Implementation of IEC 61499 function blocks for conveyor sorter

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Keywords: IEC 61499; programmable logic controller; function block

ABSTRACT – The IEC 61499 standard is the one of the modern approaches which are the development of control system for automation manufacturing system. The IEC 61499 standard is describes a methodology that utilizes the function blocks as the main building block and defines the way that function blocks can be used to define robust, re-usable software components that constitute complex industrial process measurement and control systems. Function blocks (FBs) are defined as IEC 61499 standard for distributed industrial processes, measurement and control systems for PLC control. This paper present early stage of simulation for conveyor sorter based on IEC 61499 standard. The simulation of conveyor sorter have multiple devices in a network. So, IEC 61499 is used for enabling communication among devices in a network. Function Blocks Development Kit (FBDK) is used as a software tool for development of the FBs. The developed control system is simulated with FBDK and implemented in conveyor sorter.

1. INTRODUCTION

It was first introduced by the IEC 61131 standard on programming language for programmable logic controllers. However, the languages defined by IEC 61131 as well as vendor‟s proprietary tools, proved inefficient to address the increased demand for a more flexible development process in the control and automation domain. The IEC 61499 standard is extended the function blocks concept of IEC 61131 to reuse many of well-defined and widely acknowledge benefits of concepts introduced by object technology. The development of the distributed control systems are made a high-quality products and become the fast changing demands of users. Last years, many researchers have approaches many kind of software to solve the problems of this area. There are multi-gent control using UML [1,2], reconfiguration of real time distributed systems [3], function block-oriented engineering support systems, motion control design in reconfigurable machine tools and implementation of a real time distributed control model using a Java based platform [6,7]. The comparison between IEC 61131-3 and IEC 61499 is IEC 61131-3 standard has a program which is the update of inputs and outputs will triggered by the scan cycle and it will not be clear what to do until all the inputs are read. In contrast, IEC 61499 standards is implement according to the event-driven function blocks of IEC 61499. The update of the component will triggered by the call of a specific operation and update can execute only that operation. Hence, the multi operation, one of the inputs is allocated to directly determine which operation that causes the update. This paper is focused on the development of the function blocks for conveyor sorter based on the IEC 61499 standard.

2. OVERVIEW OF THE IEC 61499 STANDARD

The standard defines several function blocks which are used in distributed industrial process, measurement and control systems. This standard also can be used for specification, modeling and implementation of distributed control systems. This function block can provide a software solution to a small problem such as the control valve. Furthermore, function blocks allow industrial algorithms to be encapsulated in a form that can be readily understood. Each block has a defined set of input parameters which can read by the internal algorithm when it executes. The results are come from the algorithms that are written to block‟s output. The complete applications can be built from networks of function blocks and formed by interconnecting block inputs and outputs. The main function entities and applications are built of function block instances [6].

The standard defines several types of blocks. There are basic function blocks, service function blocks and composite function blocks.

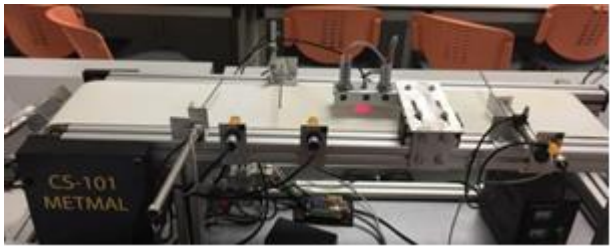

Figure 1 Conveyor sorter.

3. OVERVIEW

The conveyor sorter is used for distributing cylindrical objects based on detection by optical, inductive and capacitive sensors. The received parts are distributed through classification of material (metal) and color (white and black). On the sorting conveyor module are situated most of the sensors and all of the actuators. The optic sensor (S3) detects if there is a work piece at the beginning of the sorting conveyor module. If there is one the program for distribution of the parts is started and executed in the following sequence: the conveyor DC gear motor is started and the pneumatic stopper is off. Then capacitive sensor (S2) identifies the color of the work piece (white or black). In close proximity there is another inductive sensor (S1) which detects if the passing part is metallic or not. There are two cylinder that are connected with two different colors (black/white).

4. DEVELOPMENT OF IEC 61499

Distributed control architecture based on IEC 61499 standard is built on the following key components: application, resource, device and system. The application is composed by a network of function blocks which are data outputs, data inputs, event inputs and event outputs are interconnected. The resource is considered to be a functional unit, contained in a device that has independent control of its operation. The device in the IEC 61499 standard is the basic element of a system configuration. A device type is specified by its process interface and communication interfaces. A device can contain zero or more resources and function blocks networks. The devices are divided into two. There are device 1 in Figure 1 and device 2 in Figure 2. For the device 1, the main panel is control the switch of the control whether the system is on or off. Also, the device 2, the three types sensors; capacitive sensor, inductive sensor and optic sensor are detected by the object and then the result is get based on the detected object.The system is built by one or more devices. The devices communicate with each other over communication interfaces. The devices are linked with the controlled process via sensor and actor. When the applications are mapped to the device function blocks, so the configuration is formed.

4.1 DEVELOPEMNT OF IEC 61499 MODELS

To bring the conveyor sorter in operation it is necessary to build a communication network between the different hardware components that are involved in the control system. In order to achieve implementation of the communication network which is of local character the required components are personal computer, switch, PLC and conveyor sorter.

The PLC is connected to the PLC on which the necessary software for the control of the sorting station is loaded. The availability of JVM in the PLC enables the integration of pre-designed FB according to the IEC 61499 standard, realized with the help of the development software FBDK.

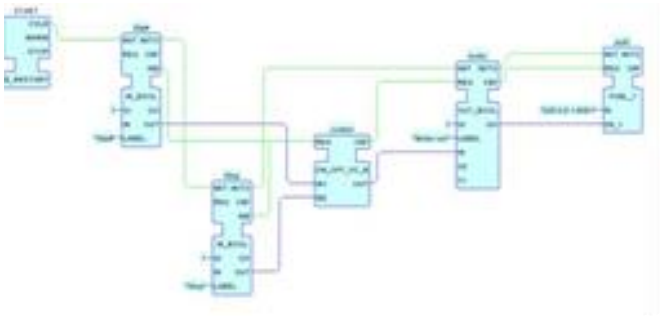

Figure 2 Interface of conveyor sorter in device1.

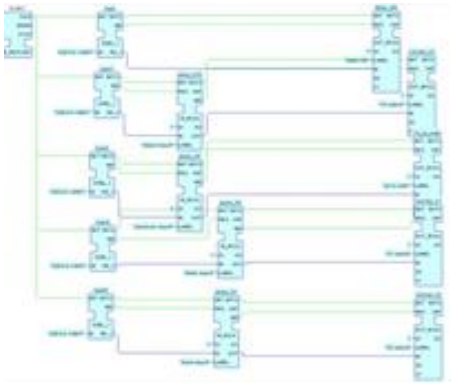

Figure 3 Interface of conveyor sorter in device2.

5. CONCLUSION

This paper present an approach for the development of automation control for conveyor sorter based on IEC 61499 function blocks. The basic function block, service interface function block and composite function block are used to construct the conveyor sorter process in simulation. This conclude that conveyor sorter have fully developed system based on IEC 61499 function blocks standard. The developed systems are can detect the three types of objects (aluminum, white and black). Then, the developed models are from the basic function block which is structured in library. For the implementation of developed IEC 61499 models a Java based PLC is used and finally, each of the part of conveyor sorter can be used like a part of every distribution control system, based on the IEC 61499 standard.

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