MON-08

Project 5: Magnetic Field Camera

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Deliverable for Milestone 1

Please see forms that will be used for Milestone 1 evaluation. Two types of forms have to be filled out: 1. EE344_2025_milestone1 (1 form per team), 2. Individual_contribution_milestone1 (1 form per student)

You'll be asked to submit the following for Milestone 1 deadline (Feb 1st 2024):

1. **PPT for Milestone 1**, containing following information:
    1. What is the problem that you are trying to solve?
    2. Proposed solution, value proposition of your solution
    3. How will you achieve the specifications? (i.e. overview of methodology, how did you arrive at the choice of solution after evaluating multiple options)
    4. Technical details: principle of operation, target specifications, block diagram, justification of choice of components, BOM and accompanying circuit diagrams
    5. Grant chart for project plan, work distribution across team members, week-wise goals
    6. Key risks and mitigation strategies
    7. Deliverables i.e. expected outcomes of the project
2. **Video recording of PPT presentation** (pre-recorded presentation. File size limit 100MB. Use Handbrake to compress video. Test your video and retake if needed)
3. **BOM sheet** (should be complete)
4. **PDF of circuit diagrams of all blocks** (as detailed as possible. BOM list should tally with circuit diagrams. Circuit diagrams may be hand-drawn using ruler and pen if that is more convenient and faster, but should be legible and all components should be clearly labeled.)

All the above deliverables have to be submitted for Milestone 1 deadline (Feb 1st 2024 - instructions and Google Form link will be shared)

01. Problem Statement

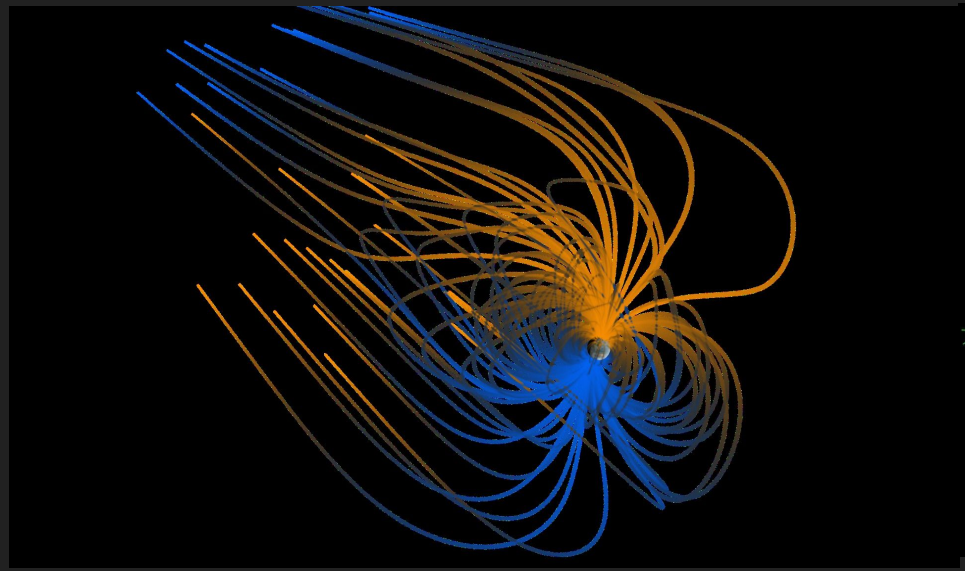
What is the problem we're trying to solve?

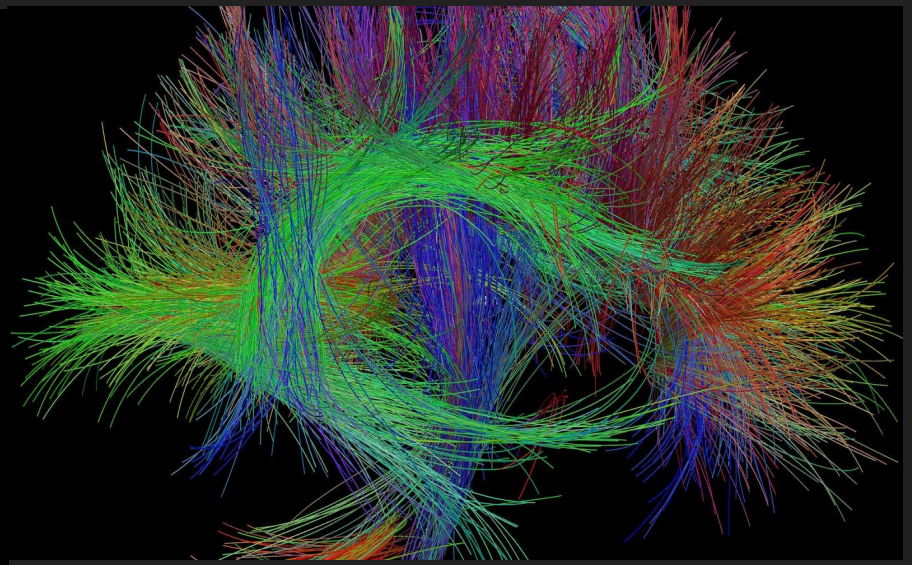
- **Quality control and manufacturing**: Cracks, defects in permanent magnets used in motors, MRI machines
- **Magnetic Shield Design and Testing**: Helps design magnetic shields widely used in medical devices
- **Medical Device Development**: Testing implantable devices near magnets used in MRI machines
- **Magnetic Levitation Systems**: Testing bearings and components used in Maglev trains

02. Proposed Solution

What is the value proposition of our solution?

Millimeter precision and 3d interactive magnetic field visualisation to map the magnetic fields for crucial components in a short duration; enabling researchers to design and troubleshoot magnetic systems.





03. Achieving Specifications

How did we arrive at this solution after evaluating multiple options?

The alternatives have considerable drawbacks

1. Hand-held alternatives: Imprecise human operators require complicated sensors to detect position with no added benefit of precision

2. Magnetic Field with Real time Video: Real time video adds immense cost without the benefit of accuracy that is crucial to all conceivable applications.

3. Magnetic Field Cube: Our design facilitates 3 dof. We can thus repurpose several sensors to increase resolution in our measurement plane.

4. 2d field camera: Loses out crucial details present in the 3d magnetic field distribution

04. Technical Details

A. Principle of Operation

An 8x8 array of magnetic field sensors is mounted on an arm that moves cylindrically around an object and senses the magnetic field distribution all around. A microcontroller also keeps track of the position of the sensing arm and controls its motion accordingly.

An fpga also on the arm, acquires the readings from the sensors and sends it to a microcontroller which then sends it via wifi to a laptop. The laptop finally extrapolates the readings to generate a 3d interactive magnetic field distribution.

04. Technical Details

B. Target Specifications

04. Technical Details

C. Block Diagram

04. Technical Details

D. Justification of Components

04. Technical Details

E. Bill of Materials

04. Technical Details

F. Circuit Diagrams

05. Work Distribution

A. Gantt Chart

05. Work Distribution

B. Team work distribution

GUI Laptop - Vema

Sensor head
Physical layout, PCB (interface sensors, fpga) - Navaneeth

FPGA coding - Suchet

Microcontroller Coding - Raunak

Prototyping Rig mechanism - Ashwajit

05. Work Distribution

C. Week-wise goals

06. Risks and Mitigations

A. Key Risks

1. Sensor Calibration: Each sensor has different sensitivities
2. Motor Calibration: Motors may be unreliable
3. Field Leakage: From motors

06. Risks and Mitigations

A. Mitigations

1. Sensor Calibration: Acquire standardised sensor as a baseline and compare measurements relative to this sensor

2. Motor Calibration: Trial and error; measure speeds

3. Field Leakage: Measure ambient field

07. Deliverables

What are the deliverables for our project?