Research: The Climate Machine creates a dialogue between the data collected by scientists in an observatory in Hawaii since 1959, and the space and time experienced by the audience. It enables the data to become tangible, by drawing the data in real time onto the paper as circular graphs, representing the ever increasing circles tree rings, as carbon dioxide in the atmosphere has increased. This recorded data is juxtaposed against the live, situated data coming from the trees in both forests, located in the here and now and collected by the artists from a tree that the audience can stand under and perceive for themselves. The dialogue that is created by these tangible interpretations of the two data sets intervenes with our preconceived ideas of what data is, how it should be represented, and how to understand data in meaningful ways, as metaphors, stories and aesthetic experience. The machine enables people to see the data present and to make connections between wood, burning, trees, paper and carbon dioxide, revealing layers of meaning embedded in the data and demanding questions of the viewer that the pure statistics might not do on their own. Physicality is very important to this in a number of ways. Burning the data into paper takes something completely intangible and gives it a material form. The burning of the paper is a very physical process, much more so than if we just used a pen or printer to draw - the extent of the burn varies depending on the size of the circle, it produces heat, and you can smell it. Although we're using recycled paper, the use of a destructive process on a material that is linked to deforestation is also very confrontational and was perceived as quite provocative to some of the audience.

Audience: "The machine is, without knowing it, inside out, it seems to be doing a graph. It must have some sensor or little scientific sort of

The soldering iron and mechanical arm of the climate machine

Looking down over the Climate Machine as it burns carbon dioxide levels from 1959 as a circular graph onto paper

and out.

It moves very slowly to scorch the paper effectively, so it takes about 25 minutes to complete a single drawing. The machine sits in the middle of the exhibition, between two real time visualisations of environmental data, the idea being the machine connects the present experience of the forest visualised within a more temporal scientific perspective of climate change.

"There is a point where the clearing, the landscaped space inhabited by us humans stops and the boundary, a dark line of trees, appears in front of you. The edge of the forest. If you cross this line you become submerged. The light changes, shadows deepen, sounds are layered and you can breathe deeply. There are new rules."

Introduction

Active Ingredient is an award winning artist-led group founded in 1996, creating interactive artworks merging art, technology and science.

'A Conversation Between Trees' is our latest project, a touring artwork that connects forests in the UK with forest regions in Brazil. It has evolved since August 2010 involving five artists' residencies, three exhibitions, and many more public interventions across both countries.

The resulting interactive artwork reveals unseen aspects of these forest environments. Each element of the exhibition provides a clue for visitors to piece together an unfolding story of 100 years of the forests and climate change.

Active Ingredient is Rachel Jacobs, Robin Shackford, Matt Watkins and Rebecca Lee in collaboration with Silvia Leal, Matt Davenport, Mark Selby and Mike Golembewski, working in partnership with Dr Carlo Buontempo, Head of the Climate Adaptation Team, MET Office Hadley Centre, UK, Prof. Mario Jorge Ferreira de Oliveira and researchers at the Horizon Digital Economy Research Hub.

The artists' residencies and the exhibitions were commissioned by Fermynwoods Contemporary Art, Yorkshire Sculpture Park, Nottinghamshire County Council Arts and Leisure Services (at Ruffford Craft Centre) and the Centre for Contemporary Art and the Natural World.

Light through an Oak Tree, Sherwood Forest, UK

Light through the Tijuca Forest, Mata Atlantica, Brazil

Conditions of practice

The artwork 'A Conversation Between Trees' has been created alongside my doctorate research at the Horizon Doctorate Centre, at the University of Nottingham. I am one of the founder members of Active Ingredient, and have had a key role in developing the project since the first conversation about connecting British and Brazilian forests took place, with Marcelo Godoy and Paulo Hartmann from Mobilefest, over Caipirinhas in Sao Paulo in 2008, leading to our initial research project 'The Dark Forest'.

My doctorate research explores the opportunities and potential value of artists' interpretations of environmental data, as part of an interdisciplinary PhD entitled 'The Artist's Footprint'. This involves practice based research alongside more traditional qualitative ethnographic methodologies. I am based in a computer science department and approaching this research from both an arts and human computer interaction (HCI) perspective.

By merging arts practice and research as part of 'A Conversation Between Trees', three stories have begun to emerge – the story of the artwork, the artist's story and the researcher's story. These are becoming the new conditions of my practice.

This collection of thoughts and experiences is brought together from all of the key artists involved in the project and the audiences that took part. Each section is a literal exploration of the materials, conditions, research and audience involved in the project, providing us with an opportunity to bring together comments, extracts from interviews and research documents. It is our hope that this creates a series of snapshots – new conditions of practice – from this

A Conversation Between Trees

Active Ingredient

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ambitious project that merges art, science and technological practice and research through a dialogue that spans the Atlantic Ocean, from English to Brazilian forest regions, between audiences, scientists, technologists and artists.

Rachel Jacobs

Diagram of elements of the artwork and technical infrastructure

A Dialogue Between Artists and Scientists

Materials: A VW Camper Van, Skype; A broken record player; Mauna Loa Series Carbon Dioxide Data recorded at an observatory in Hawaii (ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt); Predicted future scenarios of carbon dioxide levels from the IPCC based on a worse case scenario (www.ipcc-data.org).

Conditions:

A dialogue between artists and scientists has taken place during 'A Conversation Between Trees, in two parts since August 2010. Active Ingredient were invited by Estudio Movel Experimental (EME) to be artists in residence on board a VW camper van in November 2010. EME is an experimental mobile studio that functions as a mobile interface for the arts and sciences to take action upon the city of Rio and its urban and natural spaces through observation, negotiation, participation and play, led by and in collaboration with the artist and curator Silvia Leal. Taking part in EME enabled Rachel, Matt and Silvia to spend time at the Rio Botanical Gardens with the botanist and artist Bruno Rezende, to talk with Dora Hees, scientist and director of the beautiful Guanabara Bay Institute in Niterói, and visit Nicholas and Raquel Locke at REGUA – a conservation site deep in the Mata Atlantica mountain region of Serro do Mar. This dialogue resulted in a series of interviews, photographic documentation and ongoing conversations about the Mata Atlantica.

Back in England from August 2010, Active Ingredient had also begun a dialogue with Carlo Buontempo from Hadley Centre, UK MET office about creating a way to interpret environmental data related to

Credits

Active Ingredient have developed a reputation since 1996 for creating award winning interactive artworks merging art, technology and science. Active Ingredient create innovative artworks that bring together location, social networking, bio and environmental sensing, data collection and play. Their work has included installations, large scale projections, mobile phone games and performance. Their work is often interactive and generated in collaboration with the audience, other artists, scientists and technologists.

A Conversation Between Trees has been funded by Arts Council England, Nottinghamshire County Council and part funded by the RCUK's Horizon Digital Economy Research Hub grant, EP/G065802/1. The tour has been commissioned by Fermynwoods Contemporary Art, Yorkshire Sculpture Park, Nottinghamshire County Council and the Centre for Contemporary Art and the Natural World. CCANW is grateful to the Jerwood Charitable Foundation for the grant to support A Conversation Between Trees.

The installation is sponsored by Arjowiggins Graphic and Antalis McNaughton.

With thanks to the Rio Botanical Gardens, Bruno Rezende, the Mixed Reality Lab (University of Nottingham), the Forestry Commission, Lizzie Haines, Juliet Robson, Gabriella Giannachi, Bronac Ferran, Paulo Hartmann, Marcelo Godoy and Mobilefest.

Thank you to Fran Junqueira and Fabiano Araruna for their invaluable participation in the walk in Tijuca Forest event.

Photographs by Rachel Jacobs, Rebecca Lee, Silvia Leal, Mark Selby, Matt Davenport and Robin Shackford.

Text by Rachel Jacobs, Rebecca Lee, Silvia Leal and Mark Selby.

Extracts taken from an interview conducted by Nottingham Visual Arts.

Rachel Jacobs and Mark Selby are supported by the Horizon Doctoral Training Centre at the University of Nottingham (RCUK Grant No. EP/G037574/1)

climate change. Carlo presented us with data sets of recorded carbon dioxide levels in the Earth's atmosphere since 1959 and we created a set of experiments exploring how to represent this data in a way that revealed that which we cannot see in tangible forms. Through this dialogue we built the climate machine, a tactile, kinetic object that attempts to relate carbon dioxide to forest environments. The first prototype of Active Ingredient's climate machine was made out of a broken record player.

Record player used to prototype the climate machine

Meeting Dora Hees, Director of IBG, Niteroi, Brazil

Human Sensors

Materials: Temperature, humidity, atmospheric pressure, decibels and carbon dioxide sensors; A Sciencescope sensor hub and a Nokia Phone, Dark Forest sensor application; Pen, Paper; Forests, trees, air, sky; Human Body - Touch, Smell, Sight, Sound, Taste, Movement, Memory

Conditions:

The human sensor activity was developed during the first residency that took place in August 2010 at the Yorkshire Sculpture Park and the second residency with Estudio Movel Experimental in Rio de Janeiro, Brazil, by Rachel and Silvia in discussion with Rebecca, who manages Active Ingredient's participation activities. The aim was to encourage participants to embody the technology that the artists were using to sense the forest environments, using their bodies to sense the environment and compare the results with the 'scientific data' captured by the sensor kit.

Each visitor was asked to **1)** Take a photo of the light and colour looking up at the canopy of the forest, then **2)** Sense and rate the temperature, humidity, sound, light and air on a scale of 1 -10.

The artists explained that the visitors should rate the five elements in the environment based on their subjective experience of each element, e.g. for temperature they were asked to base their judgement on the coldest they had ever felt being 1, and 10 being the hottest they had ever experienced. We also suggested that they looked for other clues - in the light and shadows under the trees, the way their skin felt, by touching the earth or tree bark (particularly in reference to

data about the work, in a way that doesn't impact on your feelings about making work, and doesn't let 'too much in', in terms of self reflection?

Yet this is the point where the research is expected to occur, particularly when it comes to ethnographic methodologies. So there is a conflict between the interrogation required for reflection and observation and potential overexposure of the artist to the gaze of the audience.

Audience:

The decisions that I made as one of the artists arose from previous experience, instinct, personal and individual reflection on the world, collaborative thinking with my colleagues and playing. This is hopefully what makes the work unique, that makes it art rather than purely science and technology – and yet, by opening up the process to an analytical methodology, by conducting an ethnographic study of the way audiences engage and interpret the work, I needed to find a way to open up to their questions and answers, their concerns, desires and expectations, in a manner that didn't break through the protective wall that enables me to commit to my own creative vision.

Here lies the conflict. At the same time it is exciting and thrilling to see people re-interpreting your work, challenging it and coming up with their own solutions, ideas or stories around it. As the artist and maker you have a unique insight into the connection between the motivations behind the work and the ways that people engage with it, in a way that an objective researcher would not see. You can make necessary connections that could potentially provide new knowledge.

This experiment in itself, I hope, has created new knowledge about the reality of being an artist researcher and a new set of questions for both sides of the story.

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The sensor within a custom made box in an Autumnal Service tree, Haldon Forest, UK

humidity), using all of their senses to perceive the environment as they stood or sat under the tree canopy.

During the formal workshops this activity was then developed by participants to make their own data maps. This activity also informed the design of the Hello Tree phone experience within the final exhibition. This activity was presented as part of workshops and public interventions to schools and visitors at each residency in the UK and Brazil, with a total of 28 public sessions taking place.

MA Art and the Environment students from Falmouth College using human sensors in Haldon Forest

Artist Walk using human sensors at the Yorkshire Sculpture Park

Research:

The human sensor activity relates environmental science and geographic research to 'sensory geography'. This area of research describes how geographers conduct a 'multi-sensory' approach to understanding landscape (Rodaway, 1994), to visual and sensory ethnographic methodologies for understanding how humans sense the world around them (Pink, 2009). These methods support the artistic concepts within the artwork, how to 'humanise' the scientific data. The artistic intention (the artist's story) was to engage visitors in interpreting the data, as a narrative experience that pieced together the invisible perceptions of being a human in a forest creating a sensory and aesthetic response to this experience. The research aim was to explore how this could be embedded in the design of the experience and how it was then interpreted by the audience.

The 'human sensor' activity created a performed narrative experience of our interaction with sensor technology, in a forest. If the audience takes 'the part' of the sensor, and 'performs' the role of the technology themselves, opportunities to engage with and question the use and role of the technology can be enabled, breaking down the power relations between the authority of the 'machine' and the human as user of the machine, who often needs specific skills in order to decode the knowledge or data held by it.

Audience:

"When the students visited Fineshade lots of curriculum areas were targeted by the visit. They had data analysis to feed Maths and Geography, addressed by looking at different environments and also the arts, as they have brought artwork back to school. This could have

The Artist's Footprint

Materials: Interviews, Questionnaires, Photography, Observations

Conditions:

The story of the artwork, audience interactions and design process make up part of my doctoral research. This is the more objective story of how the project works, who the stakeholders and collaborators were, and how the audience interpreted the work.

But then there is the other story, the 'artists' perspective. This one is a much more personal story. It is about how you make decisions, when to ask questions and when to find answers. When do you open yourself up to research and when do you close yourself down to make, to ensure your vision is clear and the details are in place? How to discover that moment where the aesthetic experience and the contextual and environmental factors surrounding the experience, connect with the vision? This can be a deeply personal process, fed by expertise, your own often undocumented experience of materials, space and technology, the canon of your own and other practitioners' previous work, past research and often the resources and time at hand. In the case of 'A Conversation Between Trees', also by the collaborative process.

Much of this is timing. When to narrow your focus, when to make decisions based on creative vision and when to make decisions based on resources, deadlines and the contextual and environmental factors that are often out of your control.

'A Conversation Between Trees' has been a long process. The research phase lasted 2 years as part of a previous project by Active Ingredient called the Dark Forest, which began prior to my doctoral research. It is possible to match this timeline to some of the reflexive, action research methods that I have been exploring in my PhD research, taken from both the social sciences and art and design theory.

Research:

I would suggest from the experience of working on A Conversation Between Trees as both an artist and researcher, that there were two points of personal and objective conflict.

When you are taking action, producing or making, is a point when you potentially need to shut out the external world, stop the research and make the decisions – immerse yourself in the making and production, sometimes even stop talking to people altogether and focus on your vision. It is at this point that the observation (externally – how does this respond to existing knowledge and practices) and the reflection (internally – what methodology is occurring) can begin to disrupt the process or method for making. You need to ask questions of yourself and your materials, not of others.

Secondly the disruption can also happen at the point of performing, where the spectacle, exhibition or workshop is occurring and this is the hardest point. This is where the personal artist's story becomes difficult to separate from the objective story of the researcher. How do you listen objectively to the audience's response, go beyond the dialogue (that is inherent in this kind of generative, interactive and participatory arts practice) towards an analytical method for capturing

formed an entire project as it was broad enough to bring data back to the classroom to look at geography, science, art, I.T and maths. Students were allowed to be active outdoors and create responses to the environment. They are now aware that data can be gathered from trees and elements in the environment, and that the environment is alive."

Comment from a teacher at Irthlingborough Primary School who took part in a workshop

An installation in Haldon Forest representing temperature, humidity, light and decibels created by students from Falmouth College

Felt data maps created by participants at CCANW

Estudio Movel Experimental Residency, November 2010

Materials: A VW camper van; Multi-coloured Felt; Temperature, humidity, atmospheric pressure, decibels and carbon dioxide sensors; A Sciencescope sensor hub; A Nokia Phone; Various trees in the Mata Atlantica, Guanabara Bay area, Rio State

Conditions:

During the EME residency Rachel and Silvia developed workshops for school groups, based on the human sensor activity. These workshops were conducted from the EME van, that worked as a mobile artist's studio as they travelled around the Guanabara Bay region. The sensors were set up in trees nearby and Active Ingredient's visualisation of the data was projected into the van.

Rachel and Silvia ran the human sensor activity with 120 students, walking into the forest, standing under the trees and asking the students to sense and rate the temperature, humidity, atmospheric pressure and sound using their bodies. Each student took a photo of the light in the canopy of the trees and documented their results. Both artists cut out circles of felt in different colours to represent each of the data sets and a set of colours decided by the school children in previous workshops. The children then chose the colours and cut out symbols to represent each data set in a design that represented the levels they had sensed with their bodies in the forest around their school. These were displayed in the hallway of the school. Every student received a certificate at the end of the session with the data they collected and a copy of the photograph they had taken. The teachers also took documentation of the activity away with

you will cross to enter a new environment. Could you describe the relationship you had with the narrator?

I thought it was really lovely the moment in which the narrator says that the rules here are different, this raised my expectations. It is interesting to think how little we pay attention to what is around us. I'm more attentive to people than to the natural environment, or even to the city. The environment which I entered through with the guidance of the narrator did not differ much from where I was, but I felt a very strong separation. It was more mental than physical.

3) *How do you relate the 3D image on the phone with the levels of temperature, humidity, decibels and carbon present in the forest? Do you see any relation to data collected and the 3D image?*

The relationship I noticed most between the technology and the different measurements was with light. The graph generated and related to the photographs I was taking almost like a mirror, that is, there seemed to be higher peaks appear on the reverse of where there was actually more light.

4) *Could you remember any stories as you walked through the forest? What are these stories?*

I really like stories, I create some myself. One story I particularly like and especially remembered during the walk, is an Indian myth which explains the importance of the Blue Jay, a bird which helps in the maintenance of the forest, because it eats only part of the seed which it feeds on and spits out the remainder to be sown, and so the legend goes that God protects them for this reason. But this myth was not related to my experience of the environment at the time, it was a flash that popped into my head about this connection of the animals to their habitat. But something about my childhood, being steeped in fairy tales means I cannot see a twisted trunk without it reminding me of a face, and the fear Snow White must have had in the forest!

5) *The project aims to use new technologies, arts and sciences to foster research and experience in forest environments. Could you comment on your experience within this interdisciplinary context?*

I have no experience with art in relation to science and technology before now, so my notion is superficial. For me, it was ironic and interesting to use a high-tech device to realise that something is just there under my nose.

6) *As a visual artist and educator, how would you place this work within the context of contemporary art? Does the work relate to any other kind of work, artists or groups you know?*

I've never experienced anything like this and think that this work is part of a movement to appreciate the environment and think about sustainability. I know some artists who use elements of nature, but nothing related to technology.

7) *Do you think the experience you have had with the phone in the forest would be suitable for people of any age?*

It is suitable for all ages, but due to the sensitive equipment, it may be that not everyone feels comfortable to use it. This touch technology is not yet known by all hands! But nothing that a little bit of patience would not resolve.

Silvia Leal

them for future use in the classroom and follow up work. The human sensor activity was then repeated with another school group at the Guanabara Bay Institute.

Silvia in the EME van cutting felt with participants in the workshop

Felt data maps representing decibels, atmospheric pressure, humidity, temperature and light made by students from Escola Camilo Castelo Branco

Exhibitions at Fineshade Woods May 2011, Ruffford Abbey Country Park (Sherwood Forest) September 2011 and Haldon Forest Park October 2011

Materials:

Temperature, humidity, atmospheric pressure, decibels and carbon dioxide sensors; A Sciencescope sensor hub and a Nokia Phone, Dark Forest sensor application; An Arduino sensor hub, an Android phone and the Hello Tree sensor application; A wooden box, a recycled bicycle tyre; A small light blue leather suitcase; Two very light collapsible frames, parachute material, ground sheet; Coloured soft pastels and compressed charcoals; Two seats

Conditions: The exhibitions of A Conversation Between Trees took place in forests in the UK throughout 2011. Building the sensors for the exhibition tour has been the hardest technical and practical battle of the project and they have taken several iterations. Working with researchers at Horizon and the artist and PhD Student Mike Golembewski we have finally built a sensor, using our original Sciencescope sensors, but with an Arduino hub that works with Android smart phones. The phone works by taking a photograph every minute and collecting data through the hub via USB. The application then sends the data using 3G to the server, which is then downloaded to the visualisation interface and interpreted as a 3D dynamic animation. Sadly, the new sensor sent to Brazil got caught up in Brazilian customs and so during our exhibitions the Mango Tree was still being sensed using the old system. Thanks to Silvia Leal and Prof. Mario Jorge Ferreira de Oliveira's painting experiments with the sensors, moving them about to create beautiful visual effects, we managed to collect live data throughout the project. The Carbon

Photographs captured by visitors whilst using the phone at CCANW, Haldon Forest, Devon, UK

Comments from visitors to the exhibition

"I was really tuned into the forest then, because the artists had sort of opened that up to me and I could hear the sounds more and I could see some of the forest like really clearly, and really it was almost like I walked into the forest just kind of a bit shut off really, and in 2D, and I walked back in 3D, it was like Avatar. I was walking back, it was quite bonkers, yeah, I could see some of the leaves, I just really noticed how amazing the forest was and I hadn't noticed that before really, I had shamefully been tuned out, but, which was really cool, yeah a real eye opener, its good."

A Walk in Tijuca Forest with the Phone

The notion of a temporary mobile space was here further dissolved with the event that took place on October 22nd, as a link up with the CCANW exhibition opening in the UK. With just a small hand-held device, you are guided through a unique individual experience of the forest environment. The narrative, now in Portuguese, worked in parallel with the periodic visualisations, simultaneously on display in the UK. This event opens up the possibilities of sharing the subjective experience, and relies on the people directly involved to choose to share their 'data'. I place the emphasis on these temporary spaces. We can choose the most adequate space each and every time to work. The hand-held technology is inspiring and satellite communication is useful. If only it were so easy to bring people together in the real world – that is why it is so important to value when they do come together. Thank you to Fran Junqueira and Fabiano Araruna for their invaluable participation. Below is an interview with Fran about her experience in the forest:

1) *How was your experience walking through the Tijuca Forest from the time the application 'A Conversation Between Trees' began on the mobile phone you were carrying with you? Was there a change in your experience of the forest? Describe these changes if any.*

Yes, I realised that my relationship with the forest had changed. I started to notice elements that I don't normally perceive, such as moisture and cold. Above all, the narrative inserted me into a poetic framework or Aura even. The relationship with the environment took place under the influence of this poetry, which encouraged me to open my eyes more, be more susceptible to the details around me.

2) *The voice on the application points to a limit in the forest which*

Dioxide monitors were sponsored by the sensing company Vaisala Ltd who, with Carlo, supported our visualisations and understanding of the data as part of creating the artwork.

Whilst in the UK Silvia put together a prototype of her first portable studio, 'Port' as a direct extension of the bridge building, sensing and long-distance collaboration between the UK and Brazil. 'Port' formed a temporary satellite space in the forest, an open invitation to observe and draw the forest surrounding us directly onto the interior of the structure, to capture the forms, the light, colours and movement , as a trace of a temperate forest, which she took back to Brazil.

Rachel setting up the old sensors at Yorkshire Sculpture Park

Visitors drawing the light and colour in the forest as part of Silvia's portable studio experiment 'Port'

The Conversation Between Two Trees (Visualisation)

Materials: Temperature, humidity, atmospheric pressure, decibels and carbon dioxide sensors; A Sciencescope sensor hub and a Nokia Phone, Dark Forest sensor application; An Arduino sensor hub, an android phone and the Hello Tree sensor application; A Mango Tree in the Mata Atlantica, on the edge of Rio de Janeiro, Brazil; A Jequitib tree in the Mata Atlantica, Rio Botanical Gardens, Brazil; A 750 year old Ash Tree, Fineshade Woods, Northamptonshire, UK; An Oak Tree, Rufford Country Park, Sherwood Forest, UK; A Beech Tree, a Downy Birch Tree and a Service Tree, Haldon Forest, UK; Two Projectors, two laptops, two large projection screens with wood frames; A wooden box, a recycled bicycle tyre

Conditions:

Temperature, humidity, sound, C02 levels and a photograph are sent live from the canopy of a tree in each forest to the gallery once a minute. The phone camera is positioned to look up at the tree canopy and the sky. Through 3G internet, the temperature, humidity, decibels, C02, light and colour levels around the tree are sent to an online database. This data is then pulled into a visual interface designed in Unity by the artists.

The colour in the dynamic 3D image comes from each pixel in the photograph that is taken at the tree (the photograph appears in the corner of the screen). This abstraction rotates and dynamically responds to changes in the environmental and climate data around the tree as it receives it, live in the gallery. Light levels lengthen the pixel's colours which extend like tentacles outwards, temperature changes affect the image's brightness, creating a sparkling effect

Fran using the phone application in Tijuca Forest

Looking at the visualisation through the Hello Tree Phone experience

humidity, light, sound, and air quality is like by moving a slider bar on the screen of the phone. Finally they are asked to input three words describing how they feel. This data is recorded and uploaded to the server. The original idea was to upload it directly to a website, but sadly the technology for this proved problematic, this will be developed in future versions.

Research:

Further research is required to begin to understand whether the re-enactment and 'humanising' of the technology through the phone experience enables participants to engage on a deeper level with the functions of the technology and their experience in the forest environment. Through the collaboration with Carlo it has also revealed that the work with human sensing connects directly to current research occurring within environmental science around the recognition of a human's ability to accurately sense and perceive temperature (thermal comfort) and the factors that influence these perceptions. Future work is due to take place with Carlo and Horizon to explore the opportunities that arise from the phone experience and linking human sensing with scientific data.

Audience:

"I pointed it at toadstools and it really looked like it was taking the colours."

"A good tool for artists to look at colour."

"It is inspirational."

"I went through the recorded voice the artists had recorded, so I listened to all that and then went through all the, I don't know what it is, the process or doing the little programs and little tasks which she set, which I enjoyed, and then they slowly tuned me in really to the forest and tuned me into the sort of the subtleties of it and the sounds and tuning out of the sort of hustle of Haldon and where we were in the art space with lots of people and walking away from that, so by the time I was finished with that, when I was walking back to the gallery just on my own with the sounds and my own thoughts, I found

from dark to light, sound levels affects the movement of the 3D image, CO2 increases or decreases the size of the whole image. One screen shows data collected from a tree in Brazil's Mata Atlantica and the other from a tree in a UK forest, local to wherever the exhibition is happening. These are very much about giving a sense of the environmental conditions around those trees at that specific moment and location. In comparison with the machine, the visualisations connect the present experience of the forests within a more temporal scientific perspective of climate change.

The exhibition at CCANW, Haldon Forest, UK

The exhibition commissioned by Fermynwoods Contemporary Art, Fineshade Woods, UK

Research: The artwork is a conversation not only between the trees and locations connected by the two sensor kits but also across different temporal zones, enabling the public to experience forest environments as an evolving, moving landscape that changes over time. This begins to reveal the contextual importance of location and environment on environmental sensing technology. Understanding how research occurs within 'natural environments' requires an understanding of what and where these 'spaces' are and how we capture the impact of these spaces on the tools that we use, the data we collect and our interpretation of this data. The act of capturing data across Brazil and the UK gives a sense of the situated environmental conditions around those trees and within the temporal constraints set by the technology. The visual effects within the interface were designed based on photographs, memories and sensory responses, captured as the artists walked in forests in both the UK and Brazil, influenced by the patterns they found in nature and their own sensations of standing under the canopy of trees.

Audience: "I think I will go away today with that feeling that I haven't just been to Haldon today, I've experienced another forest, a very long way away, you know, and the great similarities as well as the differences. You know, I feel like I've got a lot, it's brought up a lot of questions, all this."

"I would say these very kind of slow abstract compositions are kind of slowly spiralling or slowly turning, they're made up of spokes of different colours, but what I was really intrigued by is the fact that they look a bit like spores or kind of natural forms, not in a kind of lens based realistic way, but they refer to more forms that you would find in nature, they seem to kind of tap into a shape that changes and moves

Labelled and embossed sheets with the year and average carbon dioxide reading

Sheets of paper with a year of carbon dioxide levels, scorched as circular graphs on each sheet.

Comments from visitors to the exhibition

Audience: "I just found the whole hanging circles of paper really visually exciting, but then I like circles and I like the orderliness of it."

"Thank you for doing this. I work with this data and it is really scary. We need more people explaining what is happening in a way people can understand"

Being a human sensor in the forest (the phone application)

Materials:

Android phone with camera, 3G; Human Body - Touch, Smell, Sight, Sound, Taste, Movement, Memory; Forest, trees and sky

Conditions:

Visitors borrow a mobile phone to take into the forest. A phone application guides them into the woods, asking them to act as human sensors and take control of the way the forest is captured, visualised and sensed as they explore. Photographs are captured automatically using the camera on the back of the phone every ten seconds. There is a countdown on the top left hand side of the screen to the next photograph being taken so that people can move the phone to frame the image themselves, within the time constraints set by the countdown. The live data being collected from the forest appears at the bottom of the screen and the same visualisation as projected in the gallery appears in the centre of the screen. People can move the visualisation around, zoom in and out and discover for themselves how the light, colour and data creates the abstracted image. The phone 'paints' the image with the data that the audience capture as they walk through the forest. The soundtrack is a dialogue between the artists Rachel and Silvia, a narrative describing a journey through the forest from the artists perspectives, asking a set of questions based on the human sensor activity.

There is an English and Brazilian Portuguese version. People are asked to choose on a scale of 1-10 what they think the temperature,

with the data that has a life of its own."

"I like how soft it looks. The subtle colours of Sherwood, as lovely as Brazil."

"It is like a kaleidoscope. You could waste half a day here."

"It is amazing. Reminds me of the film Predator – the heat sensors looking for monsters in the jungle."

"It is beyond language and cultural references."

Comments from visitors to the exhibition

Looking up through the branches of a Mango Tree on the edge of Rio de Janeiro, Mata Atlantica, Brazil

Looking up through the branches of a Service Tree, Haldon Forest, Devon, UK

The Climate Machine

Materials: Wood; 3D Printed joints and cog; Metal; Paper; Soldering Iron; Legs; Metal Button; Arduino; USB cable; Laptop; Motors; Cardboard; Bolts; Embosser; Pencil; rubber; Terminal blocks; Ferrules; Metal cord

Conditions:

The machine was born from experiments with heat, paper and climate data and built by the interaction designer and PhD student Mark Selby, who worked as part of the Active Ingredient team on the design. The paper was provided as sponsorship by Arjowiggins Graphics and Antalis McNaughton who specialise in 100% recycled paper, and also supported by Ridge and Tyler Services, local paper cutters who cut the paper to size with a central hole for the paper to sit on the turntable.

The machine scorches global CO2 (Carbon Dioxide) levels in the earth's atmosphere onto rotating circular sheets of recycled paper to make drawings that are reminiscent of tree rings. The turntable rotates with a stack of paper on it, a drawing arm that holds a heating element moves in and out to burn a circular graph of recorded monthly CO2 levels for an individual year. This data is processed and translated into mechanical movement using open source hardware and software platforms. When you press the button on the front of the machine a custom application written in Processing takes the data, breaks it up into months and years and translates the numbers into a set of basic direction commands. These commands are sent to an Arduino board which uses them to drive two stepper motors, one of which rotates the platform, while the other moves the drawing arm in

The soldering iron scorching circular graphs onto paper

Close up of the soldering iron burning 50 years of predicted carbon dioxide levels onto one sheet of paper

Comments by visitors to CCANW, Haldon Forest

"The elements of the wood are really key, like there's a visual kind of rhyme, it also reminds you that you are within a forest. So, as the circumference of the machine is made of wood and the frames have quite definite wooden structures, you are really aware that you within a forest, when you're in here"

laboratory inside to measure the C02. It would be interesting to take it, to see it, in pieces you know."

Circular Heat Drawings

Materials:

51 x 1m diameter circular 100% recycled paper discs; Heat; Metal cord; Terminal Blocks; Curtain clips; Mauna Loa Series Carbon Dioxide Data recorded at an observatory in Hawaii (ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt); Predicted future scenarios of carbon dioxide levels from the IPCC (www.ipcc-data.org).

Conditions:

The drawings produced throughout the exhibition physically fill up the space as time passes – you wouldn't get this sense of accumulation through a screen or projected image. Beginning in 1959 and continuing until 2010, each drawing represents a single year of monthly CO2 readings and is labelled so that the series of data can be read collectively as an ongoing story of climate change. The further from the centre the line is drawn, the higher the amount of carbon dioxide measured at that time. A drawing of data from 1959 shows a very small circle close to the centre of the paper, while one from 2010 is close to the outside edge.

At the end of each residency the full set of heat drawings were hung from the ceiling – a suspended tree trunk made of paper discs, each with a single circular ring representing the CO2 levels of that specific year. This continued to be exhibited in the gallery as a representation of the scale of change in CO2 levels from 1959 – 2010, alongside a projection replaying the data recorded in Brazil and UK during the residency.