InternPro Weekly Progress Update

Name	Email	Project Name	NDA/ Non-NDA	InternPro Start Date	OPT
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Progress

Include an itemized list of the tasks you completed this week.

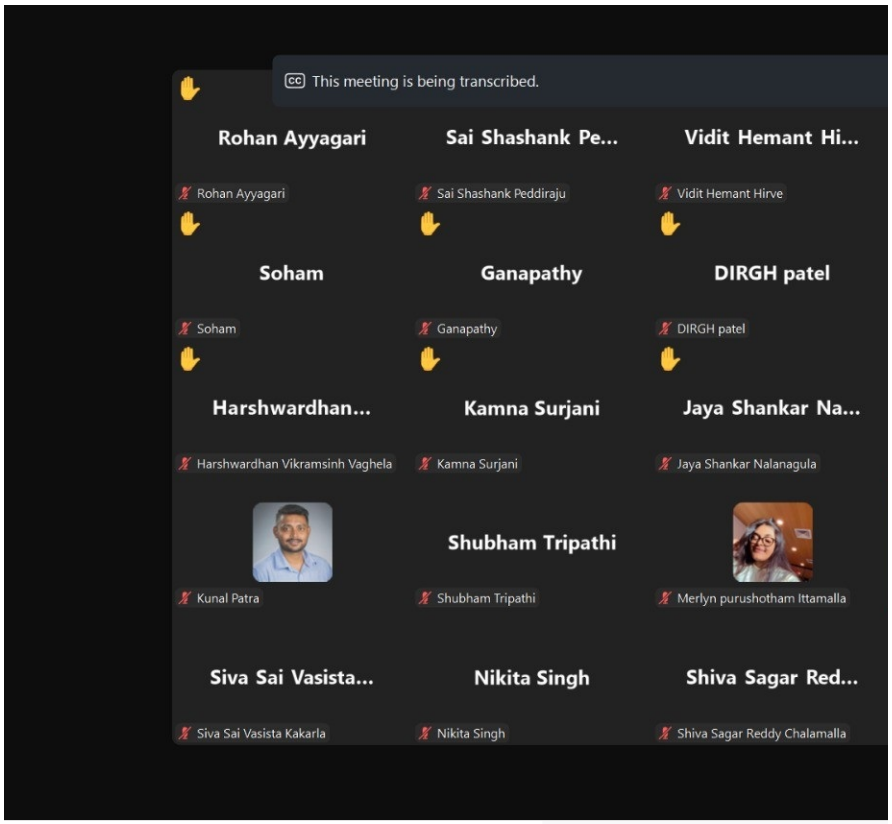
#	Action Item/ Explanation	Total Time This Week (hours)
1	Office Hour	1
2	EPICS Portal	1
3	Weekly Meeting	1
4	Introduction to the Project	2
5	DIY GNSS Reference Station	3
6	Review on Precise Positioning	3
7	State-of-the-Art Solutions in Precision Agriculture	3
8	Precision Positioning Technology for Agricultural Robots	3
9	Weekly Report	3
	Total hours for the week:	20

Verification Documentation:

Action Item 1: Office Hour – 1 hour(s).

Office Hours

- 09/23/2024 Monday Office Hours
- I wanted to leave from my previous project, so I asked Professor Jared to remove me from the Integrated Travels project.



Action Item 2: EPICS Portal – 1 hour(s).

Office Hours

- Created word document layout to write contents of the weekly progress.
- Created relevant subsections in the epicspro website and documented 20 hours of weekly progress.
- Collected relevant documents research papers, relevant links aligning to weekly objective.

Action Item 3: Weekly Meeting – 1 hour(s).

Project Meeting Summary

- 09-27-2024 Meeting
- Attended the weekly meeting, got a chance to meet other team mates and the work they were doing. Majorly was about designing the CAD diagram for the FarmBot robot.
- I attended the weekly meeting and had the opportunity to meet my teammates and learn about their work. My primary focus was on designing the CAD diagram for the FarmBot robot.

Action Item 4: Introduction to the Project – 2 hour(s).

Project Work Summary

- I was going through the documents provided to me to get me introduced and gain knowledge of what work has been done yet and what I to contribute.
- Studied the FarmBots Fall 2022 Design document and about the project's objectives, needs assessment, and proposed solutions for creating an autonomous farming robot for small-scale agriculture.
- Learnt about the design overview of the Farmbots Agriculture Rover, including its functional modules like plowing, seed sowing, watering, and fertilizing mechanisms.
- I have gained insights into the project's goals of improving local farming practices, addressing labor shortages, and implementing sustainable agricultural methods using robotics and automation.

Action Item 5: DIY GNSS Reference Station – 3 hour(s).

Research

- https://learn.sparkfun.com/tutorials/how-to-build-a-diy-gnss-reference-station/all
- How to Build a DIY GNSS Reference Station(Reference Link provided for understanding DIY GNSS reference station)
- Summary of Report
  - The article provides a comprehensive guide on setting up a GNSS (Global Navigation Satellite System) reference station for RTK (Real-Time Kinematics) applications.
  - It covers the process of establishing a fixed antenna location, gathering raw GNSS data, and setting up a system to broadcast correction data over the internet.
  - The guide offers multiple setup options, including using a mini-computer, an ESP32, or a Raspberry Pi.
- Relation to Project
  - Provides detailed instructions on setting up a fixed GNSS base station, which is crucial for accurate positioning in agricultural robotics.
  - Explains how to broadcast correction data, which can be used by rover units to achieve high-precision positioning.
  - Offers cost-effective solutions for creating a custom GNSS reference station, which aligns with our project's goal of developing affordable farming technology.
- Motivation for Research
  - To understand the process of creating a reliable GNSS reference station for improved positioning accuracy in our FarmBot project.
  - To explore different hardware options and setups that could be integrated into our system design.
  - To gain insights into the technical aspects of GNSS data processing and broadcasting for navigation and positioning strategies.

Action Item 6: Review on Precise Positioning – 3 hour(s).

Research

- https://www.mdpi.com/2072-4292/16/6/985
- On the Importance of Precise Positioning in Robotised Agriculture
- Summary of Report
  - The paper explores the integration of precision positioning based on GNSS in agriculture, particularly for fieldwork operations.
  - It examines the impact of GNSS on automation and robotisation in agriculture, focusing on intelligent agricultural guidance.
  - The study compares commercial and low-cost GNSS solutions, along with integrating satellite navigation with visual odometry for improved positioning accuracy.
- Relation to Project
  - Paper was chosen because it goes through various state of the art precise positioning techniques for agricultural robots.
  - Discusses low-cost GNSS solutions which could potentially be helpful for creating affordable farming robots.
  - Explores the integration of visual odometry with GNSS which could also be a potential positioning technique if we are going towards openCV mapping.
- Motivation for Research
  - To understand the state of the art methods available for achieving precise positioning in agricultural robotics.
  - To explore cost-effective solutions for high-precision positioning through GNSS and possibility for other cheaper GNSS techniques.
  - To investigate ways to improve positioning accuracy and reliability in agricultural settings and possible effects in real world application.

Action Item 7: State-of-the-Art Solutions in Precision Agriculture – 3 hour(s).

Research

- https://www.mdpi.com/2077-0472/13/7/1417
- Global Navigation Satellite Systems as State-of-the-Art Solutions in Precision Agriculture: A Review of Studies Indexed in the Web of Science
- Summary of Report
  - The paper reviews recent advancements in GNSS technologies and their applications in precision agriculture, focusing on positioning accuracy and integration with other technologies.
  - It analyzes trends in GNSS research for agriculture based on Web of Science data, highlighting emerging areas like multi-constellation receivers and precise point positioning.
  - The review covers both remote sensing and computer processing-based solutions that utilize GNSS for precise positioning and mapping in agricultural contexts.
- Relation to Project
  - Multi-constellation receivers improve positioning accuracy and signal availability, crucial for precise robot navigation in fields.
  - Integration of GNSS with IMUs enhances positioning accuracy and robustness, especially for dynamic agricultural machinery operations.
  - Precise Point Positioning (PPP) provides centimeter-level accuracy using a single GNSS receiver, beneficial for autonomous agricultural robots.
- Motivation for Research
  - To understand the state of the art methods available for achieving precise positioning in agricultural robotics.
  - Precise positioning is essential for various precision agriculture

applications, including autonomous navigation and variable rate technology.
    - Improved positioning accuracy enables more efficient and sustainable farming practices, reducing input costs and environmental impact.

Action Item 8: Precision Positioning Technology for Agricultural Robots – 3 hour(s).

Research

- https://www.mdpi.com/2227-9717/12/9/1833
- A Review on the High-Efficiency Detection and Precision Positioning Technology Application of Agricultural Robots
- Summary of Report
    - The paper reviews various methods for detection and localization in agricultural robots, including UWB, deep learning, SLAM, and multi-sensor fusion.
    - The review examines the accuracy of different positioning methods for agricultural robots.
    - It additionally discusses potential applications of deep learning algorithms for crop maturity assessment and pest analysis.
- Relation to Project
    - The paper addresses precise positioning techniques for agricultural robots, aligning with the research for finding the suitable positioning technique.
    - It discusses GNSS and other positioning technologies, which is relevant to your goal of comparing various positioning techniques.
    - The review of multi-sensor fusion approaches provides valuable insights for potentially improving positioning accuracy in agricultural settings.
- Motivation for Research
    - The paper highlights the importance of accurate positioning for efficient and autonomous operation of agricultural robots.
    - It addresses the challenges of positioning in complex agricultural environments, motivating the need for advanced techniques.
    - The review of multiple positioning methods provides a foundation for identifying the most suitable approaches for specific agricultural applications.

Action Item 9: Weekly Report – 3 hour(s).

Project Work Summary

- Documented the research papers, review papers and relevant links that were inferred during the research regarding GNSS and precision positioning.
- Enlisted all the current techniques available for positioning of rovers both applied in agriculture as well as other applications.
- Formed a excel table to tabulate the key finding and comparison of available positioning techniques and documented a word document to compile this weeks research.