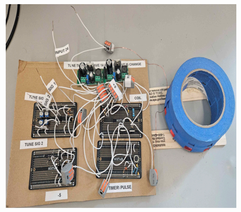
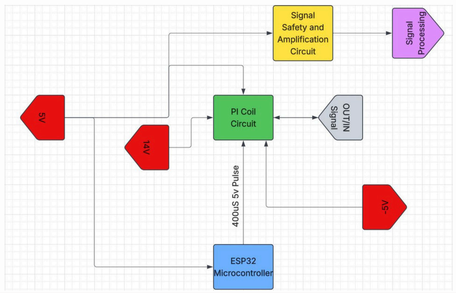
PULSE INDUCTION PROTOTYPE



The Pulse Induction (PI) system is used to classify the Magnetic property of the detected metal. A strong magnetic pulse is emitted by the coil, then the return signal is captured by the same coil and sent to the Signal Sampling circuit to be analyzed.

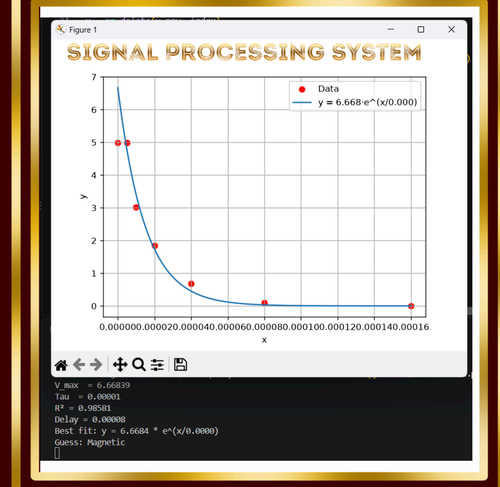
BLOCK DIAGRAM FOR PULSE INDUCTION SYSTEM



TEXAS STATE UNIVERSITY
Ingram School of Engineering

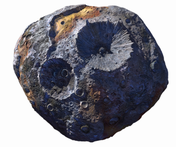
Psyche Surface Composition Detection

EE 1.02 PSYCHENAUTS SEAN WIEMKEN, BRET R. LANTZ II, JOAO KLEIN XAVIER TERCK, CAMERON TOBIAS



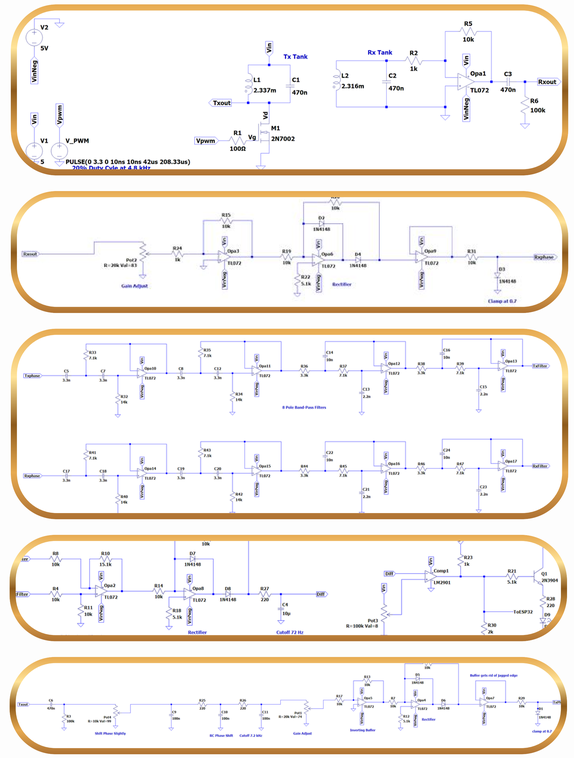
The Signal Processing system classifies ferromagnetic material using the data received from the PI system. The decay curve from a potentially magnetic material is shown in the image above.

OUR PURPOSE



Our product consists of a Surface Detection System for a future Psyche Rover concept to locate specifically ferromagnetic elements in the surface of the Psyche asteroid. It combines a low-power VLF metal detector that runs constantly to determine the presence of metallic objects, and a pulse induction system that is able to discern the type of metal that the Rover is detecting. This will provide useful information for material analysis, collecting surface samples, rover magnetic drive system and navigation.

VLF SCHEMATICS



Design Decisions

The team decided to use both the VLF and PI detection methods because the PI system uses too much power to run consistently, but the PI system will also give us more information.

The team decided on a 205mm DD coil design for the VLF system due to its sensitivity, simple design and its' Affordability.

The team decided on 26 AWG wire and 150 wraps for the transmit coil and 34 AWG 700 wraps for the receive coil to increase range and sensitivity.

Next Semester

In the second half of our design challenge our team will focus on four primary goals.

- Completion and integration of the website and User Interface.
- Increasing range and sensitivity of the VLF system.
- Verification of the PI system's ability to correctly distinguish between magnetic and non-magnetic material in a test bed.
- Design and integration of the rovers drive controls and electronics.

Future Plans

Future teams have several options to further improve upon this design.

- Design a foldable rotating arm to mount the detection systems.
- Design automated rover drive system.
- Design electromagnetic drive / anchoring system.
- Design machine learning to improve PI system material classification.
- Design changeable tool heads to switch between VLF and PI systems.

Acknowledgements

Dr. Bowman - Sponsor

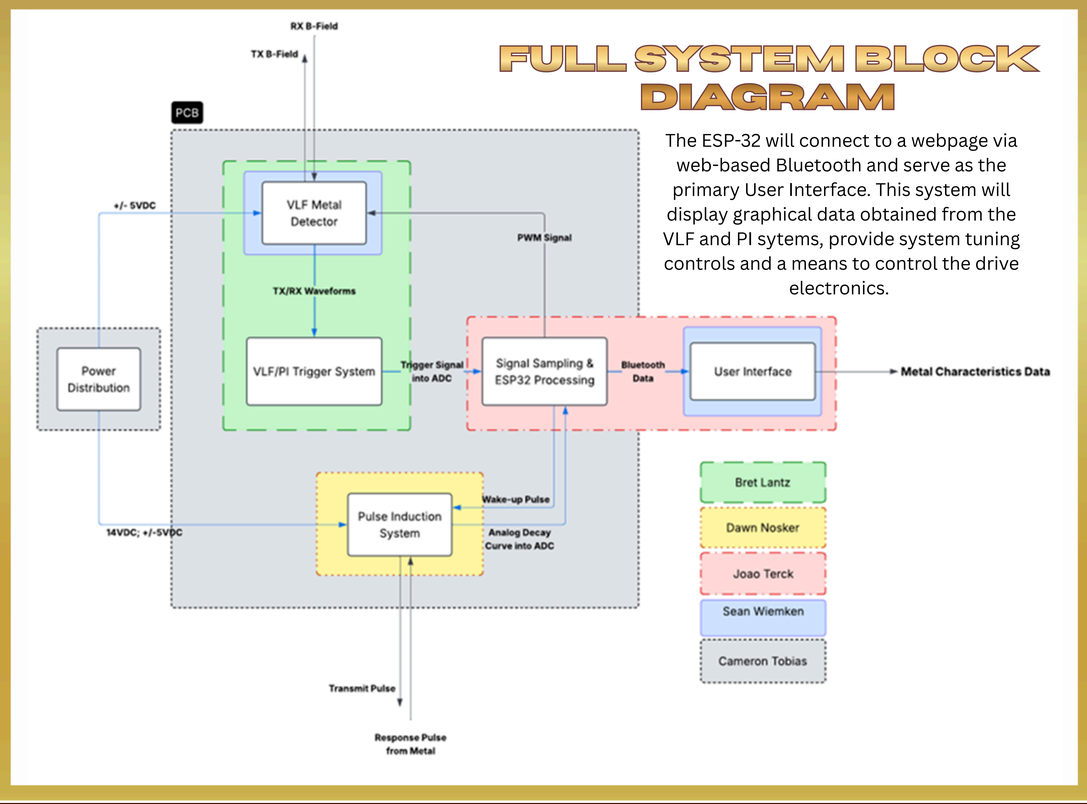
Professor Stevens - Instructor

Dr. Stephan - Advisor

Dr. Compeau - Advisor

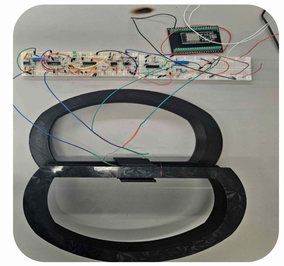
Mr. Cameron - Mentor

FULL SYSTEM BLOCK DIAGRAM



The ESP-32 will connect to a webpage via web-based Bluetooth and serve as the primary User Interface. This system will display graphical data obtained from the VLF and PI sytems, provide system tuning controls and a means to control the drive electronics.

DD COIL AND CIRCUIT PROTOTYPE FOR THE VLF METAL DETECTOR



The Very Low Frequency (VLF) system uses a double D coil design where the transmit coil is excited by the transmit circuit. The receive coil sends data to the VLF signal processing circuit. When metal is detected an awake signal is sent to the ESP-32 to turn on the Pulse Induction system.

If you have any questions please contact me at s_w251@txstate.edu

This work was created in partial fulfillment of Texas State University Capstone Course "EE4290". The work is a result of the Psyche Student Collaborations component of NASA's Psyche Mission (https://psyche.ssl.berkeley.edu). "Psyche: A Journey to a Metal World" [Contract number NNM16AA09C] is part of the NASA Discovery Program mission to solar system targets. Trade names and trademarks of ASU and NASA are used in this work for identification only. Their usage does not constitute an official endorsement, either expressed or implied, by Arizona State University or National Aeronautics and Space Administration. The content is solely the responsibility of the authors and does not necessarily represent the official views of ASU or NASA.