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COLLECTION OF PRODUCTION DATA FOR THE POSSIBILITY OF CREATING A SIMULATION MODEL USING RTLS LOCALIZATION TECHNOLOGY

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Abstract: This paper deals with the collection of production data using elements of a specific localization technology in real time for later use and subsequent possible verification via the TX Plant simulation software platform. The paper defines terms such as RTLS system and its main parts, topology, coverage and hardware part of localization technology.

1 Introduction

In today's modern world, engineers are increasingly focused on full-fledged data collection. In many ways, it is not just about production data based on material flow values and the like. Values such as movements of machines, equipment but also workers are also taken into account. These data are increasingly able to refine our simulations due to more accurate and especially real collected production data. The form of data collection for evaluation and processing of simulations is usually performed by combining software and hardware parts, which ultimately form a unique way for data collection and possibly statistical evaluation, which the simulation program can verify or build on.

2 RTLS technology

Real-time positioning system (RTLS) refers to any system that accurately determines the location of an item or person. RTLS is not a specific type of system or technology, but rather a goal that can be achieved by different asset localization and management systems. An important aspect of RTLS is the time at which assets are monitored, and this data can be used in different ways depending on the application. For example, some applications only need timestamps as the asset traverses the area, while other RTLS applications require much more detailed visibility and require constant updating of time data. The ideal real-time location system can accurately locate, track and manage assets, inventory or people and help companies make informed decisions based on the location data collected [1-3].

Furthermore, it can be said that the RTLS system serves not only to identify the tag, but also to locate it and track the movement in real time. The system determines the location using small devices placed on the objects we track, active RFID tags. RTLS technology is designed mainly for monitoring and determining the position of objects in the interior or exterior (production area, etc.). RTLS is used in many industries with specific applications such as employee tracking and asset tracking. These applications can be found in the manufacturing and mining industries, but are most important in healthcare. The accuracy of this system ranges from meters to tens of centimeters depending on the technology used.

Figure 1 RTLS tags

We can use several methods to determine the position of the tag in the RTLS system. Most positioning methods are based on the dependence of the distance traveled on the time required to cover that distance.

A method that only works on this principle is called ToA (Time of Arrival). For accurate and continuous measurement, it is necessary to synchronize the time on the receiver and transmitter, which is the biggest disadvantage of this method. The TDoA (Time Difference of Arrival) method eliminated this disadvantage in that, similarly to GPS location, the time differences between neighboring transmitters are based not only on absolute time values. All these methods work with time and are suitable mainly for the exterior, where there is direct visibility from the transmitter to the receiver and a minimum of reflections.

The RSSI (Received Signal Strength Indication) method is based on the signal strength at radio-visible access points. It is based on the dependence of signal strength and distance from the transmitter. The method is easy to apply to spaces inside buildings and to accurately determine the position of the tag, we must know the signal strength of at least three receivers.

3 Parts of the RTLS system

All RTLS applications will consist of several basic components: a transponder, a receiver, and software for interpreting the data from each. The complexity of the system, the technology chosen, and the scope of the application will determine the amount of hardware and software needed to create the ideal RTLS.

Each technology used for RTLS uses its own terminology. Here are some general concepts to help you understand the items and their roles in the system in general.

4 RTLS coverage options

RTLS options and reading ranges vary from one technology and setting to another. For example, the system with the longest reading range, GNSS (GPS), can provide the location of an item in real time anywhere in the world, because the receivers are satellites orbiting the Earth. Other technologies with shorter reading ranges, such as UHF passive RFID, can provide placement in a building or zone. The following are the different levels of coverage achievable with RTLS. It is noted that increased granularity can be achieved with each of these coverage options depending on the technology selected, the number of receivers, the labels, or the type of positioning method chosen.

5 Transponders

A transponder is connected to an item or person to uniquely identify that item or person. A transponder typically receives a signal from a receiver and responds back with its unique ID, but can also transmit an initial signal if it contains an internal power source.

Depending on the type of technology and the purpose of the application, transponders can be:

- Radio Frequency Identification Tags (RFID)
- Bluetooth beacons
- Smart devices
- Wi-Fi tags
- Global Navigation Satellite System (GNSS) / Global Positioning System (GPS) markings
- Ultrasonic markers
- Infrared markers
- Smart devices (depending on mode)

6 Receivers

A receiver is hardware with a power source connected to a network that transmits and receives signals from transponders. The receiver then forwards the collected data to end hosts or databases. In some systems, the receiver may be an existing infrastructure, but in others the receivers need to be purchased and integrated into the application environment.

Depending on the type of technology and the goal of the application, the hardware can be:

- Readers
- Position sensors
- Access points
- Receivers
- Beacons (depending on mode)
- Smart devices (depending on mode)

7 Software

The software in these systems can vary in complexity, from simple software integrated into the receiver's hardware to multiple software instances, such as localization software, middleware, and application software on the host computer. The software can be combined to create the desired system functionality. Three main types are used in RTLS applications:

- Firmware - software that resides on the hardware
- Software or application software - Software that resides on a back-end computer or server
- Middleware - used to connect firmware and application software

Figure 2 Logo of Sewio company

In the case of data collection, in our case the software platform from Sewio is used, which contains all the necessary collection modules [4,5]. Models such as Sensemap, RTLS monitor or SAGE analytics are mainly used.

Four examples of real-time data collection:

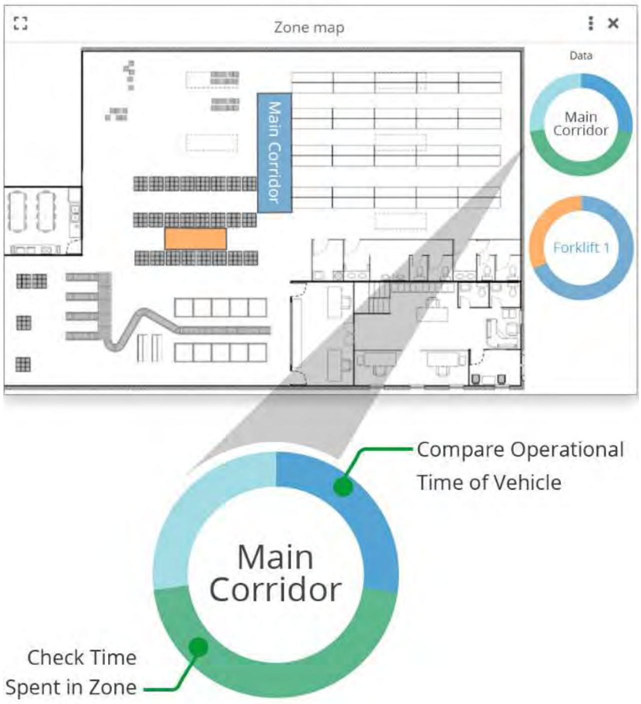

Figure 3 Vehicle time spent in the area

By setting up virtual zones (they can be unlimited) above the devices, it is possible to measure the time spent by vehicles or other assets in those zones. This collected information can be classified into days or individual work shifts.

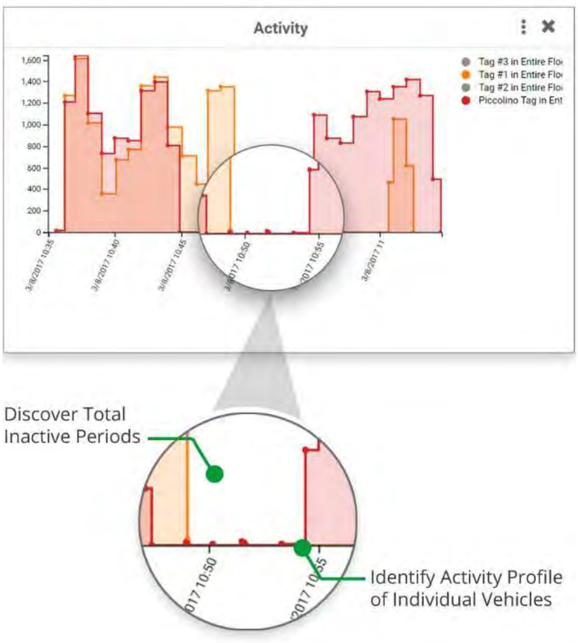

Figure 4 Vehicle activity log

Vehicle activity log can optimize overall fleet utilization efficiency. Elements such as inactive recovery and repair periods are used. Data can be compared with each other.

Figure 5 Heatmap

Heatmaps in general can provide a relatively high level of process clarity in the sense that it is able to detect the distribution and density of in-house operations as well as vulnerabilities that ultimately cause delays.

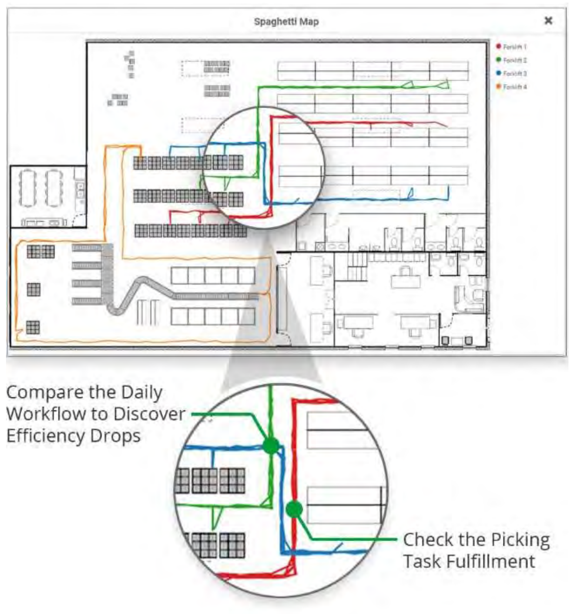

Figure 6 Spaghetti diagram

In this case, the purpose of the spaghetti diagram is to determine the continuity of the material flow for the possibility of further process optimization and to identify inefficiencies in work arrangements, also by wasting transport and unjustified reductions in activity.

The collection of working data for the purpose of creating a simulation model begins in the initial part with the layout, installation and configuration of the hardware and software part of the localization RTLS system. It is necessary to insert a CAD model or layout of the given monitored area from which the data will be collected. If the dxf file is not available. (CAD), the Planner software module allows you to use other file formats such as pdf. In any case, the advantage of CAD files is the possibility of a more sophisticated 3D model if required. In the RTLS studio software, this layout is inserted and its dimensions are also determined, based on which the data will be collected in real parameters. Data is collected based on customer requirements.

In the examples below it is possible to see four examples resp. types of data collection that can be transformed as a basis for creating a simulation, in other words, possible verification of measurement results. For the purpose of linking the collected data and the simulation software in our case TX Plant Simulation, a common excel table is used as the output, which is fully compatible with this software platform [6-10].

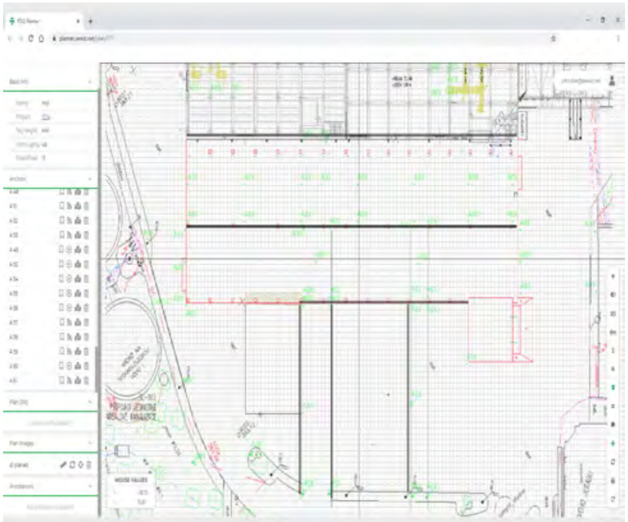

Figure RTLS Planner

8 Conclusions

The idea of Smart Factory today does not bypass any modern enterprise. The process of digitization is becoming faster and faster and it is important to continue this trend and not lag behind the competition if the company wants to be competitive. In this sense, the collection of production data seems to be one of the most important stages in creating this concept. The importance appears only in the optimization of material and production flows, but also in better transparency of production and the overall operation and life of the company. The creation and connection of this model is provided by localization technology in conjunction with the TX Plant Simulation software platform.

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