ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume X (XX), 2011, NR2

ROBOT PROGRAM GENERATION IN REAL TIME.

Ondrej Staš[1], Marián Tolnay[1], Dušan Kravec[1], Michal Jedinák[1], Michal Bachratý[1]
[1] USETM, SjF STU Bratislava, Nám. slobody 17, 812 31 Bratislava, Slovakia,
{ondrej.stas, marian.tolnay, dusan.kravec, michal.jedinak}@stuba.sk

Keywords: robotics, real time, modularity system.

Abstract: This work is focused on real time program generation for robot manipulation from the conditions of vision system. It describes the article inputting the manipulation process in various conditions, such as different color, various positions, various manipulating situation. The system gets information from the vision system informing the program generation engine about the state of an article in the manipulation process. The idea is in modularity, creating software communicating interface, which is able to exchange information via this interface.

1. INTRODUCTION

Usually machine vision systems are encapsulated systems, dependent on the software and hardware solutions from one supplier, which makes problems with hardware and software changing. The easiest way is to create modular system, cooperating via predefined interface, each to other independent, depended only on the condition of communication interface. The systems propose some variability of communicating with an external environment, but mostly via the hardware ports or digital outputs, software cooperation with en external environment is encapsulated in solution packet. The aim of this work is to propose different look on the communication of different hardware parts of machine vision system in manipulation process, especially focused on communication of object recognition, position determining system (incorporated in the machine vision system) and program generation system for SCARA robot, generating real time program for picking and placing product in the production line.

2. PROBLEM DESCRIPTION

The systems, where the vision technology is used, are based upon semiautomatic and automatic manipulation and detection systems, where individual subsystems are hierarchically ordered, usually as actuators reflecting information from sensors, reacting on the currently verified article, or on the articles in the production buffer. The problem arises if we want to collect information and react on objects in area of interest separately, meant that every subsystem gets and influences the state of information located in technology process, so we can say that every module of system works independently. Sovereignty of modules is acceptable only in condition of sufficient information, the only one module that chains the subsystems is communication layer, knowledge base, detection of errors in data and modules. One very important and hierarchically superior module is emergency and malfunction handling subsystem, which is the only one part that gives orders. These orders must be performed without any exceptions. The main aim of this work is to focus on the development of these kind of module systems.

3. THE STATE OF ART

As was mentioned, nowadays these systems are solved as semiautomatic and automatic systems with vision systems and PLC systems, communicating via standard automation buses, could be said as discrete systems reacting on the controlling signals. The systems are usually applied for positioning, for selection and for detection. Their functionality is action to action, reflecting only several signals and suitable only for few or one designation, where equipment works until the production line is active and is not suitable for use in multiple different applications. The situation can be demonstrated on system for paletisation and depaletisation, where the robot gets signal for starting picking operation or more sophisticated, sending coordinates for the desired operation. The solution is designed for unique application, not suitable for more complex use. This was a description of usual applications, of course there is an existence of complex systems, but these are enclosed and their use is costly, demands experts for their operation and maintenance.

4. MODULARITY OF THE SYSTEM

Every modular system consists of several modules with their hierarchy in solution, connection between them and outer environment, and of course at least one data storage or data distribution place, available for every module connected to the system. The strategy for our developed system is to have fully modulated system with minimum dependences between modules, that allows us to incorporate or extract modules as is necessary. This leads to definition of several types of modules that are described in table 1. In order to accomplish full functionality and minimum dependency, the hierarchical scheme must be established, where the only one module is prior and has got direct access to plugged devices. The Distribution of its commands is arranged by separate link and orders from this module must be performed immediately as they arise. Other modules communicate with one data link, and the information are stored to data buffer, where they are handled to data storage module. The hierarchy of this system is demonstrated in Figure 1.

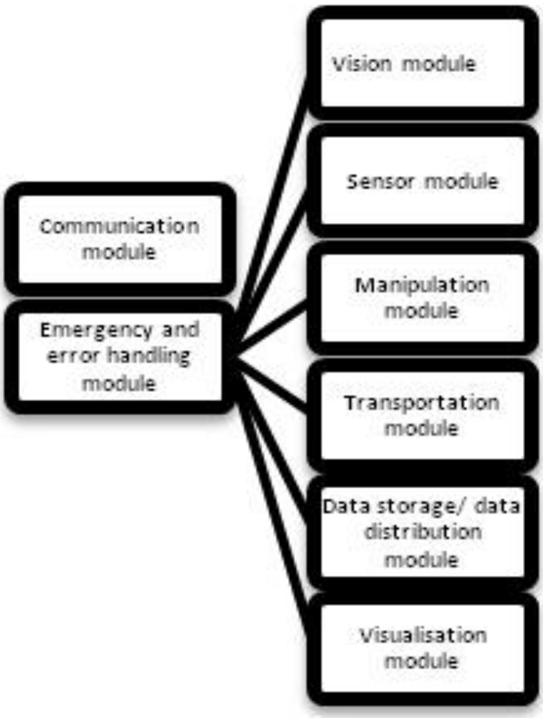

Figure 1. Module hierarchy in system

Module	Description	Hardware determination
Emergency and error handling module	This module is dedicated for handling critical situation corresponding to FMEA analysis	External alarm connection, main switch, emergency switch, stop button, etc.
Vision module	Consists of camera sensors, colour sensors, sensors using visual signal	2D cameras,3D cameras, colour determination sensors, etc.
Sensor module	Implements sensors differing from vision, which are placed in the system	Position sensors, rotation sensors, etc.
Manipulation module	Determines manipulation units (differs from transportation units)	Includes robots (SCARA, Cartesian, cylindrical, etc.), manipulation semiautomatic and automatic machines, etc.
Transportation module	Consists of all transportation units	Conveyors, stacks, accumulators, etc.
Data storage/ data manipulation module	Contains of data demanded by modules and stores interfaces information	SQL database, file, RAM or Flash memory units, data storage medium, etc.

Table 1. Module description

5. SOFTWARE AND HARDWARE LAYER OF THE SOLUTION

Different layers incorporated in to this system can be diversified into two main layers. Hardware layer consists of hardware components and communication accessories used in the system. For our purposes this communication hardware layer was simplified to serial link connection, which proposes the most complex applicability, because the equipment used in this project allows us to easy use this type of connection. For mounting all the devices into our solution was developed serial link router, which allows us to connect multiple point into one in our hardware solution that propose computational capacity for software solution of the complex modular system. If there is a need to use different types of hardware communication solution, there should be a need to develop connection to computational device, but software interface is developed as universal capability, so there is a need to develop hardware communication interface to communication module. Software layer incorporates solution for every module as service running in thread, so there is a need to use multitasking operating system. Communication between modules is ensured by several system streams. Concerning the environment, where the whole complex solution is made, decision of multiplatform development system was used. This ensures the minimum portability requirements, solution can be performed wherever the java runtime environment is available. Of course there are necessary some code adjustments in adapting to new platform. Must be mentioned that this system does not react immediately on occasion that happens, except error handling unit, the minimum reaction time must be settled and tested.

6. THE ROLE OF COMMON AND SUPERIOR MODULES

The role of individual modules is already outlined in table num. 1. The only one superior module is an emergency and error handling module (EEHM), which immediately stops the execution of indentified module, or preferred to stop the whole system. EEHM takes the responsibility to collect information about functionality and stores history of execution for error determination. Reaction time to EEHM commands must be minimum, the stopping process is controlled and recorded via this superior module to ensure non offending system start up. Vision and sensor modules are internally analogues, difference between them is results from the difference of proposed data, vision module offers more complex data than the sensor module. For example there can be proposed preprocessed or raw image data for visualization module, which can visualize them on the screen for operator. Data flow, especially from this vision module can influence the data throughput in system, so this must be used carefully. Visualization module collects desired data from data storage module and visualizes them on the screen. Internally it is realized by developed visual components fed by prepared data structure periodically refreshed. Should be mentioned that this module has got the highest data flow demand, therefore for bigger application it is recommended to suppress this module.

7. CONCLUSION

The work is a part of national research activities financed by KEGA and VEGA funds. The theme described in this article is subpart of activities in developing of manufacturing system in global use, not focused on special application, so it is described base principle in developing system for robotics, where the real state through real time program is determined and can be visualized for production control.

References:

1. Staš, O., Tolnay, M., Magdolen, L. Application of artificial intelligence in manufacturing systems. In: Mechanical and Electronics Engineering. ICMEE 2009 Proceedings of the 2009 international conference. Singapore : World Scientific Publishing Co.Pte.Ltd .

2. Mikuláš Hajduk, K. Boldocký. Treningové pracovisko s robotom KUKA : Acta Mechanica Slovaca, 2006. ISSN 1335-. 2393.

3. BRADÁČ, F.; PAVLÍK, J.; KOLÍBAL, Z.; POCHYLÝ, A.; KUBELA, T.; BLECHA,P.; BLECHA, Re. ROBOTIC MANIPULATORS FOR TOOLS MANIPULATION. In Summaries Volume. Bratislava: SLOVAK UNIVERSITY OF TECHNOLOGY, BRATISLAVA, 2007. s. 162-1 (282 s.)ISBN: 978-80-227-2677-1.