TO: Professor Benjamin Cohen May 8, 2013

FROM: Terrin Kalian, Samuel Burd

SUBJECT: Updated Project Memo

## Introduction:

Brain-Computer Interfaces, also known as Human-Machine Interface technology, are devices that allow humans to control various computer systems using their own brainwaves. These systems are being developed for medical, military, and even entertainment purposes, and show promise of becoming a common technology of the near future. BCI devices can be used to control anything from a fully bionic limb, to a guided missile, but that is only a small amount of their potential. So, what information does the public need to know in order to understand the possible affects such technologies could have on society?

Recently, development of Brain-Computer Interface technology has seen rapid increase in growth. For instance, invasive BCIs in the medical field, which were massive electronic protrusions jutting out of a patient's skull less than a decade ago, now have been reduced to a tiny (smaller than the nail of a pinky finger) array of electrodes placed directly on the brain. Only a wire is visible to an onlooker. That is why now, more than ever, it is important to ask the question, "How will BCI affect society in the future?" How should policies regarding this technology be drafted? Should all of these uses be outlawed, or can there be a middle ground so we can allow the development of a potentially beneficial technology to all of mankind? Although its uses can be revolutionary to the world of medicine, that does not necessarily mean they are all ethically sound. How do we, as humans, decide what needs to be "fixed" and what is just natural part of life that people are born with? Some of these BCI systems must be implanted in the user's brain in order for a good connection, but others are as simple as a headset that can read pulses through the skull. This non-invasive form of the technology can be used by anyone without having to undergo surgery, making it more marketable to the average person. In the near future, systems like this will be cheap and able to perform a multitude of tasks, including anything from controlling a video game character to flying an armed drone in combat.

## Significance:

Our research on BCI and ethical debates surrounding it is significant because it is an exceptional case study on technological determinism, moral standing, and engineering's relationship with society. Brain-Computer Interface is a technology that society may struggle accepting for many years before it is, if ever, an average part of life. Just because there is a potential for misuse of this technology, does that mean we should forgo all of the benefits that could also come with it? Will it be

possible to keep society from accessing BCI in the future? Who will have access to it and why? We intend to analyze specific uses in each field, examine how each works, and raise ethical questions for the public to read and answer for themselves. People should have a basic understanding of how BCI works and what its future and existing uses are, then with that knowledge assess potential uses and misuses based upon their moral standings.

**Methodology:**

To start our research, we compiled about twenty articles, as well as other types of sources (videos, websites, etc) in the three areas we are interested in highlighting. Even after we had read and summarized each of the articles, we continued to do research throughout the construction of the project. We turned all our ideas into a tangible outlet of information, one that is organized well and communicates information efficiently and elegantly. We chose to display this information on a website; this way we can maximize the exposure of our work and BCI in general. Also, during our research we never encountered a site that summarized all the fields of BCI like ours does. We started the site by organizing all of the major parts into order so it would be easier to write once we were ready. The site was divided into sections for context, medical, military, and societal use. We chose these three areas because they cover a majority of the research currently underway in the BCI field. Once we had decided on a structure of the site, we started writing sections on each of our fields of research. Each section then had sub-topics that went into detail about specific devices being developed in that field. We chose the sub-topics that were frequently mentioned in articles, as well as ones we felt were particularly captivating. For each sub-topic (ex. Cochlear implants for medical or "super soldiers" for military) we gave a basic description of the technology then discussed the controversy that surrounds it. The end of each of these pages includes a "questions to ask yourself" section for the reader to consider so that they might form an opinion based on the reading. We also provided links to additional information.

For a source outside of the engineering department, we have contacted Professor Michael Nees from the psychology department. Since many of the questionable medical uses of BCI technology involve "curing" disorders such as Obsessive Compulsive Disorder that are part of innate human psychology, we expected a professor of psychology to have an informed opinion on the matter. He understands the ongoing debates between different patients and doctors regarding definitions of illnesses. For instance, members of the deaf community may not see their deafness as a problem that needs fixing, yet doctors are pouring resources into trying to develop systems that will allow their patients to hear again. Yet, the blind community almost unanimously supports innovation in sight aids. He also helped us understand how BCI could affect neurological disorders.

## Conclusion/Recommendations:

This is just the beginning of a project that can be expanded indefinitely. Our site covers a very limited number of topics, and there is so much more to know than what we offer. This means that future students can add as many more sub-topics and major fields of research that come about. A student next year could spend as much time as we did creating the site by adding additional uses and current research. Also, most of the uses described on the site are future outlooks, so when these technologies become reality, a real analysis of their affects on the world can be done. As the technologies become less theoretical and are implemented in society, some of the questions we asked can be answered. Right now, our project is in its infancy and eventually we will have tangible knowledge regarding BCI's affects on society.