

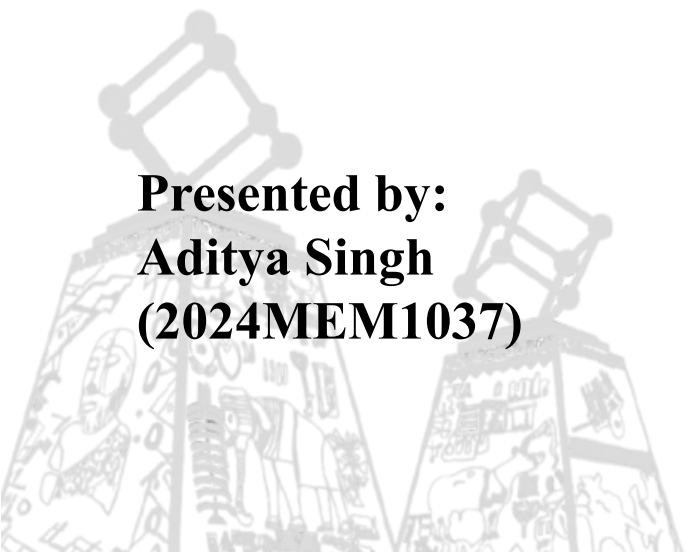


# Design and Analysis of a Dual-action End-effector for Robotic Assistance in Leafy-vegetables Farming

Master of Technology in Mechanical Engineering

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**Under The Supervision of:**  
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- ❑ Automation in agriculture is rapidly expanding, and there is a need of advanced end-effectors to improve the efficiency.
- ❑ Traditional grippers are limited to **single tasks**, while modern agriculture demands **multi-task functionality**.
- ❑ Harvesting of leafy vegetables requires **delicate handling** to maintain quality, with end-effectors still a major challenge in automation.
- ❑ **Adaptive grippers** can handle varying geometry and soft stems of leafy vegetables.



Figure (i)



Figure (ii) Harvesting of leafy vegetables



Figure (iii) Tendon-driven adaptive gripper [1]

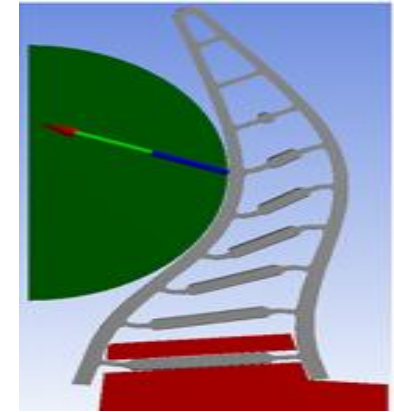


Figure (iv) Fin-ray inspired gripper's finger [4]



# Literature



Paper by	Year	Important information taken
Mart Bluiminck et.al.	2023	<b>2-finger</b> , underactuated, <b>tendon-driven gripper</b> with variable stiffness to handle fragile, deformable agri-food products.
Johannes F.Elferich et.al.	2022	This paper gives review of soft robotics grippers for crop handling or harvesting.
Ji Hyeon Shin et.al.	2021	This study enhances the design through <b>structural optimization</b> , switchable grip modes, and <b>friction pads</b> , achieving improvement in load capacity and handling of high–aspect ratio objects.
Xiaowei Shan et.al.	2020	This paper explores <b>Fin Ray–based adaptive robotic fingers</b> , which adapt naturally to an object’s shape.
Wenqi Wang et.al.	2020	It gives information about physical and mechanical properties of <b>hydroponic lettuce</b> for automatic harvesting.
Z. Samadikhoshkho et.al.	2019	<b>Robotic grippers are classified</b> based on configuration, actuation, application, size, and stiffness.
Baozeng Jia et.al.	2009	Developed an <b>integrated gripper-cutter</b> mainly targeting peduncle cutting of fruiting vegetables.

- ❑ The literature mainly focuses on the **gripper design for fruits** or flowering vegetables, while limited work has been reported for leafy vegetables.
- ❑ Leafy vegetables require **adaptive gripping** because of their delicate and irregular structure but most vegetable grippers lack this adaptiveness.
- ❑ The robotic assistance normally involves one manipulator, which is the bottleneck in **replicating human work** using two-arms.

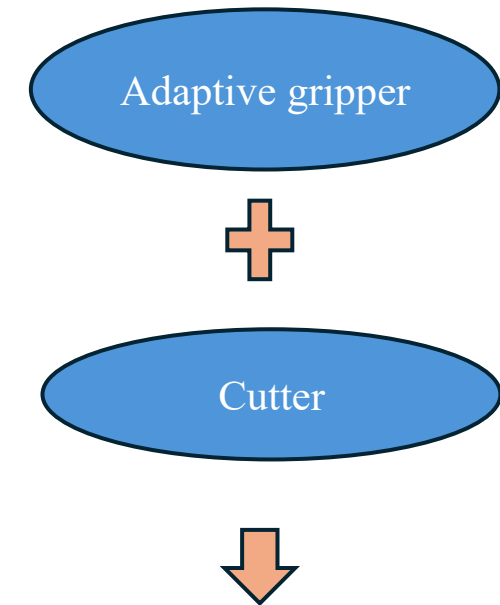


**Figure (i)** Integrated gripper-cutter mainly targeting **peduncle** of flowering vegetables [7]



**Figure (ii)** Harvesting of leafy vegetables

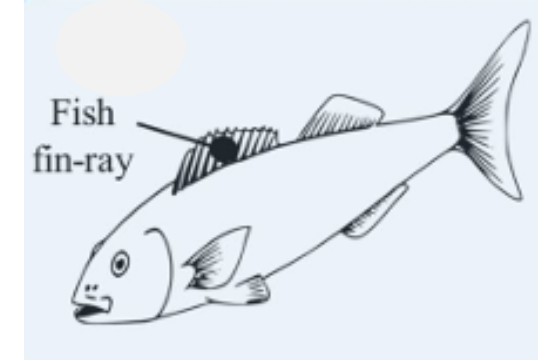
- ❑ Concept Design and **CAD Modelling** of an Adaptive Gripper integrated with a cutter mechanism.
- ❑ **Analysis of the gripper's finger** to determine its optimal shape.
- ❑ Study of cutting and gripping forces of proposed end-effector.
- ❑ Fabrication of the Dual -Action Gripper.



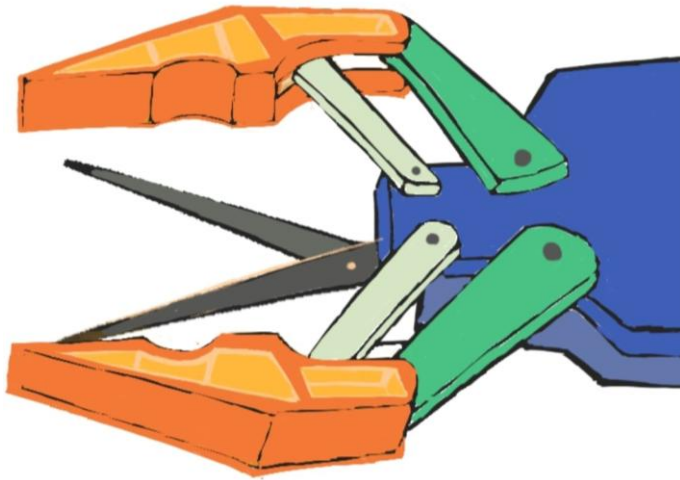
**Dual- Action End-Effector**



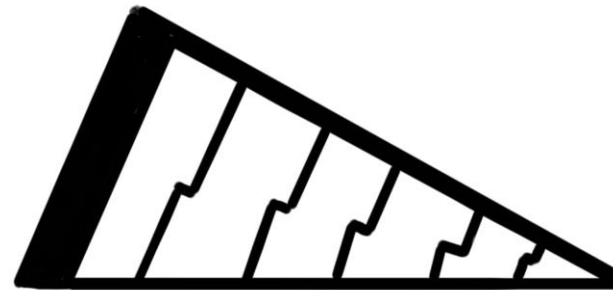
- ❑ The initial focus is on the gripping part. For adaptive gripping, the fin-ray inspired gripper has been identified.
- ❑ The fin ray principle draws inspiration from the properties of fish fins.
- ❑ The current focus is to develop CAD model of dual-action gripper.



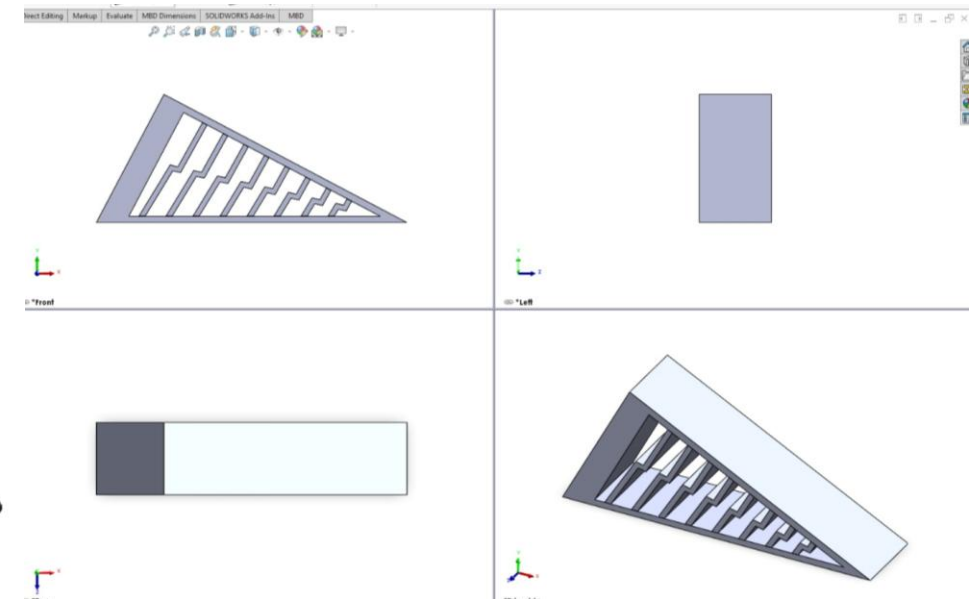
**Figure(ii)**



**Figure(i)** Concept diagram of the dual-action gripper



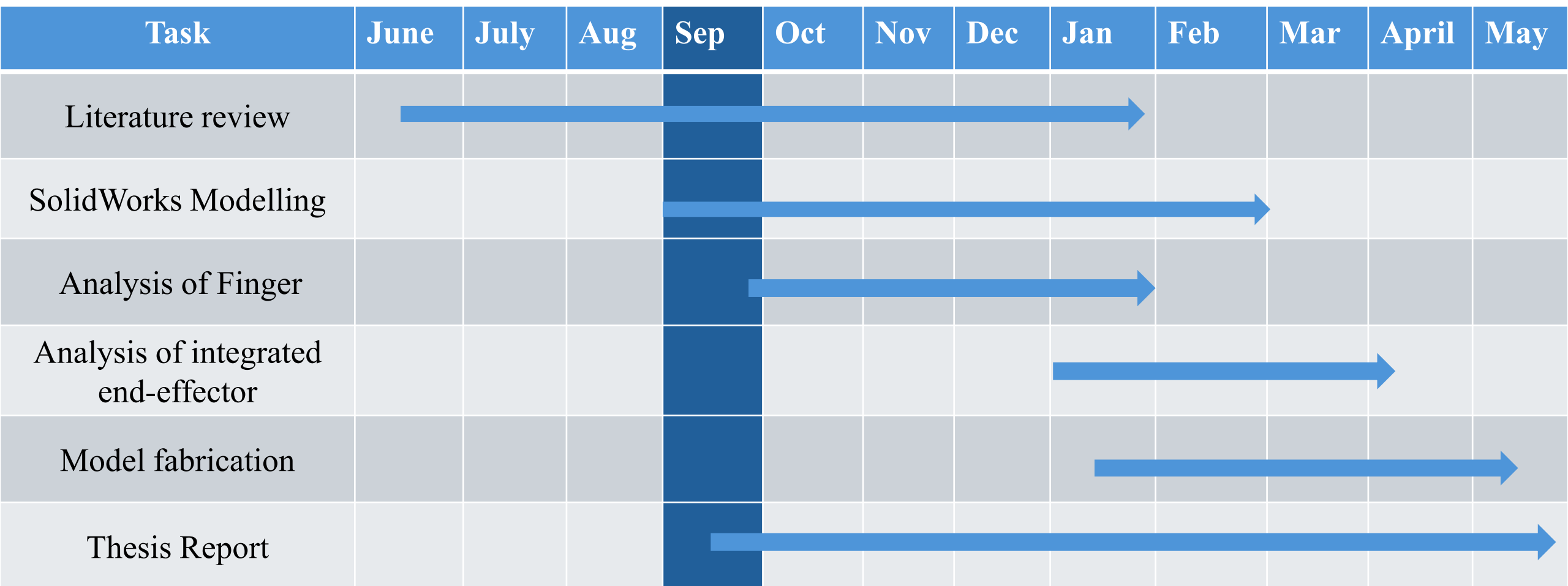
**Figure(iii)** Concept diagram of fin-ray inspired finger



**Figure(iv)** SolidWorks model of fin-ray inspired finger



# Timeline





Thank You

