There Does Not, in Fact, Appear to Be a Plan: A Collaborative Experiment in Creative Robotics

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Abstract

This paper describes a recent collaborative creative robotics project which developed two exhibits (*There does not, in fact, appear to be a plan* and *Clutch*) that were shown at the Big Blip 04. It gives an overview of two key aspects of the project: the design of the robot technology; and the collaborative process between the participating artists and scientists. We highlight some of the key lessons learnt and outline some possible future developments of the project.

1 Introduction

The collaborative project described in this paper was organized by Blip, a Brighton-based arts-science forum (www.blip.me.uk) where artists and scientists can meet, exchange ideas, get advice, form collaborations and seed projects. It aims to explore the relationship between scientific enquiry and artistic practice and stimulate new critical debate about this emerging cultural hybrid. Traditionally, the sciences and the arts have worked in isolation from each other. At Blip scientists and artists of note are invited to present their work through talks and performances, with a focus on how art and science combine in their practice. We also organize a larger two day festival (the Big Blip) where we curate a generative art show

of both local and international artists. As part of the Big Blip 04 we decided to encourage local artists and scientists to collaboratively develop an installation for the show.

This paper combines, on the one hand, a technical description of the robot design and, on the other, reflections by the participants on the collaborative process that determined how this technology was used to create two installations: *There does not, in fact, appear to be a plan* (see Figures 1 and 2) and *Clutch* (see Figure 5). This structure echoes the tension between practical constraints and creative ideas that was very evident in the collaborative project and that is at the heart of much artistic and scientific practice.

2 Organization of the Project

2.1 Call for Participants

We put out a call to the local artistic and scientific communities for enthusiastic, open-minded artists, scientists and technologists who could make a commitment to working collaboratively for up to twelve weeks with the goal of producing an interactive artwork for the Big Blip 04. Participants had to have some free time during the day to attend workshops at the University of Sussex and the University of Brighton. We offered training, equipment and support. We emphasized that enthusiasm and a willingness to collaborate and learn new skills were of more importance than any particular expertise.

2.2 Participants

The project was initiated and co-ordinated by Jon Bird, Bill Bigge was technical co-ordinator and the artists Tom Grimsey, Richard Brown and Andy Webster acted as mentors (the latter two through web-based feedback). Two Brighton-based artists, Ed Clive and Rowena Easton, and three scientists from the EASy MSc course at the University of Sussex, Mike Blow, Garvin Haslett and John Popadic, committed two months of their time to collaboratively develop an installation for the Big Blip 04.

2.3 Training

We began the project with two one-day workshops. The first, held at the University of Brighton, was run by sculptor Tom Grimsey. In the morning, his challenging brief was to give a wide perspective on sculpture through time and across cultures and highlight some of the current issues in this artistic practice. In the afternoon he gave a hands-on introduction to sculpting with foam. The second workshop, run by Bill Bigge, introduced real-time robot control. Using Lego robots, participants explored how to link sensors and motors to generate simple behaviours such as light seeking and obstacle avoidance. The aim was to introduce simple robot technology to people with no previous experience of this area. In a later third workshop, Tom Grimsey taught the participants how to cast polyurethane foam rubber structures.

Figure 1: *There does not, in fact, appear to be a plan* installed at the Big Blip 04. Photo by James Fry.

2.4 Facilitating the Collaborative Process

We tried to facilitate the collaborative process in four ways:

1. As well as identifying some of the artistic and technical issues that formed the context of the project, the two initial one-day workshops introduced the participants to each other and got them working together to achieve practical goals (constructing foam sculptures and Lego robots).

2. We set up a web-based collaborative forum that enabled participants to send messages to each

Figure 2: Visitor interacting with *There does not, in fact, appear to be a plan* at the Big Blip 04. Photo by Andrea Campos-Little.

other, upload shared files and co-ordinate meeting times.

3. The participants met regularly, initially once a week and then more frequently closer to the exhibition.

4. Artists Richard Brown and Andy Webster acted as distance mentors to the project, responding to the postings on the online forum and offering a 'big picture' perspective.

3 Concept Development

The initial project concept was structured by three main constraints: the resulting installation would have an interactive aspect (in keeping with much of the work being exhibited at the Big Blip 04); it had to be constructed in two months in time for the exhibition; and it had to be realised with a small budget. As the project was supported by the Autonomous Systems Lab at the University of Sussex, we decided to use robots as the basis for the art work. Given the financial constraints we decided to build simple, custom-made robots, with 2 degrees of freedom (DOF) and limited sensors, whose motor behaviours could be tuned without requiring extensive programming or electronics knowledge. The general aim was to enable participants to experiment with the dynamics of both individual and group robot behaviours and explore how they could be incorporated into an interactive installation.

A major issue throughout the project was how the installation would function as an artwork: what would the group of robots do?; how they should be decorated (if at all)?; and how should they be displayed as an installation? By the third week of the project the group decided that eight to ten robots would be used to make a dynamic assembling/disassembling three dimensional sculpture. It was decided that the simplest solution for enabling the robots to stick to each other and other structures in their environment was to cover them in velcro (the black circles in Figures 1 and 2 on the foam cubes and robots). Different robot arm shapes were experimented with to see which would facilitate the dynamic formation of structures. However, the issue of what the robots would look like and how they would be displayed was still not resolved. After six weeks of the project, the group refined their installation concept and decided to build an art work that explored the relationship between voyeurism and interactivity. The development of this idea is shown by the following project documentation.

Richard Brown (from an email, 18 August, 2004) *Voyeurism, cameras, suggestive sounds and any other devices could be explored to great effect... webcam robots, sensual fabrics, lighting - the installation(s) could reference kitsch, soft porn, Amsterdam windows, red lights, peep shows etc etc... I guess its now down to how far or how explicit or subtle people want to go with this... I can imagine a twist on the museum display of animals in their natural habitat - glass/perspex display boxes/tanks, erotic robot rooms.*

Rowena Easton (from an email, 18 August, 2004) *SHOULD THEY SEPARATE WHEN THEY REALISE THEY ARE BEING WATCHED? This would create a nice tension between notions of the 'viewer' or 'voyeur' versus the 'user' or 'interactivist', as they would only make themselves into sculptural forms when nobody's looking. The visitor may be able to sneak a peek at the robots sticking themselves together, and he may also have access to a video of a remote performance, but on one level he will only ever see his own distorted reflection.*

Garvin Haslett (from an email, 24 August, 2004) *The idea we are going after at the moment is that of trying to get the robots to do what they do only when people aren't looking. Our intuition at this stage is that the motion of the robots should make interesting forms out of static objects when those movements are*

slow. On the other hand when the robots move rapidly the structure should hopefully disassemble. So what we're trying at the moment is to use some sort sensor (light, infrared) that will tally with the presence of a viewer. Sensor off: robots elegantly form structures; sensor on: robots wiggle like crazy for 15 seconds and demolish all their hard work.

Constructing eight robots took most of the two months of the project and consequently it was not possible to construct the planned voyeuristic installation. There was also limited time for the participants to explore the dynamics of the robot behaviour. The final installation was comprised of six 'trash aesthetic' robots: the motor-controller units were encased in the ends of transparent plastic bottles covered in black velcro discs and the central joint was covered with a black tights material (see Figure 1) The back wall of the display cabinet contained a hole through which the public could handle the robots (see Figure 2). Two microphones picked up the noises of the robots slapping against the wooden floor and their clutches popping (see Section 4) which were amplified and played in the exhibition space. The robots were able to move across flat surfaces but only very occasionally able to roll over each other. Although the robots did stick together and to the cubes, their random interactions did not lead to the formation of ordered three-dimensional structures and the overall effect was one of a noisy mass of writhing movement.

During the process of installing *There does not, in fact, appear to be a plan* on the day before the exhibition, an unexpected artwork, *Clutch* (see Figure 5) was constructed by the two participating artists as they were dissatisfied with the installation and its failure to realise either the voyeuristic concept or a dynamic three dimensional sculpture. *Clutch* was a visually arresting piece: the display cabinet was taken apart, the robots switched off and the velcro covered foam cubes scattered on the floor. This installation was filmed for display on a monitor at the Big Blip 04 and then the participants reconstructed *There does not, in fact, appear to be a plan*. Section 5.2 gives some of the participant's perspectives on this stage of the collaborative process.

4 The Robot Hardware

The robots consist of two identical arms linked by a two DOF joint. It was not necessary for the arms to communicate with each other so each one was designed as an essentially self-contained unit containing a motor, controller electronics and batteries (see Figures 3 and 4).

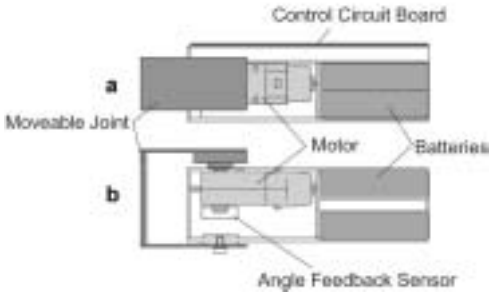

Figure 3: A single motor-controller unit: (a) top-down view, (b) side view.

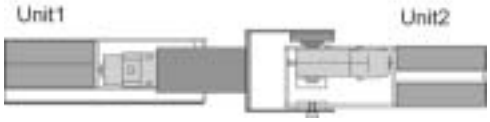

Figure 4: Two motor-controller units coupled to form a robot.

The first task in building a prototype robot was to choose the motors we would use. The obvious choice was to use servo motors of the type normally found in radio controlled cars and aircraft. These are often used in robotics because: they are relatively inexpensive; they come in a huge range of sizes and powers; and they are simple to use. The servo contains its own electronics, gearing and feedback systems that together control the position, or angle, of the motor output shaft. It is easy to construct motorised joints which are controlled by sending a servo motor a series of pulses whose length specifies a target angle.

However, the principal drawback with servo motors is that they provide no feedback about whether the motor shaft is at the target angle. Furthermore, while some servo motors are extremely tough, our limited budget meant that we were restricted to the cheaper, less robust models. This was a significant limitation within the context of our project where the robots had to interact with the public, including children. We needed motors with tough gearboxes or there was a risk that rough handling would result in stripped gears and non-functional robots. Consequently, we decided to use gear motors obtained from Solarbotics (www.solarbotics.com). Their advantages over servo motors are: they are cheap but reasonably powerful; they can be easily modified to include a cheap angle sensor; and they have torque limiting clutches. These clutches pop if the strain on the gears reaches a certain point, preventing damage

to the motor.

The motors and control units were mounted in custom-made ABS plastic boxes. Each robot used eight rechargeable Nickel Metal Hydride AA batteries (four in each of the two motor-controller units), giving a working voltage of 9.6v. The power switch was added on a trailing lead to allow each robot to be covered or decorated. We also added a charging socket on a separate lead so that the robots could be plugged in for recharging without the need to disassemble them and extract the batteries. The power switch, charging socket and batteries were all wired together so both motor-controller units ran off the same set of batteries and could be controlled from one power switch. To make a complete robot two motor-controller units were attached to each other at ninety degrees so that each unit provided movement in orthogonal axes, giving each robot two DOF (see Figure 4).

4.1 Robot Controllers

Each motor is controlled with a small microcontroller, the PIC16F876, which is relatively cheap and easy to work with. This PIC (programmable interrupt controller) chip has five analogue inputs. One of these is used to measure the motor's angle sensor and the remaining four are connected to potentiometers so that they can be used to adjust the behaviour of a motor-controller. A number of pin headers and jumper switches were also added to allow additional inputs and outputs. Each motor-controller unit is programmed to constantly oscillate between two angles at a fixed speed. The two angles and the motor speed can be set independently using three of the potentiometers attached to the PIC chip. A fourth potentiometer sets an error threshold which is used to provide some crude feedback on how a motor-controller unit is moving. If something in the environment inhibits its movement, then the angular error accumulates and if it reaches the error threshold the motor reverses its direction.

Although in the basic design each half of the robot is completely independent, the circuit board was constructed so that there is an option to add extra sensors and share signals between the two motor-controller units. A series of experiments were carried out where a light sensor was attached to a motor-controller unit, resulting in a robot displaying rudimentary phototactic behaviour. One idea was to implement the voyeuristic installation by placing the robots in a dark cabinet and forcing viewers to use a torch to see their behaviour, thereby triggering the robots' light sensors and changing their movements (see Section 3). However, there was not enough time to incorporate this capability in the final installation.

5 Views of the Participants

In this section we present some of the views of the participants on different aspects of the project. The text is an edited version of their written feedback after the exhibition.

5.1 Collaborative Process

Andy Webster
I feel this project is a good case study for further discussion surrounding the pros and cons of collaboration. The question today is no longer 'why collaborate?' but rather 'how might one collaborate?'. The carefully planned structuring of meetings, workshops, and further discussion online encouraged the development of common goals and ambitions, no mean feat considering the diversity of the collaborators' interests and backgrounds. Importantly, the development of this common goal, a necessary facet of the project, did not impose order and stability on the development of the collaboration. In the place of certitude, the collaboration explored connective possibilities, evolutionary methodologies, and most importantly collaborative practice as a dynamic learning system with multiple feedback loops.

Ed Clive
I have not had much success collaborating with artists in the past - perhaps due to a battle of egos, perhaps because realistically everyone has a different agenda. I thought that working with scientists would be different because of their different work ethic - more test and experiment. In retrospect I have learnt that the spirit of collaboration is much the same across both fields. Everyone does have their own agenda and some voices are louder than others.

However I feel the collaboration progressed well - despite the artists being outnumbered 2:1! It was probably this ratio that led the project, initially, towards a more science-based approach. The early process for the artists was an incredibly steep learning curve, a crash course in the fascinating history of robotics and current theories and practices of robot making. It was difficult for the artists to be sure of their input - this was partly due to the fact that we never planned how we were going to work (hence the title of the installation) and partly because any aesthetic thoughts were always replaced with practical considerations.

5.2 The Emergence of Clutch

Ed Clive

As the opening of the exhibition drew closer, last minute problem solving became more and more hurried. It was at this point *Clutch* was formed - understandably to the dismay and confusion of surrounding participants. I would like to state here, and this was paramount to our thoughts at the time, that *Clutch* was not in any way meant to be degrading to the work we had achieved in the previous months. On the contrary, despite *Clutch's* spontaneous birth we felt it captured the spirit of collaboration more successfully than *There does not, in fact, appear to be a plan*. That is not to belittle what was achieved in that project; rather, *Clutch* was meant as a commentary about the working process between two different practices. The discarded velcro buttons, coke bottles and BHS tights were shown off in all their glory, demonstrating the 'make do and adapt' aesthetic of scientific experiments. I love that use of materials - the adaptation of the nearest thing to hand to demonstrate or explain the idea in your head.

Rowena Easton

Up to the point of installation the project had been concerned with getting the robots to function. It then became apparent that we would not be able to achieve the original idea of making a robotic sculpture which made and remade itself into different forms. The artists, not understanding the technology, did not recognise its limitations in time and that this project would need a lot more work to be fully realised. *Clutch* evolved because Ed and I were very unhappy about showing the installation as it was and were desperately trying to find some way to make it work as art. Until we installed the work, and explored how we could make it work as art (a period of intense and chaotic playing) the artists did not own it. It was inevitable that they would take it apart and recreate it in their own image when left to their own devices. I was shocked by the angry reaction that *Clutch* provoked from some of the scientists. One of the jobs I was given (lightheartedly?) as part of the team was to decide at what point the installation became Art. When I did make that decision I was not believed. This reinforced a feeling that not enough respect was given me as an artist. Although my initial reaction was also one of anger, because my practice seemed to count for nothing in this discussion, I was, however, interested that we had managed to provoke such a strong response and felt it lent weight to the work. Unable to reconcile the logic of a scientific approach with the creative impulse, it came down to keeping the scientists happy.

A compromise suggested by Ed was that *Clutch* could be shown as a video. I was all for 'battling it out', feeling that *Clutch's* dynamic qualities and presence would be lost, but this was impossible without the whole team there to discuss it. A failure of the project was that, when something interesting happened, the whole team was not involved. Another familiar argument put forward was that *Clutch* was not possible from a practical point of view. This is a distraction. The splitting of the work into two was the real cop out (it could have been made to work), and as such the integrity of the project suffered. The result was that clutch was seen only as a document of this particular collaborative process, and a simple illustration of one moment in time. Nothing other than an interesting footnote to the project. Instead of a work in its own right, with a wider significance than this collaboration. Its wonderfully dysfunctional presence could have had a real impact on the Big Blip exhibition, which tended towards the sterility of the execution of the 'cute idea'.

Garvin Haslett

My underlying motive, derived from my training as an Artificial Life researcher, was to explore the extent to which the general public would accept an artifact as alive. Hence, I was happier with *There does not, in fact, appear to be a plan* than the artists were. *Clutch* appeared magically for a few brief hours during the endless tweaking that was the search for an ideal configuration for *There does not, in fact, appear to be a plan*. I initially found the artists' satisfaction with *Clutch* utterly beyond my comprehension. Upon reflection though I think the video has significance in that it captures aspects of the scientific process that don't make it to scientific journals. Firstly, the murky issue of results that don't conform with a desired hypothesis. Secondly, the lonely romance of the road to implementation.

5.3 Assessment of the Project

Andy Webster

A natural, if predictable response, is to look at the outcomes in order to evaluate a project's success, but I think it is crucial to shift the focus onto the dynamics of the evolving discourse that led to the concrete results. A simple critique of this project is therefore that the discussion, dialogue, testing and lab culture was ultimately displaced by orthodoxy and obsolete tradition: 'It's an exhibition so we must have an object/closure. For me, the real area of interest was the discourse developed through the art/science collaboration and not the resulting object. If collaborative

practice engenders the potential for dynamic learning, why not use an exhibition to expand the feedback loops rather than deny the audience access to these?

Tom Grimsey

The title of the installation captures the fact that there was not a single plan but a rich variety of possibilities that could not be explored in the limited time. The video piece, *Clutch*, was perhaps a necessary diversion, expressing some of the chaos along the way out of which came very tangible results. A diversion, but not without its own charm. *There does not, in fact, appear to be a plan* is a strong prototype which is operationally fragile but conceptually robust. I enjoyed the scientists' easy facility in practical problem solving. Their experience and a mental agility in these areas often quickly generated a range of possible solutions - practical issues are often formative of the whole look and feel of the end results.

Rowena Easton

It is very liberating to work in a new area and with people who have different perspectives. I also enjoy the friction it creates. I was very encouraged that the scientists came round to taking *Clutch* seriously and that through it they gained an understanding of how art works. The difficulties enabled a real dialogue. I still believe in the original idea and would love to see it happen. I would definitely do it again, having wanted to work with scientists for ages, and am now collaborating with one of the team on another project.

Mike Blow

The Blip project was enormous fun and was a learning experience for me. As an engineer, working with artists broadened my outlook and gave me an insight into what aspects of an artwork they deem important. The conceptual distinction between a 'diagram' and a 'sculpture', that is, the merely representational as opposed to the symbolic, was a point that had particular impact. However, given the short duration of the project, I am pleased, and surprised, that we got two exhibits out of the collaboration. It strikes me that the two exhibits neatly exemplify the differing approaches of artists and engineers. *Clutch* was contemplative, extremely interesting to view and totally impractical to exhibit in a show open to children. *There does not, in fact, appear to be a plan* on the other hand, was more direct, more interactive and easier to look after, but less symbolic and provoking. There was always quite a crowd around the piece at the demonstration times and in this respect it was very successful. The hole in the back of the display cabinet allowed the robots to be withdrawn and handled and the audience would stroke the robots, cuddle them like a baby, pass them around, and even throw them against the wall (luckily we had spares!). There was also some squeamishness at picking up writhing objects. The intensity of reaction was noticeably greater when the robots were handled than when they were simply observed. An important point here is that the robots did not look at all lifelike. Due to time constraints they were, in fact, quite obviously made of plastic bottles and black socks the trash aesthetic! The reaction of people watching and handling the robots was due to their behaviour rather than their appearance.

5.4 Enhancing Collaboration

Rowena Easton

We needed to spend more time together at the beginning thinking about the project in creative terms, but because of time pressures it was felt we needed to start making as quickly as possible. The making took over and became a production line. The project became driven by the technology. I think it would have been helpful if Ed and I had given a presentation about our own work, instead of giving a potted account of hundreds of other artists work. With so little time, the scientists would have gained more of an insight into art practice if they had been able to ask an artist standing in front of them questions about their work.

Mike Blow

In retrospect there are things I would do differently: perhaps make fewer robots in order to allow allow more time for the aesthetic considerations and testing to discover the capability of the robots to self-assemble and so on.

Tom Grimsey

I still think there is still plenty to do in the area of how the results appear. The appearance of the robots and of course the evolution of the work through mutation, could, in future collaborations, be more of a motor to developing ideas. This is ground where we might expect the artists to feel more sure-footed but certainly not exclusively. In summary, it was a very exciting project which I was sorry not to have been more directly involved in.

6 Conclusions

There does not, in fact, appear to be a plan did not achieve the artistic goals of the participants, who spent most of their time constructing the robots and had very little time to explore their behaviour and artistic potential. Time restrictions meant that the

Figure 5: The *Clutch* installation at the Big Blip 04. Photo by Ed Clive.

robot sensors were not used and the voyeuristic installation was not implemented. The idea of an emergent sculpture was not fully realised due to the high mass to power ratio of the robots and the limited ways that they could form bonds. The construction of *Clutch* was partly a consequence of the frustration of the artists with the robot technology. Having struggled right up to the last minute to try and get the installation to work, the artists focused on making an alternative work which they felt had artistic integrity. It was perhaps understandable that the scientists initially viewed this work as a rejection of all the hard work and emotional investment that had gone into building the robots. Although *Clutch* may initially appear a destructive critique of the use of technology in art, it also positively highlights the most successful aspect of the project: the creative interaction of the artists and scientists led to the generation of a work that had not been envisaged when the project was set up and that would not have been produced by the artists or scientists working in isolation. All the scientists eventually came to appreciate *Clutch*, both as an expression of the collaborative dynamic and for the insights it offered into artistic practice.

Clutch seems an aptly named piece as it released the pressure that had built up in the collaborative process in a creative way, just like the motor clutches prevent damage to the robots' gears. As a result of that work, all of the participants are positive about the project and still convinced about the value of their original concept for an interactive installation. The collaborative process is still ongoing, as this paper illustrates. Some of the participants have moved away from Brighton, but the intention is to continue with the project and bring in some more collaborators in order to try and construct the voyeuristic installation. It will be beneficial to have more time to creatively explore the robot technology rather than having to focus on the fabrication process. It would also be useful to get the distance mentors more involved as their overview of the project is very useful, and in hindsight, their emails identified the key issues in the collaborative process at an early stage.

The main reason for collaborating with another person is because they can add something to a project that we could not do on our own. An analogy can be drawn between the collaborative process and the biological phenomenon of symbiosis: the close association of two distinct entities. Biologists have identified three different types of association: parasitism, where the host suffers; mutualism, where both entities require each other for survival; and commensalism where one entity benefits, but not at the expense of the other one. Arts-science collaborations have the potential to be parasitic; for example, scientists using artists as 'decorators' or 'illustrators' of their scientific project, or conversely artists using scientists as technicians to implement their ideas. However, collaborations also have the potential to be mutually beneficial to both artists and scientists, enabling them to generate and explore more creative opportunities than would be possible alone.

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