



Product Description

Soft robotic gripper designed to harvest delicate fruit without bruising. Uses soft contact surfaces and vacuum suction to apply controlled, even force. Adapts to different fruit sizes for reliable agricultural handling

Primary Market

- Large scale fruit farms that rely on manual picking and sorting

Secondary Market

- Packaging systems
- Grocery stores
- Researchers & Universities

STAKEHOLDERS



Customer Needs

A total of 68 Customer Needs were identified by collecting and analyzing raw data from sources. Down below are some customer needs we felt are most important.

Pick up fruit without damaging the fruit

Apply controlled & consistent force

Distribute even pressure over the fruit

Secure fruit during initial pick up, transport, and dropping

Able to adapt to different sizes and shapes

Able to work in harsh agricultural settings

Target Specs

Metric	Target
Fruit damage rate	≤ 5%
Gripping force	3–8 N
Max contact pressure	≤ 25 kPa
Fruit size range	50–100 mm
Cycle time	≤ 3 s

Critical Subproblems

Damage-Free gripping

- Essential to grip soft peaches without causing external or internal damage

Grip force Control

- The Gripper must be able to apply the correct amount of force consistently

Reliability & Durability In Agriculture

- The Gripper must be able to perform in harsh agricultural environments, such as; dust, heat, and humidity

Accessibility to Fruit Within Clusters

- The Gripper must be able to reach its desired object amongst obstacles such as other fruit, leaves, and or branches

Key Benefits

Minimizes external & internal damage

Cost effective compared to manual labor

Easy to maintain

Durable & Reliable in agricultural conditions

Allows for versatility in fruit shape

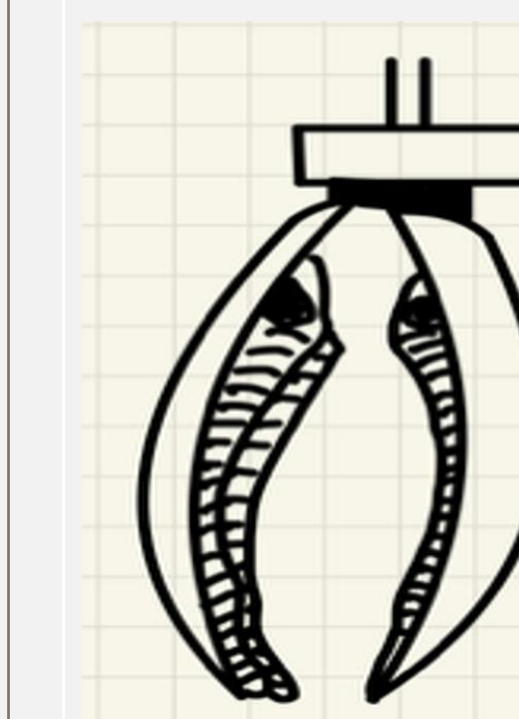
Effective in dense cluster environments

interchangeable gripper heads

Able to adapt to fruit size

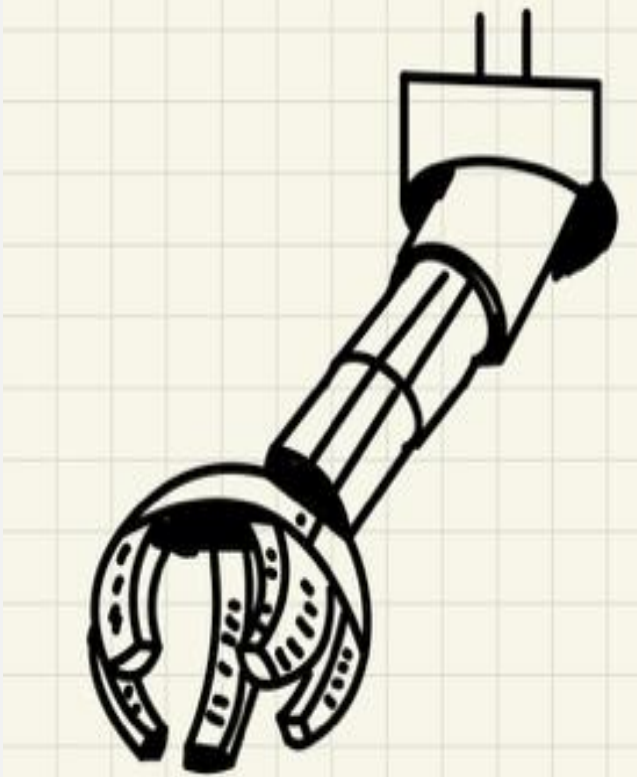
Concept Generation

During the Concept Generation phase, a total of 80 ideas were generated as a team, this resulted in 16 feasible concepts that were compared to a reference robotic gripper. Top 3 concepts are mentioned below:



Concept 15 – Slim Precision Gripper

- Slim
- Sealed
- Multi-contact
- Sensor-based
- Compact



Concept 11 - Telescopic Soft Gripper

- Telescopic
- Extendable
- Supportive
- Gentle
- Adaptive



Concept 14 – Flexible Tendon-Driven Gripper.

- Flexible
- Tendon- driven
- Curved
- Wrapping
- Modular

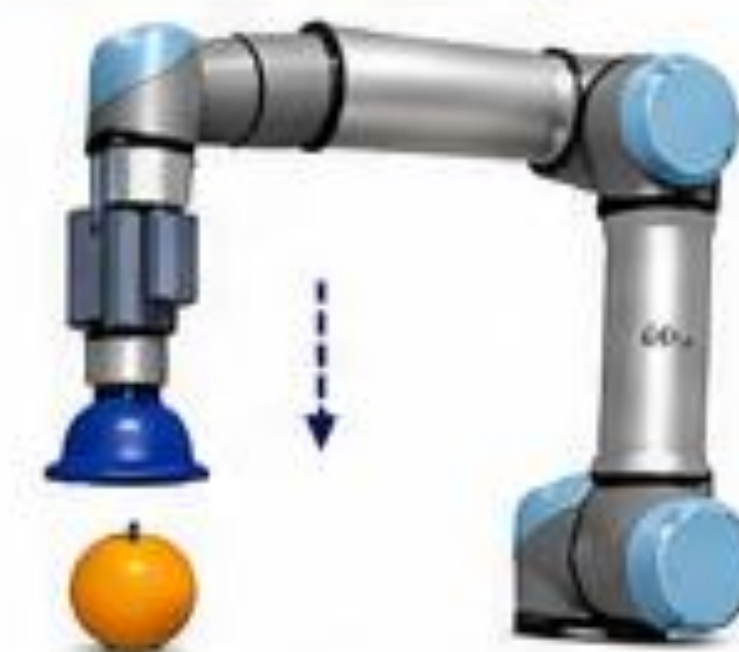


Reference- OnRobot Soft Gripper

Chosen as a benchmark due to its proven performance, gentle handling, and adaptability, while its high cost provides motivation for a more cost-effective design

How it Works

1 APPROACH THE FRUIT



The URX moves toward the fruit and aligns the gripper with the target.

2 GENTLE CONTACT



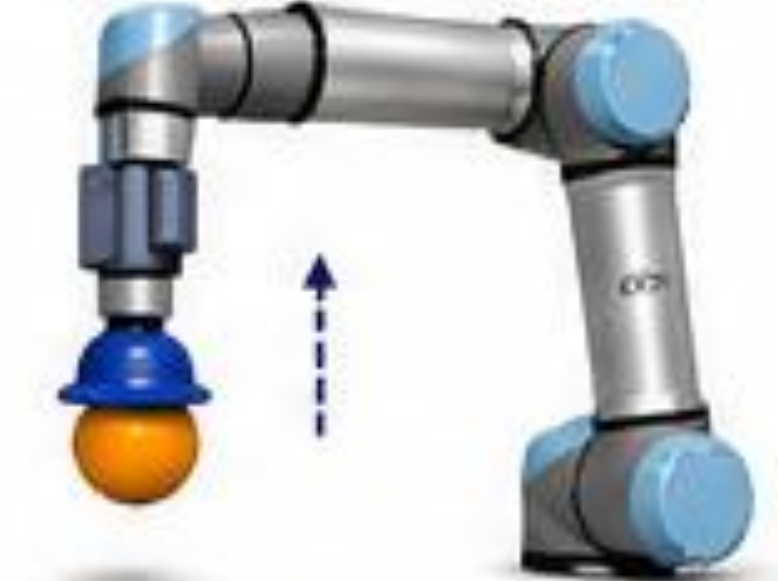
The soft suction cup makes light contact with the fruit to ensure a gentle touch.

3 GRIP ACTIVATION



The suction cup creates a vacuum force to securely hold the fruit without damage.

4 DETACHMENT



The gripper pulls straight up to detach the fruit from the surface.

5 TRANSPORT



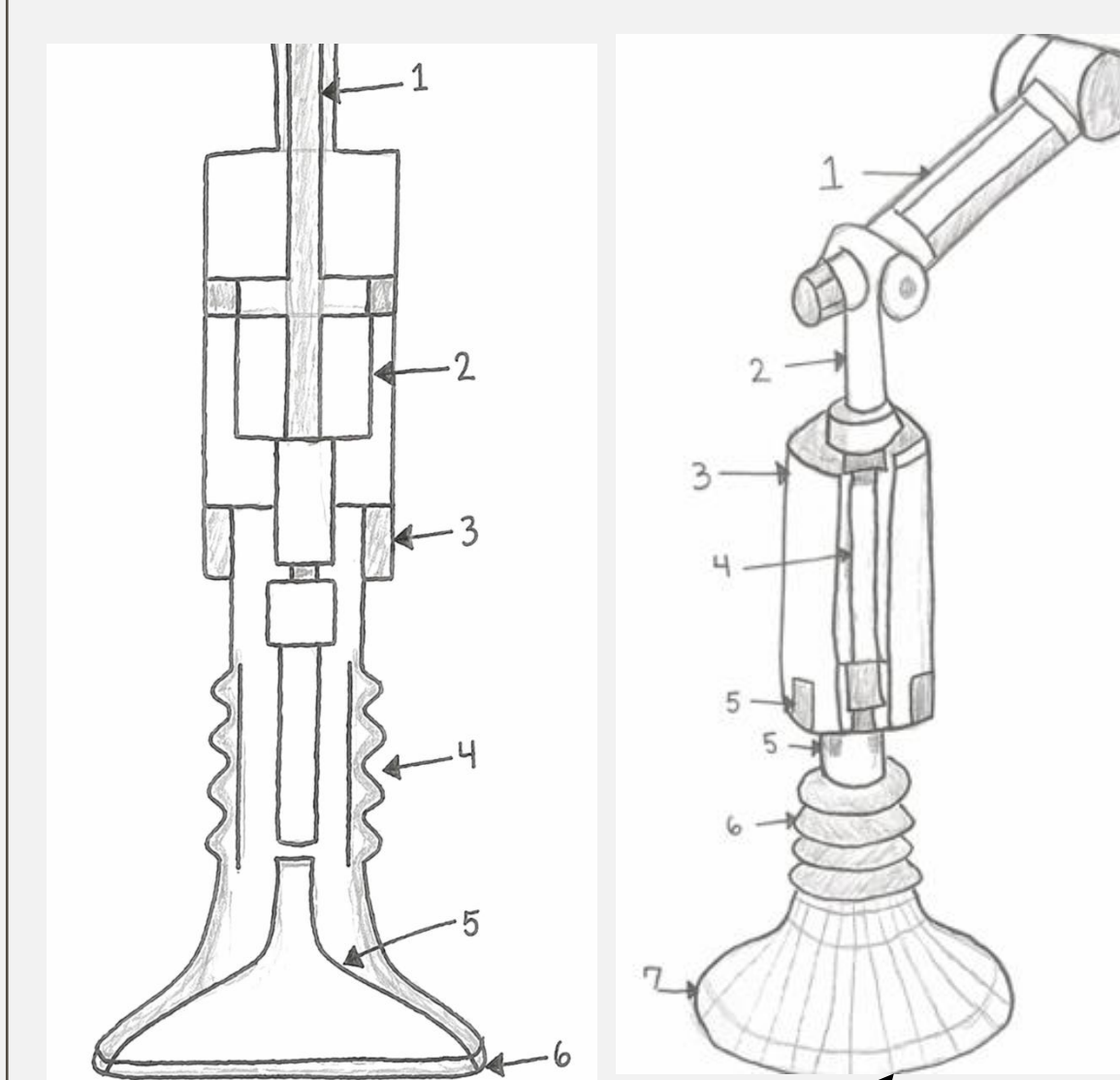
The URX moves the fruit to the desired location while holding it securely.

6 RELEASE



The gripper releases the vacuum force, releasing the fruit so it can be safely placed without damage.

Final Design



Solenoid push pull actuator

Plunger head

Vacuum chamber

Suction Head

Suction head is approximately 2 inches in diameter

This soft robotic gripper uses a suction-based mechanism to gently grasp delicate fruit without damage. A push-pull solenoid drives a plunger to create vacuum for gripping and positive pressure for release.

- Solenoid-driven vacuum gripping system
- Controlled release using positive pressure
- Compact design for tight fruit clusters
- Interchangeable heads for different fruits

Next Steps

System level design

Detail Design

Testing and Refinement

Prototype