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Using the concept of Multi-Threaded Programming Preparing the Object Oriented Design Model

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Abstract

There are various models of Multithreading, but one multithreading model which is gaining popularity is message-driven model. In this model, an arriving model starts a block of computation to process that model. In this paper, Using these multithreading concept we discuss an object oriented model to analyze and discuss the features of industrial monitoring process (IMP). We are using the concept of encapsulation to encapsulate control logic of industry into business objects methods, which will allow allocating the resources dynamically to specific business objects. We also have give various threads of activity diagrams i.e. activity diagram for workers, resource manager etc, along with class diagram of various objects in the model which will depict the scenario.

Keywords

Multithreading, industrial monitoring process (IMP), class diagram, activity diagram.

1. Introduction

When we designing any software of any kind industry for monitoring it then we know, that there will be various situations of multitasking and these multitasking will also cause various processes to interact with each other. So, in this case, we will need the concept of multithreading because by this we can easily get simultaneous operation of objects and they can also interact with each other.

Now a days most of enterprises are willing to change their business processes into agile, product- and customer-oriented architecture to withstand in the very thought competition in the global business environment. To overcome this problem, one of the most important solutions for the problem of decreased productivity and declining quality is the automation of factories [1]. As the level of automation increases, material flows and process control methods of the shop floor become more complicated [2].

In Object-oriented software design, system designers does not think in terms of methods, functions and operations but they think in terms of 'things' .The main system is consist of objects that interact with each other, and they also maintain their own state and also gives methods on that state (Figure1). Objects protect the internal information of the state and by this way they provide the limitation on its access [3]. An object- oriented design process focuses on the design of the object and its relationship between object classes [4]. When the design is realized as an executing program, the required objects are created dynamically using the class definitions [3].

An encapsulation of object and its method together form an entity. Through object interface, these objects can interact with another object. These interaction these objects is defined in Object oriented program. Object-oriented design is the discipline of defining the object and their interactions to solve a problem that was identified and documented during Object-Oriented Analysis [3].

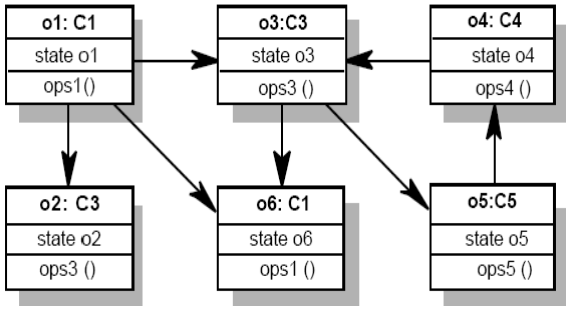

Figure 1: System with Interacting Objects

2. Overview of industrial monitoring process

Any industrial software can be divided into three main modules: (a) Graphical User Interface (b) Main Control (c)Interface for Receiving and transmitting. Its overview is shown in Figure 2.

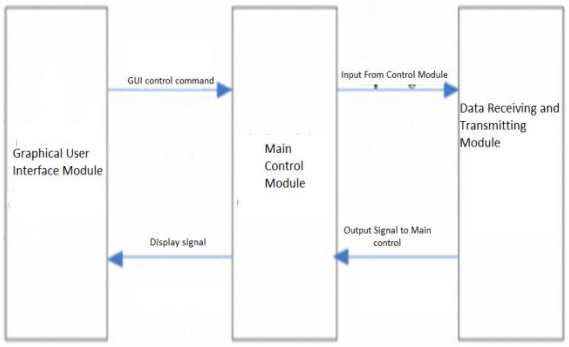

Figure 2: Overview of IMP

Now, we are going to discuss the working of each of three modules i.e. how they are going to help in the working of IMP.

Graphical user interface module
The user interface, in the industrial design field of human–machine interaction, is the space where interaction between humans and machines occurs. The goal of interaction between a human and a machine at the user interface is effective operation and control of the machine, and feedback from the machine which aids the operator in making operational decisions.

A user interface is the system by which people (users) interact with a machine. The user interface includes hardware (physical) and software (logical) components. User interfaces exist for various systems, and provide a means of: Input, allowing the users to manipulate a system and output, allowing the system to indicate the effects of the users' manipulation.

Main control module
Control module is a key part of a Industrial Monitoring Process (IMP) that controls the operations of the program. It performs mainly: The control module responds to commands from the user and it also acts on its own to perform automated tasks on the data transmitted from data receiving and transmitting module.

Data receiving and transmitting module
It is an interface between IMP and industrial field. It collects all the required data from the field and convert it into required signal and it as input to the main control module for processing, and it also convert the output of the main control module into appropriate signal and gives it to control field.

We have three modules here, and we know, we have many toolkits available to design the GUI of the IMP, such as Gtk# etc. and VC6.0, Visual Studio 2005, QT etc. for interface program. The main control module is the heart of the IMP, and it is the most difficult to develop because it has many requirements like its multithreading and interaction between the threads and it can have very complex control logic which may not be easy to design and efficiency is also a point of consideration while developing the main control module, so it is not easy to develop a design plan for this module that is accepted by all the main control module of all the IMPs.

3. Design concept

The main idea behind design is to incorporate multithreading design concept into the object oriented designing i.e. basically encapsulating main control logic into method of business objects and giving these threads resources to business objects when they really comes into work.

Encapsulation
Here a part of this concept is to decompose the main control logic and then encapsulate them into appropriate business object. The decomposition is done according to level and type, it basically include vertical and horizontal decomposition. In vertical decomposition encapsulation is done in respect of derivational relationship and compositional relationship among the classes and methods respectively. In horizontal decomposition basically shows different implementations of some methods in some class and its parent class. Figure 3 represents class diagram of business object.

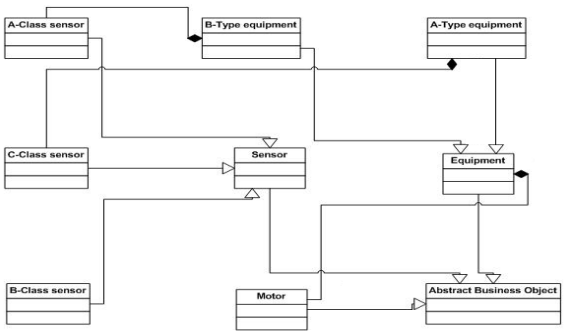

Figure 3: Abstract business diagram

Figure 3: shows class diagram and the relationship among the classes and composition and inheritance among various classes.

Run-time distribution of thread resources

Each business object is managed by Object manager and each business object has its own thread resources and these resources are managed by their corresponding managers. These thread managers dynamically allocates the thread resources.

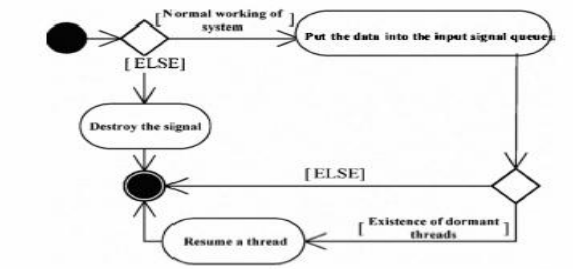

Figure 4: Activity diagram of resource manager receiving an input signal

Figure 4 show that a thread resource manager receives an input signal and dynamic relation between thread resource and business object.

The informal algorithm for thread resource management is;

a) begin
b) check normal working of the system, if yes goto step d, otherwise goto step c.
c) destroy the signal and goto step g
d) now the input signal is pushed into the input signal queue
e) check whether any sleeping thread exist, if yes, goto step f otherwise goto step g
f) resume the sleeping thread
g) end

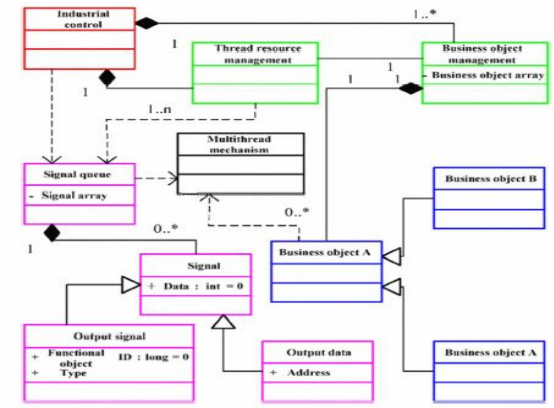

Figure 5: Class hierarchy diagram of the Model

It contains five sections as follows:

a) Thread synchronization mechanism
b) Signal and signal queue
c) Business Object management
d) Thread resource management
e) Industrial Control

We are going to discuss these five sections in the following sections;

Synchronization is basically needed in for making all threads working cooperatively in a multithreaded system. Synchronization can be achieved by [5]

1) Critical section
2) Semaphores
3) Mutex
4) Event

In this paper we use critical section, semaphore and event for protection data and to realize multithreaded synchronization respectively.

From figure1, we know that we have three module and one of them, that is also the heart of the this model is, main control module, and all the receiving and transmitting signals coming from this module is associated with the signal queue, not all the signals are associated with this signal queue, this signal queue is also associated with some thread which operate on these signals.

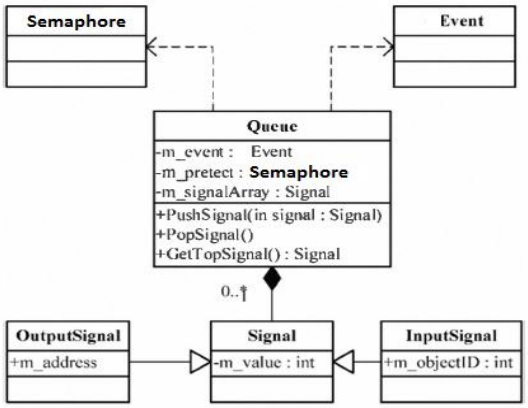

Figure 6: Diagram of signal with queuing

Here in figure 6, we have used thread synchronization techniques because it is possible that conflict can occur here.

There are two kinds of business object classes:

1) Abstract business object class
2) Derived from Abstract industrial class

The first kind of classes is highly abstract and cannot be defined in real objects. These classes are inherited by other child classes. The second class is abstraction of functional modules, which encapsulates industrial main control logic.

With the cooperation business object and thread management run-time association of thread and resources can be achieved.

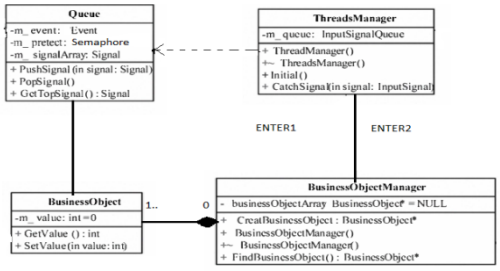

Figure 7: Thread resource and business object management

The industrial control class can be seen as the abstract of the industrial field, and it can switch data with the GUI module on behalf of the industrial module.

There are some important functions in the industrial control:

1) When initializing, we need to create variety of business objects dynamically in terms of configuration information.
2) When exit form the system, the business object which initialized need to destroy. In order to manage the industrial control easily, we need to establish the entry functions and the export functions.
3) The signal from the industrial control need to send to the thread resource manager object, moreover the date form the business object need to send to the data receiving and transmitting module.

4. Conclusion

The main aim of analyzing this whole system is to encapsulate main control module of the industry into business object and after that distributing the thread resources to these business objects at the run time.

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