Eddy Current Imaging

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ABSTRACT

Numerous Imaging technologies have been in use in airports, buildings and different establishments to prevent potential threats to security. However, those imaging devices could reach up to tens of thousands of dollars to purchase and install. Our research solves this issue by implementing an Eddy current imaging technology which uses inexpensive inductance sensors to detect and image metals. This in turn will provide an alternative affordable means to prevent those security threats such as weapons and explosives before they cause harm to our society.

UNDERLYING PRINCIPLE

Faraday's and Lenz's Law

- **Faraday's Law** states that a changing magnetic field in a conductor induces an electromotive force.
- **Lenz's Law** states that the direction of the current induced in a conductor by a changing magnetic field is such that the magnetic field created by the induced current opposes the initial changing magnetic field.

$$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$$

OBJECTIVES

Overall Objective:
Detect and image metals for security applications by using eddy current imaging technology

Specific Objective:
Image metals that can be located at different depth

Eddy Current Imaging Technology

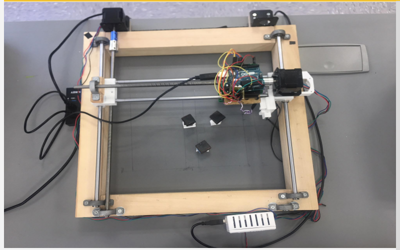

Fig. 1: Eddy current imaging device

- Our system uses 2 limiting switches to auto home position the data acquisition board which will allow the imaging to start every time from the origin.
- The data acquisition board includes two inductive sensors that allow us to detect the eddy current generated on the metal object.
- Two stepper motors are used to control the movement of the scanner along the x-axis and y-axis.
- To produce the image of the metal the system takes 30 X 30 samples and it uses matlab to analyze those samples.

RESULTS

Image reconstruction algorithm
[involves fourier transform and solution of system of linear equation]

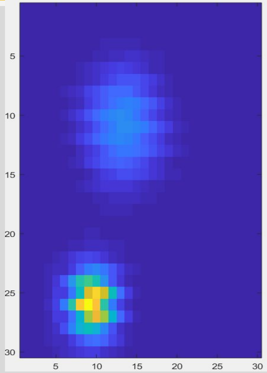

Fig. 2: Raw data from big sensor

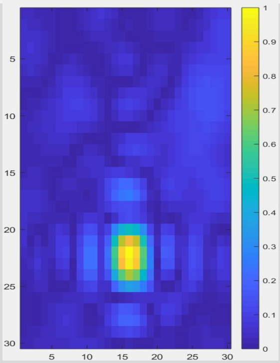

Fig. 3: Image of object at depth 1

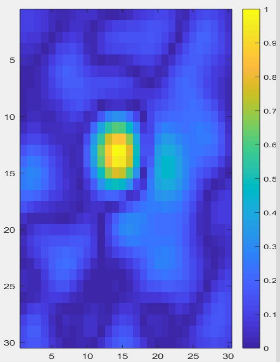

Fig. 4: Image of object at depth 2

DISCUSSION

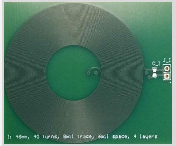

Fig. 5: LDC sensor

- The inductive sensor has an LC circuit that serves as a resonator.
- The LC tank operates in resonance mode without the presence of metals.
- LDC sensors convert the inductance value to a digital value.
- In the presence of metals the resonance frequency of the LC tank changes.

$$F_r = \frac{1}{2\Pi\sqrt{LC}}$$

CONCLUSIONS

Eddy current Imaging technology provides a cheap and affordable metal detection means for security purposes. The governing principles of the technology makes the system reliable and sustainable. We have shown the capability of image reconstruction in various depth.

REFERENCES

- *Faraday's Law*, hyperphysics.phy-astr.gsu.edu/hbase/electric/farlaw.htm
- *H. Tsuboi and N. Seshima, "Improvement of Eddy Current Distribution," 2006 12th, Miami, FL, 2006, pp. 317-317.*

ACKNOWLEDGEMENT

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