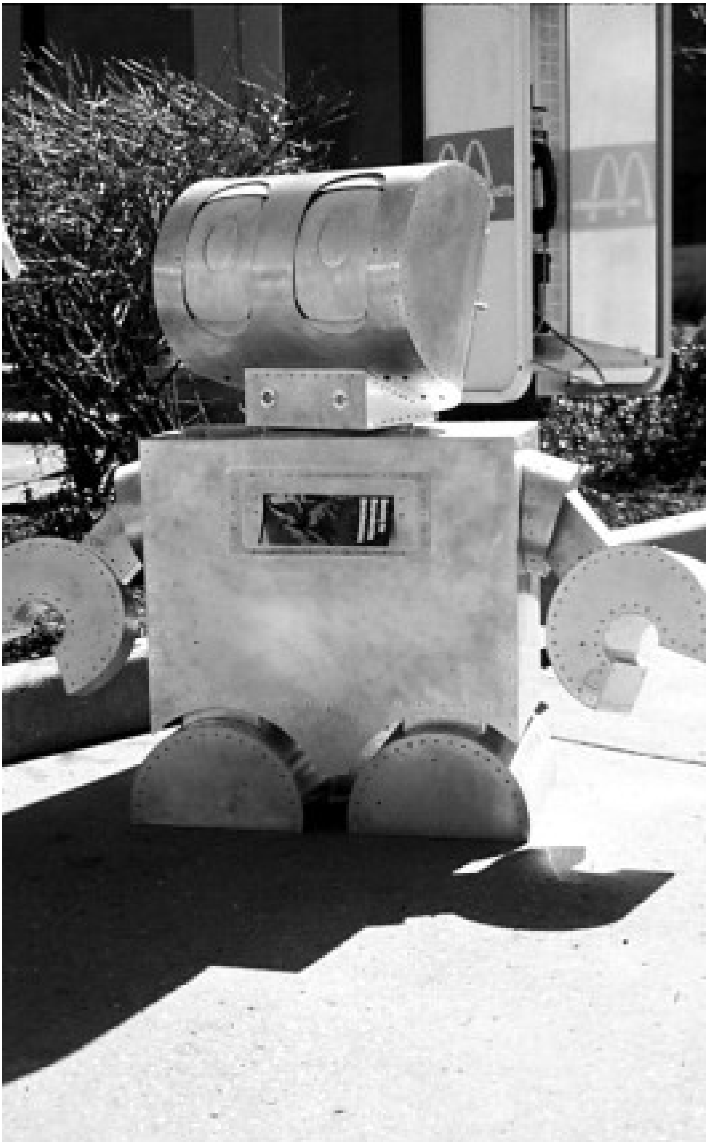

Little Brother IAA

6

Contestational Robotics

Critical Art Ensemble & The Institute for Applied Autonomy

Part I

Since the modern notion of public space has been increasingly recognized as a bourgeois fantasy that was dead on arrival at its inception in the 19th century, an urgent need has emerged for continuous development of tactics to reestablish a means of expression and a space of temporary autonomy within the realm of the social. This problem has worsened in the latter half of the 20th century since new electronic media have advanced surveillance capabilities, which in turn are supported by stronger and increasingly pervasive police mechanisms that now function in both presence and absence. Indeed, the need to appropriate social space has decreased with the rise of nomadic power vectors and with the disappearance of borders in regard to

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multinational corporate political and economic policy construction; however, on the micro-level of everyday life activity, and within the parameters of physical locality, spatial appropriations and the disruption of mechanisms for extreme expression management still have value. Each of us, at one point or another, and to varying degrees, has had to face the constraints of specific social spaces that are so repressive that any act beyond those of service to normative comportment, the commodity, or any other component of the status quo is strictly prohibited. Such situations are most common at the monuments to capital that dot the urban landscape, but they can also be witnessed in spectacular moments when extreme repression shines through the screenal mediator as an alibi for democracy and freedom. The finest example to date in the U.S. was the 1996 presidential election. A protest area was constructed at the Republican National Convention, where protesters could sign up for fifteen-minute intervals during which they were permitted to speak openly. This political joke played on naive activists had the paradoxical effect of turning the protesters into street corner kooks screaming from their soapbox about issues with no history or context, while at the same time reinforcing the illusion that there is free speech in the public sphere. Certainly, for anyone who was paying attention enough to see through the thin glaze of capital's "open society," this ritualized discontent was the funeral for all the myths of citizenry, public space, or open discourse. To speak of censorship in this situation (or in the many others that could be cited by any reader) is deeply foolish, when there was no free speech or open discourse to begin with. What is really being referred to when the charge of censorship is made is an increase in expression management and spatial fortification that surpasses the everyday life expectation of repression. Censorship and self-censorship (internalized censorship) is our environment of locality, and it is within this realm that contestational robots can perform a useful service.

The Function of Robots

While robots are generally multifunctional and useful for a broad variety of duties such as rote tasks, high-precision activities, telepresent operations, data collection, and so on, one function above all other is of greatest interest to the contestational roboticist. That function is the ability of robots to insinuate themselves into situations that are mortally dangerous or otherwise hazardous to humans. Take, for example, three robots developed at Carnegie Mellon University. The first is a robot that can be affixed to pipes with asbestos insulation; it will inch its way down the pipe, cutting away the asbestos and safely collecting the remains at the same time. For a robot, this one is relatively inexpensive to produce, and could reduce the costs of removing extremely carcinogenic materials. The second is a robot designed in case of a nuclear accident. This robot has the capability of cutting into a nuclear containment tank of a power plant and testing for the degree of core corruption and area contamination. Once again, this method is certainly preferable to having a person suit up in protective gear and doing the inspection he/rself. Finally, an autonomous military vehicle is under development. The reasons for the development of this vehicle are not publicly discussed, so let's just imagine for a moment what they might be. What could an autonomous military vehicle be used for? Let's make the fair and reasonable assumption that it has direct military application as a tactical vehicle (it is a humvee after all). It could have scouting capabilities; since the vision engines of this vehicle are very advanced this possibility seems likely. At present, the vehicle has no weapons or weapon mounts. Of course, such an oversight could be easily remedied. If the vehicle was used as an assault vehicle it would still follow the model set by the prior two robots. In other words, it could go into a situation unfit for humans and take action in response to that environment. However, one element distinguishes the potential assault vehicle from the other two robots. While the other two are primarily designed for a physical function, the latter has a social function—the militarization of space by an intelligent agent. Of modest fortune is the fact that this model can be inverted. Militarized social space can be appropriated by robots, and alternative expressions could be insinuated into the space by robotic simulations of human actions. While autonomous robotic action in contestational conditions is beyond the reach of the amateur roboticist, basic telepresent action may not be.

The Space of Contestational Robots

Like the physical dangers of being irradiated or breathing asbestos, there are dangers in specific social spaces which are too great to allow those of contestational consciousness and subversive intent to enter. Even the tiniest voice of disruption is met by silencing mechanisms that can range from ejection from the space to arrest and/or violence. For example, being in or around the grand majority of governmental spaces and displaying any form of behavior outside the narrow parameters designated for those spaces will bring a swift response from authorities. Think back to the example of the convention protest space. Using the designated protest area was the only possibility, as no protest permits (an oxymoron) were being issued. Those who attempted to challenge this extensively managed territory were promptly told to leave or face arrest. These are the hazardous conditions under which robotic objectors could be useful; they would allow agents of contestation to enter their discourse into public record, while keeping the agent at a safe distance from the disturbance. (The remotes can work at distances up to ninety meters; however, the robot has to be kept within the operator's line of sight.)

Performative Possibilities

What could a robotic objector do in these spaces? We believe that it could simulate many of the possibilities for human action within fortified domains. For example:

Robotic Graffiti Writers. These robots are basically a combination of a remote control toy car linked with airbrushes and some simple chip technology. When running smoothly, this robot can lay down slogans (much like a mobile dot matrix printer) at speeds of 15 mph. (See part two.)

Robotic Pamphleteers. Simply distributing information in many spaces (such as malls, airports, etc.) can get a person arrested. These

> are the spaces where a robotic delivery system could come in handy—especially if deployed in flocks. Remember, people love cute robots (anthropomorphic, round-eyed japanamation cuteness is a recommended aesthetic for this variety of robot), and are more likely to take literature from a robot than from most humans. At the same time, the excessively cute aesthetic can lead to robotnapping.
>
> *Noise Robots*. These are very cheap to make from existing parts and are particularly recommended for indoor situations. By just adding a canned foghorn or siren to a remote toy car, one can create a noise bomb that can disrupt just about any type of small- to medium-scale proceeding into which it can be insinuated.

These are but a few ideas of how relatively simple technologies could be used for micro-level disturbances. Given the subversive imagination of tactical media practitioners around the world, it's easy to believe that better ideas and more efficient ways of creating such robots will soon be on the table. However, it also has to be kept in mind that robotic objectors are of greater value as spectacle than they are as militarized resistance. After all, they are only toybots. Yet these objects of play can demonstrate what public space could be, and that there are other potentials in any given area beyond the authoritarian realities that secured space imposes on those within it.

Costs

There is a triple cost to this type of robotic practice. First, it does require a modest amount of electrical engineering knowledge, and as we all know, education costs money. Second, it requires access to basic tools, but access to a machine shop would be better. Third is the cost of hardware. Robots are expensive, and there is no getting around it. In the field of robotics proper, it is barely possible to build a toy for less than 10,000 USD. We have brought the cost down to between 100 and 1,000 USD, but this could add up very quickly for a garage tinkerer or for underfunded tactical media practitioners. It seems safe to assume that a robot will be used more than once in most cases, but even so, robotic objectors are outside the parameters for a common, low-cost, tactical weapon. To be sure, this research is in its experimental stages.

Security

In spite of the fact that contestational robotics is a completely civil action and poses no danger to anyone, do not expect authority to share this belief. First, when placed in a militarized area (i.e., any space in which deep capital is being protected), robots are assumed to be of military origin. Given this association, it is likely that the robotic objector will be perceived as a weapon, and treated accordingly. In conjunction, the builder of the robot is very likely to be treated as military personnel. Even if the robot is captured and found to be only a toy, the builder of the robot will be subject to arrest and serious jail time, because the military/police were deployed against a militarized menace. The charges that an activist may face vary in number and wording from state to state and from country to country, but they all have one common function. They give police discretionary arrest privileges. Even though no violent crime is committed, those associated with the state's perception of attempted violence can be arrested as if a violent crime had been committed. Laws against "crimes," such as creating a false public emergency, are regularly used in such situations by authoritarian agencies. These laws are designed specifically to make it easier to arrest political dissidents and to stifle determined attempts at open discourse. They are also a way of re-presenting ethical political protest as terrorist action, and are one of the state's best sleight-of-hand tricks. This situation is very much the same as when hackers are called terrorists, even though their only crime is trespassing in an electronic environment where there is no one to terrorize. Given this extreme and unjust reaction, be sure to purchase supplies with cash, wear gloves when building robots, use only common parts and/ or materials, remove serial numbers when necessary, and do not routinely frequent any supplier. Be careful: capital gets very reactionary when you hack its technology.

A Note on the Relationship of Amateurism to Contestational Robotics

The amateur has been a scorned figure in post-Enlightenment knowledge management. Specialists and experts are the ones who get the praise. In this situation, each knowledge specialist hides in h/er own tower, making occasional encroachments on neighboring territories. In turn, these short-range migrations are rebuked as amateur attempts to marshal information resources that trespassers cannot understand. This attitude is not totally without merit. Knowledge specializations are very complex and do require years of study to master. At the same time, dismissing the amateur out of hand can have a detrimental impact on the practical aspects of applying a specialization, whether in the material or policy arenas.

In relation to robotics, most of us aren't mechanical science experts, or software or electrical engineers, but we do have the advantages of being naive visionaries with collective political experience, the desire to share skills and resources, and the collective ability to open any desired field of knowledge. Home tinkering is of necessity in robotics and biotechnology to the same degree we have seen it used successfully in information and communications technology (everything from simple shareware to ascii culture to hardware recycling). New versions of expertise must be constructed. Without tinkerers using models of anarchist epistemology, contestational robotics will not come to be.

Part II

How to Build a Robotic Graffiti Writer

This manual is the first in a series of robotic objector projects for the home roboticist/techno-anarchist. This design combines the integrated perception and autonomous navigation skills of the human dissident with the efficiency and compact size of a robot specifically adapted to the goals and terrain of street actions. The basic design calls for a roughly shoe-box-sized trailer to be drawn by a remote-controlled vehicle. The trailer consists of an array of five

spray paint units that are controlled by a central processor. The vehicle is navigated into the target area by its human operator. At the appropriate time a switch on the controller is thrown, signaling the start of the "action." As the vehicle rolls along the ground, the row of spray cans prints a text message in much the same way that a dot-matrix printer would. For example the word CAPITALIST would be written as:

```
***  *  *** *** * * *** * * *** **
* *  *  *   *   * * *   **  *   * *
***  *  * * **  * * *   *   **  **
*    *  * * *   * * *   **  *   * *
*    *  *** *   *** *** * * *** * *
```

Depending on the nature of the action, the vehicle can either be navigated to a secluded "safe-zone" or considered a worthy sacrifice in the name of robotic objection.

The skills needed to build this robot do not require an engineering degree, although they do require a reasonable amount of experience in building circuits, programming micro-controllers (Basic STAMP), and shop skills/metalworking; the project might best be accomplished by a small group of individuals.

Materials

REMOTE CONTROL CAR. This will be by far the most costly aspect of this project. When coupled with the radio controller and essentials such as a battery charger, the vehicle represents roughly a $500 investment. What makes this car exceptional is that it needs to be capable of pulling 3-4 kilograms of additional weight and still maintain a top speed of 10-15 mph. This generally means a scaled-down version of a "Monster Truck" i.e., multiple engines, etc.

Consult your local RC enthusiast—they love these sort of specialty problems. It also must be able to receive three channels instead of the usual two.

RADIO CONTROLLER. Any three-channel controller will do.

2 WHEELS. Light-weight street wheels from an RC catalog.

5 INTERMITTENT SOLENOIDS. The surplus variety will be more than adequate here. Something in the neighborhood of 24v (.25 - .3 amp) that can hold itself shut against fairly vigorous tugging.

BATTERIES. One to power the solenoids (probably 24v) and one to power the circuitry (9v).

5 SPRAY CANS. The 3 oz miniature variety is best for reasons of weight and size. However, the industrial paint that road workers use could be used if the weight is less of a problem. Remember to choose a color that complements the terrain.

MICRO-CONTROLLER. Almost any standard chip (i.e., BASIC stamp) will suffice as long as it has at least two inputs and five outputs.

LED/OPTO-TRANSISTOR. For use as an encoder.

TRANSISTORS, RESISTORS, CAPACITORS, and WIRE. Specific values cannot be given here, as there are too many variables to worry about.

RAW MATERIALS. 1/32" aluminum or plastic sheet, lightweight plastic or wood square stock (1/4" by 1/4").

Construction

There are too many variables at work here to describe the construction or components in extreme detail. Availability of surplus goods and access to means of production will vary from group to group.

As with any robotics project, the strategy is to work on individual parts AND the overall product AT THE SAME TIME. One needs to be building working sub-systems, while continually evaluating them to ensure that they will work together.

The project is divided into four subsystems.

1) Micro-controller (+software)
2) encoder
3) structure of trailer
4) Solenoid–spray-can system

The Micro-Controller

A plethora of micro-controllers exist that are easy to learn to use. Any of the more popular packages that clutter the pages of hobbyist magazines will suffice as long as they meet the requirements of having at least two inputs and five outputs. The first input pin is used for the signal that comes from the controller and tells the microprocessor to start performing its task, i.e., print the text. The second input pin is for the encoder that attaches to one of the wheels or axles. The encoder tells the processor how fast the vehicle is moving in terms of "clicks" (see encoder section). Each "click," or 1/4 turn of the wheels, will mean that one column of a letter is to be printed. This allows the processor to adjust the space of the letters according to how fast the car is moving. The five output pins are all used for controlling the solenoids that activate the spray cans.

The Text

As mentioned earlier, the text is printed as if by a dot-matrix printer. Each individual letter is printed with a 5x3 grid of dots and therefore requires a minimum of 15 bits to be rendered. The most cost-effective method of storing this data in terms of RAM would be to use 16-bit blocks (type SHORT) for each letter in your array and simply ignore the last bit. However, if you have the RAM, it may be more elegant to use one byte for each column (three columns per letter). This abstracts things a bit, making it easier to print simple graphics instead of text or to use the extra bits in each column as a kind of control character. For instance, you could have a bit that controls how long the can sprays, making it possible to have dots and dashes.

Depending on how much RAM the micro-controller has, you could build a function into the chip that translates the text into a binary stream using a lookup table—for instance, 111111010011100 for the letter P, as in the example earlier. Such a table would use only around 52 bytes or so (2 bytes per letter times 26 letters). Or translation could be done offline and the stream hard-coded into the chip at programming time.

The following is some pseudo-code that should give a fair idea of how the components interact with each other.

```
Typedef COLUMN = a byte

pin1 = GO signal
pin2 = wheel encoder
pin3-7 = solenoids

COLUMN the_text_array[# of letters] =
convert_text("THE MESSAGE TO PRINT")
COLUMN col

while(1){
   if(GO signal ON)      //If it gets the GO
signal, the loop
      timer + 1          //must run 5 times
with the signal ON
   if(GO signal OFF)     //before it will
GO.  This prevents false signals
      timer = 0
   if(timer > 5){
      for(i = 1 to # of letters){
         for(j = 1 to 3){           //The
number of columns in a letter
            col =
read_next_column(the_text_array)
            paint_column(col)       //writes
the bits to pins 3 thru 7
            wait (for encoder click)
         }
         all pins OFF                  //
puts a space between letters
         wait (for encoder click)
      }
   }
}
```

Signal from Controller (i.e., GO!)

The average remote control car uses a minimum of two channels in order to be controlled by the remote. That is, one channel controls forward and backward motion, and the other controls left and right motion. It is very easy to add channels by using standard parts from an RC hobbyist catalog. In this case, we need one more channel that will be used to trigger the text-printing function. The signal that comes out of the receiver on the car is most likely going to be PWM (Pulse Width Mod), in which case the supplied code should be sufficient to direct the signal straight into the micro-controller. Should the signal happen to be analog, most micro-controllers have at least one pin that can receive an analog signal.

Encoder

There's no need to run out and buy a 600-degree optical encoder for this. All we need is a standard LED and phototransistor pairing. They tend to look like this:

```
___    ___
   |L|  |P|
   |  |_|  |
   |_____|
```

There are two standard ways of implementing these as an encoder. In one version, the principle works like thus: When the LED light hits the phototransistor, it is ON. When something is stuck in between them, it is OFF. All we do is attach a pinwheel divided at 45-degree intervals to the axle of one of the wheels and have it pass through the center of the pairing, like this:

```
Fig. 1.
   ___
   \  |  /|            |
    \ | / |            |
   __\|/__|            | <- pinwheel
  |  /|\               |
  | / | \           __ | __
  |/  |__\         |L|||P|
                   | |_| |
  pinwheel         |_____|
```

This is where the “clicks,” described earlier, originate. Each space in the pinwheel causes one click in the phototransistor. The signal from the transistor is then passed on to pin 2 of the micro-controller.

In another variation on the same theme, the LED/ phototransistor pair is pointed at a black-and-white pinwheel (potentially the wheel hub). The light from the LED reflects off the white parts and triggers the phototransistor, sending it into an ON state. The light is absorbed by the black sections, sending it into an OFF state.

Trailer Construction

Anything more than a cursory description would be impossible here without the use of mechanical drawings or photographs. The basic idea is that we have a trailer chassis resting on two wheels. It is connected to the rear of the vehicle via some type of flexible joint. The chassis can be made out of a sheet of lightweight plastic or aluminum with plastic or aluminum supports. The spray cans are secured, lying flat on the trailer between the wheels. A slot or window runs the width of the trailer be-low the spray nozzles and perpendicular to the spray cans (this is what they spray through). The solenoids are mounted on a shelf raised an inch or so above the spray nozzles. This allows room for the batteries and electronics to be stored underneath. (See Fig. 2)

Solenoid–Spray-Can Mechanism

Mechanically speaking, this portion will be the most difficult to construct and will require a lot of kludging to get it right. What we've got is a row of five spray-cans facing downward and another row of five solenoids that must use their pulling motion to push the buttons of the spray cans. This is probably most easily achieved by a simple system of fixed-pivot linkages. The solenoids are arranged so that they are facing (plungers toward) the spray nozzles, and probably raised an inch or so above the nozzle center. The linkages should be in the form of the letter Z, with joints at the corners and a fixed-pivot point somewhere in the Z diagonal. The plungers of the solenoids should be attached to the upper portion of the Z and the lower one should touch the tip of the spray can.

```
Fig. 2      (Side View)
       ______
      |      |
      | Sol. |=[——O-joint
 _____|______|__       |
  ___________  |       o-pivot
  |          | |       |         _________
  |Batteries | |       |        /         |
  |          | | joint-O—— []=|  spray   |
  |__________| |                \_________|
 ______________|____________    ____________
```

The placement of the pivot point on the linkage determines how much leverage is placed on the nozzle. This may take some tweaking to get enough pressure to make it spray on command.

Conclusion

The intentions of this chapter are twofold. First, it presents one concrete example of how a robotic objector can be built to be useful to resistant forces. Second, it should open up critical discussion of the value, implications, and design of these tools. Several prototypes are already in the construction phase of development and collective discourse can only enhance the process.