Present Status and Future Prospects on Fruit Grading Facilities

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京都: 1000 年間　首都

（794-1868）

京都的四季

京都

東京

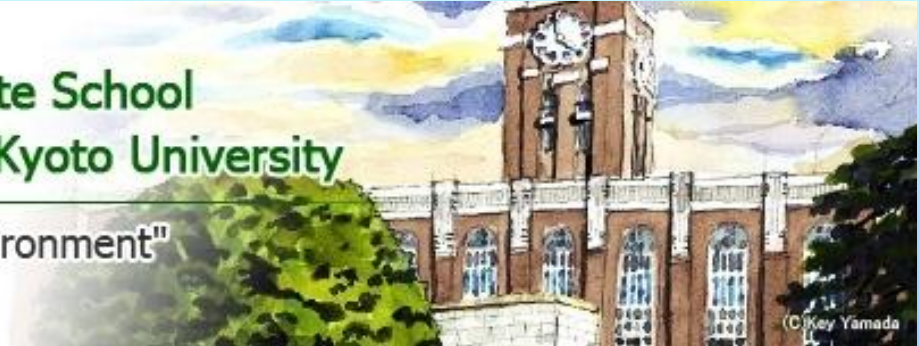京都人口: 1,470,000人

舞子

金閣寺

Buddhist monk

銀閣寺

17 世界文化遺産

京都大学

1897年 京都帝国大学成立
（The Second National Imperial University in Japan）

京都大学的研究生院介绍

17 研究生院研究科

文学研究科，教育学研究科，法学研究科，经济学研究科，理学研究科，医学研究科，药学研究科，工学研究科，农**学研究科**，人与环境研究科，能源科学研究科，亚非区域研究科，情报学研究科，生命科学研究科，地球环境学舍

Japanese Nobel Prize Laureates before 2011

Physics

Hideki Yukawa1949

Kyoto U. Sci

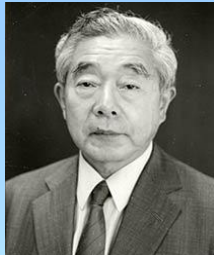**Shinichiro Tomonaga 1965**

Kyoto U. Sci

Toshihide Masukawa 2008

Kyoto U. Sci

Makoto Kobayashi 2008

Kyoto U. Sci

Chemistry

Kenichi Fukui1981
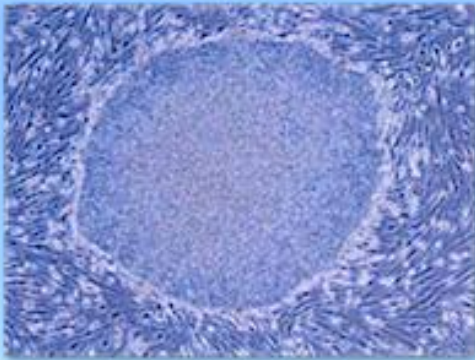
Kyoto U. Eng

Ryoji Noyori 2001

Kyoto U. Eng

Biology

Susumu Tonegawa 1987

Kyoto U. Sci

New Nobel Prize Laureate in 2012

On IPS Cells:
Induced Pluripotent Stem Cells

Prof. Shinya Yamanaka

Research oriented university

Fields Medalists

Heisuke
Hironaka1970

Shigefumi
Mori 1990

Kyoto U. Sci

Kyoto U. Sci

Research oriented university

Laboratory of Bio-Sensing Engineering

Bio-instrumentation

Machine vision

Beef cattle
Fish
Egg and Chick

Automation of agri-facility

Community & Facility

Individual system

Organ

Informatization of food

Cell

Cell
Preventive medi-care
Bio-sensor

Molecule

Functional substances and allergen inspection

Post-harvest technologies and non-destructive inspection

Spectroscopy

Sound-, photo-, and image-based sensing technologies contribute affluent and healthy life. (Food production and informatization, medi-care, and drug discovery)

近藤的経歴

1985: 岡山大学　助教
1993: 岡山大学　副教授

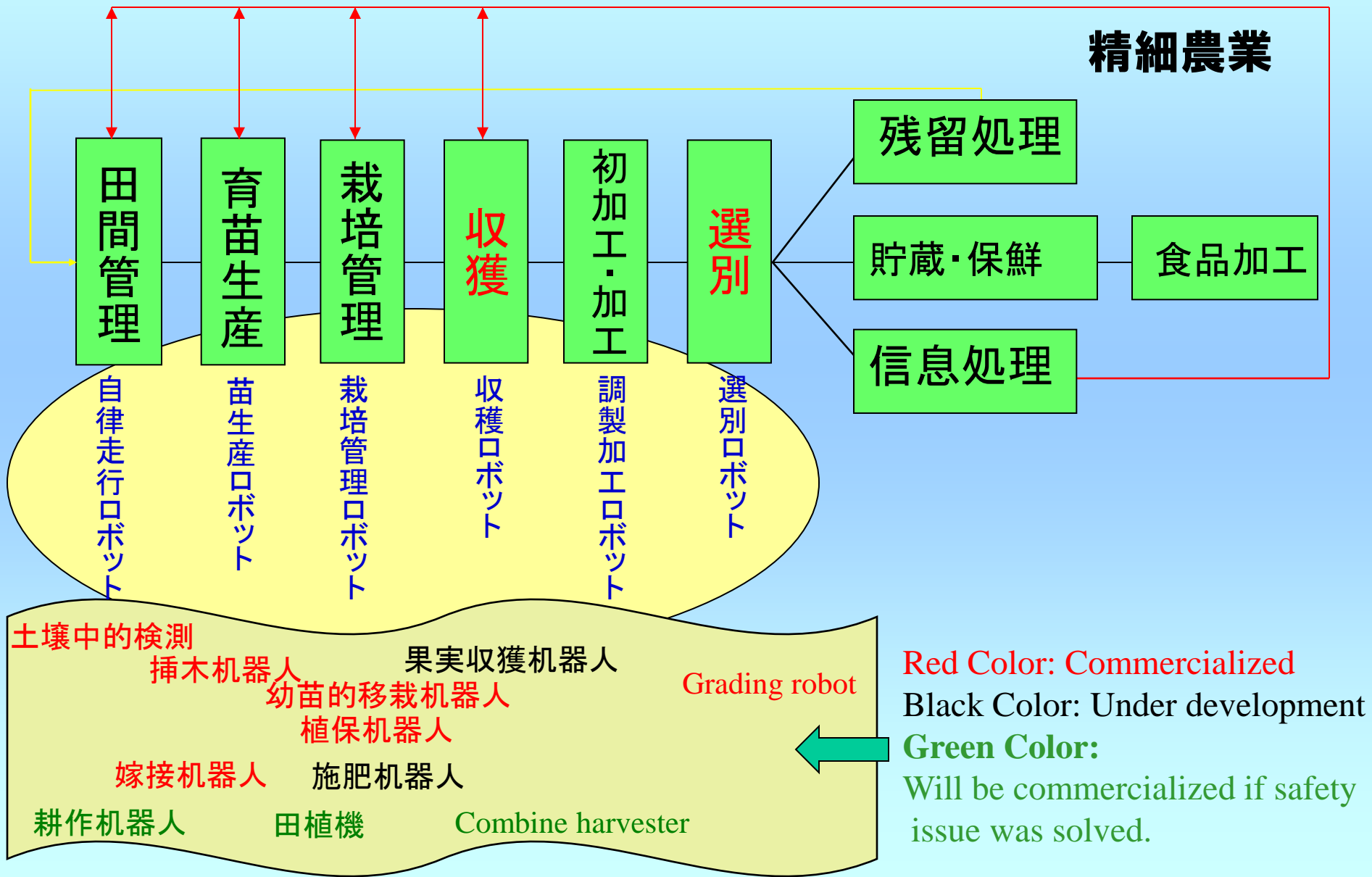2000: 石井工業株式会社　部長
（現在, 澁谷精機株式会社）
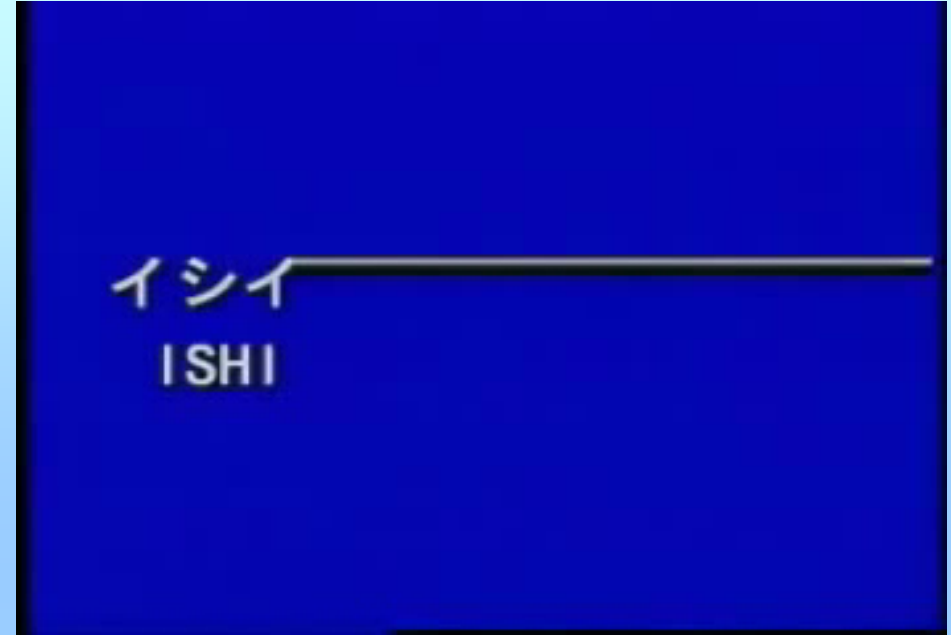
2006: 愛媛大学　教授
2007: 京都大学　教授

Waxed Apple Grading System

屏南地區蓮霧光波分級中心
室溫偵測區 料給區

枋寮名産
黑珍珠

枋寮地區農會出品
蓮霧
光波分級　PT01

Robotization in Agriculture

Citrus grading system

イシイ
ISHI

Citrus fruits
Tomato
Waxed apple (Tropical fruit)
Potato
Persimmon
Onion
Pepper

SIseiko

HostPC

JudgementPC

Imaging PC

Image PC

Image PC

Halogen lamp

X-ray generator

Scintilator

TV Camera

Lighting Device

Trigger sensor

Spectrometer

180° 反転
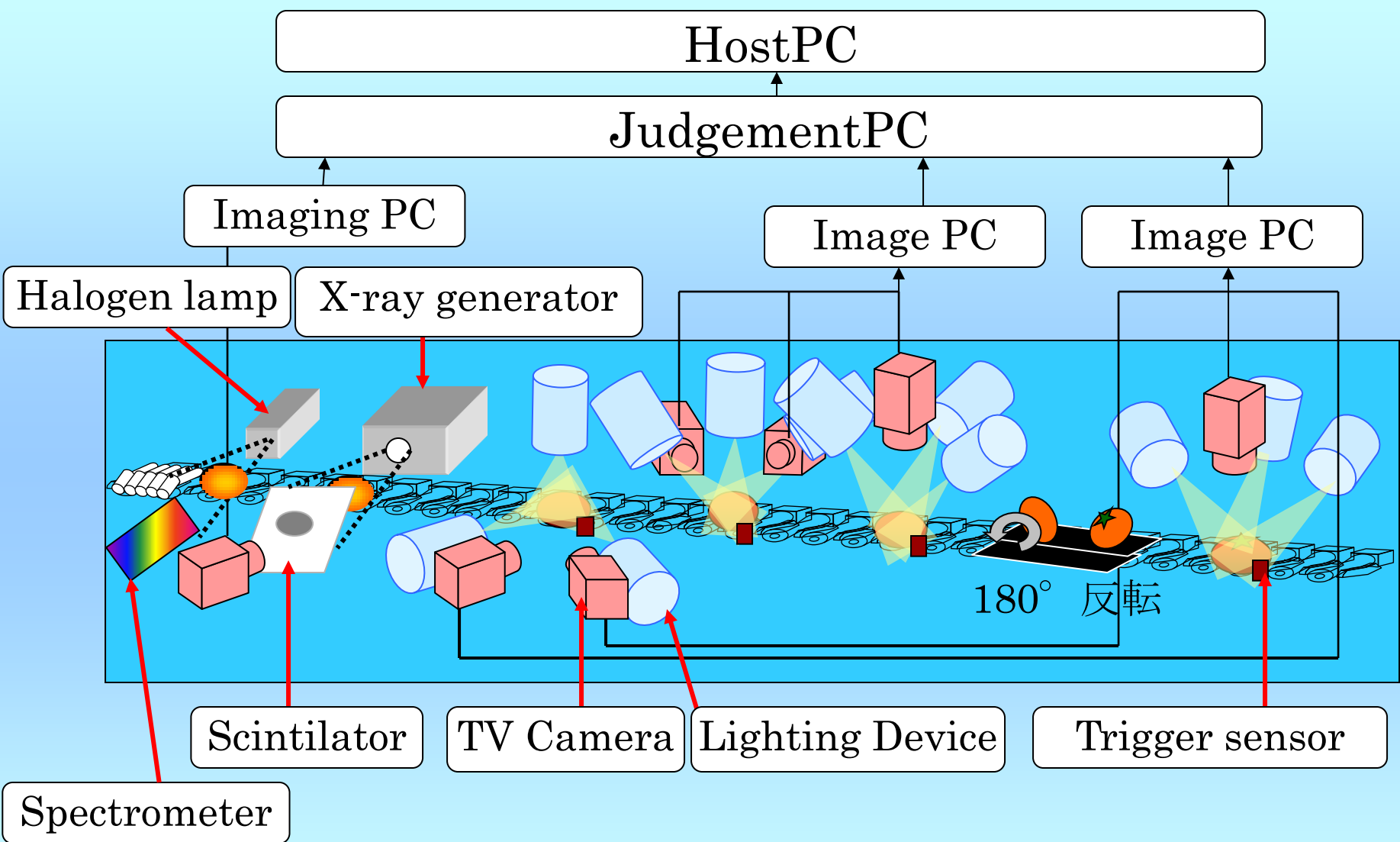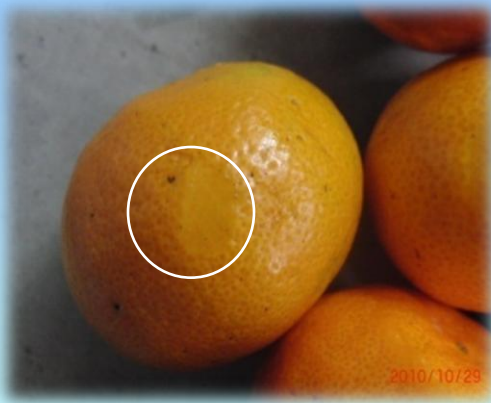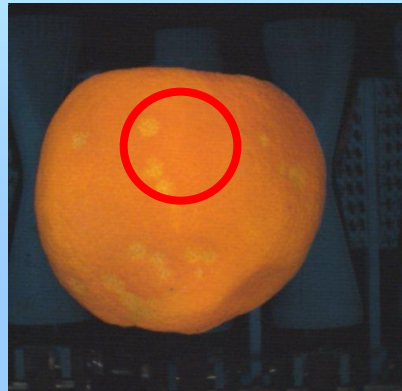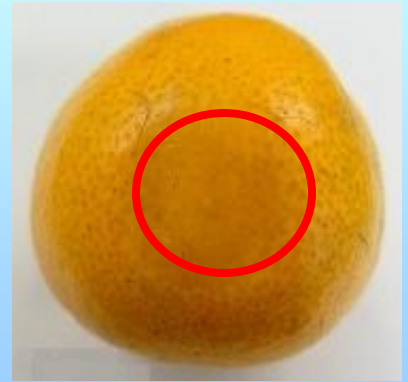
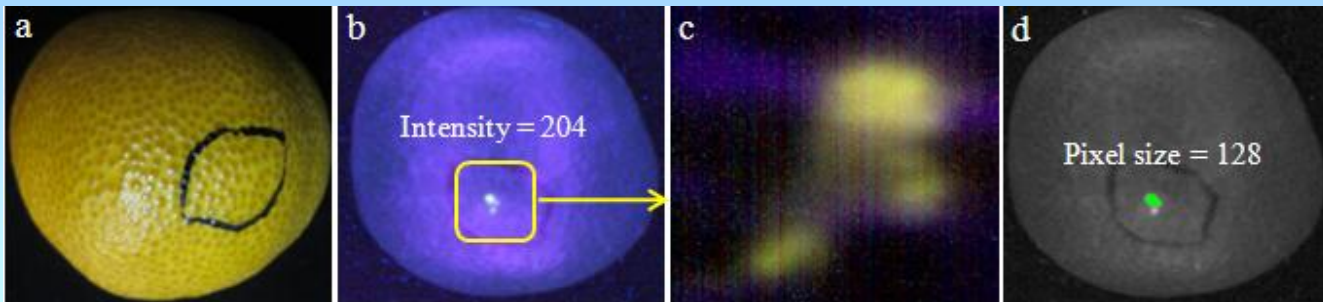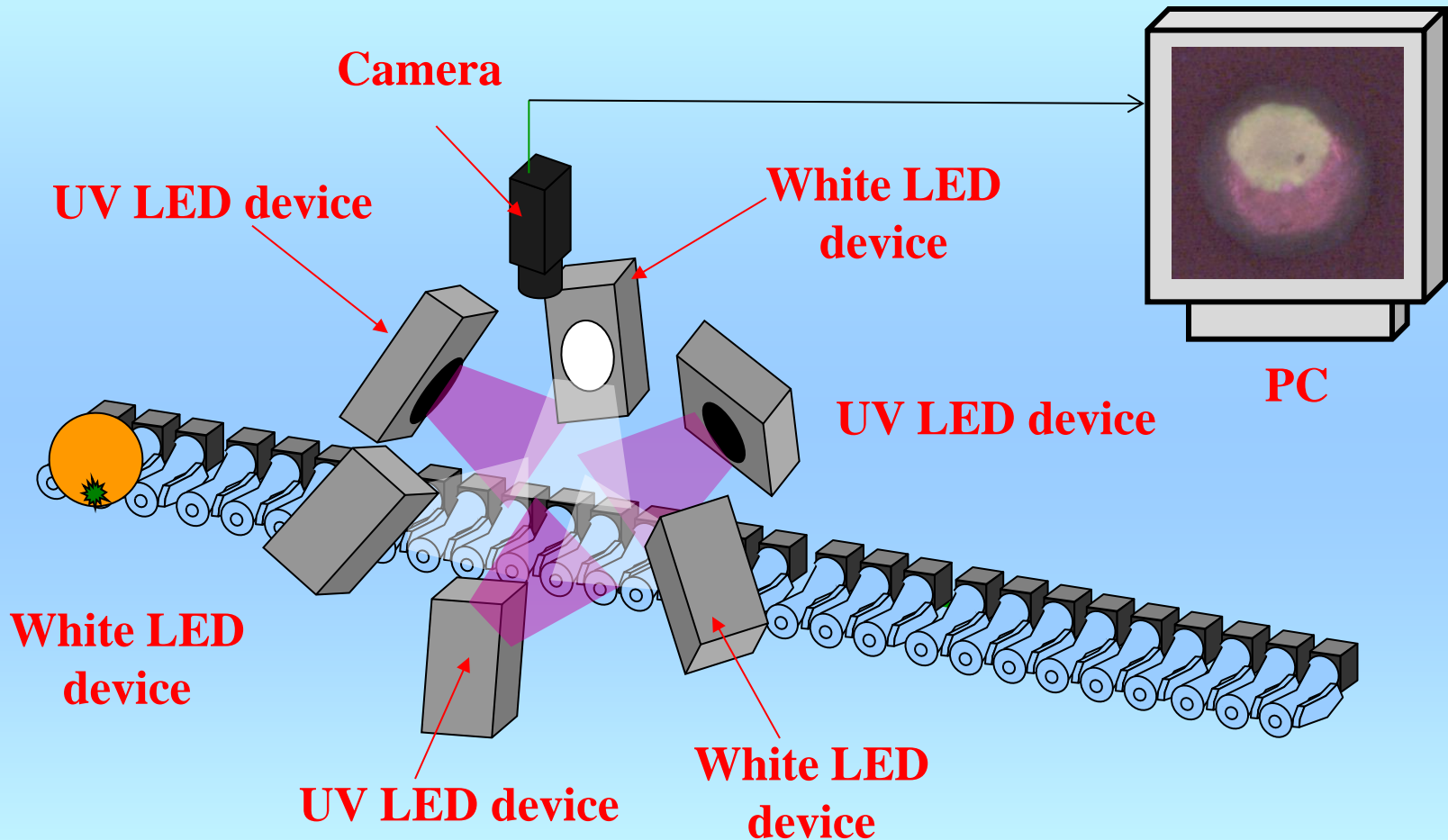# Slight injury, but possibility to be rotten

Reasons to be rotten

1. Holes
2. Crack by rind puffing
3. Bacteria from diseases

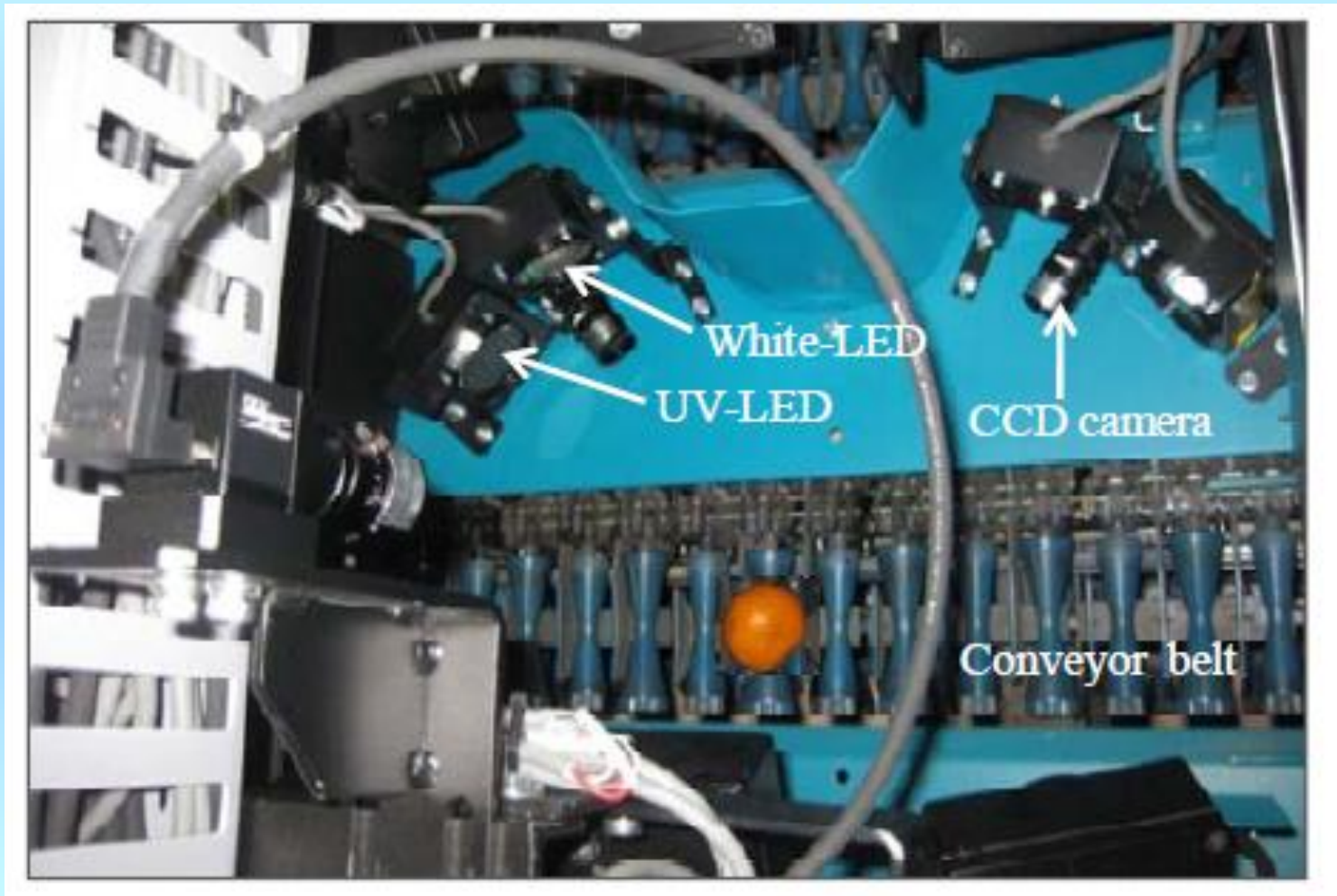Utilize fluorescent reaction

A Color TVcamera-Double LED system

Camera

UV LED device

White LED device

UV LED device

PC

White LED device

UV LED device

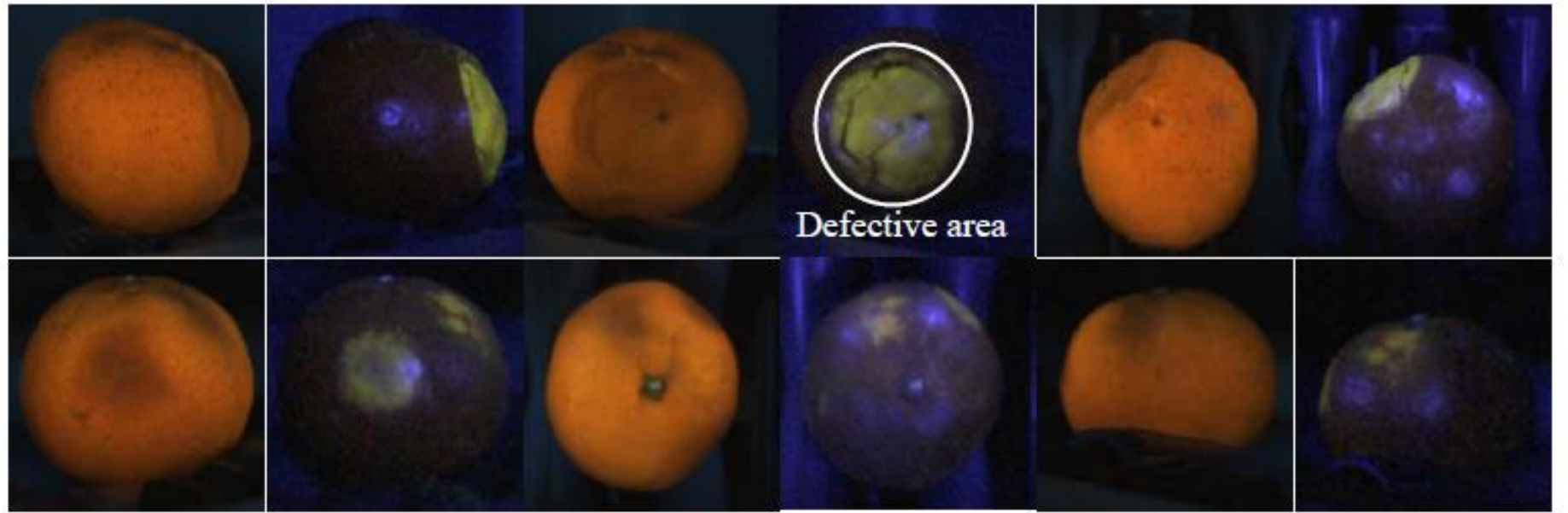White LED device

Top view of the image acquisition system on an practical grading line (Shibuya Seiki)

Actual fluorescence images on line

Defective area

(Shibuya Seiki)

Fluorescence substance holders

Citrus fruits, Cucumber fruit, and Apple fruit
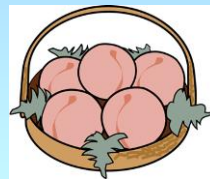
Rice grain

Moldy egg white and brown egg shell

Contaminant nuts

Some agricultural chemicals

……

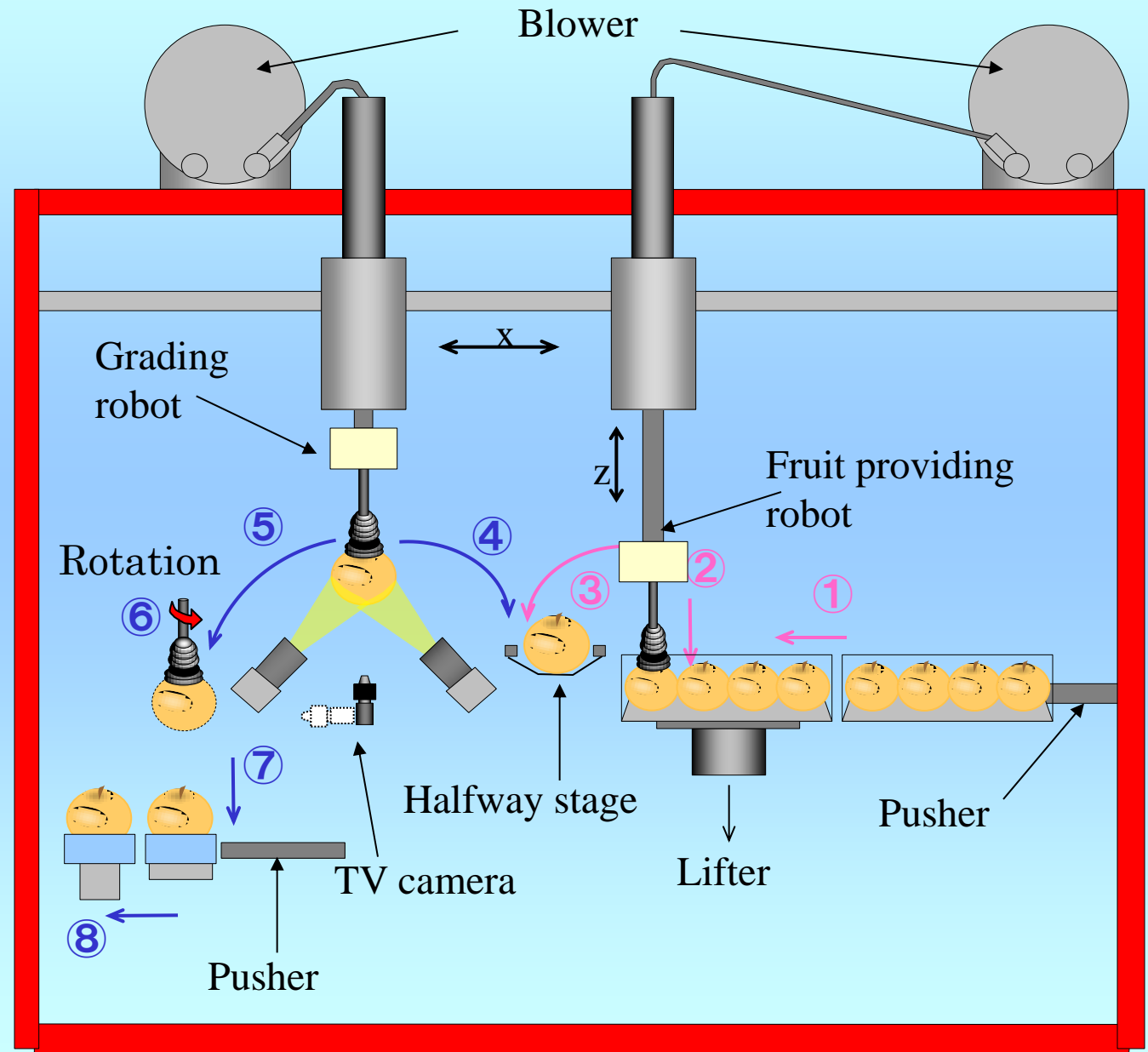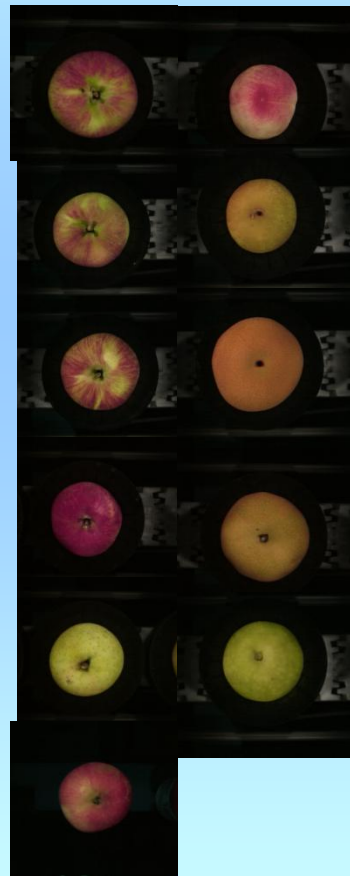# Fruit Grading Robot

Pear
Apple
Peach
Persimmon
Tomato

Constitution of robotic grading system

Information of fruit appearance

Original images   Color conversion images   Processed images

Top   Bottom

Side(1)   Side(2)

Side(3)   Side(4)
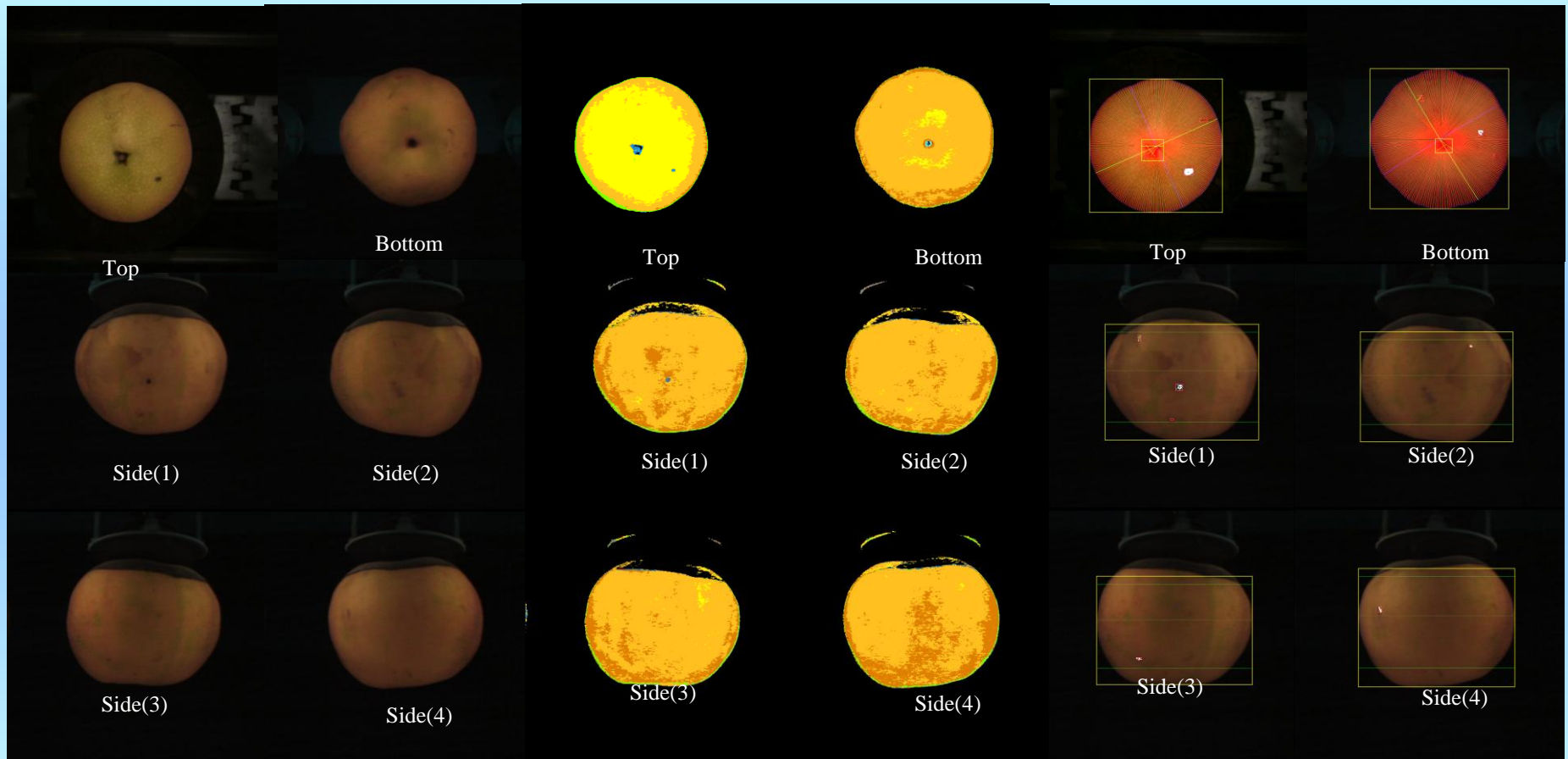
+ Internal quality information
(Sugar & acid contents, rot, ….etc.)
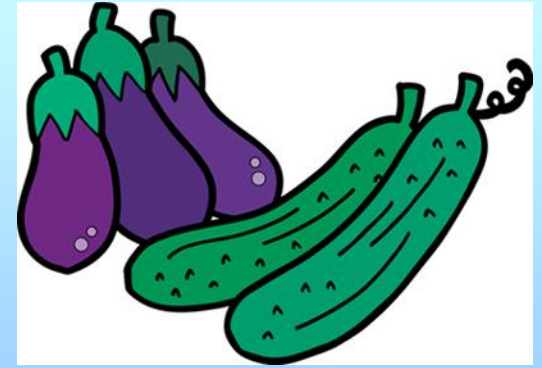
Yonjiu, Korea

Top cameras

Side camera

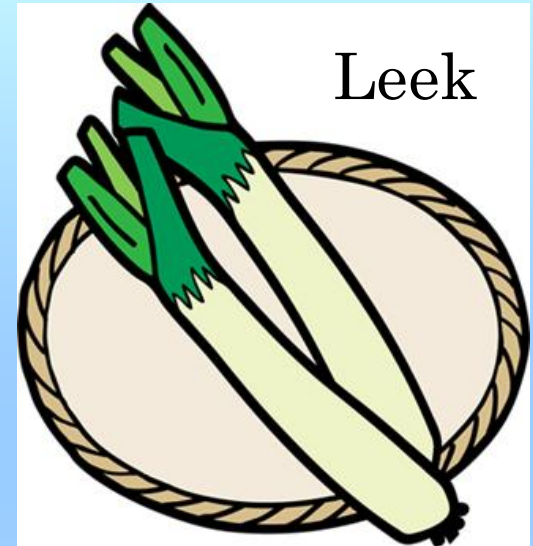**An Evolved Grading Robot**

Bottom camera
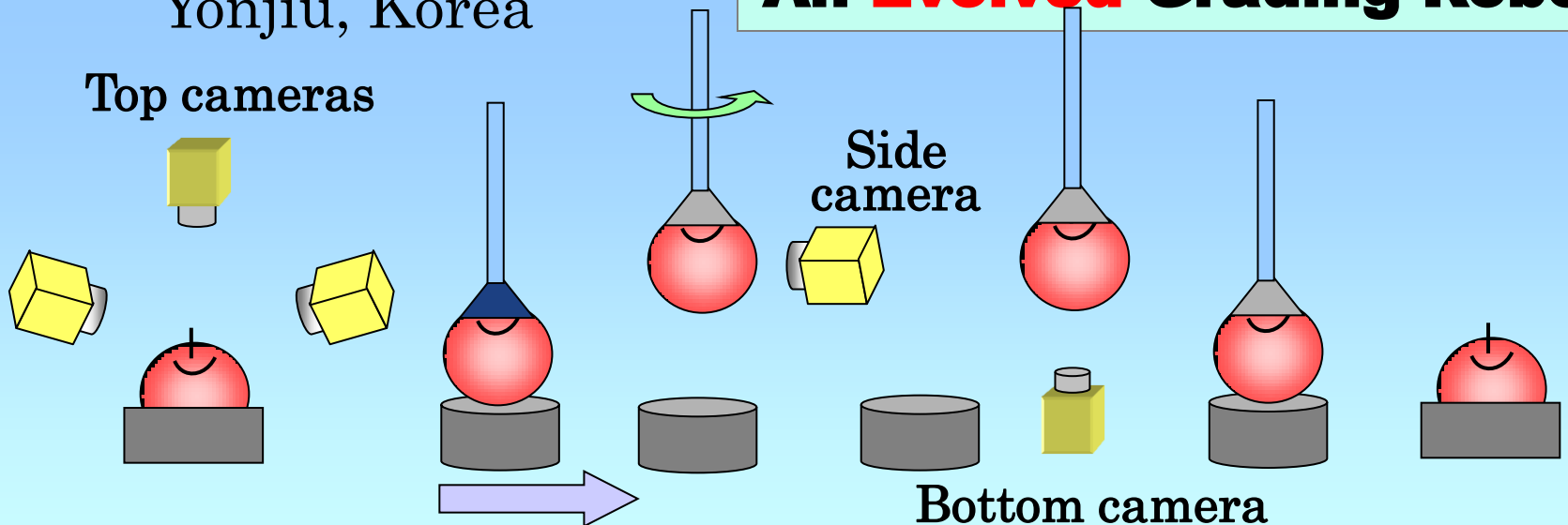
Elongated fruits

Eggplant, Cucumber

Specific longer products

Leek

Preprocessing before grading

SIseiko

size, color, shape, disease, internal injury
sugar and acid contents, residual chemical
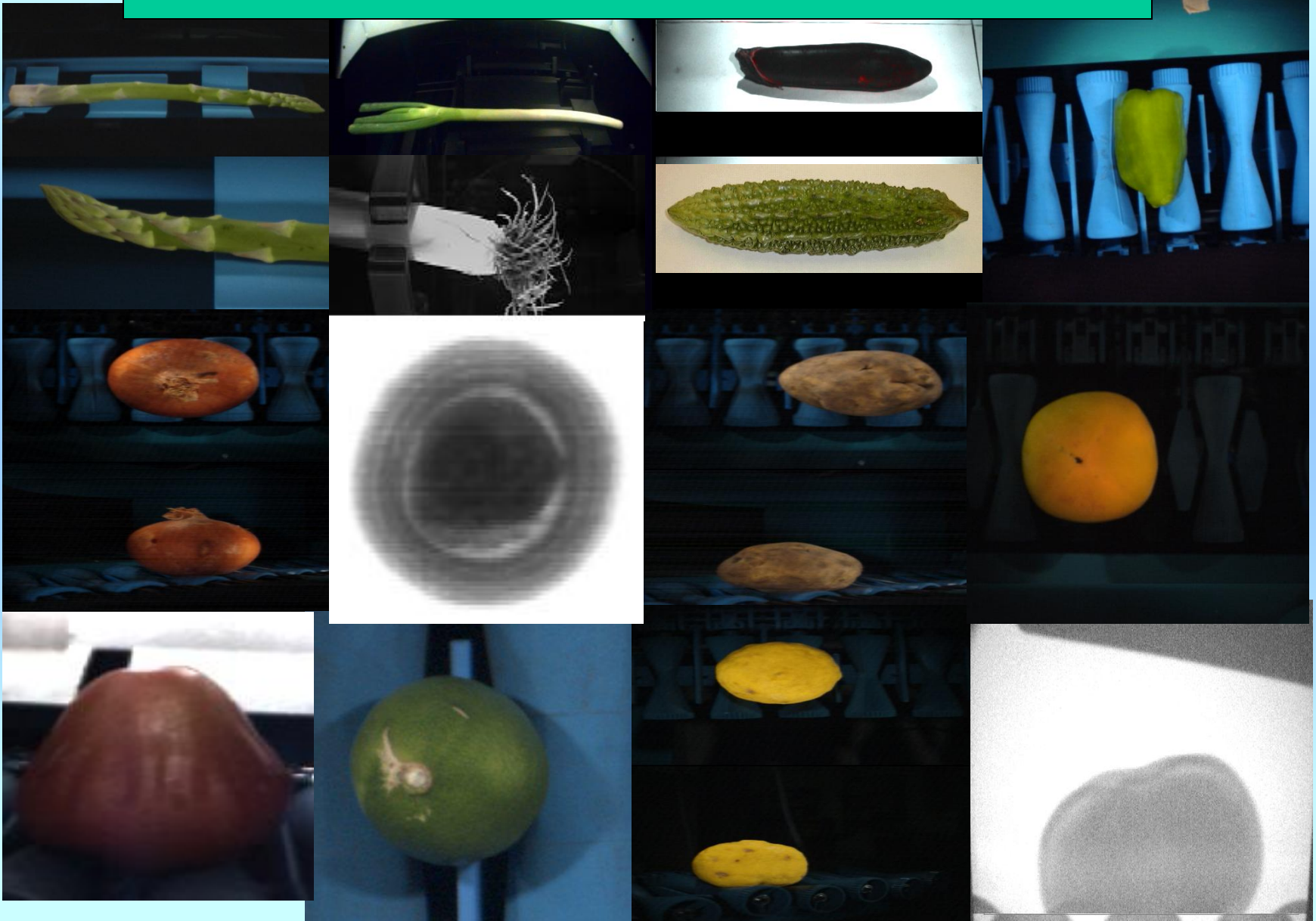
Farming support system based on GIS

Management information **Harvesting information**

Fertilizing
Chemical spraying
Irrigation......

Harvesting robot
Management robot

Grading robot
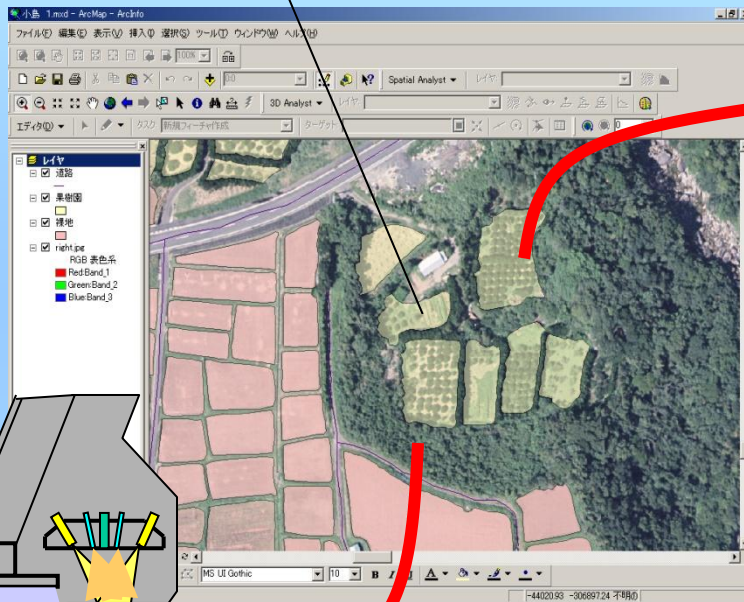
On Geographical data

- Appearance
- Internal quality

Precise information accumulated by robots

Accumulation to DB

Data from grading system can be used for precision farming

Field information

Soil sensor

7/1/2013

Roles of Fruit Grading Facility
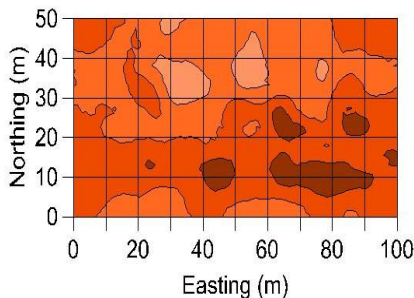
1. **Efficient sorting, and labor saving**
2. **Uniformization of fruit quality**
3. **Enhancing market value of the products**
   (Establishing local region brand of products)
4. **Fair payment to producers based**
   not only on quantity but on quality of each fruit
5. **Farming guidance from grading results and GIS**
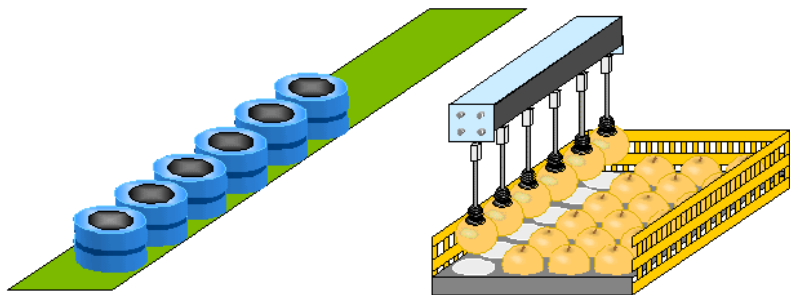6. **Contribution to the Traceability system**
   for food safety and security
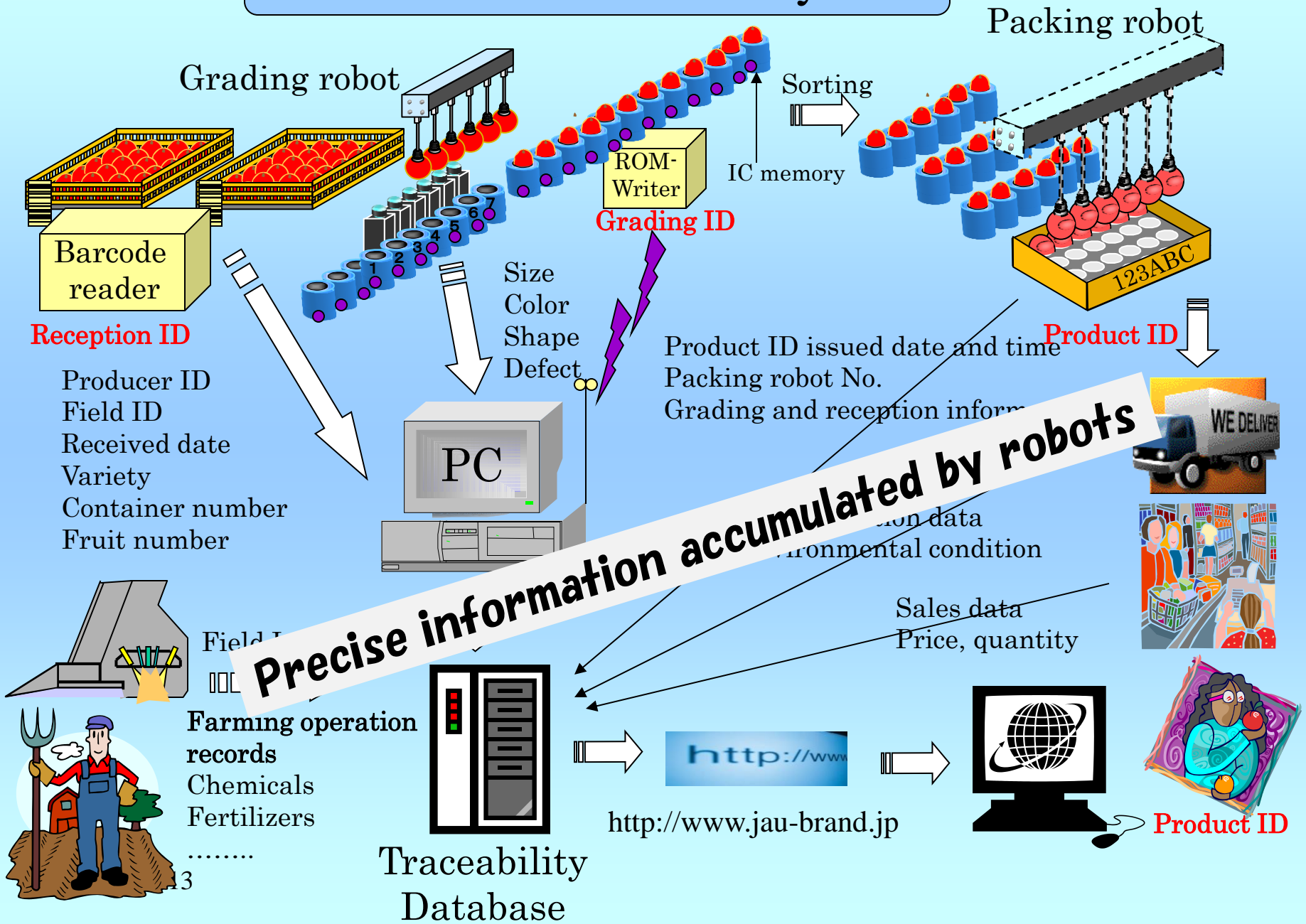
7/1/2013

Producer   Operator   Distributor   Consumer

Traceability System with a fruit grading robot

Main flow on traceability data

Grading robot

Packing robot

Sorting

IC memory

ROM-Writer

Grading ID

Barcode reader

Reception ID

Product ID

Producer ID
Field ID
Received date
Variety
Container number
Fruit number

Size
Color
Shape
Defect

Product ID issued date and time
Packing robot No.
Grading and reception inform...

PC

123ABC

WE DELIVER

Precise information accumulated by robots

...tion data
...ironmental condition

Sales data
Price, quantity

Field I...

Farming operation records
Chemicals
Fertilizers
....

Traceability Database

http://www.jau-brand.jp

Product ID

土壌検測

Information oriented field

知的農業
精細農業

Residue
Carbonization

Fresh
Product

Grading robot

Information added product

ID tags

Operation records
Sensing information

Field information

Farming guidance
DSS for farmers

Product
information

Biomass
Re-uses

農業協同組合
土壌分析中心
生産物信息中心

輸送

GIS, DSS

Analysis of soil and chemicals

Variable distribution channel
Marketing route

消費者的意見

BRAND

BRAND

価格, 量

消費者

市場

New flow of
product and information

Thank you

Any Questions?