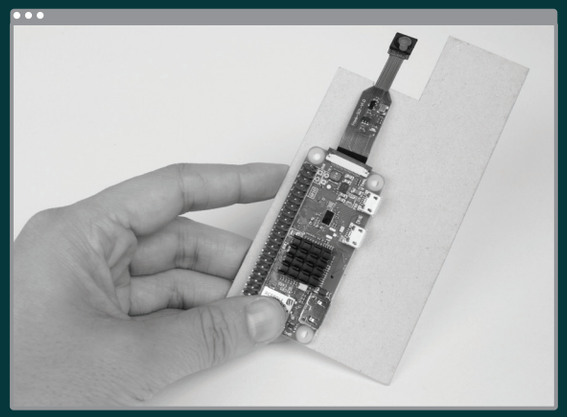
Now insert the camera module ribbon under the black strip and into the white connector - the metal side of the camera ribbon should face toward the green board. Secure the ribbon by re-clipping the black strip towards the white connector.



Attach a heatsink. In order to dissipate heat from the processor it is necessary to attach a heatsink. Raspberry Pi heatsinks generally have self-adhesive tape already applied.

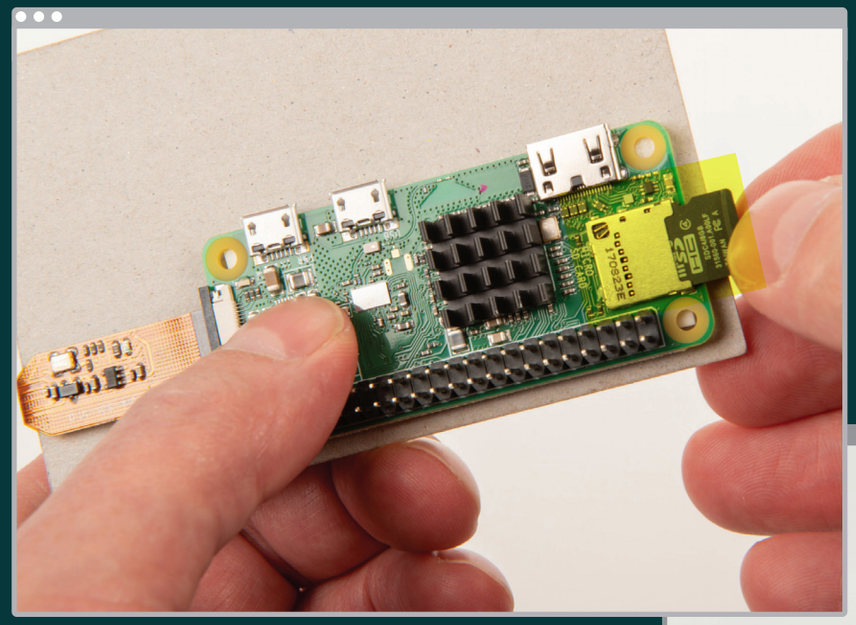


Stick your camera onto a piece of cardboard. The ribbon cable of the camera can easily detach from the Pi Zero. We recommend mounting the camera and Pi Zero to a piece of card to protect the connection.

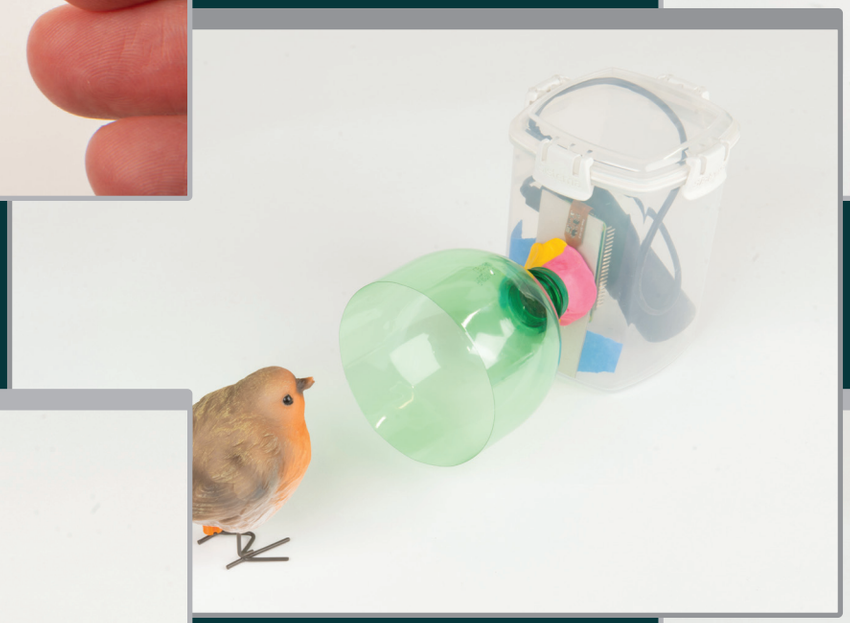


Use a stiff piece of card appropriate in size to the container you plan to house the camera. This shape is optimised for use with the Sistema Kip It 900ml cracker box. In this version, the camera and Pi Zero are mounted on opposite sides of the card.

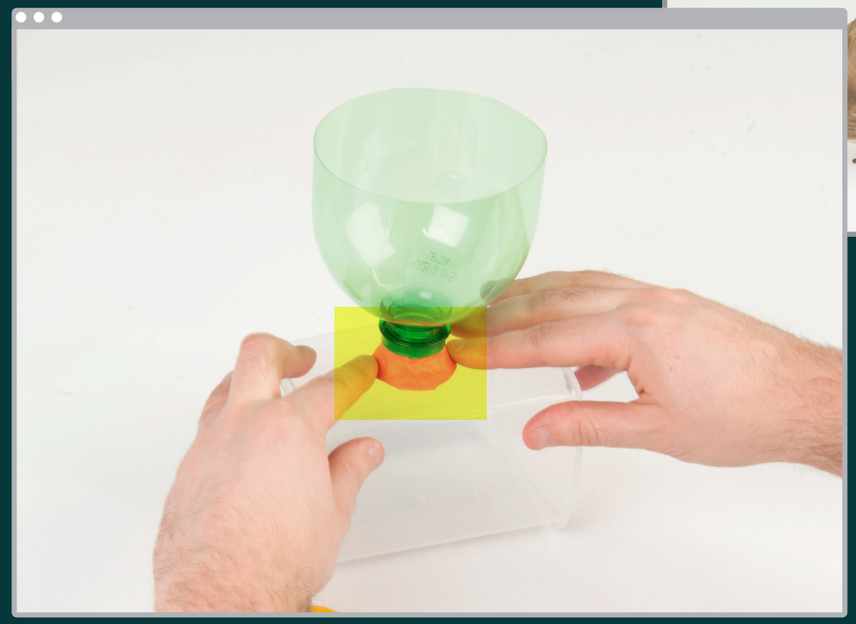
Carefully fold the camera cable ribbon cable at its narrowest point around the top of the card, remove the protective layer of the sticky tape that is factory mounted on the back of the camera, and stick to the other side on the card.



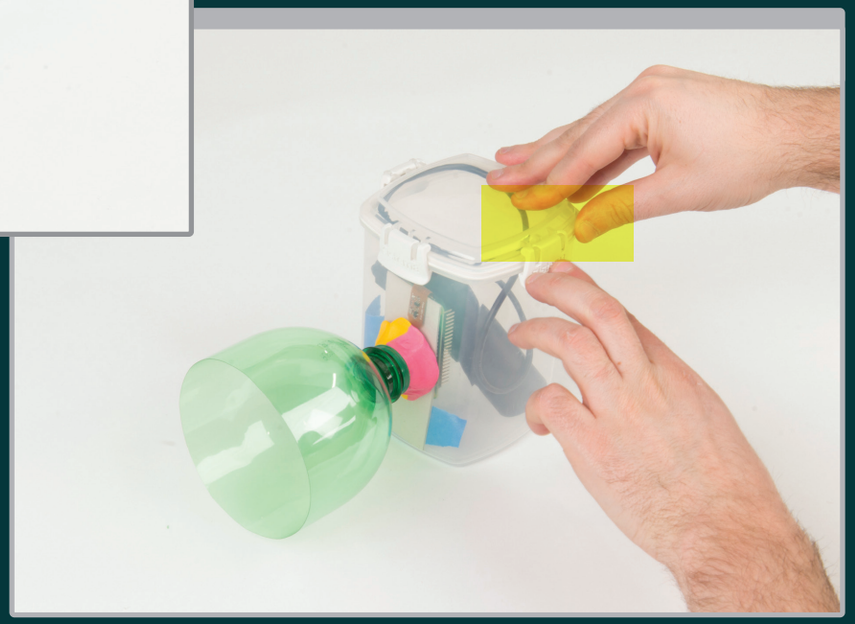
Insert the micro SD card. Insert the micro SD card into the silver socket on the Pi Zero - the metal contacts on the SD Card should face toward the green board.



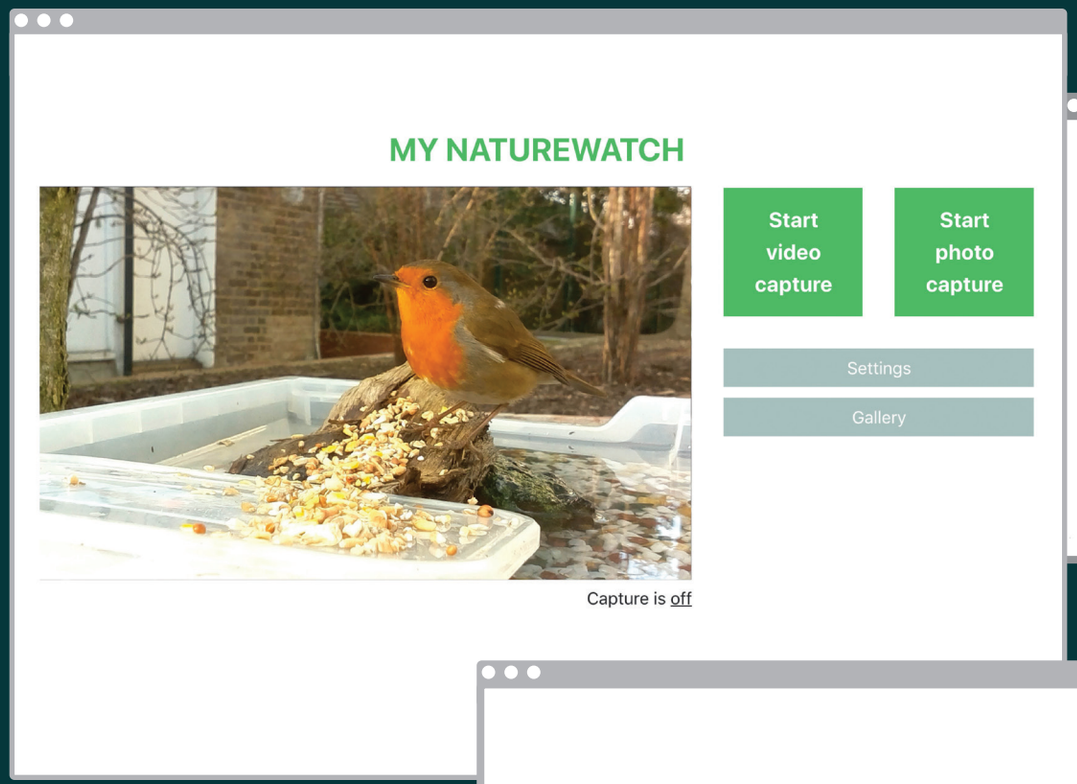
Position the electronics inside the container. Tape the cardboard camera mount inside the container, with the lens positioned to look through the hole you drilled. Attach the battery pack.

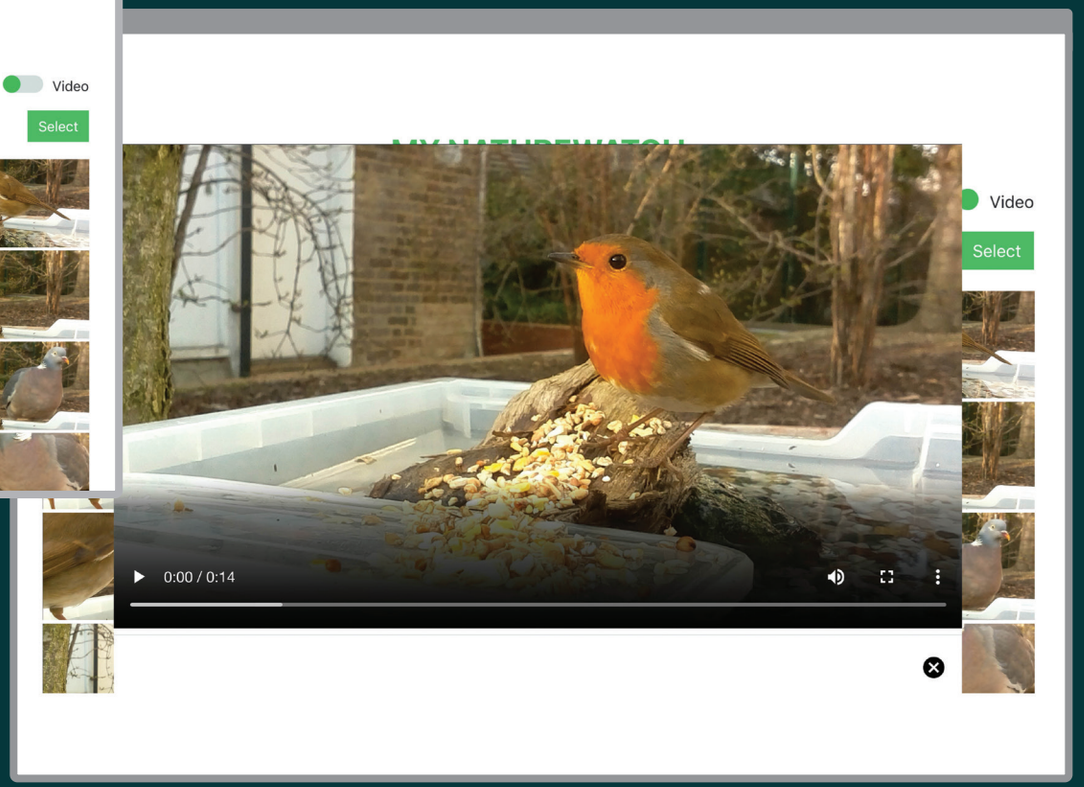


Attach the bottle to the food container. Position the drinks bottle cover (with or without the cap) over the opening in the food storage box and make a waterproof seal using a hot glue gun, Sugru or household sealant.



Seal the lid. Seal the lid - you now have a weatherproof My Naturewatch Camera!
Tip: Unplug the battery when you're not using the camera to save power.

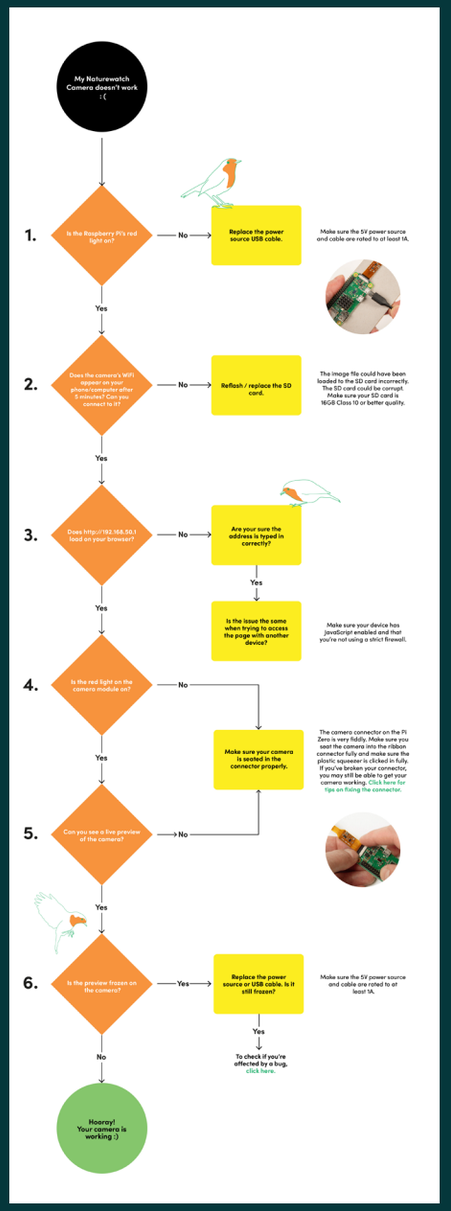




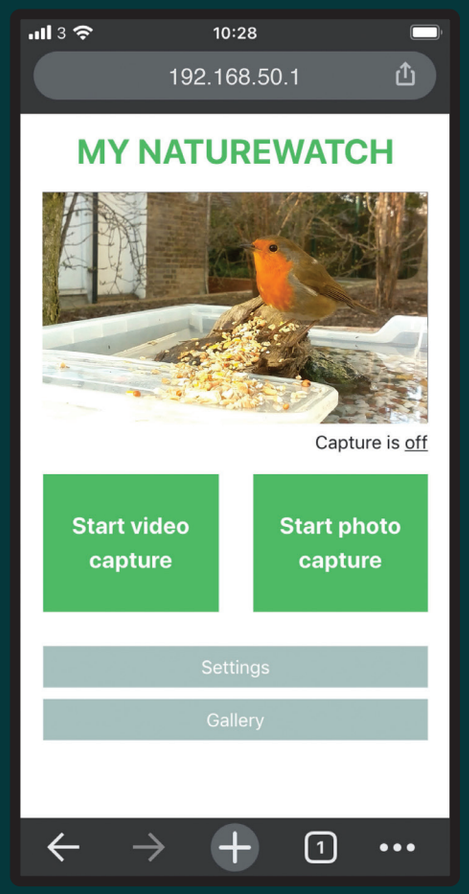
Start recording

The My Naturewatch Camera works by continuously monitoring the live preview feed for movement. To start this process select ‘Start Video Capture’ or ‘Start Photo Capture’ depending on the type of media that you would like to capture. The camera will now be taking photos/video automatically and the selected button will change to a red ‘Stop Capture’ button. All the recorded media will be stored within the Gallery. Press the ‘Stop video capture’ or the ‘Stop photo capture’ button to cease capture.

The live preview feed in the browser window is useful to setup your camera and frame the area you want to monitor for wildlife, but it is not intended for continuous use. Once the My Naturewatch Camera has been set up and the image capture begun, disconnect by closing the web browser window, whether on phone, tablet or computer. Keeping the live preview feed open in the browser will drain the battery and put extra strain on the Raspberry Pi which could lead to overheating issues.



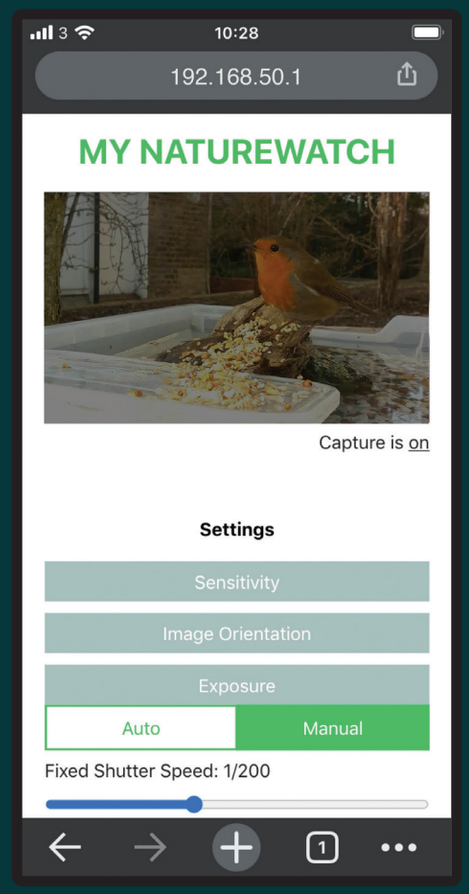
Use the following flow chart to do an initial check-up of your camera.



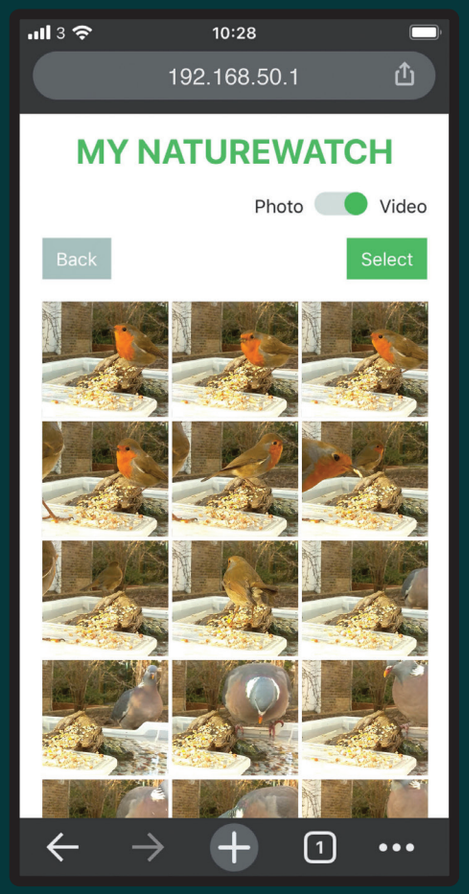
Access the camera with your browser. In your web browser, type out the following IP address into the address bar:

192.168.50.1

You should see the live preview feed from your camera along with the following simple control buttons: Start Video Capture, Start Photo Capture, Settings and Gallery.



Change Exposure. By Default, the My Naturewatch Camera is set to automatically control the exposure of the image. However the exposure can be set manually if the scene has mixed lighting conditions, or if you would simply like to modify the shutter speed to create different effects.



Using the gallery. Pressing the ' Gallery' button on the main screen will lead to a new page showing all the pictures the camera has captured. In this page you will be able to preview, save and delete the media. The features of the gallery change depending on the device you are using.


MY NATUREWATCH CAMERA