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### **Electromagnetics in my Future Career**

Electromagnetism is the study of the electromagnetic force, and is crucial in determining internal molecular properties of ordinary matter. In engineering applications, electromagnetics plays an important role in the design and operation of electronic objects.<sup>[1]</sup> The concepts of electromagnetism manifest in our everyday surroundings from inside our homes, integrated circuits and transistors in our computers and cellphones, to the skies inside satellites sent out to orbit. Electromagnets are used in a wide variety of areas, but has been most widely adopted in military defense technologies. Radio Detection and Ranging, or radars,<sup>[2]</sup> were introduced during the World War II to detect distant objects such as airplanes or ships. Radars aided the Allied Forces in achieving victory, and since then, they have been integrated among other larger systems. Radars can be found in systems such as meteorology, geophysics and astronomy. Radars are also used to detect relatively small objects, such as vehicles through radar guns, as well as human beings.

In a recent hardware hackathon, or prototyping competition, I worked in a team with students from Carnegie Mellon University. We worked on a project that attempted to detect objects through wooden walls using Arduino systems and modules. We ran into major issues when we realized infrared and ultrasound sensors are powerless with barriers in front of the targets. Due to time constraints, my team disregarded the idea, but my interest in detecting targeted objects through barriers lingered. This experience lead me to become interested in

human detection through barriers, and its possible applications. Radars for detecting humans have already been under development. Currently, the military uses optical systems such as night vision and thermal imaging to detect people in their surroundings. Although these systems achieve excellent angular resolution, “optical signals are unable to penetrate solid barriers and foliage cover and therefore are totally ineffective in detecting humans in defilade.”<sup>[3]</sup> In an experiment by the Pennsylvania State University, microwave radiation in the S-Band and W-band were used in a multifrequency radar system to detect human activities.<sup>[3]</sup> A separate experiment by the European Association for Signal Processing (EURASIP) used Ultra-Wideband technology to achieve similar results.<sup>[4]</sup> In both cases, human activities such as breathing, swinging arms and even heartbeat movements were recognized through different types of barriers.

Although these achievements in the field of human detection were remarkable, they fell short because of the material and density of several testing barriers. These experiments were also done with the targeted human beings in a short range. These technologies may be applied in the military industry, such as retrieving hostages. Detecting human movements may also be crucial in the aftermaths of natural disasters, such as finding victims of earthquakes under the rubble. The application of human detection in these critical situations can be improved through further developing material type and density and range. Through identifying the shortcomings of the field of human deduction, I am inspired to contribute through further researching and developing its applications.

## References

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