ECE 455 Capstone Design in Electrical and Computer Engineering
Project Report

LOW-FREQUENCY ELECTROMAGNETIC EMITTING AUTONOMOUS BOAT FOR OFFSHORE PLANE RECKAGE RECOVERY

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1 Introduction

This project supports the University of Wisconsin Missing in Action Recovery and Identification Project (UW MIA RIP), which aims to locate and recover U.S. service members lost in global conflicts. Many aircraft have crashed in shallow coastal waters, making underwater wreckage detection both difficult and expensive. Our team was tasked with developing a low-cost autonomous surface vehicle (ASV) that could assist in this mission by generating a detectable magnetic field for submerged autonomous systems.

The ASV is constructed from common and cost-effective materials, including PVC pipe, closed-cell foam, HDF planks, and a polycarbonate platform. The system features a 100W solar panel powering two 12.8V LiFePO4 batteries, which in turn support onboard electronics including a Raspberry Pi, SpeedyBee F405 flight controller, and magnetic field generation circuitry. A low-frequency sine wave is produced and amplified, creating an AC current that drives a large coil mounted to the boat, emitting a magnetic field for underwater detection.

Design considerations included autonomous GPS-based navigation using iNav firmware, waterproofing, modular construction, and safe power regulation. The project was completed under a $500 budget constraint. This report documents the ASV's design, hardware integration, control system, testing procedures, and potential future improvements.

2 Bill of Materials

Include a table with a list of all the materials. Include a description, quantity, cost/unit, total, and URL link for each item.

3 Circuit Schematics

In this section, provide detailed circuit schematics. Here is an example of how you insert a figure:

You can easily reference Fig. **??** (like that).

4 Simulation and Circuit Board Design

Include URL links to any circuit simulation or PCB design files. You can store them on a folder in OneDrive. **Please add me as an owner so I can access the files after your account closes.**

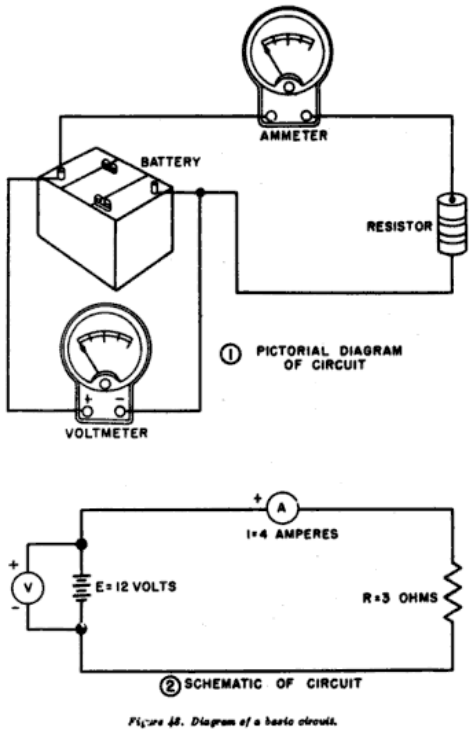

Figure 1: Caption

5 Hardware

In this section, please include detailed annotated photographs of your hardware. If you used a perforated board, make sure it is clear how you physically wired everything so that someone else could reproduce it. You can also include any OneDrive links to CAD files.

6 Coding

In this section, please provide links to your code or directly pasted in the report. You can create subsections in LaTeX like this:

6.1 Ultrasonic Sensor Code

6.2 Motor Code

Please write a paragraph summarizing the operation of the code. You should cite any references or resources that you used to make the code. You can conveniently cite sources

like this: [**?**] and [**?**]. LaTeX is really nice for writing out equations too:

$$V = \oint \overrightarrow{E} \cdot d\overrightarrow{l} \tag{1}$$

You can use this tool to help: https://webdemo.myscript.com/. Also this: https://mathpix.com/image-to-latex. You can also easily refer to equations like this: **??**.

7 Operating Instructions

In this section, please provide detailed, step by step instructions on how to operate your project (what buttons you have to push, different display readings, etc).

8 Troubleshooting

If your device is not fully working, describe exactly what is not working and the steps you have taken to fix it. If you are still unsure of the problem, carefully describe your next steps you would take if you had time.

9 Testing and Experiments

Here you can talk about your experimental results and include plots of any relevant data. The plots should be of professional quality. Use Python, MATLAB, or OriginLab. Excel in the engineering world is not professional.

10 Future Work

In this section, please discuss future work that needs to be completed.