# ECO-ROVER

## Capstone Project Proposal

**Submitted by:**

**102003584 Shivam Arora**

**102003676 Bhavya Jain**

**102003685 Arshjeet Singh**

**102003690 Amritpal Singh**

**102003696 Rishabh Mohan**

**BE Third Year- COE**

**CPG No. 235**

Under the Mentorship of

Dr. Rajkumar Tekchandani

Professor

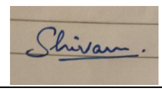
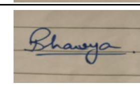
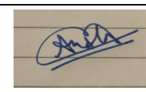
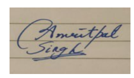
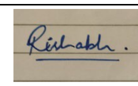
THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

**Computer Science and Engineering Department**

# TABLE OF CONTENTS

# Mentor Consent Form

I hereby agree to be the mentor of the following Capstone Project Team

| **Project Title: Farm Link** | | |
|---|---|---|
| **Roll No** | **Name** | **Signatures** |
| 102003584 | Shivam Arora |  |
| 102003676 | Bhavya Jain |  |
| 102003685 | Arshjeet Singh |  |
| 102003690 | Amritpal Singh |  |
| 102003696 | Rishabh Mohan |  |

NAME of Mentor: Dr. Rajkumar Tekchandani

SIGNATURE of Mentor:

# Project Overview

The solar-powered agricultural rover is designed to assist farmers in their efforts to improve crop yields and reduce the use of pesticides and fertilizers. The rover is equipped with NPK sensors that can analyze soil nutrient conditions in real-time, which allows it to spray fertilizers only when needed. This helps to reduce the overall amount of chemicals used on crops, which can have a positive impact on the environment.

The collected data is transmitted to a website, where it can be analyzed and used to make more informed decisions about farming strategies. By having access to real-time data about soil and weather conditions, farmers can make more targeted decisions about when to spray pesticides and fertilizers, which can help to reduce waste and improve crop yields. The use of solar energy to power the rover also has significant environmental benefits. By using renewable energy, the rover does not contribute to greenhouse gas emissions, which can help to mitigate the effects of climate change and promotes Sustainable Development.

Therefore, the solar-powered agricultural rover has significant benefits for both farmers and the environment. By reducing the labor of the farmer, using solar energy and providing farmers with real-time data, it can help to improve crop yields while also protecting the environment.

## Problem Statement

- Farmers face significant challenges in optimizing their crop yield and minimizing crop damage due to pests and diseases. Traditional farming methods often involve manual application of pesticides and fertilizers without considering soil conditions, leading to inefficiencies and potential environmental harm.

Therefore, there is a need for a solution that can help farmers optimize their crop yield and minimize damage due to excessive fertilizers while also reducing environmental harm. The solar-powered agricultural rover, with its ability to spray pesticides and fertilizers by checking soil nutrient conditions using IoT sensors, can address this need.

# Need Analysis

- Pesticide and fertilizer optimization: The use of traditional farming methods can often result in the overuse of pesticides and fertilizers. This can lead to environmental harm and also increases the cost of farming. With the help of IoT sensors, the solar-powered agricultural rover can analyze the weather and soil conditions, and optimize the application of pesticides and fertilizers, leading to more efficient and cost-effective farming.

- Labor and cost reduction: Traditional farming methods often require significant manual labor and can be expensive to maintain. The solar-powered agricultural rover, with its ability to automate certain farming tasks, can reduce the need for manual labor and also reduce costs associated with traditional farming methods.

- Easy Monitoring: The ability to control the agricultural rover by a remote with a range of 1 km can help farmers monitor their crops from a distance. This can be particularly useful in situations where physical access to the crops is limited, such as in large fields or in areas that are difficult to reach.

Thus, there is an urgent need for a solution that can optimize crop yield, reduce the overuse of pesticides and fertilizers, reduce labor and costs, and provide remote monitoring. The solar- powered agricultural rover, with its ability to address these needs, can have a significant impact on the efficiency and sustainability of farming practices.

# Literature Survey

Lalwani, Ashish et al. discusses the use of autonomous robots in agriculture for smart farming practices. The paper highlights the benefits of using robots in agriculture, such as increased efficiency, reduced labor costs, and minimized environmental impact, and reviews the various types of robots used in agriculture and the technologies used to power them. The authors also identify the challenges facing the widespread adoption of autonomous robots in agriculture, including high costs, lack of standardization, and specialized skills required for operation and maintenance.

Lalwani, Ashish et al. describes an autonomous agricultural robot designed to perform tasks such as seeding and fertilizing, and focuses on the robot's row guidance system. The authors discuss the use of GPS and computer vision technologies to guide the robot along predetermined paths and ensure accurate placement of seeds or fertilizer. They also describe the challenges associated with developing an effective row guidance system, including variable terrain and weather conditions.

AishwaryaGirishMenon et al. proposes a solution to the problem of monitoring large and remote agricultural fields in rural areas using an intelligent rover. The rover is equipped with various sensors such as temperature, humidity, soil moisture, and air quality sensors. The collected data is then transmitted to a central server via an IoT network, where it is analyzed using machine learning algorithms to provide insights and make recommendations for optimizing crop growth. The proposed solution has the potential to improve the efficiency and productivity of agriculture in rural areas.

Giuseppe Quaglia et al. presents the design and development of an Unmanned Ground Vehicle (UGV) powered by solar energy for precision agriculture applications. The UGV is equipped with various sensors such as temperature, humidity, and soil moisture sensors to collect data on crops and soil conditions. The collected data is then transmitted to a central server via a wireless network for analysis and decision- making. The proposed solution has the potential to improve the efficiency and sustainability of agriculture by reducing the use of fossil fuels.

Héctor Cadavid et al. this paper proposes an extension to Thingsboard, a popular open-source IoT platform. This extended version aims to be the core of a cloud-based Smart Farming platform that will concentrate sensors, a decision support system, and a configuration of remotely controlled and autonomous devices (e.g. water dispensers, rovers or drones). The architecture of the platform is described in detail and then showcased in a scenario with simulated sensors. In such scenario early warnings of an important plant pathogen in Colombia are generated by data analytics, and actions on third-party devices are dispatched in consequence.

Giles, D., et al. describes that Spray applications of pesticides to orchards are a common cultural practice; however, they present environmental concerns due to emissions of volatile organic compounds (VOCs), runoff that can allow pesticides to enter waterways, and spray drift onto nontarget areas. Advanced sprayer technology can address these concerns and improve application efficiency by reducing the amount of spray that does not reach the target. Target-sensing sprayers were evaluated in multiseason experiments. They reduced pesticide application rates by 15% to 40% and nontarget orchard-floor deposition by 5% to 72%, providing significant environmental and economic benefits.

Blue River Technology is a company that has developed See & Spray Technology, which uses computer vision and machine learning to identify and target individual plants with fertilizers and herbicides. The system uses a camera to capture images of the crop field and analyzes the images in real-time to identify weeds and other unwanted plants. The system then uses targeted spraying to apply fertilizers and herbicides only to the areas where they are needed. This technology helps farmers to reduce the useof chemicals while increasing yields.

AgroBot is a solar-powered, GPS-enabled agricultural rover developed by the Indian company, Invento Robotics. The rover is equipped with a sprayer system that uses AI algorithms to determine the optimal amount of pesticides and fertilizers required for each plant. It also has a camera system that can detect plant diseases and pests. The rover can be operated remotely using a smartphone app.

Overall, these existing systems/products/projects related to the solar-powered agricultural rover project demonstrate that precision agriculture technology, automated spraying and planting, computer vision, and drones are already being used to optimize crop yields and reduce inputs. The solar-powered agricultural rover project builds on these existing technologies by providing farmers with a mobile, solar-powered platform for real-time data collection and targeted spraying

# Objectives

1. Promoting Sustanable development by designing and building a Solar-powered agricultural rover.

2. Less use of chemicals by Optimum spray of Fertilizers on crops by analyzing the data given by soil NPK sensor.

3. Display & Analyze  IOT sensors data on user-friendly interface.

# Methodology

1. Design and Build the Rover: The first step in achieving the objectives of the project would be to design and build the solar-powered agricultural rover. This would involve selecting the appropriate sensors, designing the control system, and integrating the various components into a functional unit.

2. Test and Optimize the Rover: Once the rover has been built, it would need to be tested in a variety of environments to ensure that it functions as intended. This would involve testing the sensors, control system, and autonomous capabilities of the rover. Based on the test results, the design would be optimized to improve performance.

3. Develop the Website: The data collected by the rover would need to be transmitted to a website for analysis and visualization. The website would need to be designed to display the data in a user-friendly manner, allowing farmers to easily access and interpret the data.

4. Collect and Analyze Data: The sensors on the rover would collect data on soil conditions, weather, plant health, and other variables. This data would need to be analyzed to identify patterns and trends that could be used to optimize crop management.

5. Refine the System: The system would need to be refined and optimized based on feedback from farmers and ongoing testing. This would involve making improvements to the rover, the website, and the data analysis algorithms.

# Project Outcomes

1. Increased Crop Yields: By providing farmers with real-time data on soil conditions, weather, and plant health, the solar-powered agricultural rover could help farmers optimize their crop management practices. This could result in increased crop yields and improved profitability for farmers.

2. Reduced Use of Pesticides and Fertilizers: By using sensors to detect soil and plant conditions, the solar-powered agricultural rover could provide farmers with more accurate data on the amount of pesticides and fertilizers needed for each crop. This could help reduce the use of these chemicals, leading to improved environmental sustainability.

3. Improved Farm Management: By providing farmers with real-time data on soil conditions the solar-powered agricultural rover could help farmers make more informed decisions about their crop management practices. This could lead to improved efficiency, reduced costs, and improved profitability.

4. Increased Access to Information: By providing data on a website, the solar-powered agricultural rover could make this information accessible to a wider range of farmers, regardless of their location or access to resources. This could help level the playing field for small farmers, who may not have access to the same level of information as larger farms.

# Individual Roles

SHIVAM: He will handle the front-end and back-end coding part of the project.

BHAVYA: Responsible for resource gathering for the rover and the procurement of the IOT sensors. He will be also be responsible for defining the requirements for the rover's sensors .He will also be involved in hardware designing of the rover.

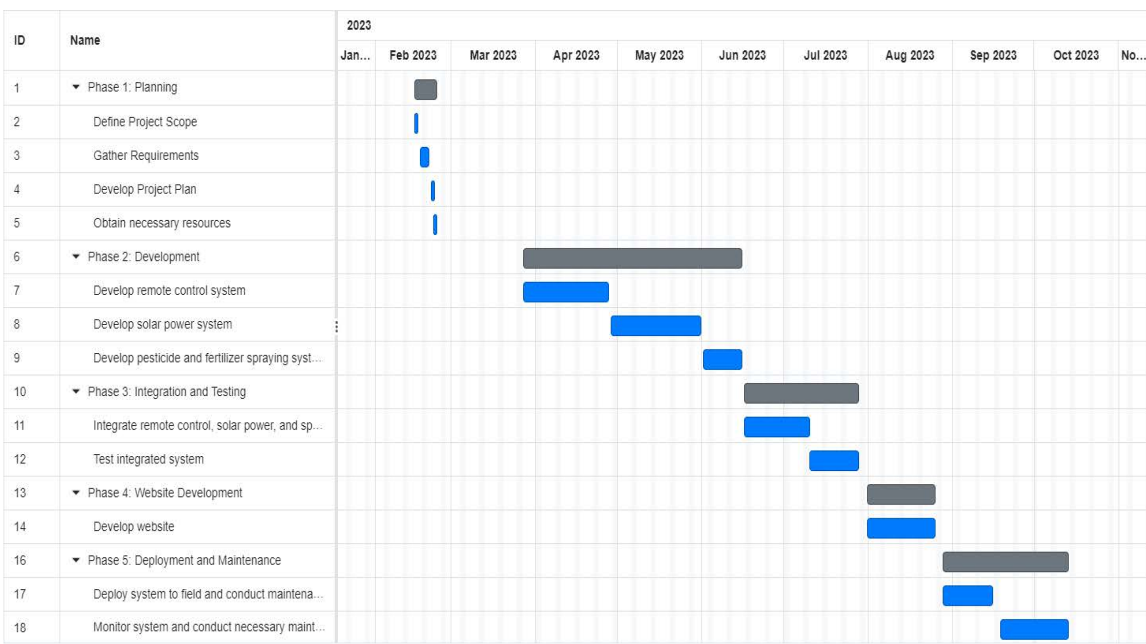
ARSHJEET: Responsible for designing and building the electrical systems of the rover, including the solar panels, battery, and control systems. He will also integrate sensors and other electronics into the rover's systems. He will also be responsible for designing and building the mechanical systems of the rover, including the chassis, wheels, and spraying mechanism.

AMRIT: He will be responsible for analyzing the data collected by the rover and providing insights to farmers to improve their farming practices. He will also be involved in the documentation of the project.He will also handle the IOT part of the project.

RISHABH: Responsible for developing the software systems that will control the rover and collect data from sensors.He will also be responsible for developing the website that will display data collected by the rover and allow farmers to make informed decisions. He will also handle the documentation of the project and also he'll handle the IOT aspect of the

# Work Plan

The work plan for the solar powered agricultural rover project consists of five main phases, with a total duration of approximately 191 days. The first phase is planning, which will take 7 days, and includes defining the project scope, gathering requirements, developing a project plan, and obtaining necessary resources. The second phase is development, which will take 77 days, and involves developing the remote control system, solar power system, and pesticide and fertilizer spraying system. The third phase is integration and testing, which will take 25 days, and includes integrating the different systems and conducting testing to ensure proper functioning. The fourth phase is website development, which will take 21 days, and involves developing a website to display data collected by the rover. The final phase is deployment and maintenance, which will take 61 days, and involves deploying the system to the field, conducting maintenance training, and monitoring the system while conducting necessary maintenance.




Workplan for capstone project

## Course Subjects

- Mechanics
- Machine Learning
- Data Science Applications: IOT
- Electronics Engineering
- Engineering Materials
- UI/UX Specialist

# References

[1] Lalwani, Ashish et al. "A REVIEW : AUTONOMOUS AGRIBOT FOR SMART FARMING." (2015).

[2] Xue Jinlin, XU Liming, "Autonomous Agriculture Robot and its row guidance", IEEE, International Conference on Measuring Technology, 2010, published

[3] Aishwarya Girish Menon & M. Prabhakar "Intelligent IoT-Based Monitoring Rover for Smart Agriculture Farming in Rural Areas " 10 June 2022 [Online]. Available: https://link.springer.com/chapter/10.1007/978-981-19-0098-3_60

[4] Giuseppe Quaglia, Carmen Visconte,Leonardo Sabatino Scimmi "Design of a UGV Powered by Solar Energy for Precision Agriculture"10 March 2020 [Online]. Available: https://www.mdpi.com/2218-6581/9/1/13

[5] Héctor Cadavid, Wilmer Garzón, Alexander Pérez, Germán López, Cristian Mendivelso & Carlos Ramírez "Towards a Smart Farming Platform: From IoT-Based Crop Sensing to Data Analytics" 19 August 2018 [Online]. Available:https://doi.org/10.1007/978-3-319-98998-3_19

[6] Durham K. Giles,Parry Klassen "Smart" sprayer technology provides environmental and economic benefits in California orchards." [Online]. Available: https://calag.ucanr.edu/archive/?article=ca.v065n02p85

[7] "John Deere's Blue River Technology & Spray Technology" [Online]. Available:https://bluerivertechnology.com/

[8] "AgroBot by Invento Robotics" [Online]. Available: https://www.agrobot.com