XERXEZ SOLUTIONS
DEVELOPMENT – TRAINING – RESEARCH

Project Name: Detecting and Separating Rotten Fruits from Conveyor Belt using Machine Learning

ABSTRACT: The automated conveyor system, as the core component in the modern manufacturing world, has gained lots of attention from researchers. To optimize the operation of the conveyor system, range-inspection control (RIC) has been considered an efficient strategy to bring this conventional technology to an intelligent level. Various algorithms have been put into use to achieve optimal control. However, the current methodologies are only focusing on control optimization, not scaled into the smart manufacturing framework. The schema of alignment and corporation between the physical and virtual spaces for the system remains an important problem. Therefore, the work in this article aims for an effective framework of implementation between the physical and virtual stations in an automated conveyor system. Since increasingly more application scenarios rely on the digital twin (DT) technology to realize the integration of physical and virtual systems, we proposed the DT automated conveyor system (DT-ACS) that constructs the road map to implement the RIC-based conveyor system under the background of a smart factory. Besides, profit-sharing-based deep Q-networks (PDQNs) have been proposed to cope with the RIC optimization problem. The robustness and efficiency of the proposed PDQN were evaluated via sets of experiments. The discussion and conclusion are presented at last accordingly.

INTRODUCTION: The successful implementation of conveyor systems in the modern production lines has significantly boosted the development and efficiency of manufacturing. Over the past years, the deployment of the smart factory has become a milestone in different industries. Under this background, the workstations situated along the conveyor system have been widely studied as intelligent agents. The industrial manipulators, such as the mechanical arms, equipped in each station are expected to take actions following the strategies generated by the control center to achieve optimal processing efficiency with the lowest cost. Meanwhile, the energy consumed by a flexible manufacturing system should be considered and minimized, as focused on in.

In conventional conveyor-based manufacturing systems, the diverse processing efficiency of workstations usually causes a loading imbalance. Then, even one single overloaded workstation can greatly degrade the processing efficiency of the entire production line. Manual intervention is still a common solution to the problem. Another example leading to the same situation is the hoist scheduling problem, for which Yan et al. tried to find a solution to minimize the scheduling time with randomly arriving orders inserted into the current schedule. The modern dynamic production environment is commonly faced with such kind of problems, while reconfigurable manufacturing systems (RMS) can be potential approaches to solve them. Generally, to optimally cope with the dynamic changes during manufacturing, the reconfiguration tasks need to be completed both at the physical and logical levels. However, the rearrangement of the workstation layout and some of the other physical adjustments generically require significant effort. Thus, to fix the problem of load imbalance more efficiently and intelligently, range-inspection control (RIC) has been taken as one of the most popular approaches to optimize the intelligent control for conveyor systems.

The manipulators can make corresponding decisions, such as continuing processing the currently stored units or unloading the upcoming pieces, according to various operation states. The range to inspect is the action the agent needs to determine to achieve optimal performance. RIC is a flexible control strategy at the physical level but is closely based on optimization at the logical level. Therefore, an effective synchronization of physical and virtual spaces is required during the manufacturing process.

RELATED WORK & EXISTING PROBLEM: typical workstation generally consists of manipulators, reserve and storage areas, and conveyors, which has been widely put into practice throughout the past decades. At the same time, the rapid rise of information technology, for instance, machine learning, and the Internet of Things (IoT), has comprehensively influenced the development of the conveyor system. The workstations have become intelligent agents equipped with smart technologies, which can maintain the optimal processing rate under dynamic circumstances. The smart conveyor system in this article is modeled under the DT framework. The feasibility and functions of each component are delineated and analyzed. Similar work has already been achieved in different scenarios. NASA regards DT technology as the crucial way to assist aerospace vehicles with increasingly more complex missions and as a mirror to reflect the entire life circle. The physical–virtual convergence for prognostics and health management (PHM) has been achieved via DT. Besides, there are also other frameworks, such as Production as a Service, which is cloud based and assists the customers with small-batch requirements to reach the manufacturers with existing resources.

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