A Study on Operating Strategy for Automated Painting System In Inner Double Hull Blocks

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Abstract: The demand for automation in the shipbuilding industry is increasing continuously, as a result of which so much production automation equipment has been developed in various processes. For example, fields such as welding and cutting have been researched and developed extensively. However, in the case of painting process, it has not been given much attention. So through this paper we intend to propose what we have to do and how communication must be initiated and efficiently used among the sub-modules of a monitoring and operating system used for automated painting systems in inner double hull blocks.

1. INTRODUCTION

Painting technology, in shipbuilding process, is the key point that determines final quality and promises a fine view of the ship. Furthermore, because customers tend to consider economical value and fine view to be important for goods, painting technology is considered as an important sales aspect these days. Contrary to other processes, painting process is a very dangerous work, for some of the ingredients of painting material is toxic to humans. It contains harmful particles that can be hazardous to health. Thus the need for a painting automation system is inevitably required. Due to the characteristics of the painting process in inner double hull blocks, the worker must enter the closed block that is filled with harmful materials to paint. To solve this problem and maintain a safe distance between the worker and the closed block we will need remote operating and monitoring system, which we put forward as follows in this paper. First, we will consider the automated painting system that does the remote operating and monitoring aspect of data information processing.

1.1 The environment of object to work

As the protection of environment is an important aspect these days, the need, for the ship built by double hull blocks, to prevent or reduce oil pollution in the event of a grounding or collision resulting in bottom or side shell damage, is a very serious consideration. But as a result of this, the production process in shipbuilding becomes complicated.

Fig.1 shows the complexity in the block. Workers have to enter closed block with protective equipment in the dark, exposed to danger throughout. Therefore we wish that workers don't get into the closed block anymore, we intend that these operations are achieved through the use of a

Fig. 1. The figure of Inner Double Hull Block

painting robot. The worker only monitors robot status and does other simple jobs staying out of blocks.

2. MONITORING SYSTEM FOR PAINTING AUTOMATION SYSTEM

2.1 The structure of fundamental concept

What configuration developers select for operating system is important in order to operate robot system smoothly. This paper suggests the configuration as shown in Fig. 2. The operation system proposed consists of three parts as follows, off-line service module; on-line sever service module and on-line client service module. We will extract information of blocks from GS-CAD, a high-tech ship-building design automation tool and the out file from the SHIMOD block modelling tool. These interface methods, with GS-CAD and SHIMOD, are in the process of study presently. The role of offline service module is to interface cad information, with the generation of path plan and job schedule for effective management. The function of online server service module is to effectively communicate between clients and this module also has database management for saving information like
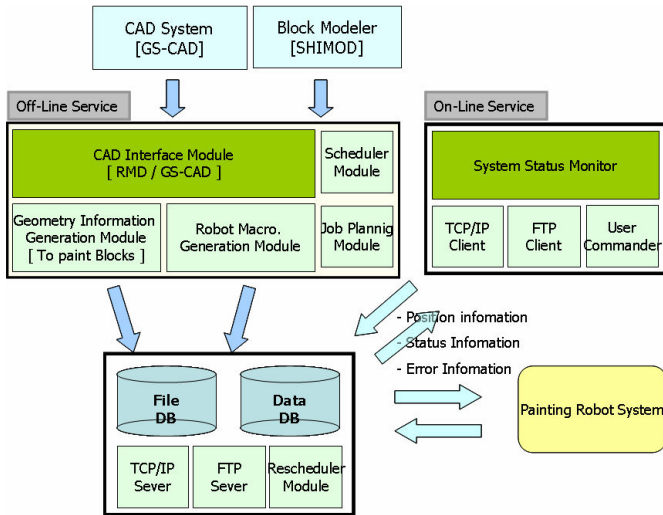
Fig. 2. The configuration of operating system

communication message histories, job result and status of every module. The main role of online client service module is to monitor, operate and command robot system automatically, or sometimes even by the user.

## 2.2. Message protocol standard for integrating system

It is intended through this paper to suggest communication standards to provide means for independent sub-modules to produce implementations which can be connected and intercommunication can be achieved without the sub-modules requiring specific knowledge of one another. This paper proposes a definition of the detailed format of messages that will be used for networking automation system. This message is transmitted as a single continuous stream of bytes. Message length varies according to the purpose of messages but although these have flexible lengths, they could be parsed by usage of start and end tag. The message header has four kinds of fields, such as message identification, a network address that message has departed, a network address that message would arrive and a system identification. The message data contains the text of the data information, formatted as specified by compounding tokens, which are nothing but a comma symbol and equal symbol put together. The reason for using these tokens is that they can very easily be defined by the user and moreover they can parse message string rapidly. For example, data are divided firstly by using a primary type separator into large sub data. These groups of large sub data are then divided in detail by use of second type separators. The main purpose of these separators is to divide the whole set of data into various categories according to their characteristics.
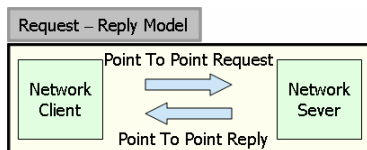
(a). Request-Rely model
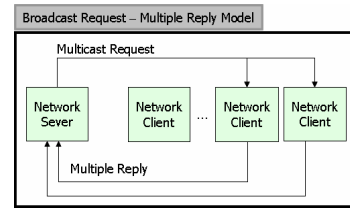
(b). Broadcast Request – Multiple Reply Model
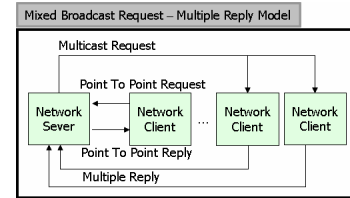
(c). Mixed Broadcast Request – Multiple Reply Model

Fig. 3. The model of exchanging data among the systems

If specific data is required to be found, firstly you have to find what kind of category the wanted data is in and then you start by searching in the nth-token region of this category accordingly, narrowing your search by looking into the detail categories of the large group of data found in the first step.

3. NETWORK MODEL TO OPERATE PAINTING AUTOMATION SYSTEM

3.1 The message exchange between sever and clients

The most technology in integrating complicated systems consists of communication infra and techniques not only in painting robot system but also in general system. There are a lot of methods that can be used for communicate among robots or between robot and monitoring system. Fig. 3(a) shows a simple procedure to communicate between two systems in a general case. This model uses a method where the client requests information from sever and gets response from server. Fig. 3(b) shows broad request-multiple reply model. This model uses a method where a server broadcasts requests about information from others and return response from each client. Fig. 3(c) shows mixed broadcast request – multiple-reply model. In this case, when particular client requests the server to broadcast information to the other target clients, the server broadcasts this information respectively and then sends returned response messages from each client back to the client that initiated the process. Our system is required to support the previously stated three cases, because the need is to have many clients communicating with each other in our painting robot system.

3.2 The message processing strategy

The message that we should deal with is as follows. This message could be sent from a server to clients, from clients to
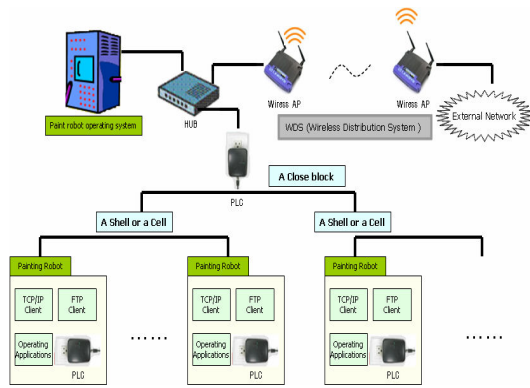
Fig. 4. The proposing network model

a server, and also from client to client or etc. when a message is received from any client, firstly a server has to interpret if this message should go to the other clients. If the destination of this message is another client, find the address of destination and then broadcast the destination of a message. Otherwise, the log manager in a sever saves message information and the database manager updates fields in the database. This database will contain operating histories as well as current status of the system.

3.3 The proposing network model for painting automation system

Painting automation systems are usually installed in very unfriendly surroundings. Also, the network infrastructure that is required by the system has to be frequently installed and removed. So we should select a network model in due consideration of these problems. The first point to be duly considered is how to reduce the number of cables used. The painting robot which works in a closed block has many utility lines. The design consideration focuses on making the robot as small and light as possible for smooth movement inside a complicated block, Therefore this paper proposes that robot systems should communicate with each other using Power Line Communication (PLC) inside a block and by using wired network lines for communication between robots and operation system. Finally we also suggest connecting our local network and any other external network using a wireless access point which will use Wireless Distribution System (WDS) as in Fig. 4.

3.4 A* algorithm to find the shortest path

This study proposes to use A* algorithm to solve avoidance problem for obstacles that scanned by the environment measurement and object recognition system. A* algorithm is a best-first, graph search algorithm that finds the least-cost path from a given initial node to one goal node.

This algorithm is sometimes inefficient in case the path doesn't exist from start node to destination node, but this algorithm is the most popular choice for path-finding, because it's fairly flexible and can be used in a wide range of contexts.

A* algorithm has two list of the nodes. An open list includes all the nodes that has been not yet expanded and a closed list includes all nodes that the don't needs to consider anymore. The algorithm works by first adding a node representing the start position to the open list. The algorithm performs by adding the node for the start position to the open list. This algorithm is repeated that pops off the node with the lowest f cost from the open list until either the destination position node is popped or the open list is empty. If an expanded node is on the open list, the f, g and h scores are estimated. The h score is the heuristic distance from the current node to the destination node. The g score is the cost from the start node to the current node and the f score is the sum of these two score. If the node on the open list has a higher f score, it's parent node and scores are updated. When the destination is found, the loop is finished and the path is generated by iterating from the destination to the start node.

4. CONCLUSIONS

Nowadays, lots of automation is being developed rapidly. As a result importance of integrating system is also rapidly increasing. The key to cope with this problem is how to communicate with each other in a complicated system. This problem can definitely be solved by us by developing the automated painting system since it should be operated and monitor status remotely, to protect workers from harmful workplaces.

Accordingly, we have studied and developed a configuration our system should have, how to define message protocol standards to communicate compatibly and how to exchange data among each sub-system effectively. On the basis of this study, we will construct automated Painting System in Inner Double Hull Block.

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