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Manufacturing analysis with discrete events using IoT platform

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Abstract. The paper presents how to integrate cloud systems and access them with IoT devices. The IoT platforms addressed in the paper are Platform as a Service (PaaS) and Software as Service (SaaS). The analysis is presented by modeling a case study for systems with discrete events. Because the general system is analyzed as a cloud system on levels, we will leave the general system as stochastic.Qualitative analysis has the role of checking the structural and behavioral properties of the system, the existence of bottlenecks, bridging, and security systems. The quantitative analysis measures the specific performance of the manufacturing system. The results show that this approach can be used to detect jams in the system. Thus, manufacturers can resize production capacity and optimize even the entire manufacturing system.

1. Introduction

According to the literature, some aspects of the possibility of standardizing IoT and a graphical presentation of life cycle and IoT innovation are highlighted [1].

Over time, it has been allowed to develop semantic interoperability standards [1] because of the options for selecting and coordinating standardization initiatives. Industrial standardization activities have been organized in the field of the Internet. Thus, cloud systems have also been implemented. With regard to IoT, interoperability, performance, optimization, IoT quality, safety, confidentiality and security are pursued [2].

The complexity of the system operations relate directly to the number and nature of the inputs, outputs, and other system components.

Cloud computing [2] is one of the most performed today's information technology systems. It is characterized by virtualizing hardware, supply fast self-service scalability, elasticity, accounting models [3].

System parameters are used to represent system components and relationships; they can be broken down into structure parameters as representations of system properties and design variables as factors that change over time [4].

Industries connected to the Internet using terms relating to new innovation phenomenon that influences the way people connect and optimize machines and systems manufacturing [5].

Different manufacturing resources and abilities can be perceived intelligently and connected to a wider Internet, managed automatically and controlled using both IoT and Cloud solutions. IoT is a basic factor, if not even the cornerstone, for product-oriented control that can lead to increased productivity.

Expanding the IoT creates widespread connectivity, which can lead to storage, processing and accessing large amounts of data. Cloud computing is an alternative to manipulating those large amounts of data [2, 5].

2. Theoretical analysis of the system

IoT technology allows businesses to easily connect to IoT devices, collect and analyze in real time so they can optimize the process and streamline it in the shortest possible time as quickly as possible [6].

For example, the benefits of IoT include:

- collect reliable and secure data from devices,
- ease of integration of devices in the enterprise,
- real-time performance of large data and predictive analysis of IoT flows and events,
- expanding the enterprise applications and processes with IoT data,
- the ability of enterprises to control their devices with mobile applications.

Businesses have problems in ensuring the operation of the most efficient equipment over a long period of time.

Costs related to equipment maintenance start to be a problem, as some faults due to older equipment occur in the rapid evolution, the association between older and new equipment or due to system errors caused by some incompatibilities may even for the same software only have another version. Remote monitoring and maintenance provide solutions to these challenges and is one of the capabilities enabled by IoT. Integrating IoT data allows for low costs, time for repairs and flow monitoring, which are solutions to the challenges of digital systems [1].

The role of IoT as a major change is determined by the capitalization of data by their acquisition, transmission and storage, cloud-based centralization on levels but also analysis of these data [1].

According to the literature focus on categories of functions provided by IoT systems.

Cloud systems are currently available from small to global businesses and are in the focus of research because it has a wide applicability. As it tends to use cloud systems, whether it's application implementation or part of the infrastructure, it's necessary to understand the differences and benefits of cloud services. In the literature, three cloud service models are analyzed: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Each of these models has its own benefits and it is good to know the differences for an optimal choice [7].

SaaS as a service is the most commonly used option for cloud users. SaaS uses the internet to deliver applications managed by a vendor. SaaS is transmitted through a web browser and does not require downloads or installations on each computer [7].

Software as a Service (SaaS) has the characteristic of providing a predefined applications as a service over the Internet or distributed environment [3].

With SaaS distributors can handle all the technical issues that appear, such as data, middleware, servers and storage, and the enterprise can simplify and maintain support.

SaaS's great advantage is to reduce the time and cost of installing, managing and updating the software. This advantage leads to the reduction of personnel and its distribution to other technical activities within the enterprise.

Optimal SaaS usage conditions:

- the business wants to quickly launch e-commerce and there is no time for servers and software,
- short-term projects that require collaboration,
- the use of less demanding epics,
- applications that require web access and mobile.

A major challenge for SaaS vendors wishing to exploit the benefits of cloud computing is to manage their engagements throughout the lifecycle of a service. The complexity of this issue has led to the emergence of new offers called PaaS aimed at abstracting this complexity through specific tools and services [3].

PaaS as a service provides cloud components of certain programs while they are used for applications. PaaS provides a framework for developers who can build and use custom applications.

Servers, storage, and networks are generally managed by the enterprise or vendor, but developers manage the application [7].

PaaS wants to use simple idea, even if the execution is complex, many applications have a single development platform and common services, including authentication, authorization and billing. PaaS developers build web applications without installing any tools on their computer and deploying these applications without having to know or take care of the complexity of the system and the management of basic hardware and software levels. A PaaS program is built on an IaaS platform and uses a powerful development and development tool [3].

PaaS architecture aims to provide tools and techniques for modeling, simulation, analysis, planning, providing and monitoring real-time service-oriented applications, implemented virtual cloud storage [3].

Platform as a Service (PaaS) is capable of providing a platform for the development and environment and to provide storage space, housed in the cloud [3].

PaaS delivery is simulated with SaaS except that PaaS provides a platform for software delivery, delivered on the web, and offers the ability to build software without worries about operating system, software upgrades, storage, or infrastructure.

PaaS components are built into special software allowing companies design and creation of custom applications.

PaaS active factors include [3]:

• PaaS hoster service: must provide adequate resources to meet market requirements, together with adequate availability opportunities.
• PaaS Provider: will provide a suitable environment for general developers to build web applications without the deep expertise of the server domain and the development or management of the website.
• The PaaS user: must have a browser-based development environment, the ability to deploy a hosted environment, management tools, monitoring capabilities, and make payments at the time stipulated in the contract.

The features that define PaaS as a cloud service include [3]:

- resources can be reduced by virtualization technology,
- provides services for application development, testing and deployment,
- the same application can be accessed by multiple users,
- web services and databases are integrated.

PaaS is useful if there are more developers working on the same project or if they are elements that need to be introduced and can provide high speed and flexibility to the whole process. PaaS has useful for creating custom applications, can reduce the costs that occur in development and application deployment.

3. Presentation of the system

In order to ensure proper management of the Information System will use a cloud levels. Thus, the primary and directly accessed information is on level I, level II is managed on the level of production, which is followed at level III where no scrapes are included, but only those products (information) that can be prepared for distribution.

Researches using Petri networks have spread a lot thanks to the mathematical and graphic model used. Petri networks have adequate platforms in the field of modeling and designing competing systems, computer systems, manufacturing systems and performance analysis.

The base of Petri Networks is to model graphics and analyze the discreet events of a manufacturing model's activities. Basic constructions of Petri networks are useful for modeling and analysis of production systems.

This paper is based on three objectives:

- basic study of petri dishes that can be analyzed and validated by a discreet system,
- Petri networks are useful for modeling and analyzing systems with discrete events,

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- validation methods and results obtained from the model analysis, deterministic and stochastic model are used to reorganize and re-evaluate the system and to increase its flexibility.

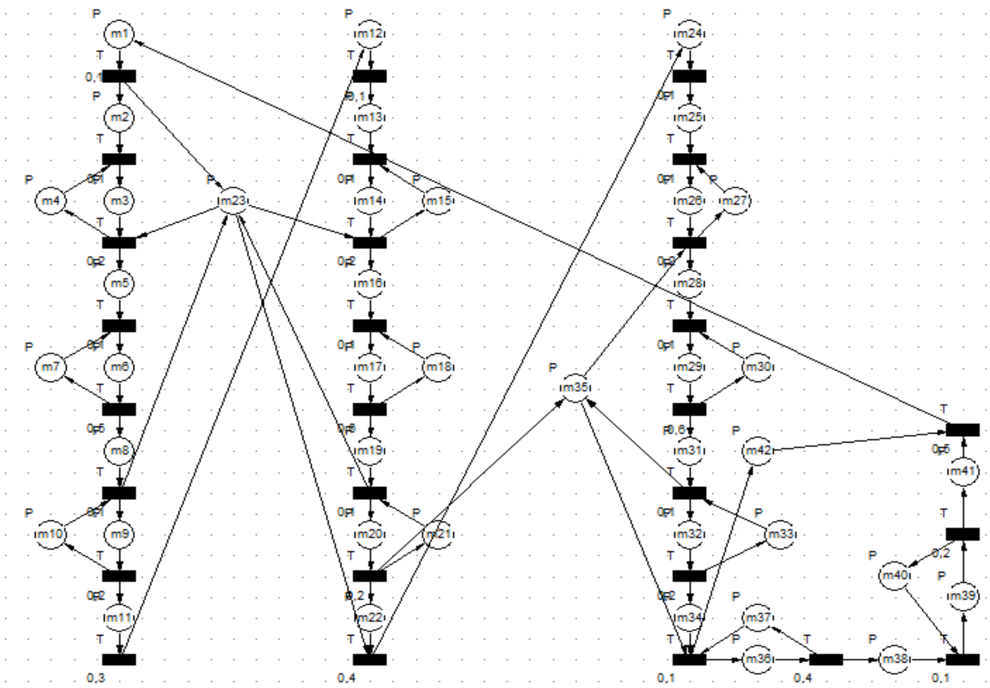

Figure 1. Centralized tracking system.

The case study uses three processing centers P7, P18, P30, a packing center P37 and P40 labeling, transposed to the current issue, each processing center is the brain of each level, packing refers to the grouping of information, and labeling is the definition and management of information. For loading and unloading are the nodes P4, P10, P15, P21, P27, P33, and for storage and transport the nodes P1, P2, P5, P8, P11, P12, P13, P16, P19, P22, P24, P25, P28, P31, P34, P38, P41. As a robotic system, a secured system linking the levels is the nodes P23, P35, P42 (figure 1).

The optimized visible part is found at level II. A real problem that occurs at this level in terms of information flow is when equipment maintenance is performed. This subject will be treated in another work.

In order to avoid very many problems and to automate the workflow, robotic systems, secure systems were introduced.

For the simulation, the P7, P18, P30, P37, P40, P23, P35, P42 nodes were used because they were considered the most representative for the case study to be analyzed. These are also the nods that are most often watched with IoT systems because they show directly where errors or malfunctions occur in the system.

Following the simulation of using information throughout the flow process, a variation is observed only at the entry to the next level in figure 2. Otherwise, the entire flow of information is linear and constant, as in figure 3. The simulation of the system was generated on levels for complete technological flow, representative variations on levels are obtained also due to the occurrence of certain possible errors or variations are determined by the maintenance. Thus, the representations in figures 2 and 3 are determined by the robotic systems determined by the same number of complete machining.

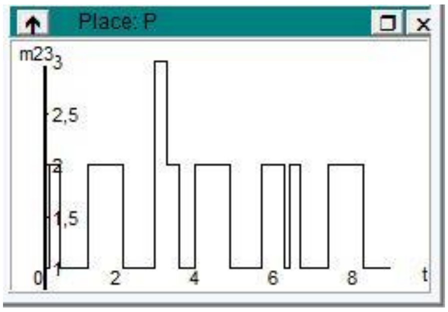

Figure 2. Flow variation of level I.

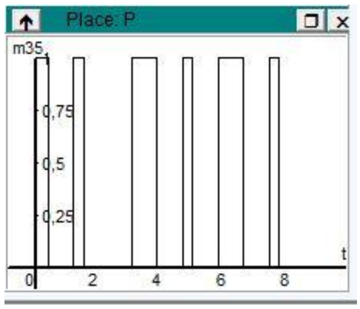

Figure 3. Flow variation of level II.

If during the simulation at each level information is processed that is then transferred to the next levels, the results from figure 4, 5 will be obtained. These results were obtained after two complete passes of the information. The flow of information is analyzed so that any problems can be determined in real time and measures can be taken to remedy them.

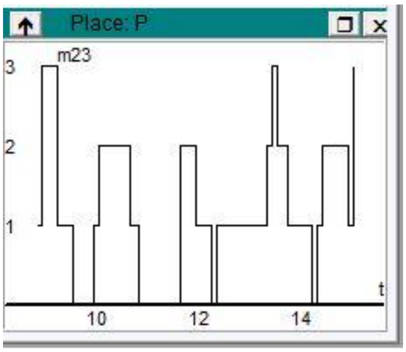

Figure 4. Variation of flow of level I after two passes.

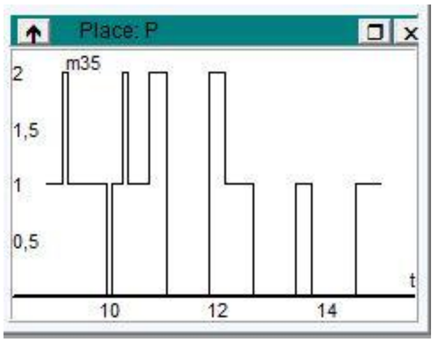

Figure 5. Variation of flow to Level II, after two passes and independent information.

If it is only from the outside for the last two machining operations, the results of the following figures can be seen.

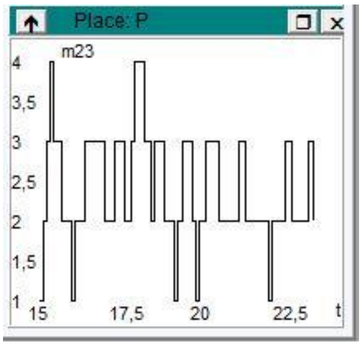

Figure 6. The flow of flow of level I, after external irreversibility at level III.

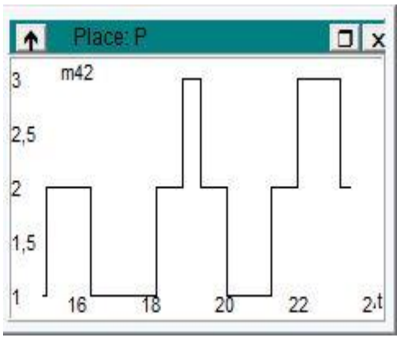

Figure 7. The flow of level III flow, after external irreverence at this level.

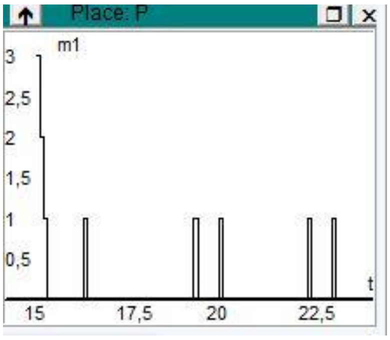

Figure 8. Variation of flow to input of information into the system.

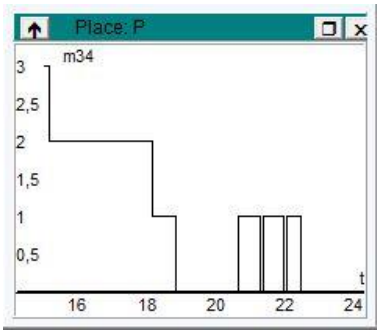

Figure 9. Flow variation at level III entry, after external action.

External interventions determine the largest variations, as can be seen in figures 6, 7, 8, and 9, where m23 is the interconnection node between interruptions, m42 provides packing and preparation for delivery, m1 is the indicator node of the technological flow that feeds at constant intervals as programmed, m34 represents the transition to the last stage, namely labeling and packaging. The entire process is carried out according to the prescribed instructions in the ideal way. The role of IoT platforms is to determine in real time the exact location of possible malfunctions or errors that may occur.

4. Conclusions

Cloud production platforms are rarely applied today due to considerable concerns about security and return on investment.

IoT standards will be the key in the future for advanced open-client-oriented development that will lead to innovative business transformation services.

Remote monitoring allows companies to update and control products in the industry. Smart products can be designed with innovative capabilities related to the ability to download new features.

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