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# Measuring360

## Optical Indoor Positioning System

FQS Poland
Parkowa 11
Krakow
Poland

# Agenda

- FQS Poland - introduction
- What is Indoor Positioning System (IPS)?
- Measuring360
- Summary

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# FQS Poland

# FQS Poland

- **Fujitsu**
  - The leading Japanese information and communication technology (ICT) company, offering a full range of technology products, solutions and services
  - Approximately 140,000 Fujitsu people support customers in more than 100 countries
  - Annual revenue 40 billion USD

- **FQS Poland**
  - Established in Krakow in 1998
  - R&D center ensuring two-way technology transfer between Japan and Europe
  - Sales, support and consulting in the area of Fujitsu technology
  - Operations in Europe, the Americas, Australia, Asia and Africa

# FQS Poland – major business lines

- Scientific software – chemistry, life science, materials science, data mining
  - Computational chemistry, drug design, pharmacokinetics, new materials design
- Financial solutions
  - Digital transformation of business data exchange, data hub platform for financial facts, anti-money laundering algorithms, fraud detection algorithms
- Manufacturing Solutions (PLM)
  - Production planning, virtual prototyping of new products, production line optimizations
- Data analysis
  - Chatbot technology, image processing, visualization of large data sets

# FQS Poland – services

- General software development
- Professional consulting
- Data analysis
- System integration
- Support

- Packages
- Web solutions
- Cloud computing
- High-performance computing (HPC)
- Tailor-made solutions




# FQS Poland – customers

772 institutions in 78 countries (in the years 1998-2021)
















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# What is Indoor Positioning System (IPS)?

# Indoor Positioning System (IPS)

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Indoor Positioning System (IPS) is a solution that continuously and in real time determines the position of a person or object inside a building. Such buildings can be: factories and warehouse halls, shopping centers, airports, multi-storey buildings, museums and amusement parks, and many others.

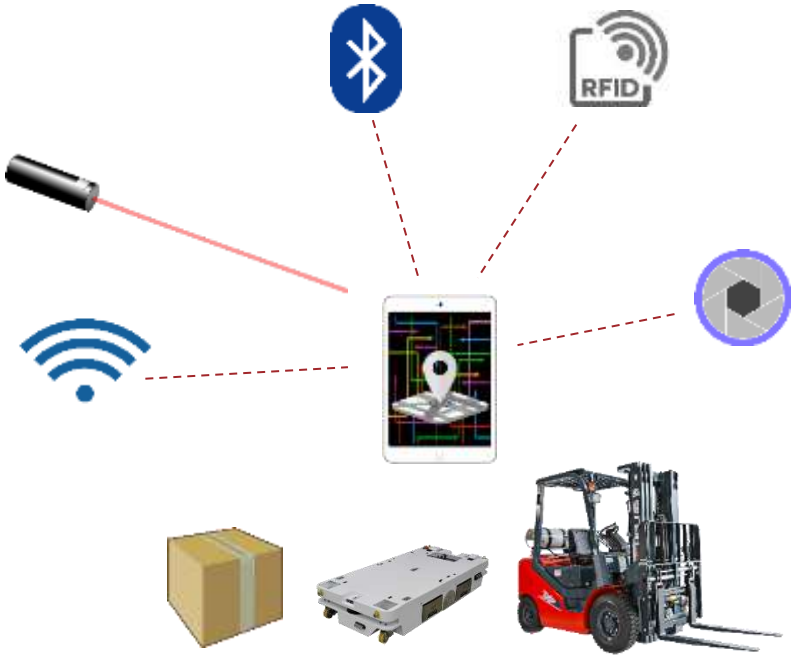
IPS is a component of larger solutions. Examples include systems enabling navigation in buildings, solutions ensuring the avoidance of obstacles by automated guided vehicles (AGV) or systems supporting the optimization of logistics processes.

Some sectors using IPS:

- Logistics and warehousing
- Industry
- Hospitals and medical centers
- Sports and entertainment
- Many others…

# Indoor Positioning System (IPS)

IPS can be compared to the operation of Global Positioning System (GPS). In both cases, the system provides information about the location of people and objects. In both cases, the position of the object (receiver) is determined on the basis of the position of the transmitters (in the case of GPS satellites in orbit around the Earth). Then the computer converts the information about the position of the receiver in relation to the transmitters into the position on the map (for GPS) or the location inside the building (for IPS).

# Indoor Positioning System (IPS)

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There are many different IPS systems with different localization methods available. These methods may include radio, optical, magnetic and acoustic technologies. Each technology has its pros and cons.

| Technology | Accuracy | Range [m] | Cost | Disadvantages |
|---|---|---|---|---|
| **Wi-Fi** | m | 1 - 50 | high | Possible signal interference |
| **Bluetooth** | m | 1 - 20 | high | Possible signal interference |
| **RFID** | dm - m | 1 - 50 | high | Small coverage |
| **UWB** | cm - dm | 1 - 50 | high | Signal may be blocked by metalic objects |
| **Camera** | mm - dm | 1 - 20 | low | Objects must be in the line of sight; requires computing power |
| **Laser** | mm | 1 - 5 | high | Objects must be in the line of sight; relative positioning |
| **Infrared** | m | 1 - 5 | medium | Objects must be in the line of sight |
| **Sonar** | cm | 1 - 10 | medium | Susceptible to acoustic disturbances |
| **Dead reckoning** | 0.1% - 20% | 1 - 100 | medium | Cumulative positioning error; relative positioning |

# Indoor Positioning System (IPS)

The IPS system is selected individually for the building, taking into account the specifics of the working environment and the efficiency and complexity of the IPS solution itself. There are no universal solutions.


The IPS provides information about the location of a person or object inside the building. It is usually a part of component of a larger IT solution - an external management system that monitors the movement of objects in a building.

# IPS – challenges

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All IPS systems struggle with problems resulting from the specificity of the used technology and the user's requirement and work environment. Examples of challenges are:

- Costs related to system scalability
  - Number and power supply of sensors in large systems (e.g., battery replacement or the need to pull-up power)
- Difficulties with installation in existing buildings
- Radio wave propagation interference (for radio technologies such as Wi-Fi, Bluetooth, RFID or UWB) caused by metal structures or radio wave interference
- Dead zone locations - areas where the signal used to measure the position is too weak

Measuring360 is the solution responding to the challenges typical to IPS systems

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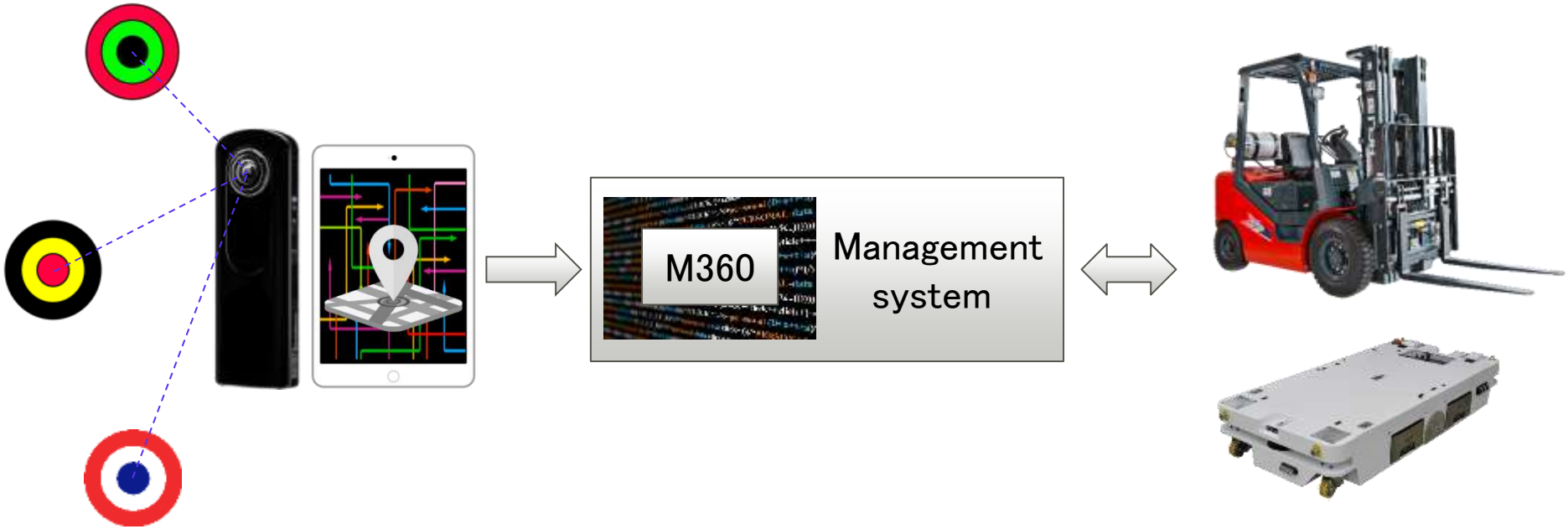
# Measuring360

# Measuring360 - overview

Measuring360 (M360) is an innovative technology based on image recognition, using an optical system (camera) to position objects inside buildings. The system consists of a camera (or several cameras), a computer and the unique M360 software. The system analyzes the image seen by the camera and then recognizes the position of special markers (multicolored concentric circles) placed on the walls or ceiling of the room. On this basis, it calculates, with high precision (10cm - 30cm), the location of the object. The whole system is coupled with an external application monitoring the movement of objects inside the building.



# Measuring360 – photos from laboratory tests

# Measuring360 – system scalability

The M360 is a highly scalable solution that is easy and cheap to maintain. Contrary to technologies based on radio waves (UWB, Wi-Fi, Bluetooth), the system does not use transmitters (beacons), which require electric power to operate. In the process of using the system, there is no need to wire the building or to replace the batteries in the transmitters. This significantly reduces the overall cost and makes maintenance easier.

# Measuring360 – working environment

The M360 is based on optical technology. The measurement method is therefore not sensitive to electromagnetic field disturbances caused by working machines or metal structures such as storage shelves or reinforcement of building walls. Thus, M360 will work better in such an environment than systems based on radio waves (UWB, Wi-Fi, Bluetooth).

# Measuring360 – barcodes

Measuring360 works in two modes:

- Positioning of moving objects
- Inventory of objects in the room

In inventory mode camera recognize barcodes placed on the goods and links them to their exact location. This functionality is used in warehouse or factory management systems.

Barcodes supported by M360:

- EAN13
- CODE39
- CODE128
- ITF
- QR Code

# Measuring360 – product features

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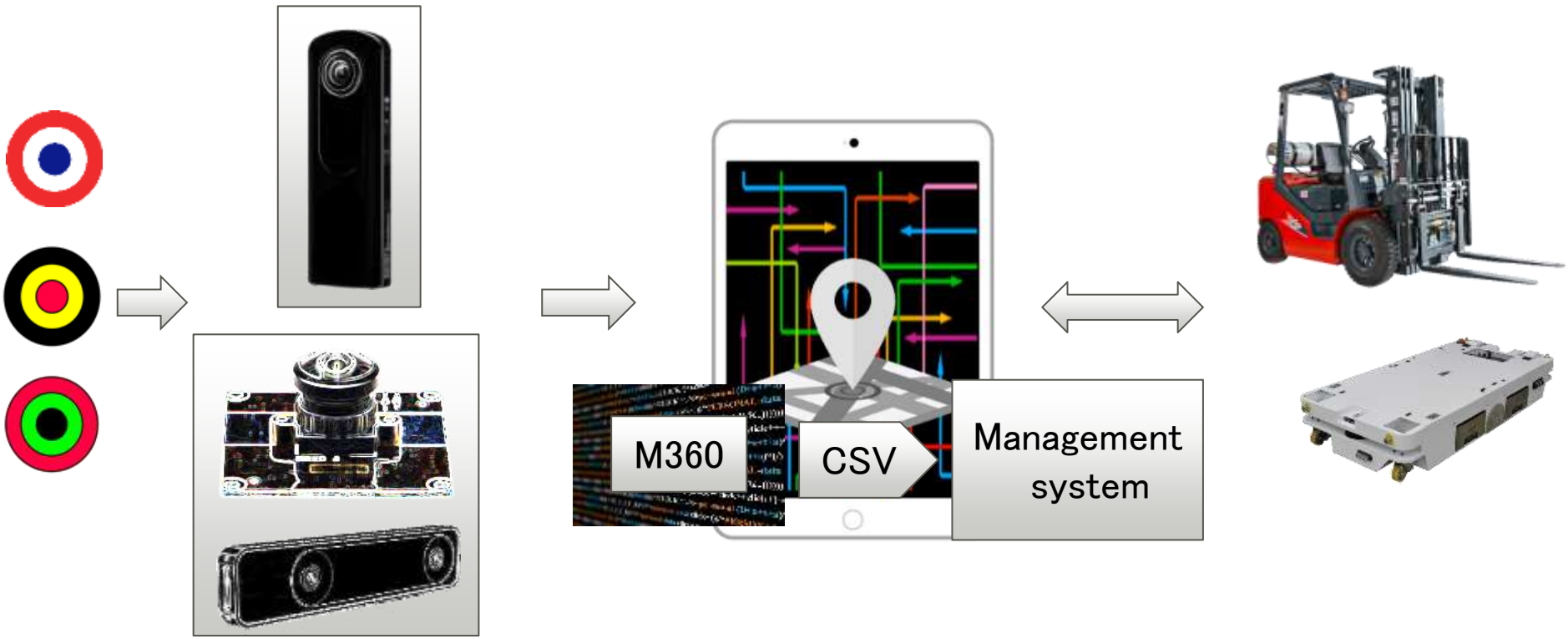
- High accuracy of the provided measurements - better than standard IPS implementations based on radio technology: Bluetooth, RFID, UWB, and Wi-Fi.
- The system provides the current position in real time (RTLS) and allows to calculate the direction of movement.
- The M360’s image recognition algorithm also provides height measurements of objects in the camera’s field of vision.
- M360 recognizes barcodes, which allows you to manage information about the location of stored goods.
- High scalability, easy and low-cost maintenance, and flexibility to fine-tune and improve measurements are the advantages of using the M360 technology.
- Image recognition on M360 addresses a number of challenges that radio technologies usually cannot handle: high-energy electromagnetic fields, radio wave interference, white spots caused by solid metal structures, etc.

# Measuring360 – technical parameters

- Hardware
  - Windows PC
  - Wide angle camera (ELP USB) or 360-degree camera
  - Positioning camera: Intel RealSense T265
  - Colored markers to be placed in predefined places inside the building
- Software
  - M360 installed on Windows PC
- Architecture
  - Position calculations performed directly on the workstation
  - Flexibility to build other architectures in the target solution (e.g. collecting the positions of all vehicles on a central server)

# Measuring360 – technical parameters

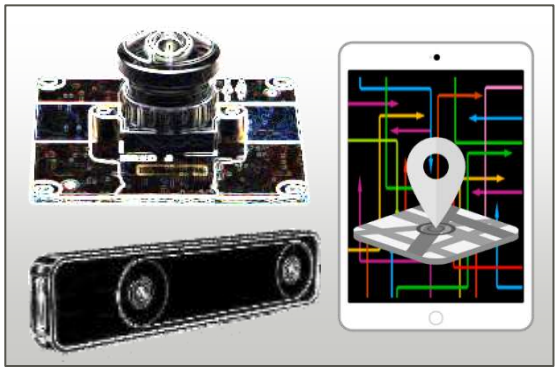
M360 can operate in two configurations using one 360-degree camera (e.g., RICOH THETA V) or a system of two cameras: wide angle (e.g., ELP USB) and positioning camera (Intel RealSense Tracking T265). The position of the system is determined by M360 based on colored markers placed at predefined locations inside the building. The result in the form of a CSV file is sent to the management system.



# Measuring360 – technical parameters – one camera

- 360-degree camera – e.g. RICOH THETA V
- PC (Windows; Intel Core i3 64-bit, 4 GB RAM, 1 GB free disk space)
- Colored markers to be placed inside the building at sites defined during the implementation phase. Markers are multi-colored concentric circles.
- Technology
  - Image recognition
  - The photo must contain three markers
  - Based on the position of the markers, the position of the object is calculated
- The measured position is sent to an external application via a CSV file
- Additional functionality - barcode recognition

# Measuring360 – technical parameters – two cameras



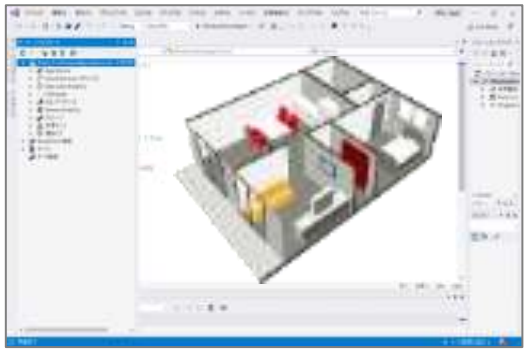
- Cameras:
  - Intel RealSense Tracking T265
  - Wide angle e.g. - ELP USB 180 Degree
- PC (Windows; Intel Core i3 64-bit, 4 GB RAM, 1 GB free disk space)
- Colored markers
- Technology
  - The tracking camera enables precise movement and position measurement
  - The positioning error is corrected by measuring the position of the markers
- The measured position is sent to an external application via a CSV file
- Additional functionality - barcode recognition

# M360 - specification

| Parameter | M360 |
|---|---|
| Technology | Image recognition<br>Dead reckoning |
| Accuracy | 10 – 30cm |
| Range | Up to 20m |
| Measurement frequency | 0.1 s |
| Positioning | Calculated during movement |
| Direction of movement | Directly calculated by M360 |
| Communication | No need to modify the building structure |
| Power | No need to modify the building structure |

# Measuring360 – example application

- Real-time locating systems (RTLS)
  - Vehicle tracking (e.g. forklifts) inside the warehouse
  - Automated guided vehicles (AGV)
- Inventory management - barcode reading
- High scalability and ease of implementation allow the use of M360 in the management of temporary warehouses - optimization of warehouse space
- The use of image recognition and positioning technology to improve remote work
  - The picture of work progress is superimposed on the construction design (CAD)
  - Possibility to assess the progress of works without the need to visit the construction site (COVID-19)



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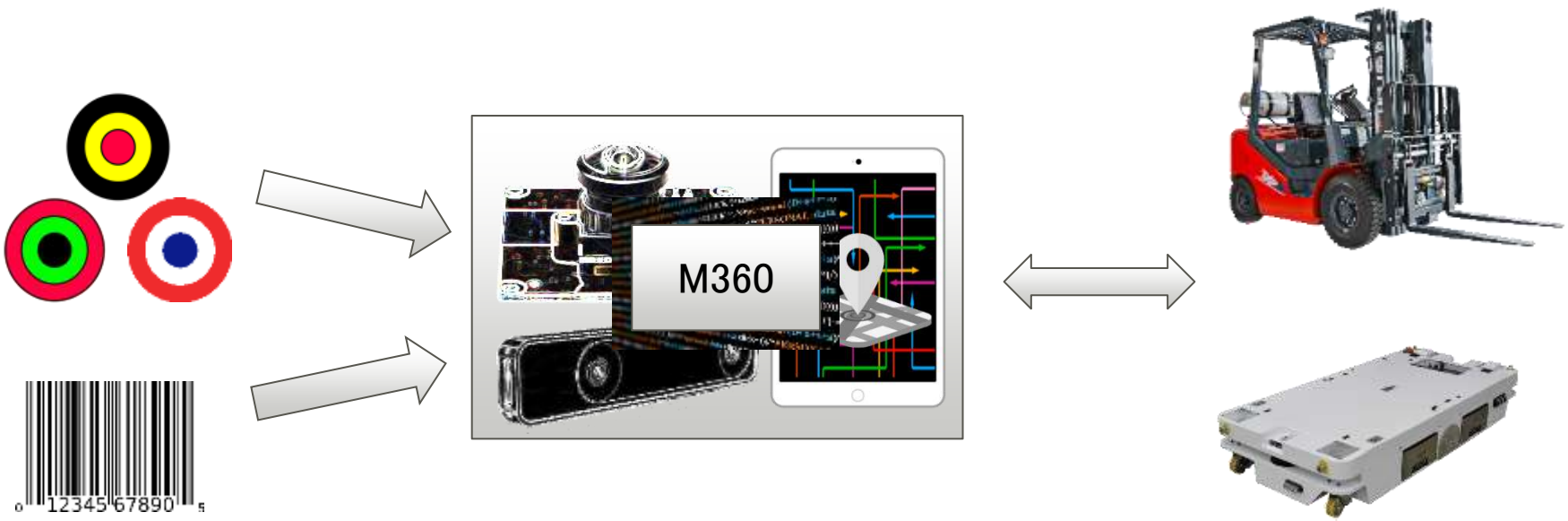
# Measuring360 - summary

# Measuring360 – summary

- Low installation and operation cost
- Easy and inexpensive deployment
- Barcodes recognition
- Can be used in places where radio wave interference occurs
- Very easy integration with other systems



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# Thank you for your attention!

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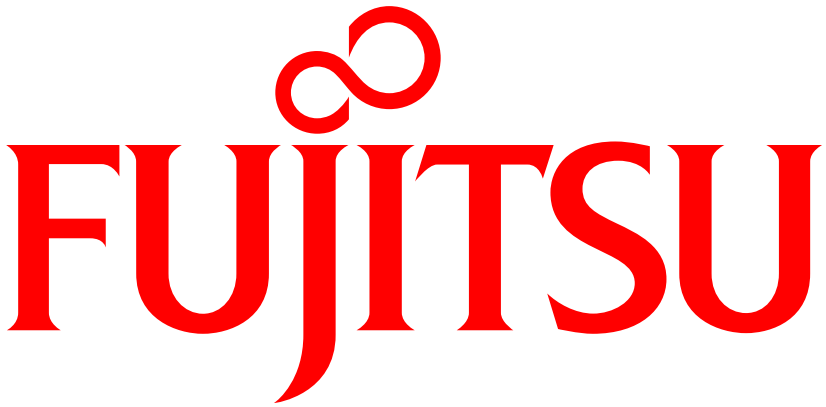


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