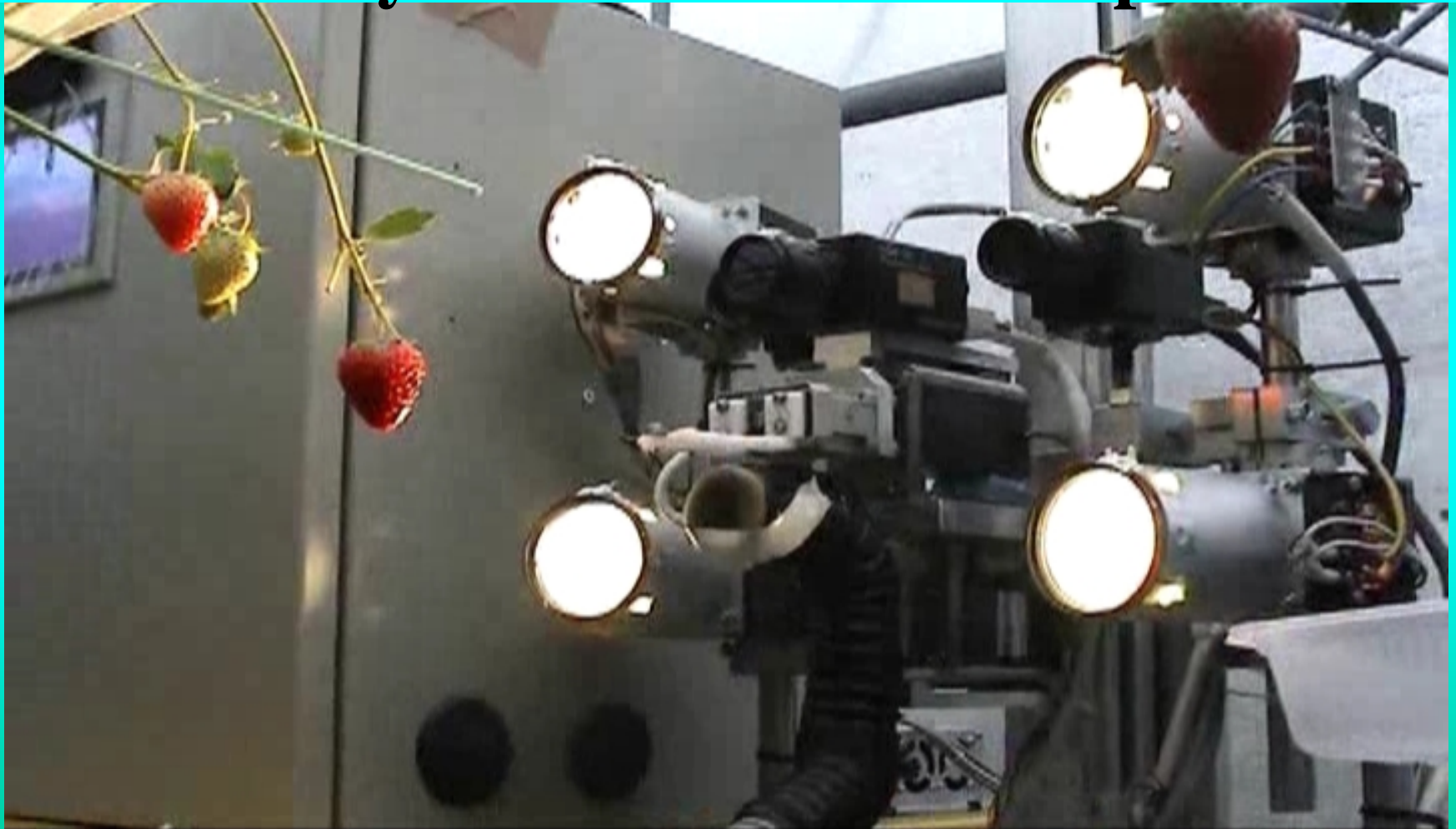


A New Challenge of Robot for Harvesting Strawberry Grown on Table Top Culture



BRAIN, SI Seiko Co., Ltd.

Strawberry harvesting robots



For Table top culture



For Annual hill culture

Problems in practical use from previous experimental results of strawberry harvesting robot

Similar operation speed with human

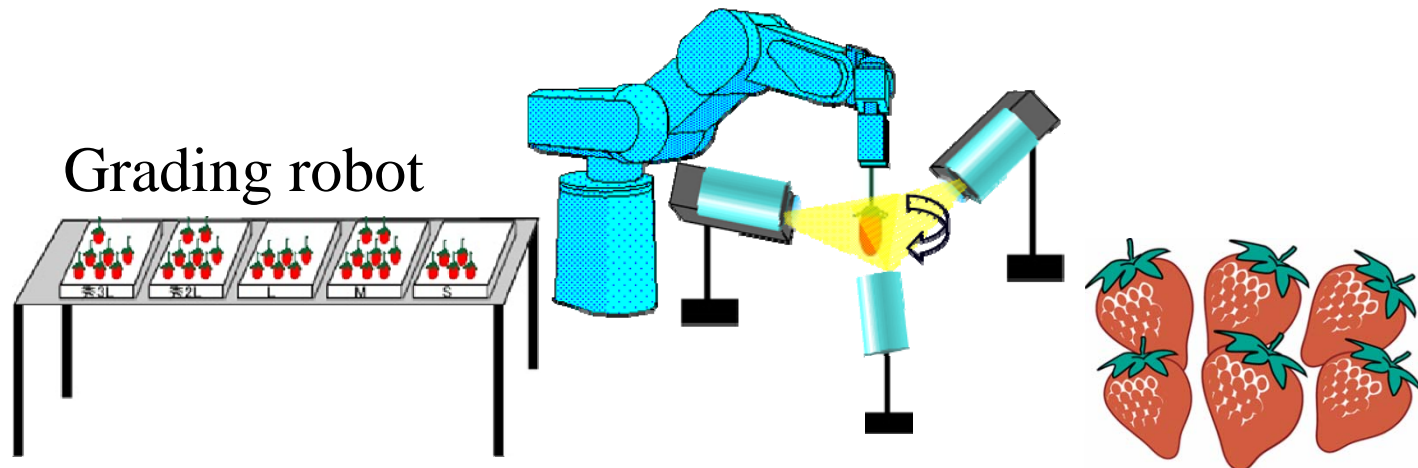
(3-10 seconds per fruit)

Inferior accuracy

(50 % of attempts included immature fruits)

Reason of only labor substitution on harvesting does not strike producers for purchasing the robot!

Because grading and packing operation is much more laborious.



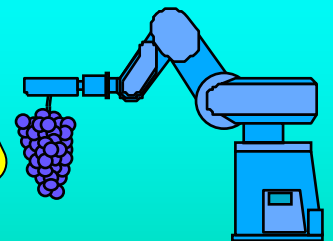
Roles of Agri-robots

- To Substitute labor and workers
- To Release from heavy, dangerous, or monotonous operations
- To increase market value of product,
- To produce uniform products
- To make hygienic / aseptic production conditions
- To give successors a hope for economic sustainability of small high value farm operations



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New role



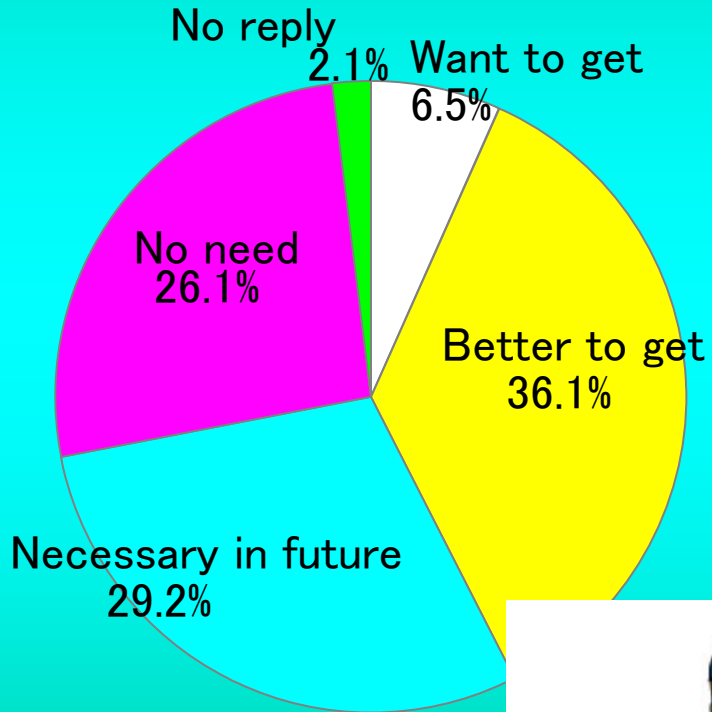
Precise operation record

Product Information accumulation

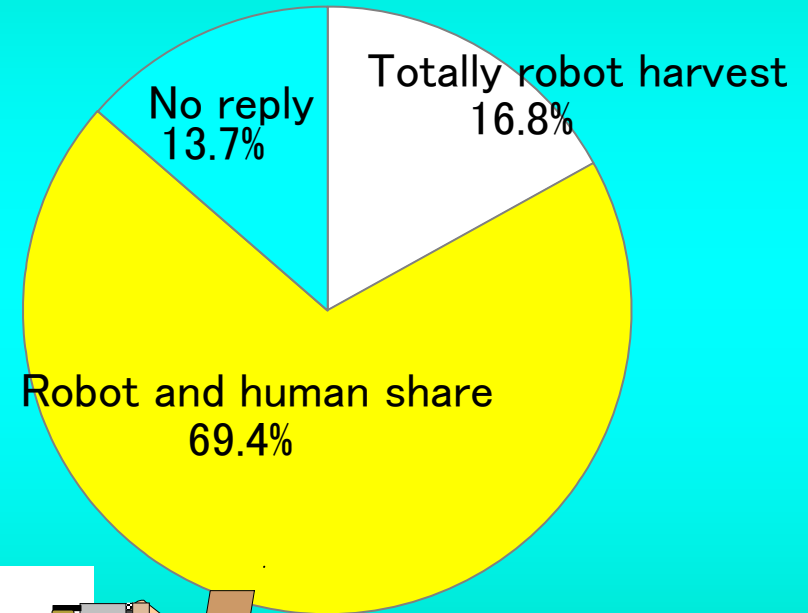
Use for safety food and farming guidance

Results Questionnaire to Producers

Do you need the harvesting robot?

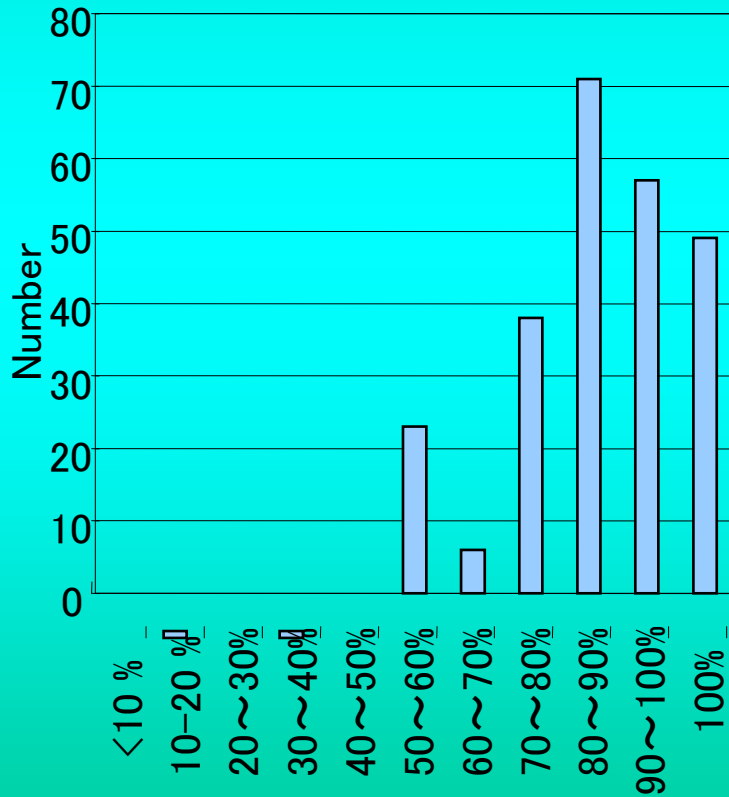


Do you require the robot 100 % harvesting?

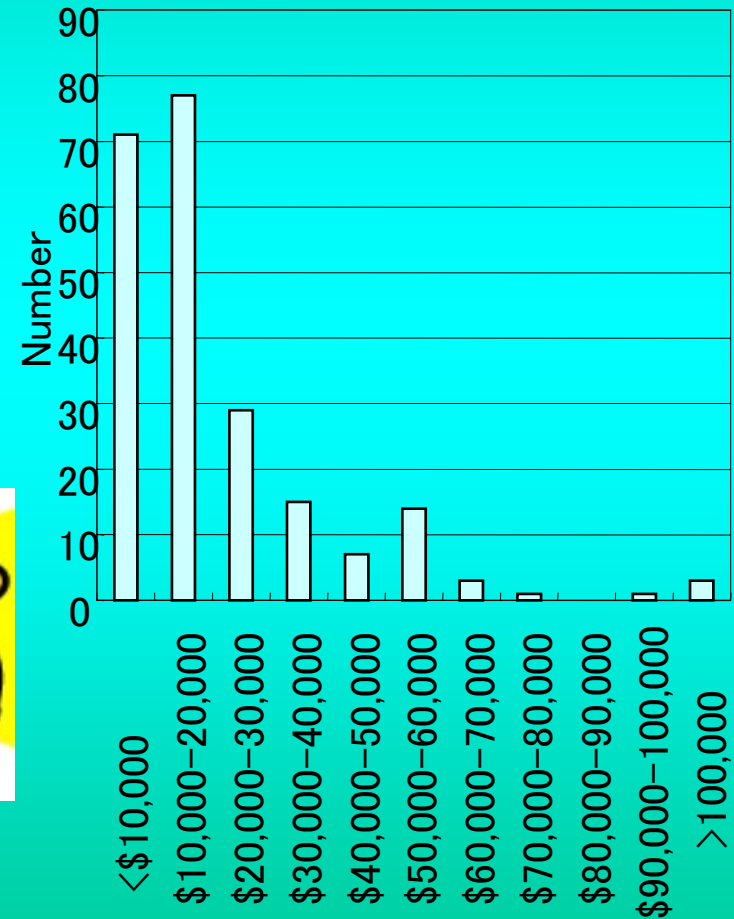


Results Questionnaire to Producers

Expectation to robot's success rate

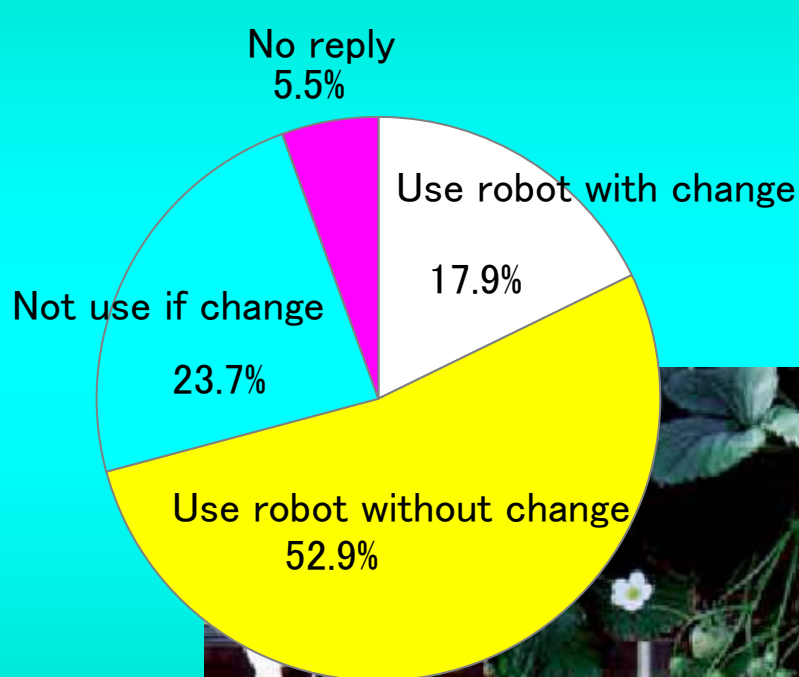


Price of robot

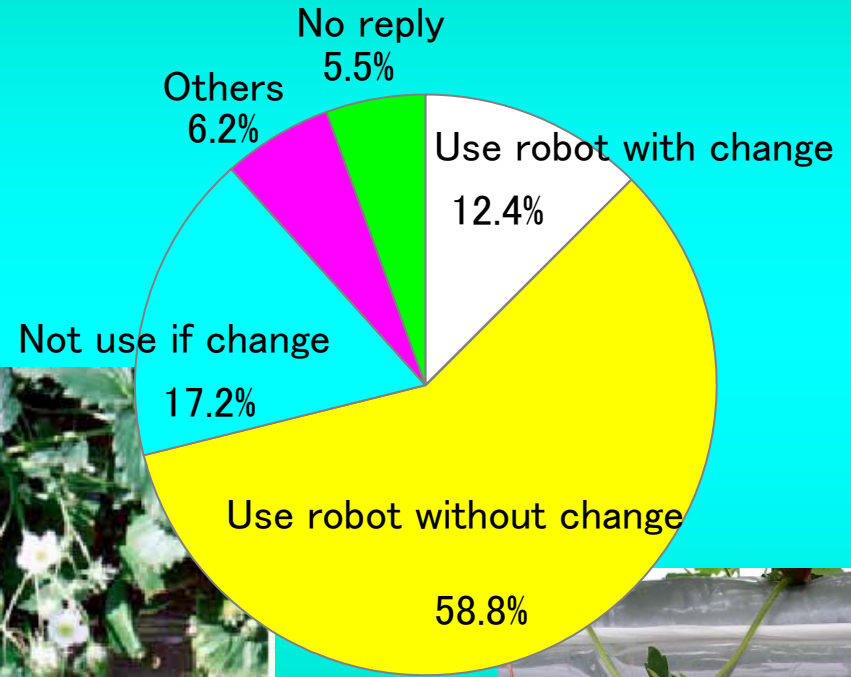


Change of growing method

Do you change plant training system for the robot?

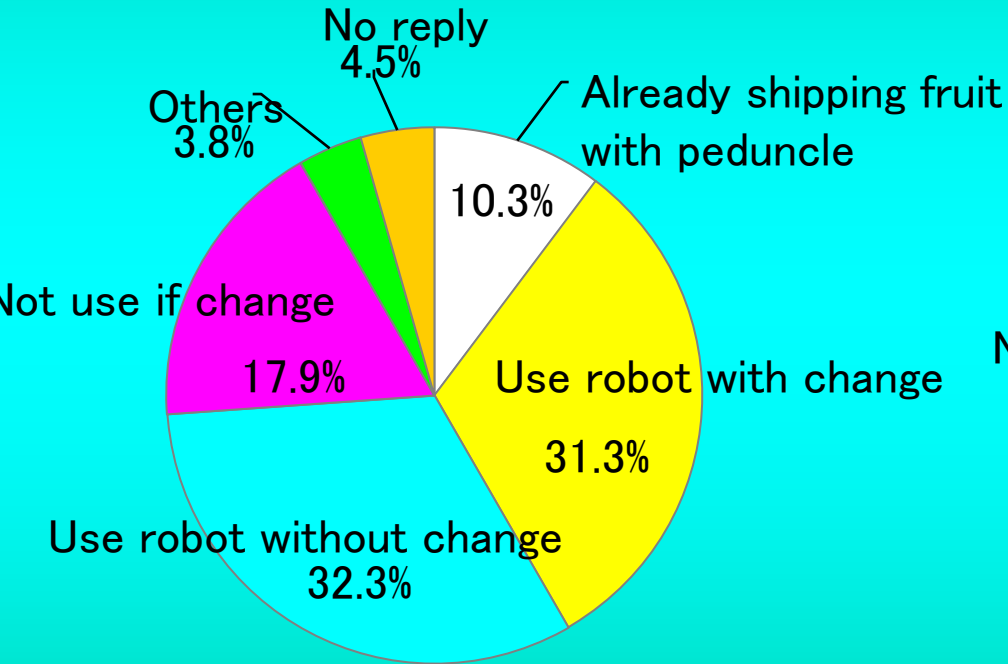


Do you change plant variety for the robot?

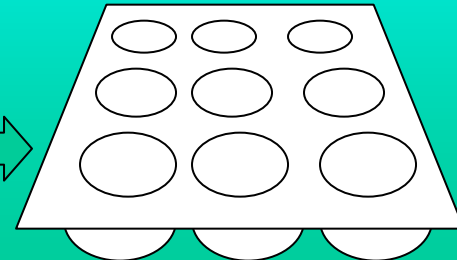
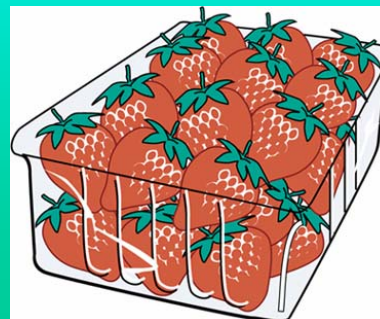
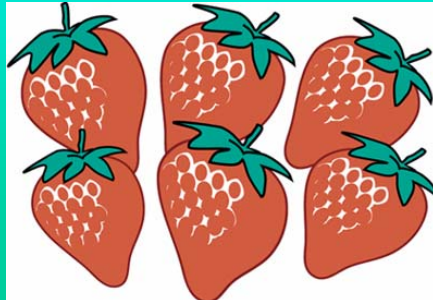
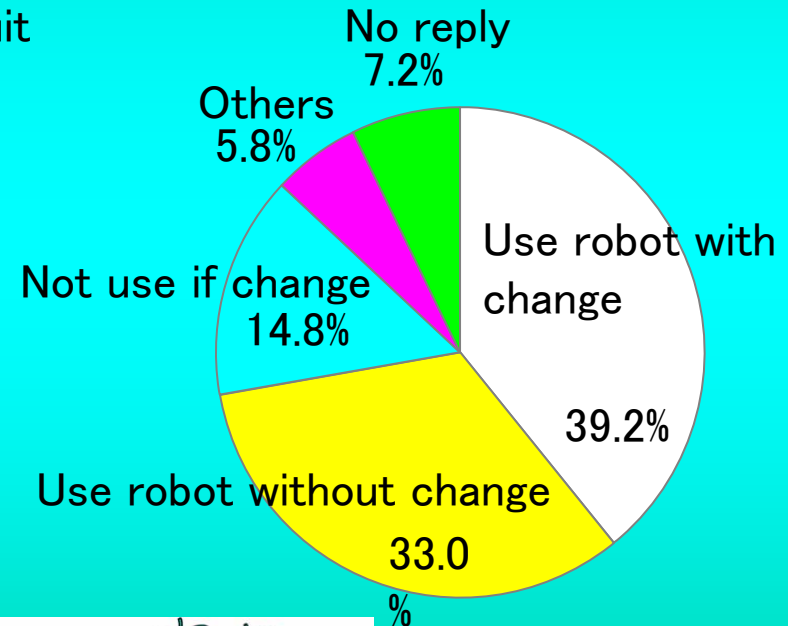


Change of product appearance

Do you change into fruit with peduncle for the robot?

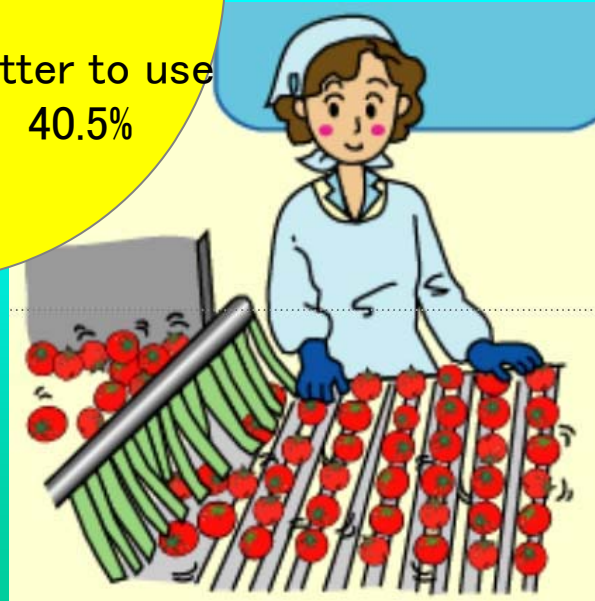
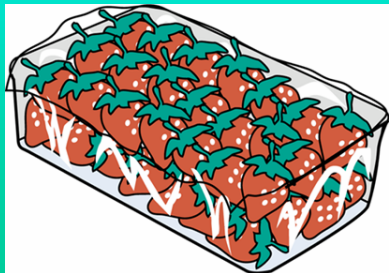
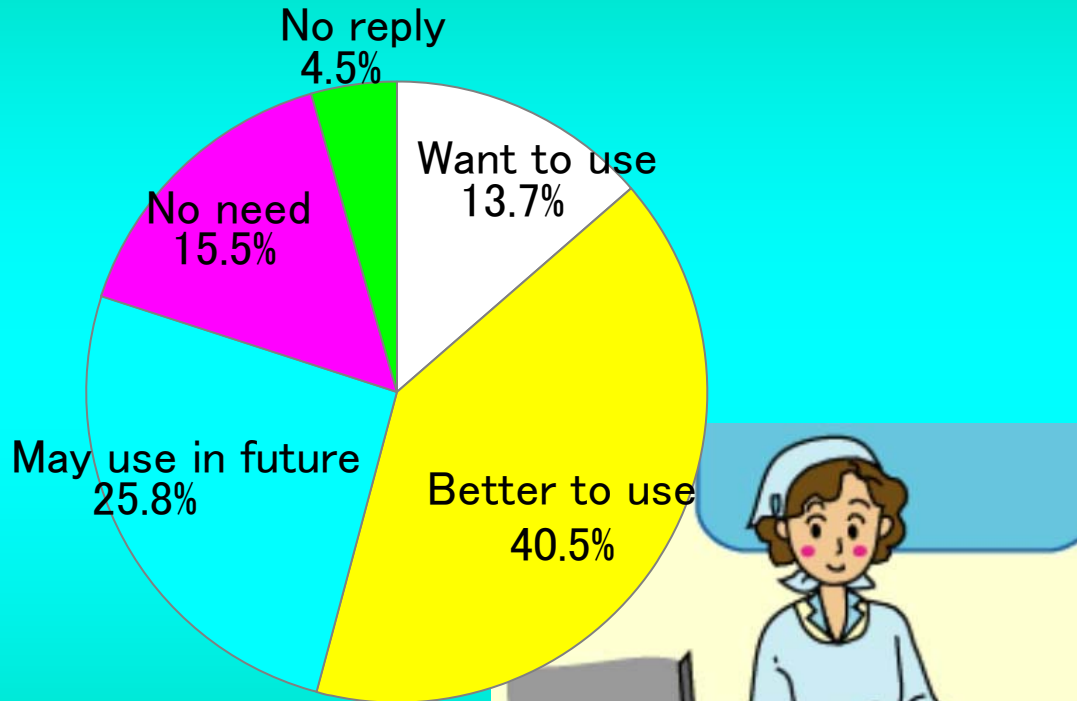


Do you change fruit packing for the robot?

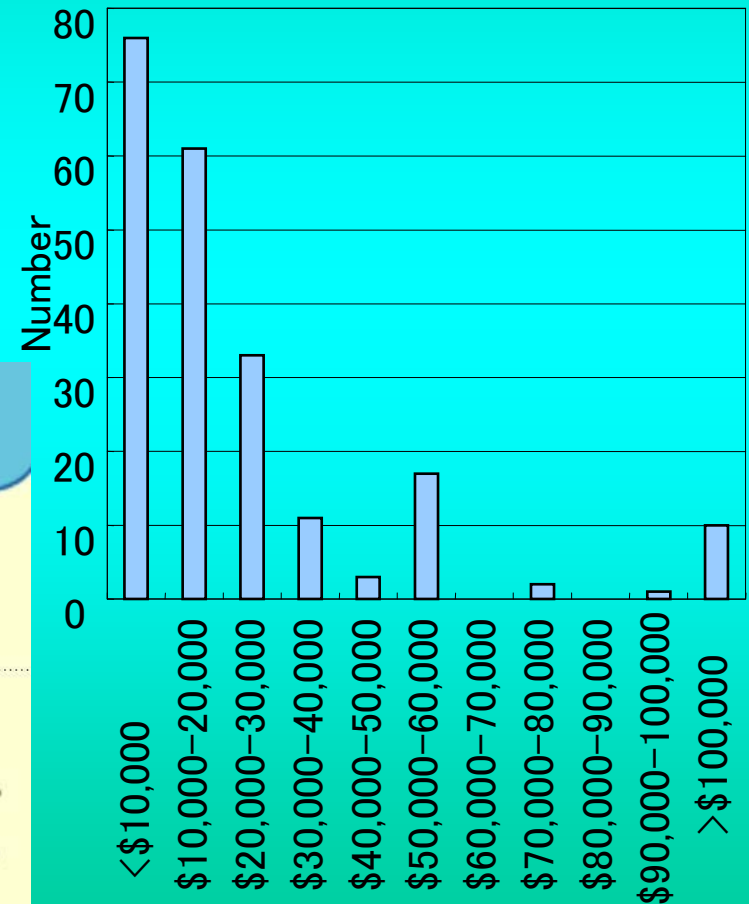


Expectation to grading robot

Do you need the grading robot (packing robot) ?



Price of the grading robot

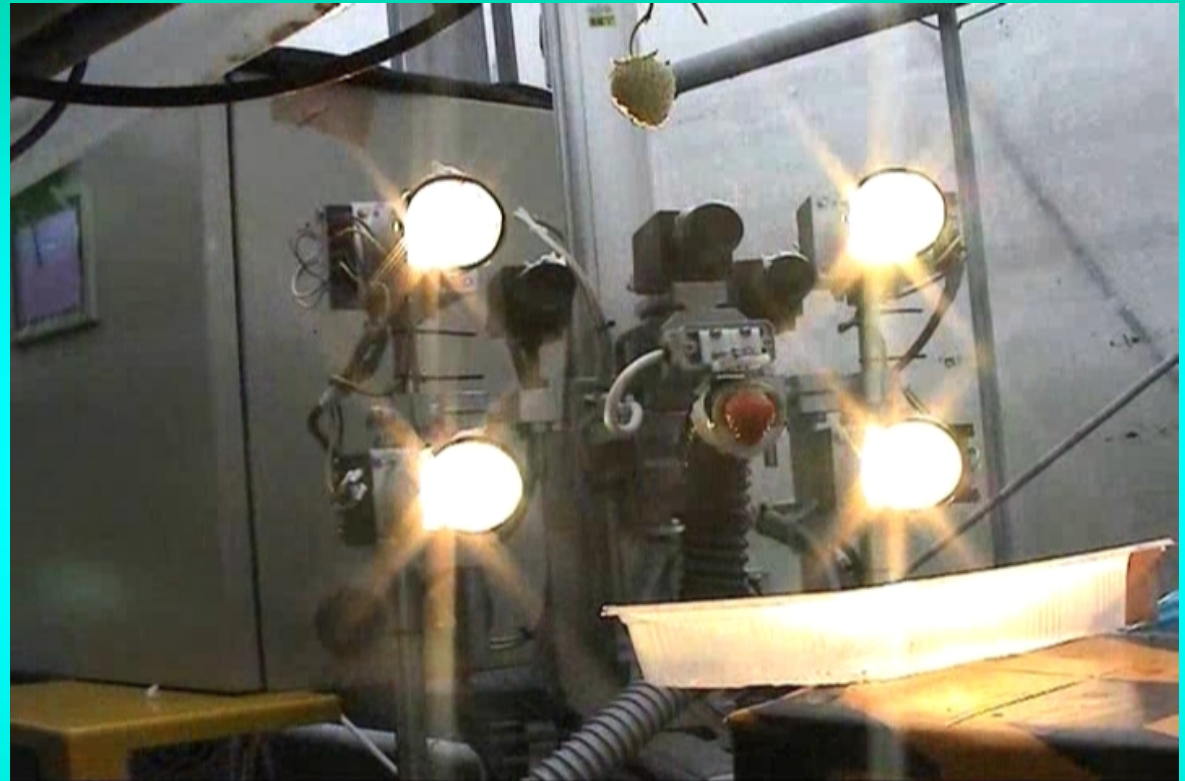


New concept of the harvesting robot



1. **Information accumulation** to contribute to traceability system and farming guidance
2. **Combination with grading and packing system** (Mobile grading robot)
3. **Multi-operation** (spraying, growth monitoring)
4. **Tailor-made-type robot** (company diagnoses producer's production way and provides a fitted system)

Strawberry harvesting robot (1st model)



Robot constitution

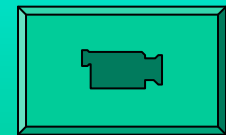
3 DOF manipulator

Sucking and cutting end-effector

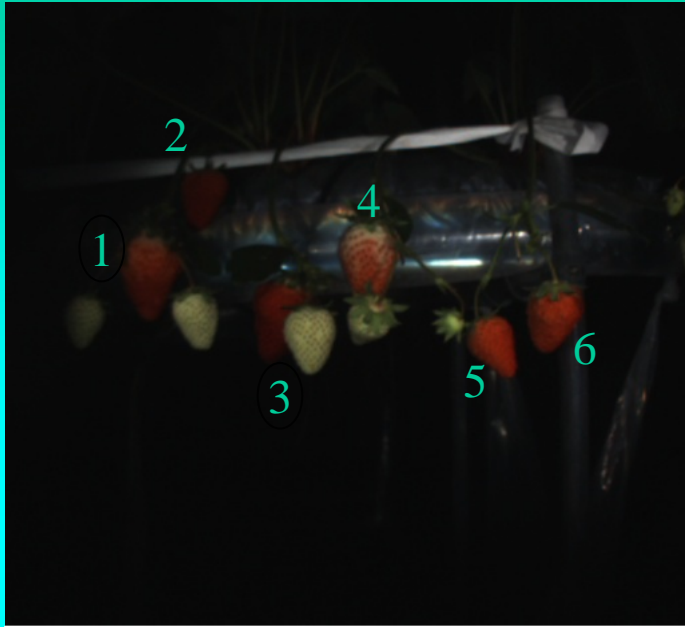
Stereo vision by use of color CCD cameras

DL (Lighting devices) with PL filter

Rail type traveling device

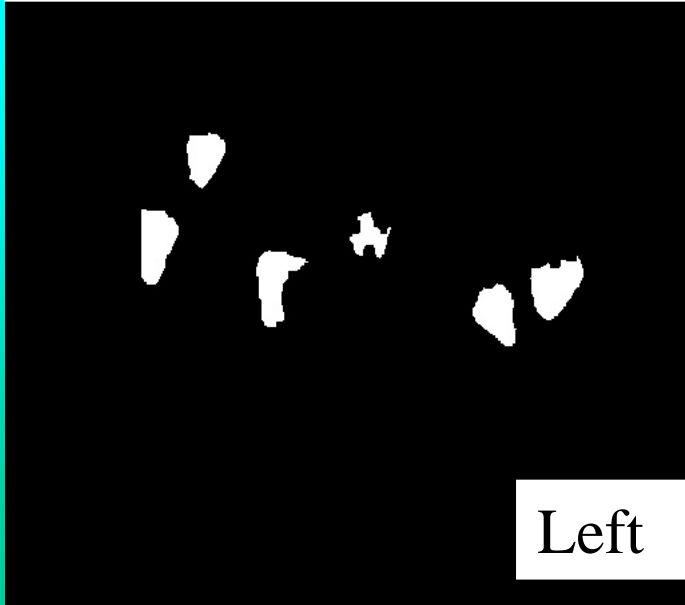


Correspondence problem in fruit cluster



Un-Matched fruits

No.1, 3, 4

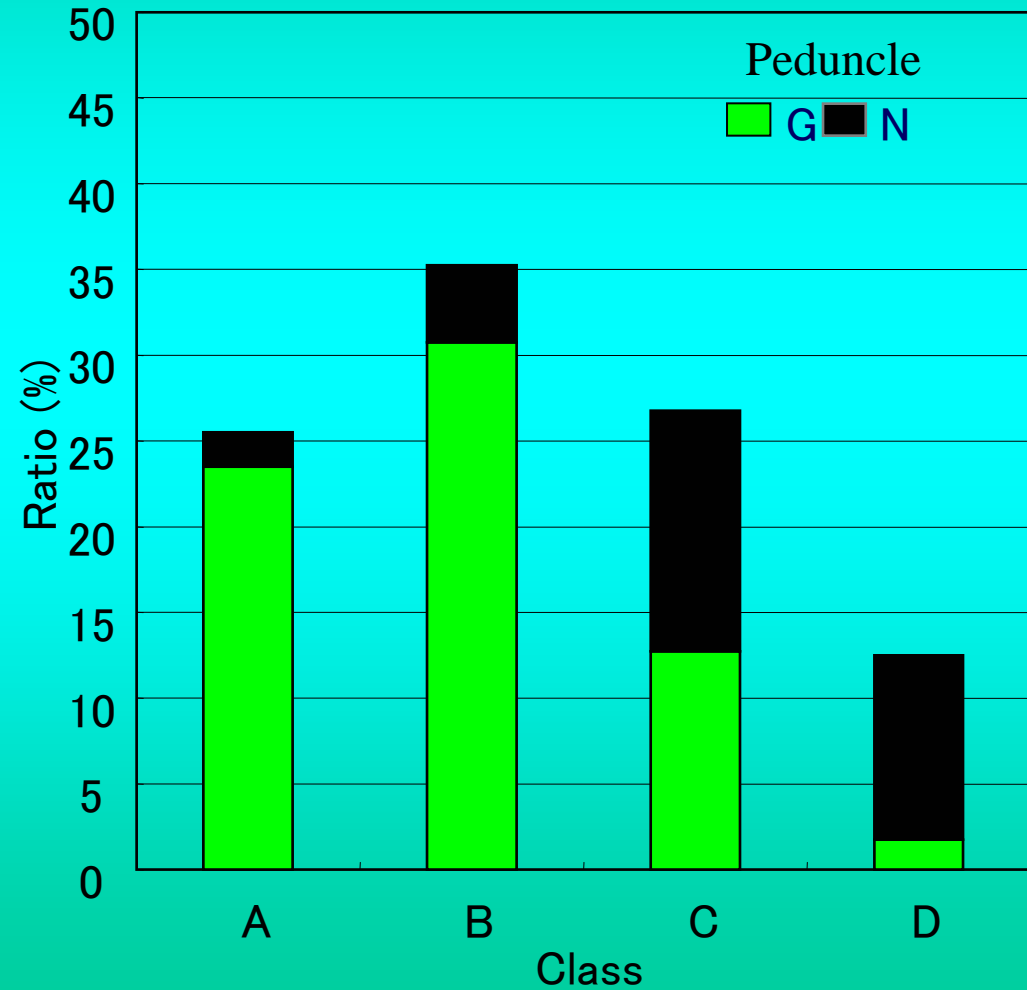
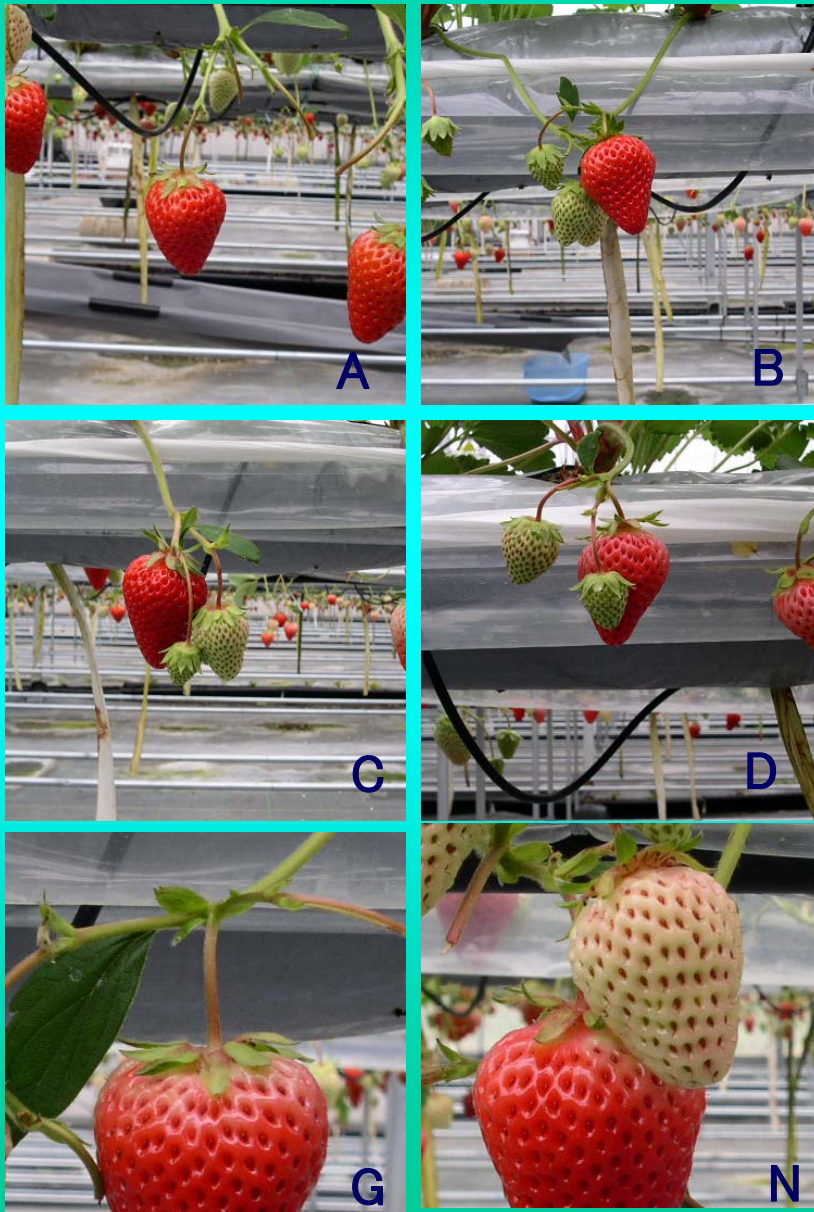


Left

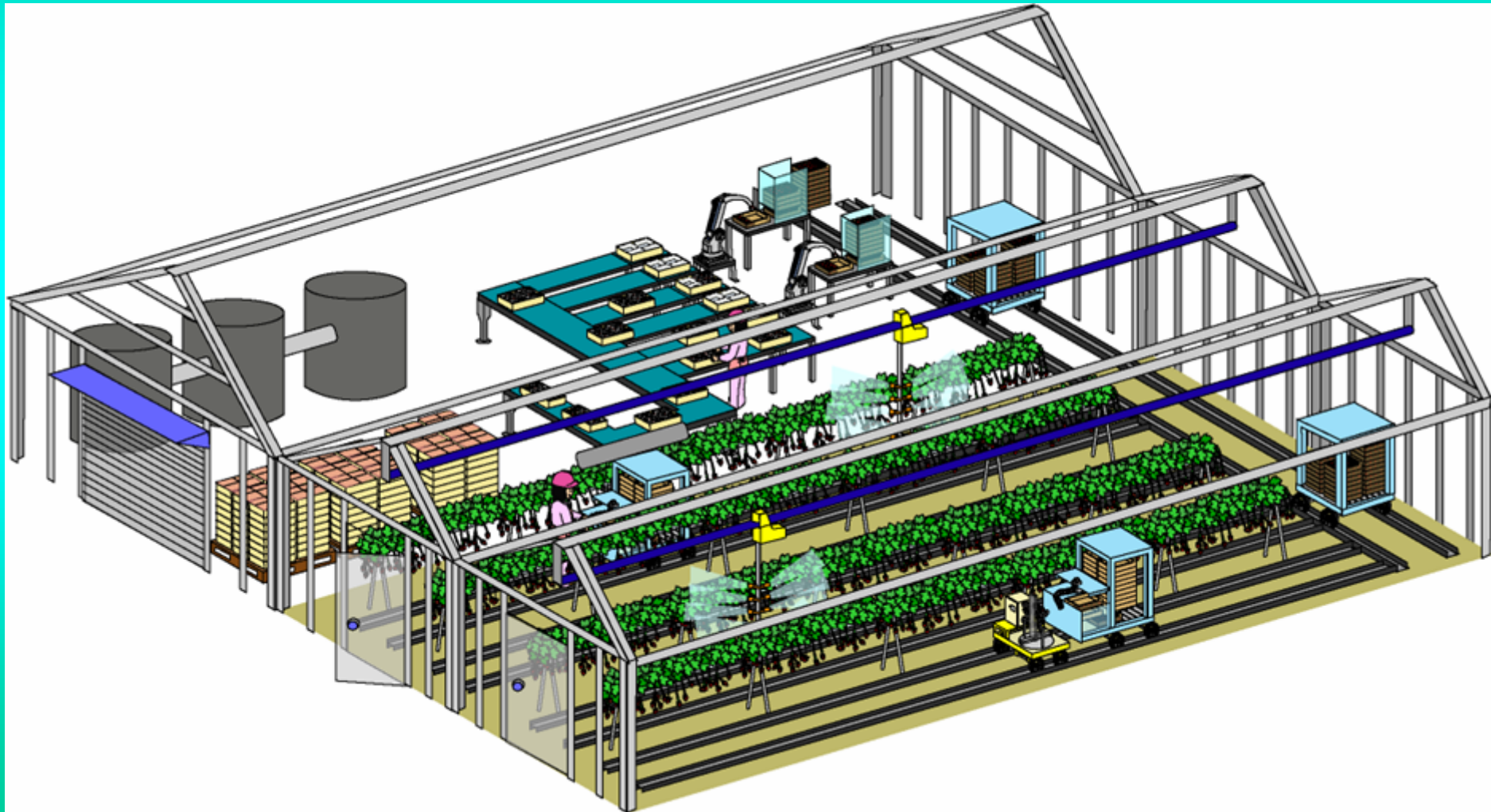
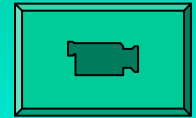


Right

Exposure of fruit and peduncle

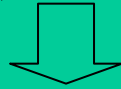


2nd model robot in plant factory



Problems and solutions for practical use from results of the new robot

Greenhouse specification is various
(lack of uniform size, width, growing methods)



Standardization of surroundings
Construction of pilot greenhouse with robot

*Government's
agricultural policy*

To add rail system for robot traveling to existed greenhouse is
expensive rather than robot-self



Encouragement of laying rails when constructing greenhouse

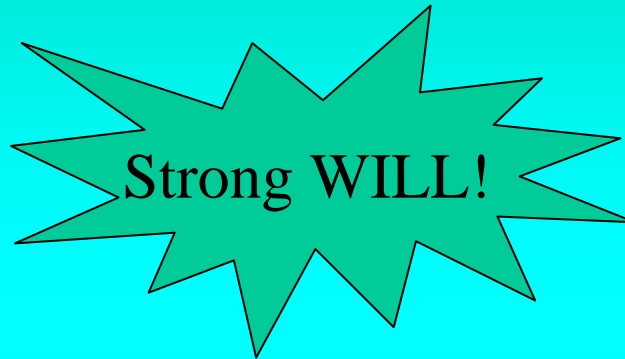
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Farmers' intention

Revolution of producers' awareness and sense
for the robotic and information agriculture

Never give up!
Never give up! Never give up! Never give
up!

Enthusiasm



Solve the problem

Solve the problem

Solve the problem

Solve the problem

Solve the problem

Commercialization

Commercialization

Commercialization

Commercialization

Advantages of development of strawberry harvesting robot

1. **Small fruit growing range**
2. **Relative few obstacles** (stems and leaves) around fruits
3. **Easy fruit transportation** due to small fruits.
4. **Color CCD camera** is usable to detect fruits because of red target fruit.
5. **Changeable peduncle length**

