

IDS APPLICATION: INTEGRATED DISPATCHING SYSTEM WITH TELEPHONE, FAX AND E-MAIL FEATURES.

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Abstract: This paper describes the purpose of using messaging application together with monitoring systems. Integrated Dispatch System (IDS) being under development in Department of Microelectronics and Computer Science is presented. The flexible configurable features of the system including telephone, fax and e-mail are shown. The paper defines also some possible fields of application for IDS system.

Introduction

In our modern world software programs can help us control all aspects of life. Furthermore, there is a need to check different processes running around us. Who can imagine nuclear power plant or modern car without sophisticated monitoring systems. On the other hand our natural environment still surprises us. In 21st century there is a great risk of human loses because of unpredicted floods, hurricanes and other disasters. Another aspect of the environment is pollution. Industrialized world makes huge amount of waste every year. Despite restrictions and financial penalties, knowingly or not, a lot of companies simply pollute the environment. From governmental and ecological point of view all hazardous processes should be monitored to minimize or avoid dangerous effects. There is SEWING project in progress (System for European Water monitorING), which objective is to create a cheap and generally accessible system for monitoring and early warning of water pollution.

But monitoring itself is not all that is required. Along with these systems there should be applications that will properly dispatch necessary information. Properly means that it should be done for example within defined time or sent to a number of defined recipients. The characteristic of dispatching system depends on field of application. Fast changing processes require different methods of dispatching messages than slow counterparts. The possible outcomes should be a factor as well.

There is lots of monitoring systems some of them are combined with different kinds of message dispatching features. Department of Microelectronics and Computer Science has started developing such systems since 1997 and till now successfully delivered monitoring programs for US and Canadian power cable supervision. Two of them strongly required messaging systems to be included. One of them is used for controlling the cable core temperature. Possible overheat of the cable may lead to its damage and in effect generates high financial loses. To avoid it the main task for dispatching system is phone message notification of defined individuals that cable thermal condition is close to critical. Another monitoring system equipped with dispatching module was installed together with power cable with cooling using high oil pressure pipes. The purpose of monitoring system is detection of an oil leakage. In

order to minimize results of such a leakage, and in effect to minimize penalties for the company, a given group of employees on duty should be alarmed. Strong demand for development of messaging systems inclined our work towards dispatching systems like Integrated Dispatch System described in this paper.

System Purpose

The main purpose of Integrated Dispatch System is to send an appropriate message using different means of communication in order to notify given recipients. Dispatching processes are initialized by external events (from the application point of view) that are received by the system.



Figure 1. Dispatch System.

Figure 1 shows Dispatch System along with its typical environment. As means of communication with recipients it uses a telephone line for voice & fax messages and also an Internet connection for e-mail messages. Event monitoring applications may be located widely or locally because the system receives notifications via network (sockets).

As the main characteristics points Dispatch System should perform:

- Reliable execution,
- Safe & Continuous execution,

- No maintenance during regular work,
- Configuring options,
- User-friendly interface.

System Architecture

Integrated Dispatch System was designed as a multithreaded application. This solution makes the program process every its task independently. The main advantage of multithreading is that every system function will not block other and will work like simultaneously. For example a time consuming fax task will not interfere with a dispatching system entry, that receives event notifications. The system was divided into several tasks, which were processed separately. Single threaded applications do not process tasks at the same moment, so such systems would not fulfill safe & continuous execution requirement.

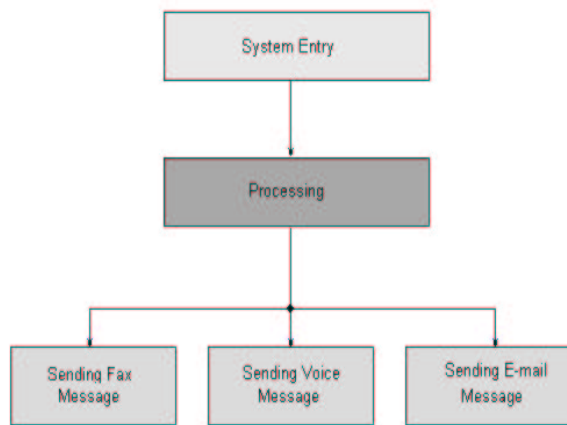


Figure 2 System architecture.

Figure 2 shows overview of the Dispatch System main functional blocks. *System Entry* receives event notifications from the remote monitoring application. The application checks defined process and in case of specified state the program sends appropriate event notification, so called event code. *System Entry*'s main task is to receive the information properly. Both parts follow the specified protocol during the connection. After completion of data exchange *System Entry* passes initiated dispatching process on to the next block.

The *Processing* block in Figure 2 defines all necessary work required to gather information about event that had occurred and recipients that should be informed in such case. Integrated Dispatch System at this point retrieves data from a database and builds a strategy for sending messages. It also manages processes of sending e-mail, fax and voice messages.

Sending Fax, *Voice* and *E-mail* blocks in Figure 2 stand for processes which are designed to send appropriate message. The mentioned *Processing* block delivers all necessary data.

Storing & Access to Data

Integrated Dispatch System uses a database called Dispatch to store information about its recipients and event notifications. The database is divided into several tables, which contain different kind of information. The system gains access to data through the ODBC interface. Due to relatively small number of information that should be written, the database is situated locally with the system.

Integrated Dispatch System also stores information in files. There are two types of system's files. First of them is used to store data associated with currently running threads. These files are used when system restarts in order to restore last state of the program. Another type of file is so called log-file in which application undertakings are written, such as time and the date of received notification event. The log-file is very helpful from administrative point of view. Example of the log-file is shown in Figure 3.

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2001-7-11 10:50:16      New code 200 received
2001-7-11 10:50:17      Starting dispatching process for clientId 16
2001-7-11 10:50:17      Starting dispatching process for clientId 16
2001-7-11 10:50:17      Starting dispatching process for clientId 2
2001-7-11 10:50:17      Starting dispatching process for clientId 3
  
```

Figure 3. Log-file example.

Notification Processes

Remote Event Notification. System receives event codes from the remote application via network. Information exchange is based on sockets and it follows a defined protocol. The specified protocol was designed especially for above purposes and it makes information exchange standardized. The protocol is based on command-answer type. The initial side of communication is an application, which monitors events. The system's entry process outcome is:

- An accepted notification code when exchange is successful
- A rejected connection after event notification (event code) was unknown.

All event codes that are accepted are stored in the program database and they are fully configurable.

Recipient Notification. Due to maximum reliability of sending an e-mail, Integrated Dispatch System uses directly the SMTP (Simple Mail Transfer Protocol) protocol and connections based on sockets. The implemented protocol allows controlling all stages of communication process. The system exchanges information directly with the SMTP server and entirely skips MAPI interface. E-mail message is composed of the subject, sender, receiver and defined text related to the event that had occurred. In case of unsuccessful message delivery system will repeat it or send it to a different recipient address (if any is defined).

For sending fax messages the Integrated Dispatching System uses Fax Client API, which is part of the Microsoft Windows 2000 operating system. The interface allows managing the fax message including a cover page, subject, sender and receiver data, and appropriate message text, as in the e-mail. Messages are placed into a FIFO queue when there is more than one. Then the system tries to send them one after another.

Unsent messages, for example due to busy number, are moved to the end of the queue.

Voice messages are sent by Integrated Dispatching System using Dialogic D/21H telephony board. The board can operate on two separate telephone lines. This feature allows sending or receiving two different voice messages in parallel. The telephony board recognizes DTMF tones, so in the future it may be used in identification purposes. Additional features are detecting busy or disconnected signal. If the message is not sent correctly the dispatching system will repeat it. The voice message is the most important mean of communication in the system. Successful information delivery means that the recipient received it. On the other hand properly sent information via an e-mail and a fax does not give the confidence that recipient has been notified.

Dispatch System Features

The following features make Integrated Dispatch System unique in its kind:

- Safe multithreaded architecture,
- Storage of the data in the database,
- Applicability of the system to different fields,
- Reception of event codes through network (including Internet),
- User-friendly configuration GUI (Figure 4),
- Restart-safe procedures,
- Log-file history,
- Simultaneous management of multiple telephone lines,
- Definition of multiple e-mail address, fax and telephone numbers for one recipient,
- Weekday dependent dispatching strategy for more effective notification process.

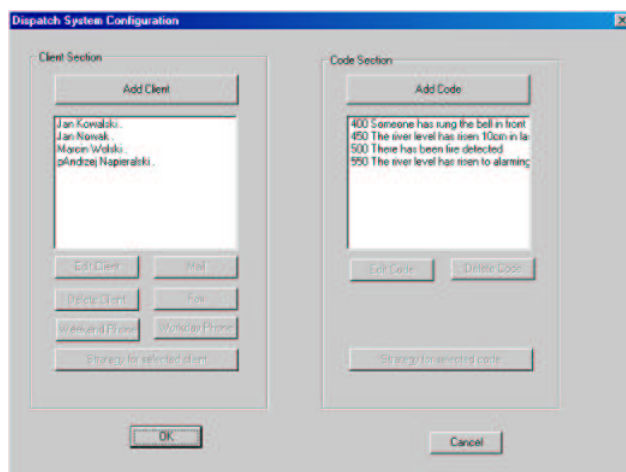


Figure 4. Dispatch System Configuration Dialog.

Fields of Application

Integrated Dispatch System may be combined with various applications, due to its flexibility. Moreover, it can work simultaneously with more than one monitoring system. Because of using event codes and

storing data in the database it does not recognize dispatching processes, it only follows defined steps of sending the message. Integrated Dispatching System should be applied in fields where relatively slow processes are monitored. The limitation comes from applied messaging techniques. The full process of sending single information may take even up to a few minutes. It is especially slow for telephone and fax messages. Integrated Dispatching System seems to be ideal for weather applications or environment-associated applications, for example water monitoring system.

Integrated Dispatch System may be used in the SEWING project. The project's objective, as above mentioned, is to create a cheap and generally accessible system for monitoring and early warning of water pollution. From the Dispatch System's point of view very important objective is an early warning feature. Along with real-time alarming applications SEWING project requires flexible broader ranged dispatching capabilities such as Dispatch System has. The SEWING project is to be suitable for monitoring all types of water resources and wastewater in high-industrial regions. For early responding reasons it is necessary to have a human being who watches for alarming states and who should be informed about them in real-time way. If something goes wrong he or she makes the decision what to do in such circumstances. In this solution there are people working for the system waiting for a signal in one place 24 hours a day and 7 days a week. The SEWING project based on mentioned architecture would require a number of people just to sit and wait. To minimize required amount of human beings the SEWING project should combine an immediate notifying system with a flexible system, such as Dispatch System, which may take control over sending messages to defined people after receiving less important alarms. It can also be used in forwarding messages to different recipients after receiving a high priority alarm.

In other words Integrated Dispatch System can be used in the SEWING project, first of all, as a stand-alone application, a fully automatic dispatching system informing about not crucial situations that have arisen. For example it may send information about situation that is not common but not alarming (immediate reaction not required), such as "Chloride ions have reached 80% of limit".

On the other hand Dispatch System can be used in the SEWING project as a helper in case of high priority alarms. These situations require immediate human reaction but may also require forwarding information to other people and this may be done automatically by the system.

Conclusion

Nowadays there is a great need for developing applications for monitoring and dispatching purposes. All these systems make our life safer and better. They are applied in different fields starting from vehicles, airplanes and weather systems ending with nuclear plants. Integrated Dispatching System is one of the dispatching applications that can be installed in various

fields. Its multithreaded architecture makes it safe and reliable. The system is also flexible, due to data storing in the database. Its features make it an ideal proposal for weather or environmental projects like the SEWING project.

System Requirements

Current Integrated Dispatch System version has software and hardware requirements:

Software:

- Platform under Microsoft Windows 2000,

Hardware:

- 133 MHz or higher Pentium-compatible CPU,
- 64 MB of RAM recommended minimum,
- Network access,
- Class 1 fax modem,
- Dialogic D/21H telephony board.

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