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# Research and Development of Digital Work Ticket Information Sharing System based on Mathematical Differential Improved Vector Space Model



**Abstract:** - In the traditional production business operation and maintenance maintenance involves the work ticket filled by hand, easy to produce errors, and need to review, approval and other operations, low efficiency. The author proposes a digital work ticket sharing system based on mathematical differential improved vector space model, through the integration with PMS2.0 system and security risk management and control platform, achieve mobile office management away from WEB, in terms of functions, it realizes all the functions of the work ticket module in the PMS2.0 system, and integrates various requirements of the on-site paper work ticket, through the application of digital work ticket, real-time data collection and comprehensive sharing of the whole process and business of work ticket are realized, at the same time, according to the requirements of security management and control, data fusion with the security risk management and control platform is realized to improve work efficiency and security sharing.

**Keywords:** Mathematical differential; Spatial model; Digital work tickets; Sharing system.

## 1 Introduction

Work ticket system is one of the organizational measures to ensure safety when the electrical equipment is faulty or repaired, a work ticket is a written order authorizing work on electrical equipment, it is also the written basis for the implementation of technical measures to ensure safety, when working on electrical equipment, work ticket or emergency repair form should be filled in <sup>[1]</sup>. In the traditional power production business, the work tickets involved in operation, maintenance and maintenance are filled in manually, which is prone to errors and requires audit, approval and other operations, resulting in low work efficiency <sup>[2]</sup>.

With the continuous development of computer technology and the continuous expansion of the power system, the WEB system has been applied in the power industry, and the work ticket has gradually changed from paper to electronic. However, as the WEB system restricts users to apply for work tickets only on the computer, the work location is relatively fixed, which has limitations in timeliness and convenience <sup>[3]</sup>. As shown in Figure (1).



Figure1 WEB terminal system application process

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## 2 Literature Review

At present, the management of all aspects of work order information required by the field work of the operation and inspection profession in the production industry completely relies on the WEB terminal to achieve the implementation through the lean management system of equipment (asset) operation and maintenance (PMS2.0 system) [4].

The work ticket management process in PMS2.0 system includes: (1) Invoice issuing: The inspection team needs to issue, issue and permit by the WEB terminal when carrying out work, then print the paper work ticket and bring it to the job site; (2) Work ticket execution: Work ticket execution information is filled in the paper ticket on site; (3) End of work and end of work ticket: After the end of work, finally, the operation and maintenance personnel will fill in the license information, operation information, time information and other information related to the execution and termination of the work ticket on the WEB end and fill in the PMS2.0 system [5].

The WEB terminal management of work tickets can not meet the actual needs of on-site work carried out by inspection team members, thus increasing the workload of grassroots staff, it cannot meet the requirements of the management for secure online sharing [6].

## 3 Digital work ticket information sharing system framework based on mathematical differential improved vector space model

Digital work ticket based on mathematical differential improved vector space model, seamless docking with PMS2.0 system and security risk management and control platform, realizing real-time interaction of maintenance plan, work task list, work ticket, recording, photo, face database and other data, data interaction and flow direction to complete information sharing, as shown in Figure (2). PMS2.0 system: Based on the existing working mode, as the data source of the mobile terminal of work ticket, add or change information to the work ticket, real-time synchronization to the security risk management and control platform [7]. Security risk control system, used to store face database and face recognition judgment logic and personnel qualification information, receive PMS system call request, the data conforming to the call request is sent to the PMS system, and the synchronized work ticket of the PMS system is received for storage [8].

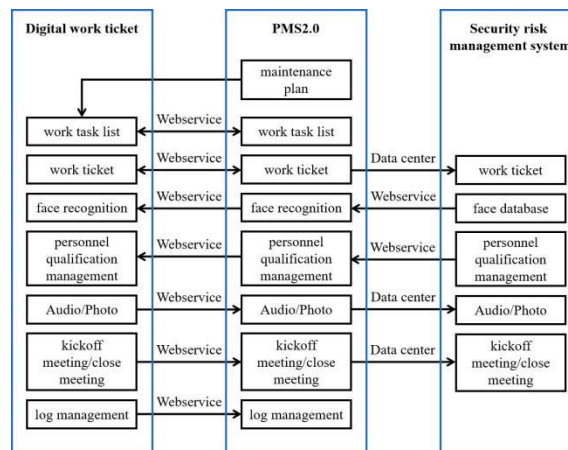


Figure2 Schematic diagram of system data interaction flow

## 4 Application and implementation of digital work ticket information sharing system

Digital work ticket includes: Work ticket generation module, work ticket execution module and work ticket management module.

#### 4.1 Work ticket generation module

Used to receive maintenance tasks, compile work tickets, and synchronize the generated work tickets to PMS2.0 system; The work ticket generation module includes work order generation and distribution unit and work ticket compilation unit; Work order generation and distribution unit is used to prepare repair orders according to the received maintenance tasks, and send to the work ticket compilation unit; A work ticket preparation unit for the receipt of repair orders, fill in the work ticket information, generate the work ticket, and send to the work ticket execution module; Send the maintenance task to the work order generation and distribution unit; Send the synchronized work ticket to the security risk management and control platform, the security risk management and control platform supports functions such as viewing and supervising work tickets, complete the synchronization of work tickets in digital work tickets, PMS2.0 system and security risk management and control platform, and realize security information sharing <sup>[9-10]</sup>.

#### 4.2 Work ticket execution module

It is used to receive work tickets, issue and permit them, and synchronize the issue and permit information of work tickets to PMS2.0 system; The issuing and licensing information includes electronic signature, personnel qualification judgment, security measures confirmation, audio and video data of the licensing process, etc <sup>[11-12]</sup>. The work ticket execution module includes work ticket issuing unit and work ticket permit unit; (1) Work ticket issuing unit for receiving generated work tickets, and judge whether the work ticket to be issued needs to be countersigned, if so, select the corresponding countersigner for electronic signature, after countersigning, the issued work ticket will be sent to the work ticket permit unit; Otherwise, the work ticket will be directly sent to the work ticket permit unit; (2) Work ticket permit unit, which is used to receive the issued work ticket and carry out the permission of security measures on it; The work ticket permit includes the confirmation of security measures, recording and photographing of the permit process, and the nullification of the work ticket before the completion of the permit <sup>[13]</sup>.

Digital work ticket in the electronic signature, provide face recognition function, through face recognition to verify the current signature personnel is correct; When judging the qualification of the personnel in the digital work ticket, the qualification of the personnel to be verified is selected, and the personnel ID is sent to the PMS2.0 system to judge the qualification of the personnel, obtain personnel qualification information from the security risk management and control system periodically through "Task scheduling +webservice", through "Webservice" to push personnel qualification information to digital work tickets, digital work ticket in personnel arrangement, personnel signature, personnel change and other operations for personnel qualification judgment; Obtain personnel qualification information from the security risk management and control system at regular intervals (every 5 minutes) through "Task Scheduling +webservice", "webservice" is used to call the face database and face recognition judgment logic of the security risk management and control system in real time to obtain the return result of face recognition <sup>[14]</sup>. The digital work ticket controls the filling of the face information of the work ticket in each link of the work ticket, and the content that can be filled in each link is different <sup>[15-16]</sup>.

#### 4.3 Work ticket management module

Including work ticket extension, work ticket interruption, increase of work tasks and work ticket annulment <sup>[17-18]</sup>.

(1) When the work ticket is delayed and the maintenance work of the day cannot be completed according to the work ticket due to special circumstances, through the work ticket extension function to realize the work ticket extension processing. As shown in Figure (3).

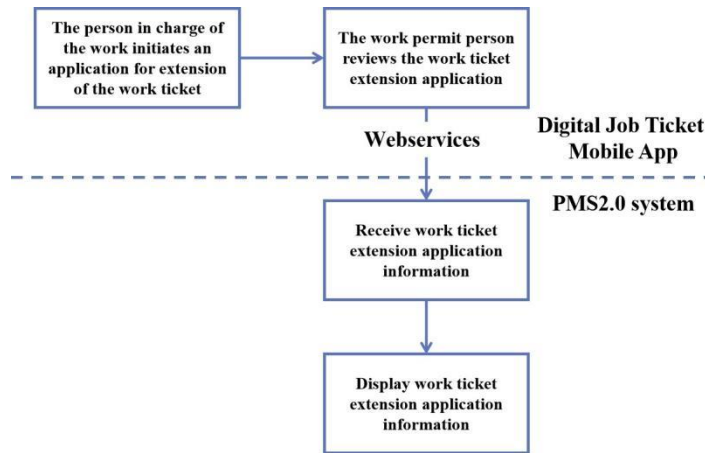


Figure 3 Schematic diagram of work ticket extension process

(2) The work ticket is interrupted, which is used to manage the work ticket for multi-day work and realize the information management of the start and finish of multi-day work, as shown in Figure (4).

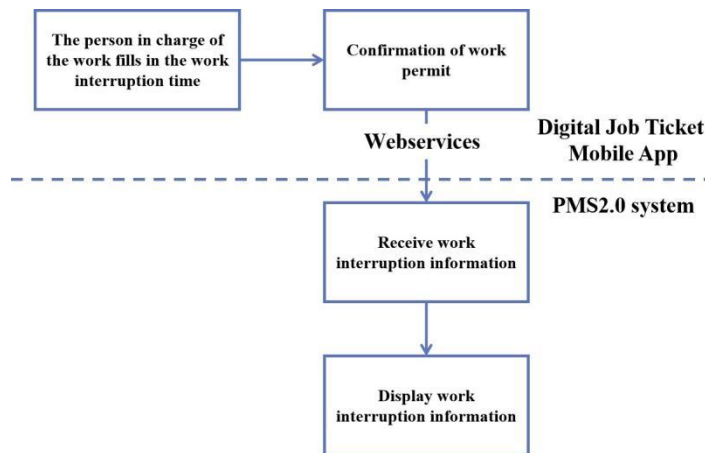


Figure 4 Schematic diagram of work ticket interruption flow

(3) Add work task, used to add work task under the maintenance task of the current work ticket, in the current work task does not meet the needs of maintenance work, the new work task function. As shown in Figure (5).

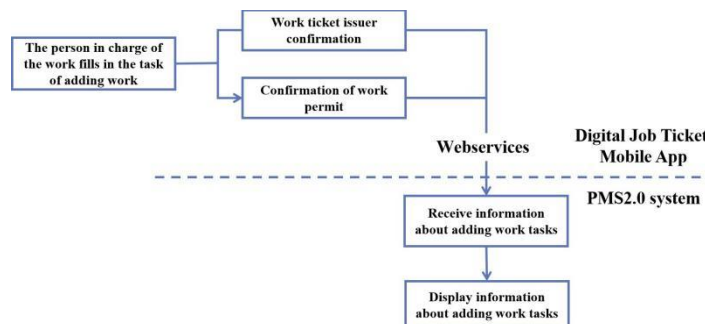


Figure 5 Schematic diagram of work ticket increase process

(4) Nullification of work tickets, used for nullification management of unlicensed work tickets. As shown in Figure (6).

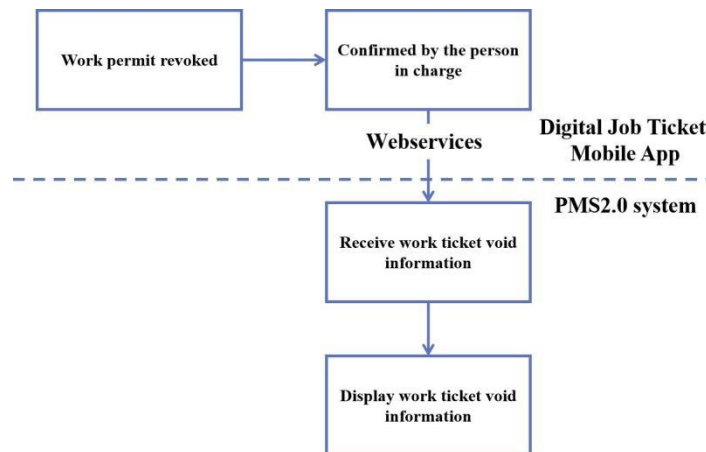


Figure 6 Schematic diagram of work ticket cancellation process

The work ticket management module also includes the change management of the person in charge of the work, when the person in charge of the current work needs to be replaced due to special reasons, need to pass the examination and signature of the work permit person, can carry on the personnel change, and record the change of the work responsible person, the new work responsible person after the change can be responsible for the current maintenance work <sup>[19-20]</sup>.

#### 4.4 Operation Execution Process

Digital work ticket in the execution: (1) The person in charge of the maintenance team shall organize the team members to hold a start meeting before the work begins, and through the recording module to achieve the work ticket permit, start, finish, staff changes and other processes of recording management functions; (2) Through the photo management module to realize the photo management of work ticket permit, start meeting, receipt and other functions, and realize the function of photo uploading PMS2.0 system, PMS2.0 photos that have not been uploaded can be deleted, and relevant data of the start meeting can be provided to the security risk control system; (3) End management of work tasks to realize end management of on-site maintenance work, by working responsible person and working permit person undertake to inspect and repair work site to confirm jointly, after all Ancuo restores to initial state, by responsible person and permit person sign respectively, end of work; (4) End of work ticket management, realize the end function of the work ticket, the person in charge of the work confirmed that the security measures have been removed, and report to the dispatcher; (5) Evaluation of work tickets, realize the evaluation function of the work ticket, including qualified and unqualified two situations.

#### 5 Conclusion

The author studies a digital work ticket sharing system based on mathematical differential improved vector space model, through the digital work ticket to realize work ticket invoicing, issuance, receipt, permit, termination, solve the problem of repeated data entry. Through the digital work ticket to the work ticket standardization compulsory check, do not meet the standards of data records, such as prohibited input or error reminder, through the Internet technology to the personnel signature to face recognition verification, in order to avoid data errors and personnel replacement, to solve the normative and security problems.

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