

Robots Don't Know When to Stop:  
Civil Liberties Challenges in the Application of an  
Autonomous Mobile Chemical Detecting Robot

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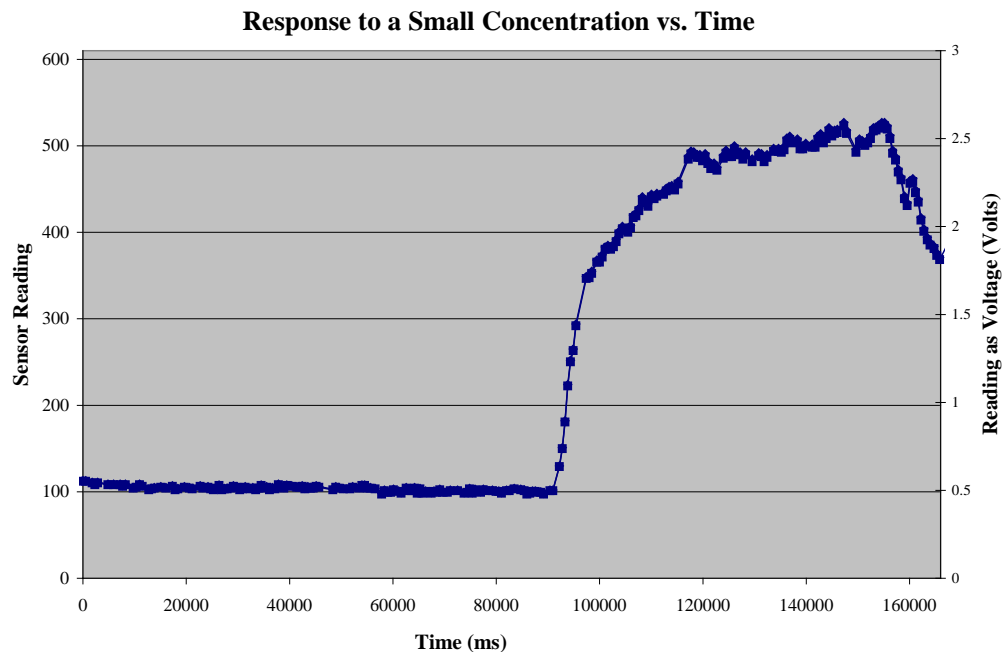
Dr. Eve Kornfeld, professor of History at SDSU, challenged me to clarify my thoughts and consider all of the ramifications of my project.

## Introduction

From the times of the founding fathers, Americans have chosen, in the words of Benjamin Franklin, not to sacrifice essential liberty for temporary security. Since the early twentieth century, the American Civil Liberties Union has worked to protect civil liberties and freedoms outlined in our Constitution and its amendments. The ACLU has worked to balance rights to privacy, due process, and equal protection with the government's plans for maintaining the safety of the country. Applications of the technology I developed in my science fair project, "A Mobile Autonomous Chemical Detecting Robot", could either enhance or infringe upon civil liberties, depending upon human vigilance and decisions governing the robot's use.

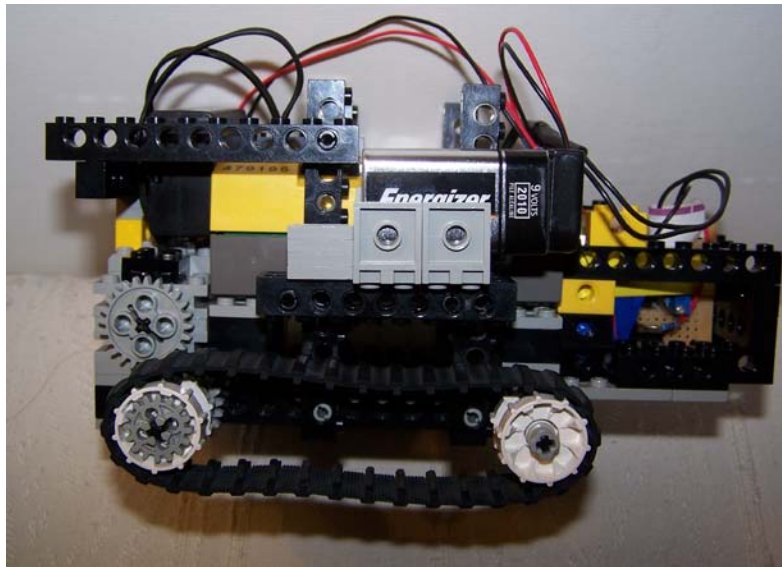
## My Research

I developed a robot that autonomously searches for, detects, and responds to chemical spills. The sensor I designed uses simple electrical parts, an LED, photodiode, op-amp and resistors in combination with a porous silicon chip that temporarily changes color in the presence of a volatile organic compound (VOC). A fan sucks up the saturated vapor into the sensor chamber holding the chip and the LED light bounces off the chip with a different intensity into the photodiode. The voltage from the photodiode is then amplified and sent to the microcomputer of the robot as the sensor signal. After creating the sensor circuit and adding the fan, I ran some tests to determine if the signal change caused by chemical was big enough to be easily seen by the robot. The change exceeded my hypothesis and was clearly large enough to differentiate between chemical and the lack of it even in very small quantities and concentrations.



**Figure 1. Response to a 5% ethanol 95% water concentration (the concentration of some alcoholic beverages). The sensor reading is the numerical system that the robotic microcomputer uses for readings; its corresponding measure in volts (linear correlation) is on the right. The data was collected using a LabVIEW program I wrote. The procedure involved a brief exposure of the sensor to the chemical.**

The sensor was then integrated onto a robotic base (see Figure 2). After teaching myself the programming language LabVIEW, I wrote a program for the robot to move autonomously. By leaving the search and response algorithms easily customizable, I made a program that can be adapted to many different applications without needing human control during a potentially hazardous situation. The robot is compact, with the sensor equipment contained in a 2 inch cube.



**Figure 2. Side view of the mobile robot. The circuitry of the sensor is visible on the right.**

It would be both easy and inexpensive to produce the sensor as part of an industrially made robot for use in a variety of security, counterterrorism, environmental, industrial, and even exploratory applications. The promise of this project's wide applications won the Senior Sweepstakes Award at the Greater San Diego Science and Engineering Fair and the Project of the Year Award at the California State Science Fair this spring.

### **Civil Liberties Implications: Applications**

Applications of this technology potentially save lives and property and maintain security at a low cost in both materials and life. However, in the areas of national security and counterterrorism, there is a possibility for infringement upon people's rights unless thoughtful measures are taken to secure them.

The fourth amendment to the Constitution of the United States guarantees a right for people to be "secure" from investigation without a warrant. Robots programmed to search are unaware of when they might encroach upon persons or their property. They just don't know when to stop. Without proper human supervision it would be easy for the robots to overstep their boundaries, and the pressures of security might tempt people to look the other way if the robots went too far without a warrant. This necessary measure of human control over the operation of

the robot provides the unfortunate potential for the infringement upon the fourth amendment rights of others.

At the same time, by making this detection more mechanical than current technologies, the possibility of abuses caused by excessive human zeal could be minimized. Replacing dogs, people and related current methods of security with robots will preserve the safety of those involved. Further, if the proper measures are taken to maintain the integrity of the fourth amendment, the robot could be less invasive than current technologies. Depending on the human consciousness and decisions about how to apply this technology, the robots have the potential to threaten the right to privacy or increase security while preserving that right.

Another crucial consideration for civil liberties in the application of this technology concerns how limited robotic resources would be employed to best cover the possible security threats. If, for example, the robots were in use in an airport or border facility, there might be an issue with how the choice is made. The fourteenth amendment demands that all people receive "the equal protection of the laws." Profiling, or selection of people for investigation based on criteria such as race, is against anti-discrimination laws and this amendment, as well as the "innocent until proven guilty" spirit of the country. The ACLU has strongly fought profiling when it has appeared in airports and other facilities as a technique for utilizing limited resources. The robots themselves, of course, are indiscriminate, and so with proper control could preserve equal protection, but there would be a large temptation for improper and illegal profiling.

The sixth amendment states that those accused have the right to be "confronted with the witnesses" who have evidence against them. Since a robot cannot be cross-examined, there are challenges in presenting the evidence while allowing the defendant to contest it. It would be tempting for security personnel to cite national security as a reason to not explain the technology, thereby denying the defendant this fundamental right. The accuracy of technology (like humanity) is never absolute, so there is a potential for failure within the robotic system based on unexpected field conditions. Mathematical tests on the signal (using data runs including the one in figure 1 above) indicate that based on the current sensitivity and noise the probability of false positive is essentially zero. However, field conditions might introduce a situation different from the standard operation of the robot, and the right of the defendant to challenge the evidence should not be compromised.

### **Stakeholders**

People most likely to be affected by this technology would be those in points of transit, such as a harbor, border, or airport. For example, at our local border with Mexico, there might be people passing who are not aware of American civil liberties, or are unable to communicate to protect their rights. For these people, everything is at stake, including life, liberty and the opportunity for happiness. The American people must safeguard the civil liberties of people everywhere so that our own are not compromised. American citizens, particularly those subject to profiling based on ethnicity, are also vulnerable to injustice if this technology is misapplied. Our stake is twofold: a commitment to security and an unwavering defense of our rights.

## **Solutions**

The autonomous mobile, chemical detecting robot that I developed has the potential to preserve human lives in a variety of security and counterterrorism applications. However, clear, exhaustive and binding guidelines will have to be instituted for the use of this technology and made available to the public so that civil liberties are not compromised in the drive to increase security. Specifically, in locations such as a harbor, a border, or an airport, the people who control the application and path of the technology must work to ensure that fourth, fourteenth and sixth amendment rights are preserved. With a clear notification of the presence of the technology and careful supervision to ensure that privacy is not compromised, this robot has the potential to enhance privacy by removing humans and animals from the actual sensing process. Guidelines to prevent illegal profiling in selection of subjects for examination will guarantee that the robot can be employed without compromising the right to equal protection. In addition, the relatively low cost of an array of chemical detecting robots might allay security fears and alleviate the pressures that lead to profiling. A conscious decision to inform the public and a balance between the need for technical secrecy and explanation will ensure that defendants have a chance to challenge evidence obtained from the robot. With these ideas governing the application of my robot, I believe that it can be used in a way that enhances security while preserving civil liberties.

## **Conclusion**

Historically, periods of great internal and external insecurity have seen the greatest threats to American civil liberties. Fear tends to overwhelm the American desire to protect freedoms. A robot that can reduce insecurity and fear can thus enhance American civil liberties – but only if those who apply this technology are conscious of the challenges it poses. Scientists and engineers, as well as humanists, lawyers and the public, must jealously guard American civil liberties, for, as citizens of this country and the world, we are all stakeholders in the end.

## Relevant Literature

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