

Improve the safety of maintenance work on the railway using computer

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Abstract

In our company, we accomplished the ATOS (Autonomous Decentralized Transport Operation Control System) for modernization of traffic managing operation and maintenance work at Tokyo metropolitan area.

ATOS has been created by using computer with fail-safe architecture and computerized network for supporting maintenance. But it costs very high. So it is very difficult to introduce them to conventional lines except Tokyo metropolitan area.

Therefore we developed a new system to keep safety of maintenance workers for conventional lines.

This system is using existing CTC (Centralized Traffic Control system) equipment. So it not only keeps high safety for maintenance workers but also reduce acquisition costs.

In this paper, we explain the outline and function of this system. And we describe the mechanism of this system for safety.

1 Background

There are some problems of the maintenance works. For example, the safeties of the maintenance works are depended on the attention of human.

In the Tokyo metropolitan area, we can keep safety for maintenance workers by maintenance work management function of ATOS. But there hasn't been a system which guarantees safety of maintenance workers for conventional lines except Tokyo metropolitan area.

In February 1999, three maintenance workers were hit by a train and die at Yamate Freight Line. So we were trying to keep safety for the maintenance workers to prevent such a tragic accident.

We were developing the system which would be able to realize the safety of the maintenance workers.

In this system, the safety is kept by not human attention but computer system which has several checking functions. We call them "Collision Check", "Adequacy Check" and "Restraint Check".

In addition, we were trying to reduce the dispatcher's duties for the maintenance works.

2 Main concepts of the system

In this chapter, we explain the constitution of the maintenance management system.

This system has two major functions; one is checking function for safety of the maintenance workers (now it depends on the dispatcher's attention) and the other is setting the route for maintenance vehicles by worker-selves with mobile terminals.

- The checking function consists of three types of checks called "Collision Check for the maintenance work plans", "Adequacy Check of the time between trains and maintenance work plans" and "Restraint Check of the trains".
- The previous way of maintenance work at the line using CTC line, the dispatchers must do some checks for safety; control signals to prevent train entering the maintenance working area and set the route for maintenance vehicles. We tried to reduce those duties.

3 Overview of this system

Fig.3-1 shows the configuration of this system. To reduce the introducing cost, this system uses existing CTC equipment.

The detailed functions are follows.

3.1 High safety

3.1.1 Collision check for the maintenance work plan

- This is a function that checks whether their work plans overlap each other on the same time and same place when they are planned.(Figure3-2)

- If their plans overlap each other, the system gives a warning to change the plans or review the plans again.

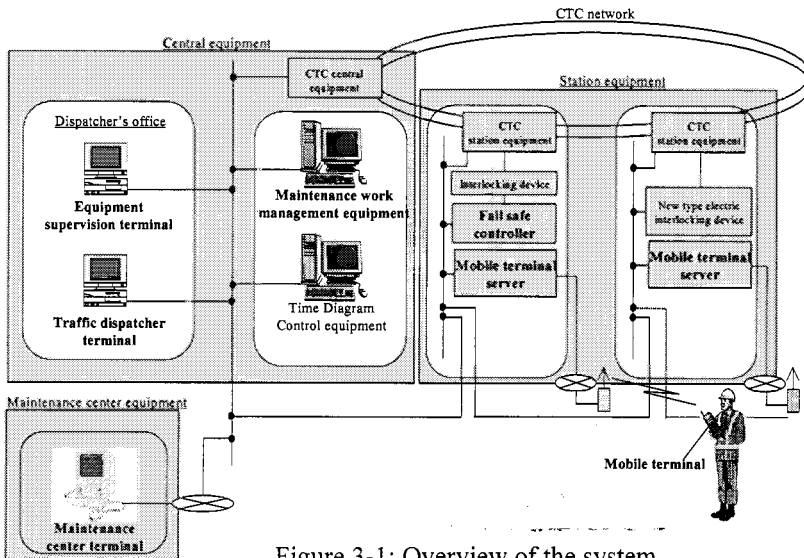


Figure 3-1: Overview of the system

3.1.2 Adequacy Check of the time between trains and maintenance work plans

- This is a function that checks whether their work plans and train schedule are overlapped.(Figure3-2)
- The train schedule is given by the time diagram control equipment.

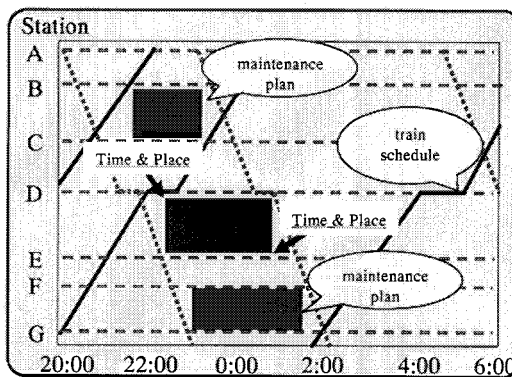


Figure 3-2: Collision check and Adequacy check

3.1.3 Restraint Check of the trains

- This is a function that checks whether the signals are stop indications both ends of the working areas through the interlocking device. (Figure3-3)
- The information of the train position is given by using the interlocking device.

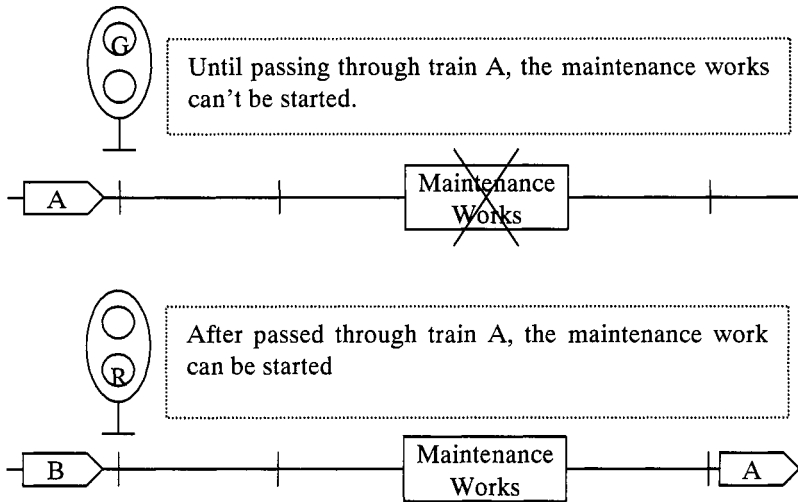


Figure3-3:Restraint Check of the trains

3.2 Reduce of dispatchers duties for the maintenance work

3.2.1 Systemizing the Adequacy Check

Previous system, the workers applied the plans of maintenance work to the dispatchers. Then the dispatcher checks the time between trains and maintenance work plans and gives the recognition to the workers.

In this system, the workers applied the plans of maintenance work to this system. Then the system checks the time between trains and maintenance work plans (Adequacy Check) [described 3.1.2].

So the dispatcher only gives the recognition by using information of this system. (Figure3-4)

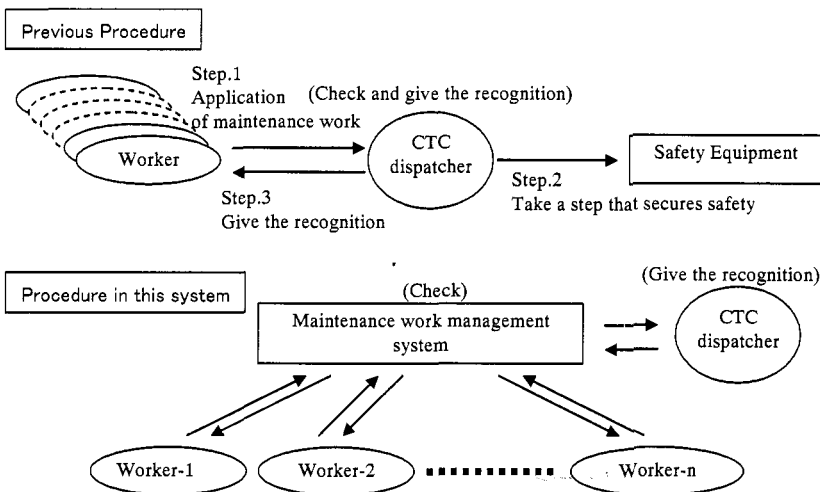


Figure 3-4: Procedure of maintenance work

3.2.2 Procedure of beginning and ending of the maintenance work using Mobile terminal

Previously system, in the case of doing the maintenance work, the worker must inform the dispatcher of the beginning the maintenance work. Then dispatchers must check the situation of running of the trains and control the signals to prevent train entering the working area.

This system checks the situation of the running of the trains and controls the signals. So the dispatchers are free from those duties. (Figure3-5, Figure3-6)

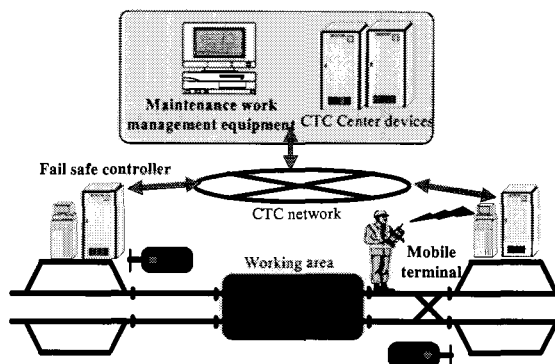


Figure 3-5: Using Mobile terminal

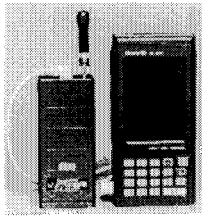


Figure 3-6: Mobile terminal

3.2.3 Setting route for maintenance vehicles by using Mobile terminal

Previously, the dispatchers set route for the maintenance vehicles when the maintenance workers request.

In this system, the workers can set the route themselves for the maintenance vehicles by using Mobile terminal. (Figure3-5, Figure3-6)

So this system will be able to realize reduction of the dispatcher's duties for maintenance work.

4 Functions of each equipment

In this section, we describe the functions of the developed equipment to be realized the system above. (Figure4-1)

4.1 Maintenance center terminal

- Maintenance center equipment consists of the PC called the information terminal for maintenance center and the Mobile terminal.
- Maintenance plans are made with information terminal, and transmitted to maintenance management equipment. And they are downloaded to the Mobile terminal.
- The maintenance workers can request the beginning and ending of the maintenance work or setting the route of the maintenance vehicle by using the Mobile terminal at the field.

4.2 Maintenance work management equipment

- It has 2 months of Maintenance plans.
- It does the Adequacy Check between train schedules and maintenance work plans.

- It does the Restraint Check of the trains if they received a request of maintenance work from Mobile terminal.

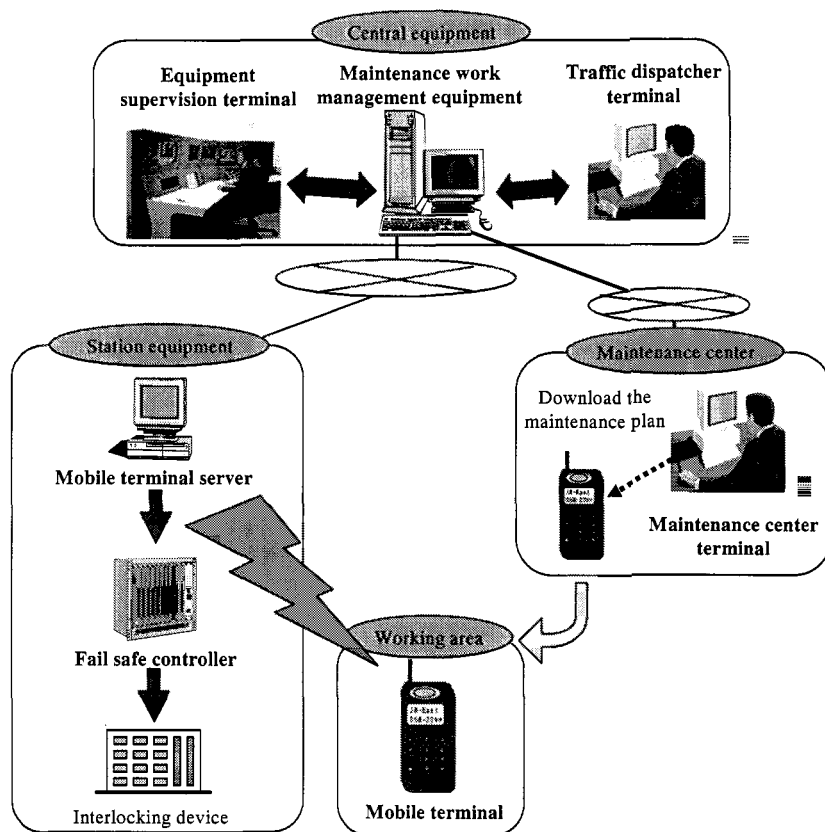


Figure 4-1: Configuration of this system

4.3 Traffic dispatcher terminal

- Status of maintenance works are displayed visually and on real-time.

4.4 Equipment supervision terminal

- Situation of maintenance works of all lines can be displayed visually and on real-time.
- It is able to monitor maintenance plans on traffic dispatcher terminal.

4.5 Mobile terminal server

- It transmits the demands and responses of maintenance works between the Mobile terminal and each equipment as a transmit server. (Figure4-2).

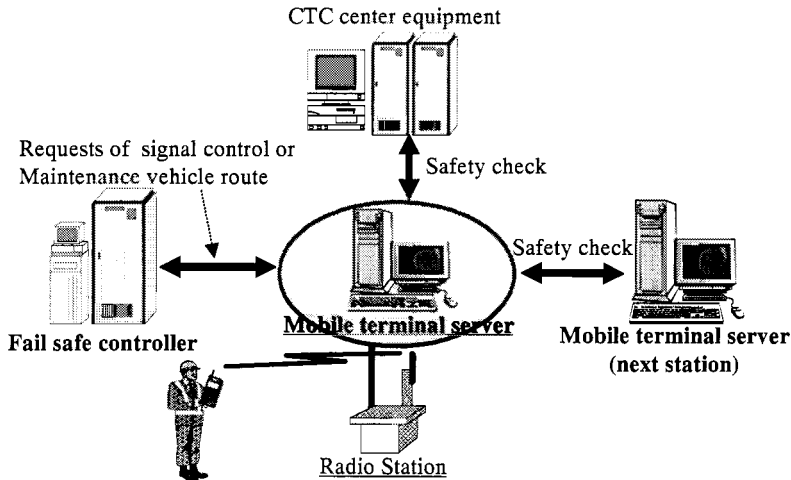


Figure 4-2:Function of Mobile terminal server

4.6 Fail safe controller (FSC)

The existing interlocking device has not any checking function for maintenance works. This equipment connects with existing interlocking device. And it makes a function of some checks for safety.

- It checks the train location and maintenance work plans, when the route of the train or route of the maintenance vehicle is requested.
- It transmits the (checked) requests to the interlocking device.
- It transmits the demand and response of the interlocking device to Mobile terminal server.

5 Conclusion

The maintenance works carried out by persons in the history of train operation have been modernized by the managing system for the maintenance work utilizing high-reliable computers. Now the maintenance works turned out efficient and highly safe.

The system will utilize from 2003's on Shinetsu-line. Utilitizing of mobile terminal makes the procedure of maintenance works smooth and extends the time of maintenance works. Additionally, the dispatcher's duties on the maintenance work become greatly reduced.

This system will be introduced for other lines.

Finally we believe that this system greatly contributes to efficient and modernized maintenance works.

References

- [1] Fumio Kitahara, Tsuneo Matsumoto, Satoshi Itou, Keisuke Bekki, Hitoshi Yanagi, Kouji Tomita: "Fail-Safe technology for General Purpose Computer (Traffic Control System) Journal of IEE Japan 1995 (Japanese)
- [2] Masayuki Yoshikawa, Masayuki Fujii, Keisuke Bekki, Mitio Fujiwara, Hitoshi Yanagi: "Electric Interlocking Device Based on General-purpose hardware, in Tokyo Metropolitan Area Train-Traffic Control System (ATOS) (Track Maintenance Operation Control) Journal of IEE Japan 1997 (Japanese)
- [3] Hidehisa Miura, Hideo Seimiya, Takashi Kunifuji: "Managing System for Track Facility Maintenance Work Utilizing Computerized Network"