

**Synopsis Report**

**On**

**DESIGN AND DEVELOPMENT OF AUTONOMOUS MOBILE ROBOT USED IN RAKING OF CASHEW NUTS**

*Submitted by*

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## February 2023

**Introduction:**

During drying process farmer must dry collected raw cashew nuts in sunlight for a minimum of 2 days. Sun-dry Raw Cashew nuts (RCN) on concrete floors, an open yard, drying mats, or tarpaulins for 2 to 4 days. Turn nuts frequently during the drying period to ensure uniform drying. Sun drying is a traditional drying method for reducing the moisture content of RCN by spreading the RCN under the sun.

Moisture rate requirements: This is an important element concerning nuts storage. It is expressed in percentage and has to be under control from harvest to the shelling. It is better to keep the Moisture Rate below 10 percent after the drying. If the rate exceeds 10 percent, nuts can go mouldy; however, if the rate is too low (under 6 percent), kernels become dry and lose weight. There is a shortfall for the seller. Moreover, kernels too dry are too flimsy during processing. Therefore, it is best to keep the moisture content between 7 and 10 percent.

Semi-autonomous mobile robot is controlled remotely by a person standing in shadow near the cashew nut drying ground. Our mobile robot is moved from its home position (a charging spot in the garage) to the nut drying area. Rake is initially in vertical position and when the robot reaches the working area that is the drying field, rake is lowered and it will be touching the ground. Working is similar to ploughing a field, instead of soil cashew nuts are the one which is being ploughed. Robot is moved along the length of the working field several times until the entire area is covered. After completion mobile robot moves to the home position to charge and cycle is repeated.

**Problem statement**

Due to uneven and untimely turning of raw cashew nuts during its sun drying process, cashew nuts are not being dried evenly resulting in its contamination due to presence of excess humidity. This contamination leads to losses for the farmers and needs to be mitigated. Manually raking of cashew nut needs to be done under hot sun and the nuts release toxic oil like substance it is a very tiresome and dangerous job.

## Objectives:

* Even spreading of raw cashew nuts during sun drying.
* Repeated turning of the nuts for 3 to 4 times a day.
* Path planning using simulation to accomplish the task.
* Development of autonomous navigation system using ROS2.
* To prevent human laborers from harmful effects of urushiol.

## Methodology

* Identify the key requirements for the path planning simulation, such as the robot model, sensors, environment, and path planning algorithm. For this use case, the requirements include an autonomous mobile robot that can navigate through the cashew nut drying area, a camera or sensor to detect the nuts, and a path planning algorithm that can efficiently cover the area with even distribution of nuts.
* Set up the development environment: Install ROS2 and any required packages or libraries for developing the simulation. Involves setting up a virtual environment or Docker container to isolate dependencies.
* Develop the robot model: Create a robot model using URDF or SDF format that accurately represents the physical characteristics of the robot. Includes the robot's dimensions, joints, sensors, and rake.[1]
* Create the environment: Create a 3D environment using Gazebo or a similar simulation tool that represents the cashew nut drying area. Includes the working field, obstacles, and any other features of the environment that are relevant to the use case.
* Implement the path planning algorithm: Select an appropriate path planning algorithm, such as a grid-based method or a potential fields method, that can effectively cover the area with even distribution of nuts. Implement the algorithm in a ROS2 package that takes into account the robot's physical characteristics and the environment.[2]
* Integrate sensors and actuators: Integrate sensors, such as cameras etc, that can detect the hindrances and actuators that can control the movement of the rake.
* Test the simulation: Test the simulation by launching it in Gazebo and sending commands to the robot to move around the environment. This should include testing the path planning algorithm to ensure that the robot can efficiently cover the area with even distribution of nuts.[3]
* Evaluate the performance: Evaluate the performance of the path planning algorithm using metrics such as nut distribution, time to cover the area, and computational resources required.
* Refine the simulation: Based on the results of testing and evaluation, refine the simulation by making adjustments to the robot model, environment, or path planning algorithm as necessary.
* Document the simulation: Document the simulation in a clear and concise manner, including instructions for running the simulation and any relevant code or data. This will ensure that others can use and build upon your work.

## References

[1] G. Rajendran, U. V, and B. O’Brien, “Unified robot task and motion planning with extended planner using ROS simulator,” *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 34, no. 9, pp. 7468–7481, 2022, doi: 10.1016/j.jksuci.2021.07.002.

[2] N. T. Tran, T. D. Ngo, D. K. Nguyen, P. X. Son, and N. H. Thai, *Mapping and Path Planning for the Differential Drive Wheeled Mobile Robot in Unknown Indoor Environments Using the Rapidly Exploring Random Tree Method*, vol. 1. Springer Nature Singapore, 2022. doi: 10.1007/978-981-19-1968-8\_43.

[3] K. A. Ketuly, A. H. A. Hadi, H. Khaledi, and E. R. T. Tiekink, “5,22-Stigmastadien-3Β-yl p-toluenesulfonate,” *Acta Crystallogr. Sect. E Struct. Reports Online*, vol. 66, no. 6, 2010, doi: 10.1107/S1600536810016661.

**Details of Group Member**

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