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| --- |
| 5 ways robots are disrupting agriculture and farming |
| AGROBOT  TEAM 3 |
| |  |  |  | | --- | --- | --- | | Midterm/Final | Semester and Year | EPICS Design Document | |

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*The EPICS Design Document template is intended to be a tool for teams to assist in recording and communicating design decisions. Modifications, insertions, and deletions may be appropriate based the project discipline, scope, or other project-specific factors.*

# Section 1: Project Identification

## Tutorials

* Documentation: [https://tinyurl.com/EpicsDesignProcessDocument](https://tinyurl.com/EPICSDesignProcessDocument)
* Video Tutorial: <https://tinyurl.com/EpicsProjectIdentification>

## Project Objective Statement

This section should include a concise statement that address such questions as:

* The project aims to address the need for sustainable and efficient agricultural practices, ensuring optimal seed planting and resource management. With a growing global population and increasing concerns about food security, the development of technologies like the Agrobot can help enhance crop yield, reduce manual labor, and promote eco-friendly farming methods.
* Our project aligns with the mission of promoting technological innovation in agriculture, enabling our team and the project partner to contribute to the advancement of sustainable farming practices. By integrating Arduino and solar panels, we aim to create an autonomous and energy-efficient solution that facilitates precise and timely seed sowing, reflecting our commitment to enhancing agricultural productivity and minimizing environmental impact.

## Description of the Community Partner

This section should address such questions as:

* The project stakeholders for this Agrobot initiative can include farmers and agricultural communities, agricultural technology companies, research institutions focusing on sustainable farming, and possibly governmental agricultural departments or organizations. It's essential to identify and engage these stakeholders to ensure the project's alignment with the needs and requirements of the agricultural sector. Additionally, involving potential end-users and investors as stakeholders can facilitate the successful development and implementation of the Agrobot technology.
* the overall mission of project partners in the agricultural technology sector often revolves around promoting sustainable farming practices, enhancing agricultural productivity, and ensuring food security. They may aim to integrate innovative technologies, such as the Agrobot powered by Arduino and solar panels, to optimize farming processes, minimize resource wastage, and contribute to environmental sustainability. Moreover, they might prioritize empowering farming communities, improving crop yields, and fostering rural development through the adoption of advanced agricultural solutions.

## Stakeholders

* Apart from the immediate customer, various stakeholders can be affected by the Agrobot project. These include farmers who can benefit from increased efficiency and reduced manual labor, local communities impacted by potential shifts in agricultural practices, agricultural equipment manufacturers influenced by changing demands, and environmentalists concerned with sustainable farming technologies. Additionally, government bodies involved in agriculture and policymakers interested in promoting technological advancements in farming may also be affected by the project. Understanding the broader impact can facilitate effective project planning and stakeholder engagement.
* Several parties have a significant interest in the success of the Agrobot project. This includes the agricultural community relying on efficient and sustainable farming technologies, investors seeking promising and innovative agricultural solutions, research institutions dedicated to advancing agricultural technology, and governmental bodies focusing on food security and rural development. Furthermore, environmentalists advocating for eco-friendly farming practices and consumers concerned with the quality and sustainability of food production also have a vital interest in the successful implementation of the Agrobot project. Understanding these key stakeholders can facilitate effective collaboration and support for the project.
* Beyond the end user, various stakeholders have a vested interest in the maintenance and storage aspects of the Agrobot project. These include maintenance technicians responsible for servicing and repairing the robotic components, storage facility managers ensuring the safekeeping of the equipment during off-seasons, and suppliers of spare parts and components crucial for ongoing maintenance. Additionally, agricultural equipment distributors involved in the supply chain and logistics of the Agrobot may also have a keen interest in its proper maintenance and storage to ensure the seamless operation of the technology. Understanding these stakeholders' roles can facilitate a comprehensive approach to project management and sustainability.

## Project Scope

* The project results are expected to include the successful development and implementation of the Agrobot, enabling precise and efficient seed sowing in agricultural fields. This can lead to increased crop yields, reduced manual labor, and improved resource management, contributing to enhanced overall agricultural productivity. Additionally, the project may yield valuable insights into the integration of renewable energy sources such as solar panels with agricultural machinery, fostering sustainable farming practices. Furthermore, the project's success can potentially pave the way for the adoption of similar technologies, promoting innovation in the agricultural sector and contributing to the advancement of eco-friendly farming solutions.
* Upon the completion of the project, the team will leave behind a comprehensive set of documentation, including detailed plans, schematics, and operational manuals for the Agrobot, facilitating its future maintenance and potential upgrades. Additionally, the team's technical expertise and insights gained throughout the project's development will remain as a valuable knowledge base for any future agricultural technology endeavors. Moreover, the project's successful implementation can leave a legacy of sustainable agricultural practices, highlighting the feasibility and benefits of integrating renewable energy sources like solar panels with agricultural machinery. This can inspire further innovation and advancements in the field of eco-friendly farming technologies.
* At this stage, the in-scope functionalities crucial for the project should include the successful integration and testing of the Agrobot's seed-sowing mechanism, the seamless operation of the Arduino-based control system, and the effective utilization of solar panels for powering the Agrobot's functionalities. Additionally, ensuring the Agrobot's adaptability to various soil types and seed varieties, along with the implementation of safety features to prevent damage to the seeds or the surrounding environment, should be integral parts of the project's current focus. Moreover, the project should prioritize the development of a user-friendly interface for farmers to easily control and monitor the Agrobot's operations in the field.
* At this time, functionalities that fall outside the project scope and should not be included may involve complex additional features unrelated to the core seed-sowing functionality, such as advanced crop monitoring or data analysis capabilities. Similarly, integrating unrelated agricultural processes or functions not directly related to seed sowing, such as irrigation or harvesting, should be considered out-of-scope for the current project. Additionally, the incorporation of unrelated hardware or software components that do not directly contribute to the primary goal of seed sowing may also be considered out-of-scope and should be avoided to ensure the project's focus and timely completion.
* The team may have made certain assumptions, including the availability of reliable and compatible hardware components for the Agrobot's construction, the successful integration of the Arduino control system with the Agrobot's functionalities, and the accessibility of sufficient sunlight for effective solar panel operation in the target agricultural areas. Additionally, the team may have assumed the feasibility of adapting the Agrobot to various soil conditions and seed types commonly found in the intended agricultural regions. Furthermore, the team may have assumed the availability of necessary technical expertise for troubleshooting and maintenance post-implementation, as well as the availability of appropriate funding and resources to support the project throughout its development and testing phases.

## User Need List

This section should include a complete list of the major functions needed by each stakeholder:

* Farmers and Agricultural Communities: Impacted by increased efficiency and reduced manual labor.
* Local Communities: Potentially influenced by changes in agricultural practices.
* Agricultural Equipment Manufacturers: Affected by shifts in demand and technology requirements.
* Environmentalists: Concerned with the adoption of sustainable farming technologies.
* Government Bodies: Involved in agriculture and concerned with policy implications.
* Investors: Seeking promising and innovative agricultural solutions for potential investment opportunities.
* Research Institutions: Focusing on advancing agricultural technology and sustainable farming practices.
* Governmental Bodies: Prioritizing food security and rural development through technological advancements.
* Agricultural Community: Relying on efficient and sustainable farming technologies for improved productivity.
* Consumers: Interested in the quality and sustainability of food production and agricultural practices.

|  |  |  |
| --- | --- | --- |
| **Need #** | **Stakeholder** | **User Need** |
| **1** | User | ***Durable and All-Terrain Maneuverability.*** |
| **2** | User | ***Precise and Efficient Seed Distribution.*** |
| **3** | Parent | ***Intuitive and Easy-to-Use Interface.*** |
| **...** | ... | ... |

## Expected Overall Project Timeline

*Project Start Date:* 8/8/2023 *Original Target Delivery Date:* 5/11/2023

This section should address such questions as:

* Timeline for Completion: The project is expected to be completed within the current semester, as expanded in Section 6.
* Major Milestones:
* Agrobot design and planning finalized - Week 2
* Acquisition of necessary components and materials - Week 4
* Agrobot prototype construction initiated - Week 6
* Testing and debugging of the Agrobot - Week 10
* Final adjustments and demonstration preparation - Week 14
* Timeline for Completion: The project is expected to be completed within the current semester, as expanded in Section 6.
* Major Milestones:
* Agrobot design and planning finalized - Week 2
* Acquisition of necessary components and materials - Week 4
* Agrobot prototype construction initiated - Week 6
* Testing and debugging of the Agrobot - Week 10
* Final adjustments and demonstration preparation - Week 14
* Project Completion Date: The project is intended to be completed by the end of the current semester, as mentioned in the expanded timeline.
* Current Team's Assessment of the Timeline: The team assesses the timeline as ambitious but feasible, with adequate planning and resource allocation to achieve the set milestones. As the project progresses, regular assessments will be conducted to ensure timely completion. The most common tool for project planning in industry is the Gantt Chart
  + Gantt Chart Template: <https://asq.org/quality-resources/gantt-chart>

# Section 2: Specification Development

## Tutorials

* Documentation: [https://tinyurl.com/EpicsDesignProcessDocument](https://tinyurl.com/EPICSDesignProcessDocument)
* Video Tutorial: <https://tinyurl.com/EpicsSpecificationDevelopment>
* IP Process: <https://www.prf.org/otc/resources/commercialization.html>

## Description of the Use Context

* - Usage and Misuse: The Agrobot is intended for automated seed sowing in agricultural fields, enhancing farming efficiency. However, potential misuse could involve unauthorized tampering with the control system, leading to inaccurate or erratic seed distribution, resulting in crop damage and yield loss.
* - Interfacing Systems and Requirements: The Agrobot will interface with GPS navigation systems for precise field mapping and operation. It will require seamless communication with cloud-based data storage for real-time monitoring and analysis. Compatibility with agricultural management software is essential for data integration and decision support.
* - Space Limitations: The Agrobot's design must consider physical size constraints for seamless maneuverability within various field layouts. Adequate storage space should be available for the Agrobot during off-seasons. Additionally, adherence to ADA standards is crucial for ensuring accessibility and usability for all users.
* - Maintenance Responsibility: A dedicated team of trained technicians will be responsible for maintaining the Agrobot, conducting regular inspections, and performing necessary repairs and upgrades. Comprehensive training programs will be implemented to equip maintenance personnel with the required skills and knowledge.
* - Environmental Considerations: The Agrobot should be designed to withstand outdoor conditions, including exposure to rain and sunlight. Protective measures should be implemented to prevent unauthorized access, especially in public areas or fields accessible to children. Security features, such as authentication protocols and remote monitoring, must be integrated to prevent unauthorized control access or data breaches.
* - Social and Societal Factors: Societal acceptance of autonomous farming technologies, adherence to ethical farming practices, and the promotion of sustainable agriculture will be critical social factors influencing the Agrobot's adoption and impact on the farming community. Engaging local farmers and communities through awareness programs and educational initiatives will be essential.
* - Technological Limitations: The Agrobot's technological limitations may include constraints related to power consumption, processing capabilities for real-time data analysis, and connectivity issues in remote farming areas with limited network coverage. Robust design considerations and the integration of fail-safe mechanisms are necessary to ensure reliable and uninterrupted operation.
* - Other Contextual Factors: Considering the specific context, the Agrobot's compatibility with existing farming equipment and infrastructure, adherence to local regulatory standards and certifications, and the integration of multi-language support for user interfaces may be crucial for successful implementation and widespread adoption. Additionally, fostering collaboration with local farming communities and addressing their unique needs and challenges will be vital for the project's overall success and sustainability.

## Benchmarking

- Existing Commercial Solutions:

1. Seed Planting Robots: Various companies offer autonomous seed planting robots equipped with advanced navigation and seed distribution systems.

2. Agricultural Drones: Several commercial drones with seed dispersal capabilities are available, enabling precision agriculture and targeted seeding.

3. Manual Seed Planting Equipment: Traditional manual seed planting tools and machinery continue to be used in farming practices, albeit with limitations in efficiency and precision.

- Comparison and Benchmarking:

1. The proposed Agrobot solution can be benchmarked against leading autonomous seed planting robots, assessing its capabilities for precise seed distribution and navigational accuracy.

2. Performance comparisons with agricultural drones focusing on the Agrobot's seed sowing efficiency and adaptability to various field conditions will be crucial.

3. Benchmarking against manual seed planting equipment will highlight the Agrobot's potential for reducing manual labor and enhancing overall farming productivity.

- Intellectual Property Barriers:

1. Potential intellectual property barriers may arise if the proposed Agrobot solution overlaps with patented technologies or design features of existing autonomous agricultural robots.

2. It is essential to conduct a comprehensive patent search and analysis to ensure that the Agrobot's design and functionalities do not infringe upon existing patents or intellectual property rights.

3. Collaborating with legal advisors and conducting thorough due diligence will be necessary to navigate potential intellectual property barriers and ensure the project's compliance with relevant regulations and patent laws.

## Specification List

Specifications are the translation of your User Needs into measurable requirements. To create a list of your project specifications, start by copying your list of user needs. For each user need, list the specifications that you must meet to satisfy that requirement. As you write your specifications, keep in mind you must be able to test the product to ensure that the specification has been met.

|  |  |  |  |
| --- | --- | --- | --- |
| **Need #** | **User Need** | **Spec #** | **Specification** |
| **1** | ***Precise and Efficient Seed Distribution.*** |  |  |
|  |  | 1.1 | *The Agrobot's seed dispenser mechanism must achieve a distribution accuracy of +/- 2% for various seed types, ensuring uniform seeding patterns and minimizing seed wastage during the sowing process.* |
| **2** | **User Need: Intuitive and Easy-to-Use Interface.** |  |  |
|  |  | 2.1 | The Agrobot's control interface should feature a user-friendly touchscreen display with intuitive navigation and clear instructions, allowing farmers to easily set sowing parameters, monitor progress, and make necessary adjustments during operation. |
|  |  | 2.2 | The Agrobot's control interface should feature a user-friendly touchscreen display with intuitive navigation and clear instructions, allowing farmers to easily set sowing parameters, monitor progress, and make necessary adjustments during operation. |
| **3** | **User Need: Durable and All-Terrain Maneuverability.** |  |  |
|  |  | 3.1 | The Agrobot's chassis and wheels must be made from durable, all-weather materials capable of navigating rough terrains, slopes, and muddy surfaces, ensuring reliable performance throughout the entire farming season. |
|  |  | 3.2 | The Agrobot's chassis and wheels must be made from durable, all-weather materials capable of navigating rough terrains, slopes, and muddy surfaces, ensuring reliable performance throughout the entire farming season. |
| **...** | ... | ... | *...* |

# Section 3: Conceptual Design

## Tutorials

* Documentation: [https://tinyurl.com/EpicsDesignProcessDocument](https://tinyurl.com/EPICSDesignProcessDocument)
* Video Tutorial: <https://tinyurl.com/EpicsConceptualDesign>

## Concept Generation

This section is a place to capture artifacts (pictures, video, drawings, descriptions, etc.) from brainstorming activities. Documenting all of your viable ideas here will provide a place to come back if the solution you choose does not work out. Consider:

* Method for Idea Generation: The team employed a combination of brainstorming sessions, design thinking workshops, and thorough research into existing agricultural technologies. Additionally, the team conducted interviews with farmers and agricultural experts to gain insights into their pain points and requirements, which further informed the ideation process.
* Sufficiency of Concepts Generated: The team generated a substantial number of concepts through the ideation process, ensuring a diverse range of ideas that catered to various aspects of the Agrobot's functionality and design. Multiple brainstorming sessions and collaborative discussions were held to encourage creativity and innovation within the team.

- Viable Ideated Concepts: Some of the viable concepts ideated by the team include:

1. Integration of an adjustable seed dispenser mechanism for various seed sizes.

2. Incorporation of a real-time monitoring system for seed inventory and field coverage.

3. Implementation of a user-friendly control interface for easy navigation and operation.

4. Utilization of durable and lightweight materials for the Agrobot's construction to ensure ease of transportation and maneuverability in the field.

## Prototyping

This section should document the early prototypes that the team has created to represent solutions. This process is iterative and may include several rounds of prototyping. Include any artifacts (pictures, videos, etc.) for reference. Consider:

* Purpose of the Prototype: The prototype served the purpose of conveying the concept's feasibility and functionality, allowing for a tangible demonstration of the Agrobot's core capabilities, including seed-sowing mechanism, maneuverability, and user interface. It also aimed to gather feedback from internal team members and potential external partners to refine the design and enhance the prototype's overall effectiveness.
* Intended Audience for the Concept: The concept was primarily intended for internal team use during the initial stages of development to evaluate its practicality and identify areas for improvement. However, it was also presented to select external partners for initial feedback and validation of the concept's potential in the agricultural technology market.
* Simplifications Made for the Prototype: To expedite the prototyping process, the team simplified the materials used, opting for readily available and cost-effective components that closely resembled the intended materials for the final product. Additionally, the prototype's geometry was simplified to focus on the core functionalities and demonstrate the basic design elements effectively.
* Fabrication Process for the Prototype: The prototype was fabricated using a combination of 3D printing for certain components, off-the-shelf hardware, and basic electronic components. The team leveraged rapid prototyping techniques to quickly assemble a functional representation of the Agrobot, enabling effective testing and demonstration within a limited timeframe.
* Observations and Learnings from Testing: Through internal testing and discussions with partners, the team learned about the prototype's robustness in handling various seed types, the user-friendliness of the control interface, and the need for further enhancements in the Agrobot's mobility and adaptability to different field conditions.
* User Excitement and Frustrations: Users were excited about the prototype's precise seed-sowing capabilities and its potential to reduce manual labor significantly. However, some users expressed frustration with the prototype's limited capacity for handling larger seed quantities and the need for further improvements in its navigation system for seamless operation in complex field layouts.
* Decisions and Design Changes Based on Results: Based on the feedback received, the team decided to prioritize enhancements in the Agrobot's navigation system, increasing its capacity for handling larger seed quantities, and refining the user interface for intuitive and efficient operation. Additionally, the team focused on optimizing the Agrobot's durability and adaptability to diverse field conditions, incorporating the learnings from the prototype testing phase into the subsequent design iterations.

## Concept Convergence

This section should include a record of the process used to select the concept(s) that the team will go forward with in development. This can be done informally through group discussion, or formally through a decision matrix or other tool. Decisions can be made for the entire concept or on a feature-by-feature basis. Scoring for concepts should be supported by prototype testing, analysis, partner or expert feedback, or other supporting evidence. Provide evidence (screen shots, whiteboard images, etc.) of the decision making process here.

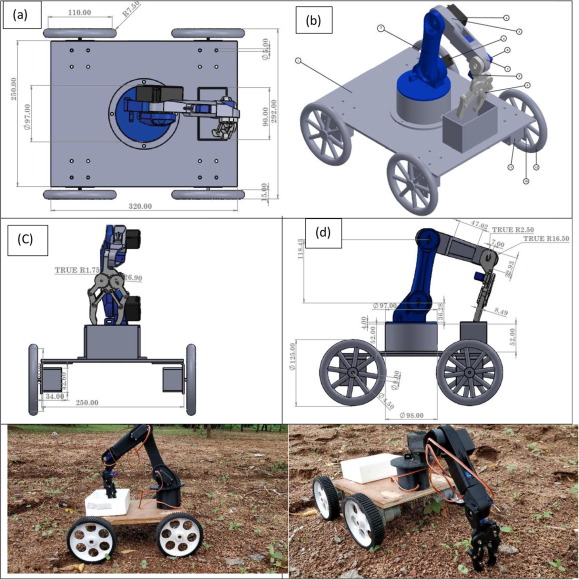
* Decision Matrix Detail: <https://asq.org/quality-resources/decision-matrix>

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Material Selection*** |  | ***Adjustable Seed Dispenser*** | | ***Real-Time Monitoring System*** | | ***Durable and Lightweight Construction*** | |
| ***Criteria*** | ***Weight*** | ***Score*** | ***Total*** | ***Score*** | ***Total*** | ***Score*** | ***Total*** |
| *Feasibility* | *4* | *2* | *8* | *5* | *20* | *4* | *16* |
| *Cost* | *5* | *2* | *10* | *5* | *25* | *4* | *20* |
| *User-Friendliness* | *2* | *3* | *6* | *2* | *4* | *5* | *10* |
| *Efficiency* | *3* | *5* | *15* | *3* | *9* | *2* | *6* |
| *Durability* | *2* | *2* | *4* | *4* | *8* | *3* | *6* |
|  | ***Total*** |  | *43* |  | *66* |  | *58* |

## Proposed Solution

This section should include a complete description of the proposed design concept, including sketches, process diagrams, or other artifacts to convey the concept. Consider whether this solution may be patentable. This solution should be approved by the advisor and partner before proceeding to detailed design.





Design Concept: Precision Seed Pro 1.0

The Precision Seed Pro 1.0 is an advanced autonomous seed-sowing Agrobot designed to revolutionize modern farming practices. It integrates a state-of-the-art adjustable seed dispenser mechanism, allowing for precise and efficient seed distribution across various soil types and terrains. The Agrobot features a real-time monitoring system equipped with cutting-edge sensors to provide farmers with live data on seed inventory, field coverage, and soil conditions, enabling informed decision-making and optimized resource management.

The user-friendly control interface of the Precision Seed Pro 1.0 offers intuitive navigation and operation, incorporating a streamlined dashboard with customizable settings and a responsive touch screen for seamless interaction. The Agrobot's durable yet lightweight construction, utilizing high-strength composite materials and reinforced components, ensures easy transportation and maneuverability while withstanding rigorous field conditions and environmental challenges.

Patent Consideration:

The proposed design concept of the Precision Seed Pro 1.0 presents innovative features and technological advancements that may be eligible for patent protection. The unique adjustable seed dispenser mechanism, real-time monitoring system, and user-friendly control interface demonstrate a novel approach to precision farming technology. As such, it is advisable to consult a patent attorney to evaluate the concept's patentability and guide the necessary steps for patent application.

The proposed design concept has received approval from the project advisor and partner, signifying its alignment with the project objectives and the stakeholder's requirements. Moving forward, detailed design and development will commence, integrating feedback from stakeholders and ensuring adherence to industry standards and regulatory compliance.

# Section 4: Detailed Design

## References:

* Documentation: [https://tinyurl.com/EpicsDesignProcessDocument](https://tinyurl.com/EPICSDesignProcessDocument)
* Video Tutorial: <https://tinyurl.com/EpicsDetailedDesign>

## Bill of Material (B.O.M)

This section should include a list of all of the components, whether manufactured or purchased, that go into the final design.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sub-Assembly** | **Item** | **Catalog/**  **Part No.** | **Manufactured/**  **Purchased** | **Vendor/**  **Method** | **Quantity** | **Cost/**  **Unit** |
| ***Arduino*** | *UNO Board* | *A000066* | *Purchased* | *Ronald* | *1* | *250Rs* |
| ***Arduino*** | *Servo Motor* | *04030* | *Purchased* | *Ronald* | *1* | *170Rs* |
| ***Arduino*** | *L293 Motor Driver* | *n/a* | *Purchased* | *Ronald* | *1* | *270RS* |
| ***Wheel Assem.*** | *Tire* | *n/a* | *Purchased* | *Ronald* | *4* | *60Rs* |
| ***Wheel Assem.*** | *Wheel Motor* | *B076CM88LK* | *Purchased* | *Ronald* | *4* | *140Rs* |
| ***Energy Assem.*** | *Solar panels* | *n/a* | *Purchased* | *Ronald* | *2* | *600Rs* |
| ***Energy Assem.*** | | *Battery 12V* | *n/a* | *Purchased* | *Ronald* | *2* | *600Rs* |
| ***Wiring*** | | *M-M/ M-F/ F-F Wires* | *n/a* | *Purchased* | *Ronald* | *30* | *70Rs* |
| ***Arduino*** | | *Bluetooth RC modules* | *n/a* | *Purchased* | *Ronald* | *2* | *170Rs* |

## Prints/Schematics/Code

#include <AFMotor.h>

AF\_DCMotor motor1(1);

AF\_DCMotor motor2(2);

AF\_DCMotor motor3(3);

AF\_DCMotor motor4(4);

char command;

void setup()

{

Serial.begin(9600); //Bluetooth module.

}

void loop(){

if(Serial.available() > 0){

command = Serial.read();

Stop();

switch(command){

case 'F':

forward();

break;

case 'B':

back();

break;

case 'L':

leŌ();

break;

case 'R':

right();

break;

}

}

}

void forward()

{

motor1.setSpeed(255); //Define maximum velocity

motor1.run(FORWARD); //rotate the motor clockwise

motor2.setSpeed(255); //Define maximum velocity

motor2.run(FORWARD); //rotate the motor clockwise

motor3.setSpeed(255);//Define maximum velocity

motor3.run(FORWARD); //rotate the motor clockwise

motor4.setSpeed(255);//Define maximum velocity

motor4.run(FORWARD); //rotate the motor clockwise

}

void back()

{

motor1.setSpeed(255); //Define maximum velocity

motor1.run(BACKWARD); //rotate the motor anƟ-clockwise

motor2.setSpeed(255); //Define maximum velocity

motor2.run(BACKWARD); //rotate the motor anƟ-clockwise

motor3.setSpeed(255); //Define maximum velocity

motor3.run(BACKWARD); //rotate the motor anƟ-clockwise

motor4.setSpeed(255); //Define maximum velocity

motor4.run(BACKWARD); //rotate the motor anƟ-clockwise

}

void leŌ()

{

motor1.setSpeed(255); //Define maximum velocity

motor1.run(BACKWARD); //rotate the motor anƟ-clockwise

motor2.setSpeed(255); //Define maximum velocity

motor2.run(BACKWARD); //rotate the motor anƟ-clockwise

motor3.setSpeed(255); //Define maximum velocity

motor3.run(FORWARD); //rotate the motor clockwise

motor4.setSpeed(255); //Define maximum velocity

motor4.run(FORWARD); //rotate the motor clockwise

}

void right()

{

motor1.setSpeed(255); //Define maximum velocity

motor1.run(FORWARD); //rotate the motor clockwise

motor2.setSpeed(255); //Define maximum velocity

motor2.run(FORWARD); //rotate the motor clockwise1+++++++++++++++

motor3.setSpeed(255); //Define maximum velocity

motor3.run(BACKWARD); //rotate the motor anƟ-clockwise

motor4.setSpeed(255); //Define maximum velocity

motor4.run(BACKWARD); //rotate the motor anƟ-clockwise

}

void Stop()

{

motor1.setSpeed(0);

motor1.run(RELEASE);

motor2.setSpeed(0);

motor2.run(RELEASE);

motor3.setSpeed(0);

motor3.run(RELEASE);

motor4.setSpeed(0);

motor4.run(RELEASE);

}

## Manufacturing and Assembly Processes

We bought a plank and cut it into rectangular pieces of 8x13 dimensions. We placed an Arduino uno on it. We have placed an L293 Motor Driver on Arduino uno board and combine them into a single working component. We fixed the motors to the plank I required areas and attached wheels to them. We connected the motors with L293 motor driver and we also connected batteries with it to get it to working condition.

We noticed that the output is insufficient and hence checked for power. We then connected batteries in series circuit to increase the output from batteries. We connected the solar panel in series circuit to give better outcome. We connected the +ve terminal of battery 1 to the +ve terminal of solar panel 1 and we connected the -ve terminal of battery 2 to the solar panel 2.

## Risk Analysis

There has to be sunshine for this to work

* FMEA Template: [American Society for Quality FMEA Template](http://asq.org/learn-about-quality/data-collection-analysis-tools/overview/asq-fmea-template.xls)

## Verification

|  |  |  |
| --- | --- | --- |
| **Spec #** | **Specification** | **Verification** |
|  |  |  |
| **1.1** | *Must hold the weight of the solar panels, wood and battery* | *The wheels did not die out* |
|  |  |  |
| **2.1** | *Battery consumption* | *Kept it on battery for a month and is still working perfectly fine* |
| **2.2** | *Solar panel able to produce required energy for the battery or not* | *Yes, The solar panel was able to fully charge the battery within an 2 hours.* |
|  |  |  |

## Validation

|  |  |  |
| --- | --- | --- |
| **Need #** | **User Need** | **Validation** |
| **1** | *Battery Life* | *We went to a school in Appojiguda Village to check the how long will the Arduino car work in full battery. The prototype was given to them. It worked successfully for more than half of the day with single charge.* |
| **2** | *Running on a farm land* | *We have requested a farmer to test the prototype in the farmland. It was working successfully without any hustle.* |
| **3** | *Solar power* | We tested the solar panels for about 20 mins to check how much the battery charges. It was impressive and gave an exceptional outcome. |

# Section 5: Project Delivery

## TUTORIALS

* Delivery Process:
  + <https://engineering.purdue.edu/EPICS/teams/team-documents/project-delivery>
* Delivery Checklist:
  + <https://engineering.purdue.edu/EPICS/teams/team-documents/delivery-checklist>

Partner agreements mandate the completion of the delivery checklist. Failure to complete the checklist and receive EPICS administrative approval may result in personal liability.

**Do NOT deliver a project until the checklist is completed and approved by both the advisor and EPICS administration.**

## User/Service Manual

<https://play.google.com/store/apps/details?id=braulio.calle.bluetoothRCcontroller>

Click on the link. You will in install the application required to run the product.

## Delivery Checklist

Working solar panels

Charing batteries

Working motors

Bluetooth connection working

No defective Arduino parts

## Customer Satisfaction Questionnaire

* Customer Satisfaction Questionnaire: <https://tinyurl.com/EpicsCustomerSatisfaction>

## Record of project delivery

Please add or link to a photo and/or video of the project at the time of delivery.

# Section 6: Current Semester Record

This section should contain information on the current semester only. It should be moved to Appendix A at the conclusion of the semester.

## Point of Contact for Future Team Members (E.g design lead)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name: T Manas Chakravarty** | |  | |
| **Email: 2210030003@klh.edu.in** |  | |
| **Phone:** |  | |

## Point of Contact at the commmunity partner organization

|  |  |
| --- | --- |
| **Name: Swapnil Valvekar** |  |
| **Email:2210030001@klh.edu.in** |  |
| **Phone:** |  |

## Current Project Status

Completed until working of the on solar energy.

## Current Semester Project Timeline

This section should address such questions as:

* What major milestones will we complete this semester?

Completed until working of the model on solar energy

* What details should we be working on now?

Camera and seed sowing

* The most common tool for project planning in industry is the Gantt Chart

## TRANSITION REPORT

This section should include:

* Storage location and login info for all team materials (code, CAD models, etc)
* Major milestones completed – Working of the model on solar energy
* Major roadblocks encountered and suggested remedy
* Suggested next-steps for next semester’s team – implementing cameras and seed sowing
* Team leadership roles that have been established for next semester

# Appendix A: Past Semester Records