Hyperintelligence - A total work support tool

Hironao Ozu, Taiji Tsuchida, Mikio Sasaki
Information Technology R & D Center
Mitsubishi Electric Corporation
oz@ap.isl.melco.co.jp

Abstract

This paper discusses 'Hyperintelligence' system and its functions. Hyperintelligence is a total work support system, not only for office works, but also for field works, in which process and transaction information are key factors.

When a worker encounters new work, s(he) might refer and re-use a similar work process and its results from the past, to do it efficiently. So, an engineering or business application program generally supports to store the work functions and the results. But, when a worker uses several application programs in a complex manner, only small amount of the work could be accumulated.

In Hyperintelligence, working processes and transactions are accumulated automatically, while a worker uses this system. The worker can easily improve either working procedures or transactions independently, to make the work more efficient, and store them in a database.

We confirmed that the basic functions of Hyperintelligence are useful, by applying it to two kinds of work; maintenance work and office work using Internet.

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Introduction

It has been a long time since computers were introduced to almost all phases of work in business and engineering fields. But, computer application systems (after this called as APs) to support these works tended to be developed for each specific area. Therefore, one application was unable to use data of another application.

Recently, as computer platforms, hardware, the OS, etc. have been developed to push the trend of open system environment, users are likely to operate several functions and various kinds of media data simultaneously on a computer. Moreover, computers are being used to connect to remote systems, as well as running desktop applications.

In addition, several new mechanisms have been developed in recent APs, for example, hypermedia system to link different information items, and OLE to make compound documents of several media data [1][2][3][5][6]. With these mechanisms, users have become free to handle various media, made in various phases.

Under such environments, remain the following problems for handling several APs in complex manner.

- No idea is given, how to make a good proposal, as if made by an expert.
- No idea is given, how to make readable documents, as if made by a proficient worker.
- No method is given, how to preserve processes of past work easily, as a reference model of future work.

Users hope to have a system, which gives advise from views of an expert or proficient worker, and supports the work with the examples of past good work.

We tried to solve this problem in the following manner. We made a mechanism to accumulate the result, how goes past excellent work, which we call as 'work information', and to modify and re-use them. A new, not accustomed worker, may refer to and re-use the accumulated work information of other skilled workers.

Some APs automatically store the kind of work information for business and engineering fields, as script or macro [7]. Other APs store used methods partly, retrievable for the next work [8][9]. For instance, Mosaic on Internet has HotList, a retrieval career list to retrieve the data once called on the WWW server.

However, users have hardly exploited various APs and their complex operations, with limitations in media and application fields. The total accumulation of the work processes has been unable. We are developing Hyperintelligence to store, modify, and re-use work information, to cope with these problems.

This paper describes the basic concepts of Hyperintelligence, its implementation, and the results of its development.

What is Work Information to Support Total Work

We investigated requirements for accumulating work information to support engineering and business workers, and we came up to the following results.

1. Definition of work model for accumulating, modifying, and re-using work information

   Efficiency and quality of work results largely depends on the performance of transactions and the quality of data. Beside them, the procedure, namely the order to execute transactions is also an important factor.

   As described, most former APs are unsatisfactory, because their functions to store and re-use work information are limited.

   A business user actually uses functions and media data of two or more APs for complex work. Thus only a part of work can be accumulated, because of different methods to do it in various APs.

   To avoid such situation, we need to establish an AP model and work model, with capability to accumulate and re-use work information. This task has not been done in the former APs.

2. Edit and upgrade support

   In business, work procedure often has many repetitions, whose part is modified for improvement. Editing of manuals or regular reports is an example. For this purpose, the accumulated work information should be improved by editing, and be upgraded.

3. Accumulation and reproduction support

   It would be no use to describe work in too much detail by complex work information, if only a few experts could use it freely. To avoid it, the accumulated work information should be visualized and understood easily. The work is to be executed according to the accumulated work information. For this purpose, work information should be re-used or modified easily, by a worker without special knowledge.

A Total Work Support Tool 'Hyperintelligence'

In this section, Hyperintelligence is introduced, based on the requirements in the previous section.

We designed this system, according to the following three steps:

- Step 1. Establishing a work model and application model to accumulate, modify, and re-use work information.
- Step 2. Establishing structure of work information, which can be modified easily.
- Step 3. Constructing an environment to accumulate and re-use work information.

We recognized, that an engineering or business worker often uses several APs, namely commercial or custom software packages, even for a single kind of work. So we allowed them to be easily incorporated in Hyperintelligence.

Design Concepts

Step 1. A Work Model and Application Model

1. Work Model

   We investigated actual business and engineering fields.

   Documentation work is an example. There is DDM (Documentation Development Methodology) [4], for making good quality document. DDM has 10 work units, and each work unit has some transactions. DDM defines the order of work and transactions. Its user follows the DDM's transactions, to get accurate, effective document. So we consider, that documentation work is an execution process of transactions, specific to the kind of document.

   Another example is maintenance work. Generally, there are procedural manuals to be followed by maintenance workers.

   In conclusion, we get a work model as in Figure 1, applicable to wide ranges of work in business and engineering fields.

   In this model, 'Work' consists of several 'Transactions', showing the functions of APs to be used, and of a 'Procedure', showing the order of 'Transactions' to be executed.

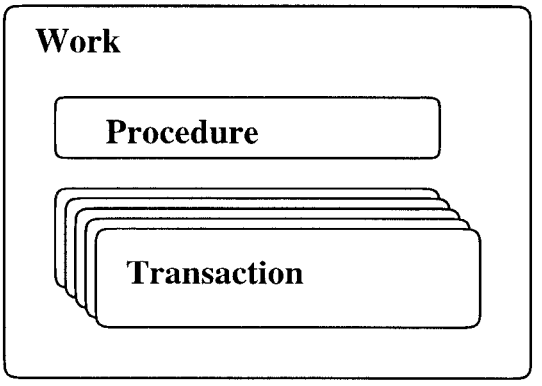

Figure 1: Work Model

2. Application Model

   Similarly, an AP model is shown in Figure 2, and contains the following elements.

   - Function Database, storing function information which indicates the actual processing function to be executed.
   - Media Database, storing media information; text and image for examples.

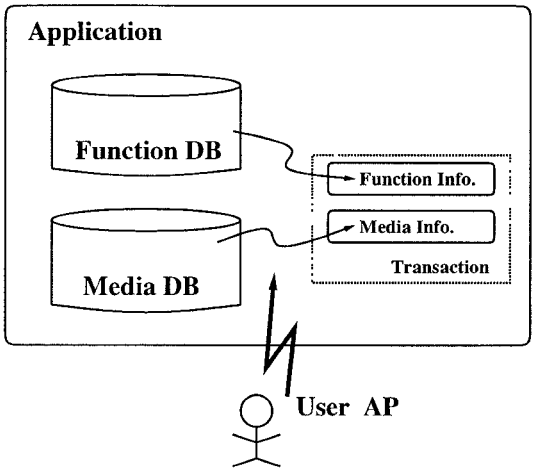

Figure 2: Application Model

In this model, a user retrieves a function from the Function Database, and media data from the Media Database, binds them into transactions, and uses them in an AP.

Step 2. Structure of Work Information, which can be modified easily

In Hyperintelligence, while execution of transactions depends on an AP, controlling of a procedure is a matter of a newly designed 'H-engine (Hyperintelligence engine)'.

Figure 3 presents work information, used in our work model and application model. Work information consists of procedure information, relation information, function information and media information. The procedure information is controlled by an H-engine, while the function information and media information are controlled by each AP. The relation information relates the procedure information to the function information and media information.

A user can modify either the procedure only by an H-engine or transactions only by APs, independently to make the work more efficient, because they are divided by relation information.

Step 3. Environment to accumulate and re-use Work Information

1. Communication in the Hyperintelligence System

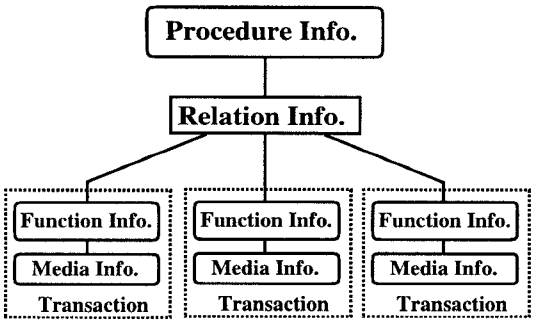

Figure 3: Work Information

Hyperintelligence uses two identifiers, method and entity, to handle function information and media information by an H-engine. A method corresponds to the processing function in an AP. An entity corresponds to the media information handled in an AP.

An H-engine and APs communicate each other by messages, which include the method name and entity name, as in Figure 4.

An H-engine sends a request message to an AP, then the AP analyzes it, retrieves the necessary function information and media information, and executes transactions. Then the AP sends back a notification message made up of a method and entity to the H-engine, according to the execution results.

In this way, Hyperintelligence calls AP's appropriate transactions from an H-engine, or returns a message.

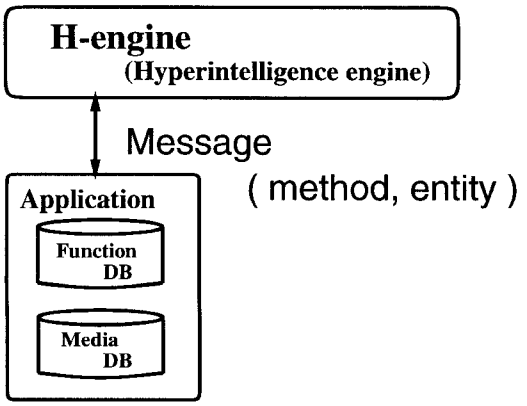

Figure 4: Message

2. Extracting procedure information and running the Transactions

   Hyperintelligence uses messages to extract procedure information from work, to store relation information, or to run the transactions by the procedure information.

   When a user uses AP's function or data, the AP sends a notification message to the H-engine, and the subsequent messages are accumulated in the receiving order. This series of messages consists the procedure information.

   When a user re-runs transactions of an AP, the H-engine sends the stored messages in an order, according to the procedure information.

Figure 5 shows the conceptual diagram of Hyperintelligence, obtained from Step 1, 2 and 3.

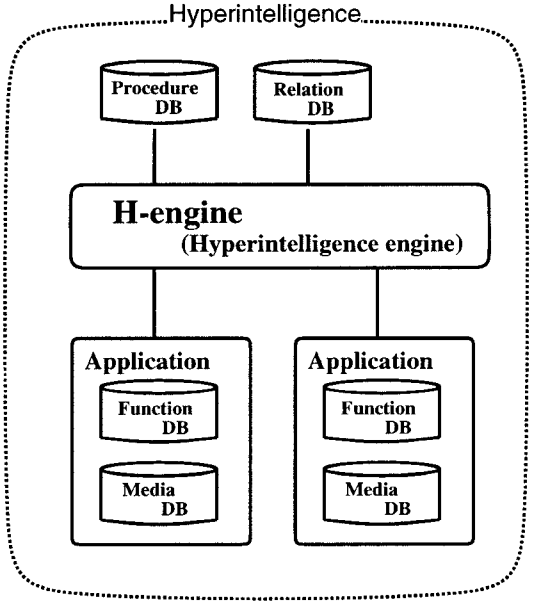

Figure 5: Hyperintelligence Conceptual Diagram

Components of Hyperintelligence

The system components and the functions of Hyperintelligence are explained in this section.

System Components

Hyperintelligence is a system, made up of an H-engine and several APs. The H-engine is divided into the fol-

lowing two components:

- Communication Manager (CM) to control processing and communication
- Flow Manager (FM) to organize, display, and present procedure information

This is because the CM part had already been ready in our earlier development called HyperFrame [1][2] .

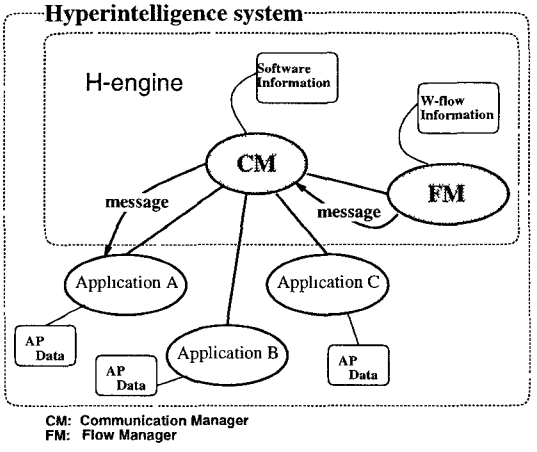

Figure 6: Summary of the System

Communication Manager (CM)

A Communication Manager (CM) controls APs, by means of monitoring, invocation, and termination of the APs, besides managing AP-to-AP communication as follows. The CM decomposes a message from an AP into parallel or serial messages, changes message format if necessary, and delivers them to other APs.

When a CM receives a request from an AP, the CM invokes other necessary APs, and transfers the request to them. The communication is carried by a message with a method name, entity name, destination AP address, etc. To be in detail, the method and entity are combined with transfer conditions (AND, OR, etc.), for use by the CM to decide the actual destination of the message to be sent.

Hyperintelligence also provides communication macros, for implementing easier communication between APs.

Flow Manager (FM)

A Flow Manager (FM) controls two kinds of information: procedure and relation information. Mainly, the FM has following functions:

- W-flow

  An FM displays the procedure graphically as in Figure 7, called W-flow (Workunit-flow). Here, a BOX means a transaction, and an ARROW between the BOXes means a flow. Each BOX has a message (method, entity, etc.). The FM provides flow-control operators as AND, OR, etc.

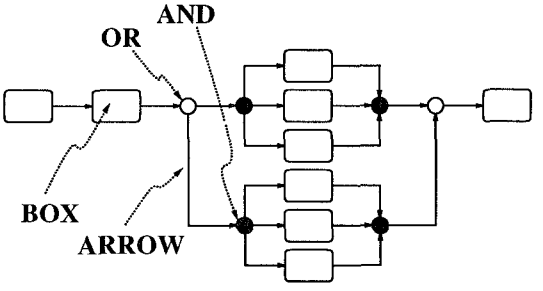

Figure 7: W-flow

- Extraction function

  An FM adds a BOX automatically to a W-flow on a display screen, when it received a notification message from an AP. How to add a BOX is designated by a user, as follows.

  – A new BOX is added as an attribute, on the location, next to the BOX with the last received message.

- Reproduction function

  This function is to reproduce the work procedure by the work information accumulated in Hyperintelligence. An FM transmits attribute information on the BOX to an AP, which executes processing. For instance, when a user clicks a BOX, an retrieval application is invoked, and retrieved data are displayed.

- Emphasis function

  An FM emphasizes a BOX, by changing its color and thickness of the outline, according to the importance degree, access frequency, etc.

- Up-to-dateness check function

  An FM inspects, whether updated is the function information or media information on the AP related to the BOX. A user decides, whether to retrieve the data or not, by this check result.

- Information integration function

  An FM integrates information. A user clicks adequate BOXes to select necessary function information and media information. And new function information or media information is automatically integrated from the extracted BOXes, according to the order shown in the W-flow.

  This function is useful to make a report, as in Figure 8. Related documents and reports are collected, and then they are combined automatically by the system.

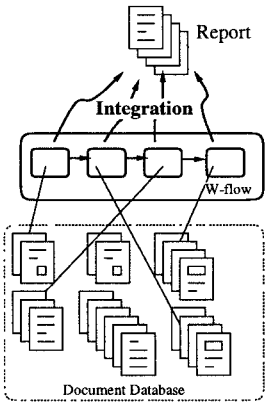

Figure 8: Making a Report Automatically

Applying to Actual Works

We made a prototype of Hyperintelligence on a PC, and applied it to two actual work examples, and we proved its usefulness.

System Configuration

The developed system comes in a PC named MITSUBISHI Apricot XEN (PC/AT) running Windows 3.1J.

A Case Study of the System (1)

We applied Hyperintelligence to work of a field worker for elevator maintenance. The work is divided into the three phases; 1. planning phase, 2. informative phase, 3. field work phase. The former systems had supported only the phases 1 and 2. Recently introduced is a system to support also the phase 3, with portable terminals. But neither systems have functions to accumulate, modify, or re-use work information of all phases. We used Hyperintelligence in each phase, as following (Figure 9).

Phase 1. planning phase

> Work planning is computerized as realization of 'W-flow'. Once a good plan is made up, other workers can re-use it. So it is easy for a novice to follow a proficient worker's plan.

Phase 2. informative phase

> This is so called deskwork, before or after the field work. As APs, software tools like database management system and word processor are linked to a work plan, by the Flow Manager. So it is easy for a worker to accumulate, modify, and re-use the work information during the work.
>
> When the field work is done, documents may be summarized in this phase by information integration function. For example, a video data taken in the phase 3 may be attached to the document.

Phase 3. field work phase

> The multimedia data retrieved in, or document written in the phase 2 is incorporated into the procedure information, to be helpful for a worker. So the worker can carry a portable terminal only with the necessary data to the field, and use them for retrieval. The worker may take videotape to use it in the phase 2, for a visual report.

We identified the following advantages, by applying Hyperintelligence to the work for elevator maintenance. (1) The proficient worker can easily accumulate procedure information and reference data only by doing regular work. (2) The work information of each phase can

be improved and re-used easily, because each information was accumulated separately. (3) The information accumulated in each phase can be easily and efficiently re-used in another phase.

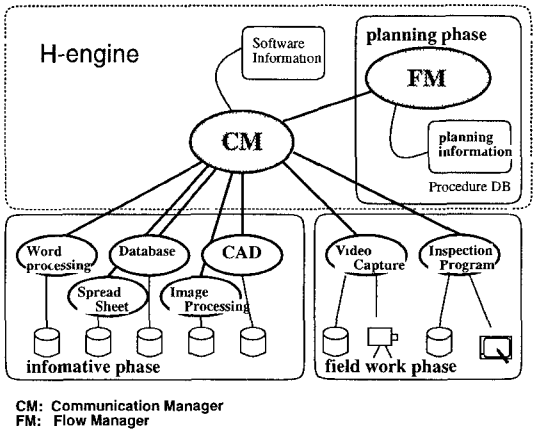

Figure 9: Applying to Elevator Maintenance

A Case Study of the System (2)

As a next case study, we applied Hyperintelligence to work, which includes information retrieval from databases located in wide area. Recently, Internet becomes popular, and users of engineering systems tend to use information on Internet such as WWW, Gopher or WAIS. This is easy, thanks to the viewer programs such as Mosaic and Netscape. Yet, there are following problems to use them in an engineering system; (1) Time-consuming work: It is very difficult to search out necessary information in a short time, because the amount of Internet information is immeasurable. Needed is a way to search useful information easily for an engineering system. (2) Incompatibility with an engineering system: Mosaic is an open application system to Internet. But, it is difficult to work in closer cooperation with an engineering system.

Upon these considerations, we integrated Mosaic into Hyperintelligence system (Figure 10).

In this system, Mosaic notifies URL, namely the address of information retrieved, to an H-engine automatically in the arriving order. And the H-engine accumulates them as retrievable procedure information. Thus, a user can visualize the history of data retrieved in the past, and can modify it apart from retrieval methods, to store it for future use. So, an engineer may work in closer cooperation with engineering applications supported by Hyperintelligence.

We identified the following advantages, by applying Hyperintelligence to the work with Internet information. (1) It is easy to retrieve the world wide information using Mosaic, by accumulating retrieval procedure information. (2) It is possible to do engineering work, using worldwide information.

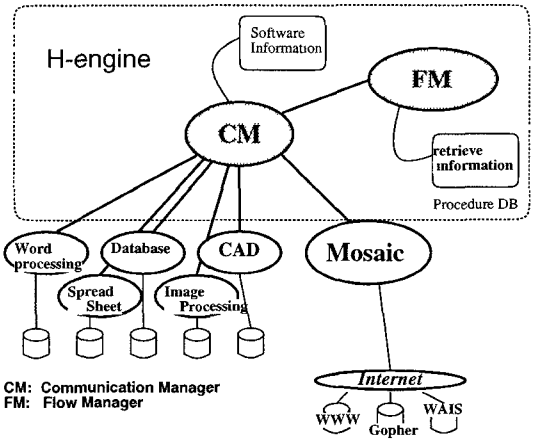

Figure 10: Applying to the Work using Worldwide Information

Future Work

1. Procedure Information Database

   In the present Hyperintelligence, procedure information is stored in a simple relational database. But as information amount rises, much retrieval time is needed. We are considering to incorporate a new procedure information database, to shorten the retrieval time.

2. Complexity of Procedure Information

   Though procedure information is automatically extracted in the present Hyperintelligence, extraction timing is yet to be set prior to work. In future, we should make the system to support the decision, how to set the most effective extraction timing.

Conclusions

We recognized that the key factor to improve work efficiency is to extract procedure information about the work, which we call work information. For this purpose, we have developed a new work support tool - Hyperintelligence. It is a tool to accumulate, modify, and re-use work information. Its main merits follow.

(1) From work, a procedure and transactions are automatically separated. (2) Either the separated procedure or transactions are easily improved independently, for efficient work. (3) Work is done, when the accumulated work information is executed. This mechanism ensures more efficient work. (4) New information is generated by using the information integration function.

We implemented our Hyperintelligence system on a PC, applied it to two actual cases, and confirmed its efficiency.

For future development, we are to reconsider a procedure information database, and to optimize the timing of procedure information extraction.

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