INCREASING ROAD MANAGEMENT EFFICIENCY
BY MAKING USE OF ITS TECHNOLOGY
1. Introduction

Accompanying changes in social conditions, there is a need for ever more advanced and more efficient road management.

Actualization of results-orientated road administration management.

1) Hours lost due to road congestion
   □ Reduce by approximately 10% by 2007

2) Road construction hours
   □ Reduce by approximately 20% by 2007, etc.

Efficient use of road stock

User services corresponding to user demand

The aim is to improve the quality of road management work, through the utilization of sensing technology, one form of IT*1, in monitoring cameras.

* 1 IT : Information Technology
In order to respond appropriately to requests made of road administration, road management work must be made more efficient, and at the same time, it is necessary to strive for quality improvements.

Issues in road management work

Society’s requests of road administration

Road management issues

(1) Road management work quality improvement

Budgetary and human resource limitations

(2) More efficient road management work

By effectively utilizing information resources such as cameras, actualize advanced information
3. Kind of Image Sensor

- Image sensor for road management is usually classified into “Road incident sensor” and “Road surface sensor”.

The possibilities for image sensor utilization in road management:

- **Road incident sensor**
  - Detects events occurring on the road, such as fallen rocks, fallen articles, stopped vehicles
  - Tracing vehicle path, etc.

- **Road surface sensor**
  - Detects the road surface conditions – wet, frozen, snow-covered, etc.
  - and changes in conditions
If Image Sensor is added on CCTV Camera, it is possible to raise the efficiency and quality of road management works.

With CCTV Cameras,
(1) it is possible to quickly confirm on-site detailed information without visiting the site.
(2) it is possible for anyone to intuitively judge the situation, thanks to image confirmation.

However, it is not possible for human beings to continually monitor the CCTV camera screen. Therefore, in reality, the conditions are confirmed on the CCTV after the event has occurred.

Can’t it be used more cleverly (strategically)?

* 1 CCTV : Closed Circuit Television
5-1 Functions of Road Incident Sensor that can be Utilized in Road Management

- It is possible to quickly and surely detection by Road incident sensors.
- By utilizing data on incident, it is possible to support of effective safety measures.

Incident Detection Confirmation Execution of work Analysis and improvement work, evaluation

Before After

- On-site reports
- Discovery by monitoring camera

- Visual confirmation with cameras
- on-site confirmation by mobilization

- Records in memos, administration (reports, photos, etc.)

- The system automatically detects

- The system automatically notifies (Cell Phone, PC, Monitoring Terminal)

- Analysis of accumulated data

- Detection of the accident without a report
- Evaluation after safety measures

Early detection of incident
Cause analysis of accidents
Understanding of potential dangers

Understanding of potential dangers
Example of Event Detection by Road Incident Sensor

- By continual processing of sensor on camera image, it is possible to detect the event as stationary vehicles.

- Vehicle swerving when there is a stationary vehicle

  When a vehicle does not move for a few seconds, it is detected as a stationary vehicle.
### 5-2 Functions of Road Surface Sensor that can be Utilized in Road Management

- By understanding changes and shifts in road surface conditions, it is possible to support road management work.
- It is efficient as a tool for offering information to road users.

#### Before
- **Detection**
  - On-site reports
  - Discovery through weather data

- **Confirmation**
  - Predicting from experience
  - On-site confirmation using patrols

- **Execution of work**
  - Implementation of work (Actual experience is necessary)
  - Provision of information to users (On-site images, etc.)

#### After
- **Supports road management work**
  - The system automatically detects

- **Provision of information to users**
  - The system automatically notifies (Cell Phone, PC, Monitoring Terminal)
  - Implementation of work (Supports uniform operation decisions)
  - Provision of information to users (Road surface conditions for an area, etc.)

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**Freezing, etc.**
Example of Event Detection

by Road Surface Sensor

- By continual processing of sensor on camera image, it is possible to detect the event as freezing road surface.

Detection of a road surface situation when a freeze road surface occurs

The still picture which removed the object which moves from the picture for 1 minute is created. Image processing of the still picture is carried out, and a road surface state is detected.
6-1 Early Discovery of Incident

CCTV camera monitoring support (rough idea)

Before
- There are many CCTV’s, and continual confirmation is difficult.
  - Can only look when a problem occurs!

After
- The situation is confirmed before instructing to the actual site.

CCTV’s are installed in important locations

24 hours a day, many cameras are automatically scanning, discovering abnormal events and making notification!
6-2 Cause Analysis of Accidents

- It is possible to have analysis of causes of traffic accidents based on quantitative and objective data. We can expect proposals for new, effective countermeasures.

Use of this equipment in accident cause analysis

Through the use of accumulated vehicle behavior data and image data (still images and quasi-dynamic images), it is possible to quickly and accurately analyze the causes of accidents.

- Before
- After

"Accident situation drawing"

"Drive Path Drawing, Speed Change Drawing, Image"

Vehicle behavior data

Image data (Record of event occurrence)
6-3 Understanding of Potential Dangers

- It is possible to understand, quantitatively, potential dangers.
- It is possible to make more appropriate evaluation than ever before, after implementation of safety countermeasures.

Potential dangers

By graphing accumulated vehicle behavior data, it is possible to understand potential dangers and to make quantitative evaluations after the implementation of safety countermeasures.

- Understanding potential dangers
  - “In comparison with daytime driving, high frequency vehicle speeds of vehicles driving at night is 20km/h higher

- Quantitatively understanding the effects of safety countermeasures
  - Before
  - Before the curve there are few cars which drive in the center lane.
  - After
It is possible to support appropriate decisions for mobilization and rational road surface management work.

### Rough idea of the system to decide on mobilization, utilizing road surface sensors

<table>
<thead>
<tr>
<th>Road surface conditions</th>
<th>Decide implement of dispersion</th>
<th>Decide implement of dispersion</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freezing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow cover</td>
<td></td>
<td></td>
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<tr>
<td>Water film</td>
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<td></td>
<td></td>
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<tr>
<td>Wet</td>
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<td></td>
<td></td>
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<tr>
<td>Dry</td>
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<td></td>
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<tr>
<td>Road surface temp.</td>
<td>Dispersion of chemicals</td>
<td>Dispersion of chemicals</td>
<td></td>
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<tr>
<td>Air temp.</td>
<td></td>
<td></td>
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<tr>
<td>Cloudy</td>
<td>Rain</td>
<td>Light snow</td>
<td>Cloudy</td>
</tr>
</tbody>
</table>

Transition of road surface conditions (mesh image) (The red areas are freezing mesh)
7-2 Provision of information to users

- It is possible to provide road users with easy-to-understand road surface information.

Rough idea of the system to provide information utilizing road surface sensors

- Camera image 2004/08/04 09:45:22
- Display combining freezing proportion, air temp change graph, and road surface conditions transitions
### Summary of image sensor functions that can be used in road management

<table>
<thead>
<tr>
<th>Function</th>
<th>Sensor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Detection of dangerous event data</td>
<td>Road incident sensor</td>
</tr>
<tr>
<td>(2) Detection of road surface conditions data</td>
<td>Road surface sensor</td>
</tr>
</tbody>
</table>

### Proposed method for utilization of image sensors in road management

The content of road management work is categorized, and specific utilization methods have been proposed.

1. **Road incident sensor**
   - Early discovery of incident
   - Cause analysis of accidents
   - Understanding of Potential Dangers

2. **Road surface sensor**
   - Winter road surface management work support
   - Provision of information to users

### Actual road verifications and evaluations are planned for the future

With the experimental introduction of the studied utilization methods onto actual roads. Functions necessary to support road management work will be added or modified.