IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

## IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 9, September 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 9, September 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1109013 |

# Work in Progress (WIP) Tracking & Monitoring in Manufacturing Industry Using IoT Tags

**Jaison Sebastian[1], Selbi M U[2]**

Chief Executive Officer, Juxtasim Technologies Pvt Ltd, Maker Village, Kinfra High Tech Park, Kerala, India.[1]

Lecturer, Dept. of Computer Engineering, Govt. Polytechnic College Kalamassery, Ernakulam, Kerala, India.[2]

**ABSTRACT**: WIP Tracking systems are available in market based on barcode and RF-IDs. Scanning points are deployed in the factory to monitor product movement and each scanning point is associated with a machine and operation. The WIP Tracking software specifically designed to provide work in progress visibility throughout the factory, validate the process flow, and provide history of the process steps accomplished on a product. It is a modular and scalable system that tracks products anywhere on the factory floor until they are finished and put in stock or shipped. With this solution, efficient data collection is combined with error proofing solutions to demonstrate process compliance while reducing material and assembly costs.WIP tracking software uses real-time information to track the physical location and quantities of all WIP in the assembly process.

**KEYWORDS**: WIP tracking; IoT; Tag; RFID interface; Moisture Sensitive Device; Real time operating system; SPI; OLED; Canban.

## I. INTRODUCTION

The core of manufacturing industry is work-in-progress (WIP) management. WIP materials are difficult to track as they move from process-to-process, station-to-station, and automated equipment to manual assembly. It is easy to lose track of the constantly moving WIP, especially when employees have to use manual methods of tracking.

The Work-in-Progress tracking is a tedious process for those manufacturing industries which does not runs on conveyor systems. There are lots of statutory and regulatory requirements implied on the shop floor like Material, machine and operator traceability, monitoring and measuring of environmental conditions, tracking of curing processes etc. Most of the manufacturing industries are still running on the conventional method of WIP Tracking and monitoring using hard copy routing sheets, reports etc.

Many industries, such as food factory, drug industry, space flight, and automobile factory, had established the information system for product tracking. Advanced WIP Tracking systems are available in market based on barcode and RF-IDs. Scanning points are deployed in the factory to monitor product movement and each scanning point is associated with a machine and operation. The operator will update the status of the production by scanning these barcodes / RF-ID by the barcode scanner / RF-ID reader. Comparing with the conventional method of WIP tracking, these systems provide a fair visibility about the shop floor processes and WIP.

The disadvantages of barcode / RF-ID is that they are passive in nature i.e., the communication is unidirectional. None of the barcode / RF-ID affixed on the product provides the status of the product unless otherwise scanned and viewed by a PC interface.

Here comes the new generation solution for the WIP tracking, The IoT Tag. The small tag will be equipped with rich set of interfaces like internet connectivity, a small graphic display, RF-ID reader, environment sensors and some product specific interfaces.

The WIP Tracking software is specifically designed to provide work in progress visibility throughout the factory, validate the process flow, and provide history of the process steps accomplished on a product. It is a modular and scalable system that tracks products anywhere on the factory floor until they are finished and put in stock or shipped. With this solution, efficient data collection is combined with error proofing solutions to demonstrate process compliance while reducing material and assembly costs.WIP Tracking software uses real-time information to track the physical location and quantities of all WIP in the assembly process. It gives users instant access to

- Exact location of products.
- Counts of products that are in WIP.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 9, September 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1109013 |

- Proof, that products have completed all the required manufacturing steps.

WIP Tracking and Route Control ensures products are manufactured following the right steps in the specified order, for optimal quality. The software validates that products flow through the proper sequence of process steps while providing visibility of products waiting for, or currently in process at an operation.

## II. RELATED WORK

The process flow of manufacturing industries are identified. The process starts with the reception of material from different suppliers. Materials are accepted based on the incoming inspection plan and moves to stores. The Production floor receives the parts as kits from stores for a particular product. The manufacturing, inspection, testing and integration is carried out in the shop floor and after the acceptance test and inspection, the finished product moves to finished goods stores and then to the customer.

The existing WIP tracking mechanisms uses hard copy, excel reports, ERP software, Barcode and RFID tracking. Most of these are purely manual operation. The operators shall provide the daily output through daily production tacker and the same is updated in the excel reports. Industries with ERP having good shop floor module uses the ERP itself to track the WIP. The hard copy reports are used to update the ERP. Barcode / RFID affixed on the products are scanned at each work stations and the same is updated to the ERP / Reporting software.

The product location tracking is required for this project to track the missing / misplaced products. GPS tracking is not possible indoor since the signals are weak inside the building. The Wi-Fi's Received Signal Strength Intensity (RSSI) can be used to find the location of the missing product. It requires at least 3 Wi-Fi routers inside the floor to get the location by triangulation method.

## III. PROPOSED SYSTEM

### System Architecture

The system is based on a small IoT Tag which was equipped with an internet connectivity, a small display to show the status of the product, an RF-ID interface to capture the operator and machine traceability and some product specific interfaces. After receiving the kit from stores, the tag will be attached to the base material of the product and assign a unique serial number for the tag. Upon completion of each operation, the operator / machine shall update the process completion thru the tag. The operator traceability will be captured thru the RF-ID interface. Operators can use their own access card to update the tag. The updated operation status along with the environmental condition and other relevant data will be send to the server through the shop floor Wi-Fi. There will be a web based user interface to monitor the WIP, generate reports etc. **Figure 1** shows the system architecture.

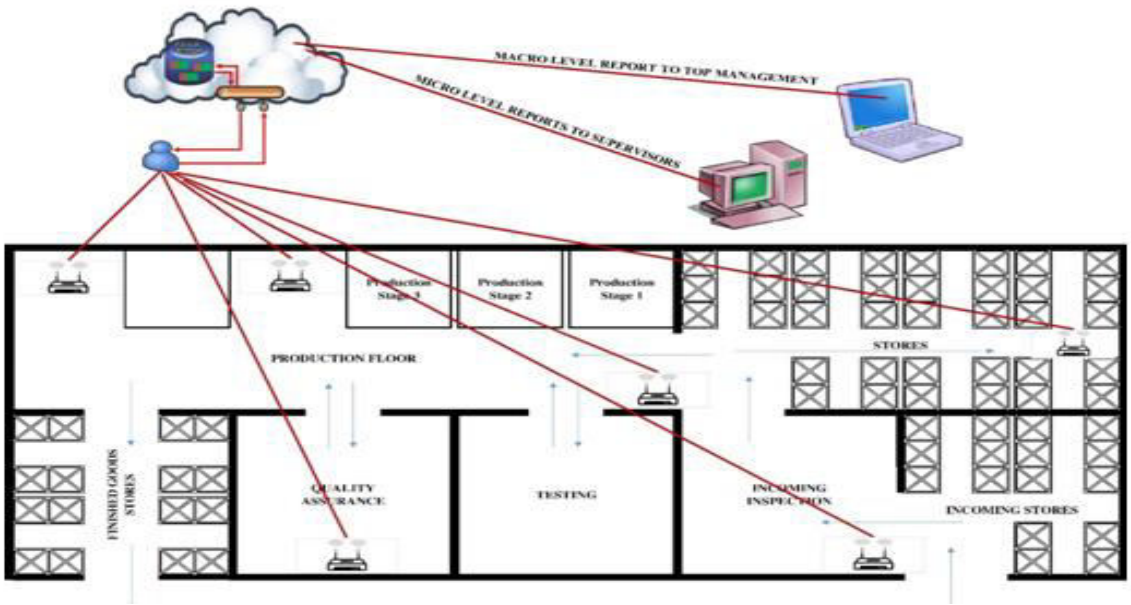


Fig.1. The system architecture.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 9, September 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1109013 |

## IV. ALGORITHM

After receiving the kit from stores, the tag will be attached to the base material of the product and assign a unique serial number for the tag. The algorithm used in tag is as follows.

1. Load the product information
2. Display the status of the product.
3. Check if operation is complete then update the status.

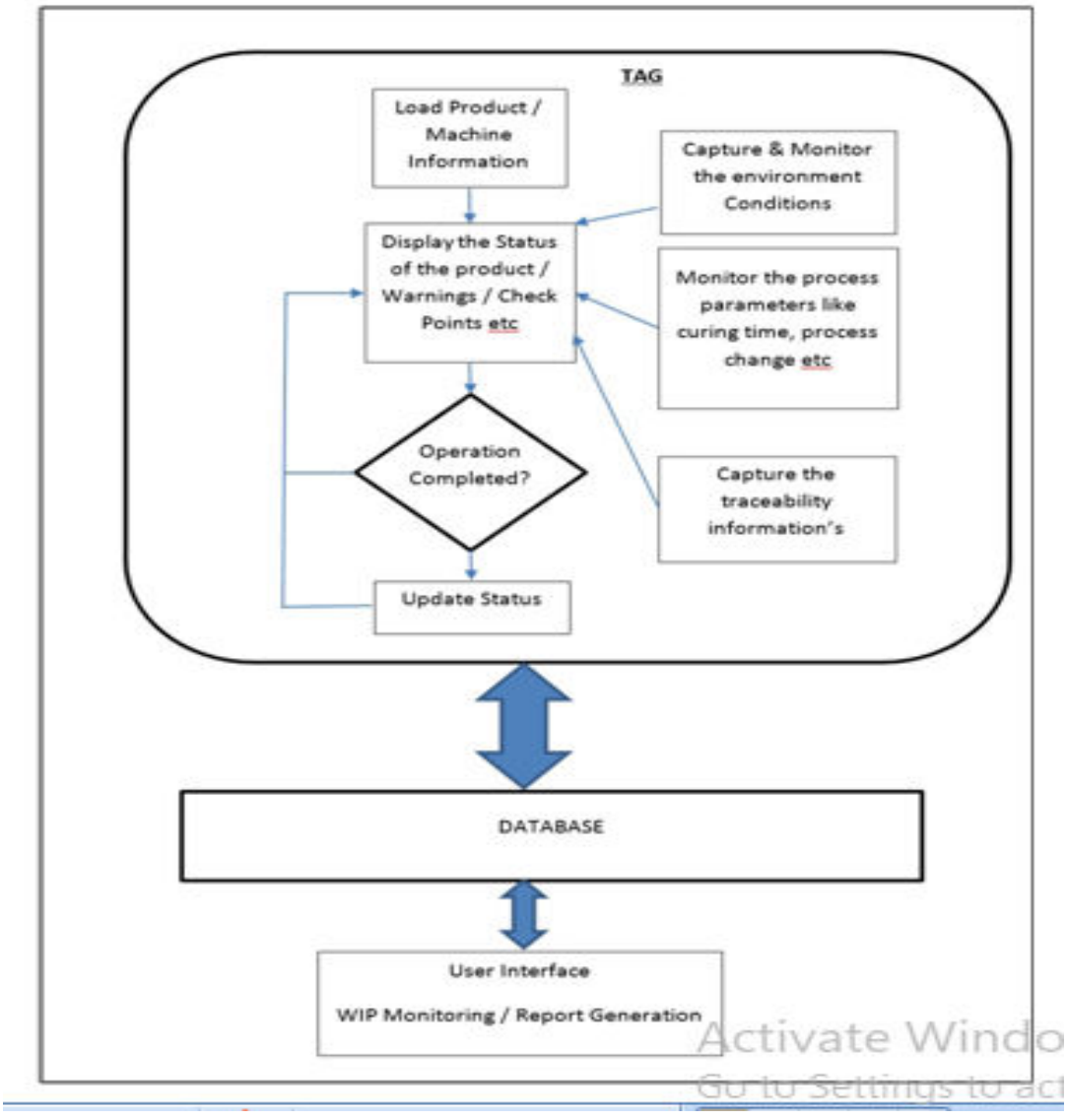


Fig.2. Flow chart

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 9, September 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1109013 |

## V. THE IOT TAG

### 1. Tag Architecture

A small tag will be attached to the base material of the product. The operator shall press on a switch after completing each stage. Operators can use their own punching card (RF_ID) to log the traceability. The Tag shall send the actual status of the product to the cloud through the shop floor Wi-Fi. It also send the environmental conditions like temperature, humidity etc. The same tag shall be used for work instruction display. This will be helpful for the operators to refer the product related instructions from the product itself. The tag can be programmed to indicate any safety warnings / indications that is managed by the concerned section in charge. Suppose there is a change in process which are to be carried out from a particular serial number say 985, the in-charge can upload the change control request to those tags with serial number above 985. The operator will get feedback from the tag regarding the process change so that they can implement the change.

Each and every operation in a machine can be tracked thru a tag fixed in a machine used in assembly shop. The tag in the machine can directly communicate with the tag in the product so that the machine traceability can be captures easily. This tag can be used for tracking the preventive maintenance schedules, breakdown services, number of strokes done, machine utilization etc.

The canban bin can be equipped with the tag to indicate the status of canban bins. The bin in stores can be provided with the tag to track the actual stock of the material. This can be used as an indicator while taking kits for assembly.

The product tag can be converted to an inspection plan or Test reference. It will shows the check list of inspection or test parameter of testing. If there is a provision for serial output in the test equipment, the tag can be directly connected to the device and the test report can be send to the data base.

Ensuring proper control of moisture sensitive devices (MSDs) during assembly has a direct impact on the reliability of the finished product. MSD Control is widely recognized as a critical and difficult process to manage because internal defects are nearly impossible to detect. The Tag shall capture the temperature, humidity etc. of the shop floor and the user will be alerted if any environment condition changed beyond the specification.

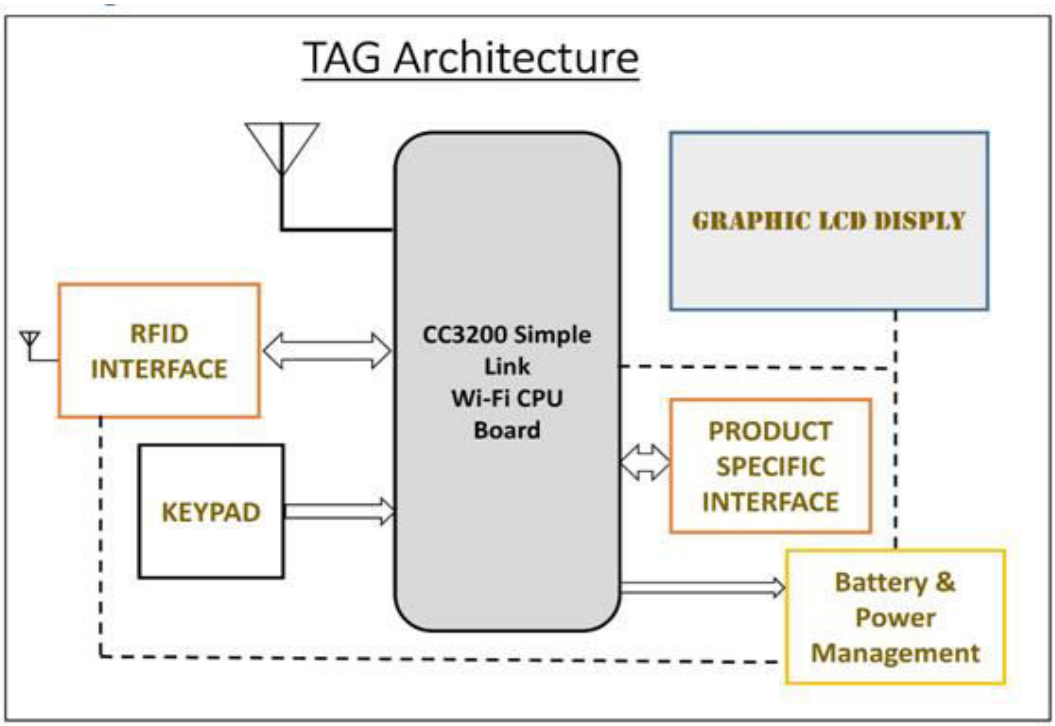


Fig.3. Tag Architecture

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 9, September 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1109013 |

### 2. The Tag Programming

The tag is programmed using the TI-RTOS real time operating system in C. The compiler used is TI's C compiler. The IDE used is TI's Code composer studio.

TI-RTOS is a scalable, one-stop embedded tools ecosystem for TI devices. It scales from a real-time multitasking kernel (SYS/BIOS) to a complete RTOS solution including additional middleware components and device drivers. By providing essential system software components that are pre-tested and pre-integrated, TI-RTOS enables us to focus on differentiating the application.

Below RTOS drivers are used for peripheral interfaces in the programming of tag.

- SPI interface for the OLED Display and Temperature sensor
- UART interface for RFID Tag
- Wi-Fi driver for the internet connectivity
- GPIOs for LED indications and input keypad

## VI. CONCLUSION AND FUTURE WORK

The study of existing WIP tracking mechanism in manufacturing industries are done. Pointed out their difficulties in tracking the WIP. We propose an active solution for the WIP tracking, monitoring and manufacturing process control using IoT Tags.

Designed and developed the hardware for the IOT Tag and programmed the same with the RTOS in C. The peripheral interfaces were made and successfully communicated.

Developed the user interface and database for the project and the tag to web communication made successful.

## REFERENCES

1. Changyong Yin, Qingzhong Gao and Jinghe Tian: WIP Tracking and Monitoring System Based on RFID (2012).
2. Gang Huang, Xiaodong Yuan, Jinhang Li: Developing Real-time Manufacturing Execution System for Automobile Assembly Factory (2010).
3. WANG Zhiguo, XU Jiahong, ZHANG Jun: Real-time WIP Status Monitoring Model in Discrete Manufacturing Workshop.
4. Tsong Jye Ng, Ming Mao Wong, Jing Bing Zhang and Oon Peen Gan: RFID for MRO Work In Progress Tracking (2006).
5. A. Ah, L. A. Latid, and N. Fisal: GPS-free Indoor Location Tracking in Mobile Ad Hoc Network (MANET)Using RSSI.
6. Anindya S. Paul and Eric A. Wan: WI-FI based indoor localization and tracking using sigma-point kalman filtering methods.
7. Da Zhang, Feng Xia, Zhuo Yang, Lin Yao and Wenhong Zhao: Localization Technologies for Indoor Human Tracking.
8. Yogaprakash.K and Wee-Seng Soh: Indoor Location Tracking Using Low-Cost Modules.

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.379

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

## IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details