FSM Online Internship Completion Report
on

Axisymmetric Part Storage and Insertion Station Dashboard

In
Industrial Internet of Things

Submitted by

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Axisymmetric Part Storage and Insertion Station Dashboard

Abstract

For various users on a factory floor to be able to effectively use the cutting-edge technology to optimize their needs, they need to be able to see what is happening in their machines on various levels. By connecting the sensors in the machine to the internet and being able to have that information in their hands whenever they need it, we are providing them the means to do so. I have created a dashboard that is able to display the information from the Kepware server and provide it to the users and optimize it for their individual needs. Dashboards are created in such a way that they are able to display the most important information in the most effective way possible.

IIoT, Dashboard, IoT, UI

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1. Introduction

Cyber physical assembly line

The Cyber physical assembly line consists of various modules which have specific purposes and a multi-purpose Robot. The objective of the assembly line is to manufacture high quality Directional control valves. Orders for the valves can be placed via mobile phones or CPs. The available valves are of the configuration – 3/2 Single Solenoid valve, 5/2 Single Solenoid valve, 5/2 Double Solenoid valve, 5/3 Double Solenoid valve. A pallet with the valve body sits on a conveyor and is moved through the assembly line.

Workstation 2

The process starts when the pallet is detected. The conveyor stops and a pair of cylinders clamp the pallet. A RFID reader scans the RFID tag to find out the type of valve present. A camera, using image processing, finds out the location of the hole where the spoolis to be inserted and this information is communicated to the PLC. The conveyor starts moving and stops at the next station. A Gripper grabs a spool from the inventory depending upon the type of valve and inserts it inside the valve. Once the gripper goes back to its home position, the pallet gets disengaged and the conveyor takes the pallett to the next station.

2. Problem Definition

Creation of a dashboard that is a complete link between simulated data for the user that will demonstrate working of an actual dashboard in Industry.

3. Existing Solution

The current solutions are as displayed below.

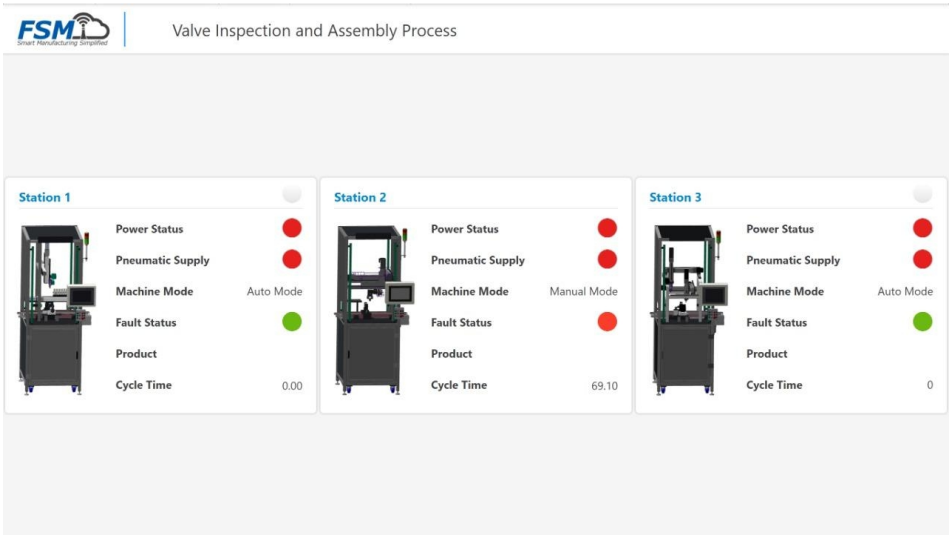

Fig1: existing solution

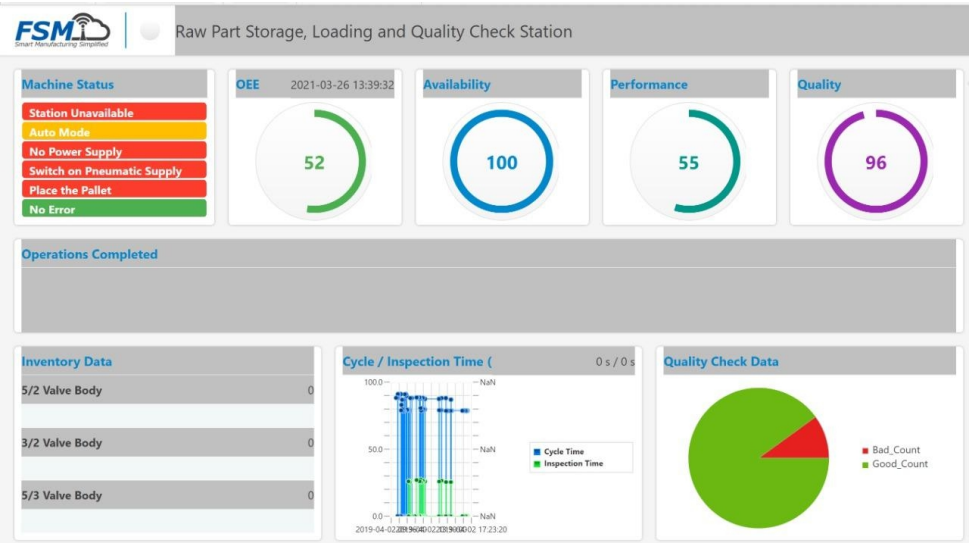

Fig 2: existing solution

The first dashboard contains an overview about the entire workstation and when clicked on leads to a specific workstation dashboard. These dashboards show vital information such as OEE, performance, Inventory data and machine status.

4. Proposed Development

My approach consists of adding more information than the previous approach. So that the operator gets all the information he needs to understand the machine and its workings. Boolean values are used to indicate on / off or healthy /faulty status. Led Displays will be used to display numeric data. There are a few cases where just displaying real time information will not be sufficient, such as speeds where the user will need to see earlier values. Graphs will be used to show historic values so that the operator can get the context about data. I have displayed current values for them as well just in case there is some need for it. I have included tables that contain multiple columns of important data that do not fit the above categories like product history to show the exact time when a product was dispatched from the workstation. I also have made aesthetic additions to the dashboard. The purpose of the dashboard is to be real time, so I have made sure that values are updated regularly and not just on refreshing the page.

5. Functional Implementation

Kepware

The data was created in Kepware by creating tags that would simulate data streams. Tags were created according to the tags given by mentors that were present in the actual workstation. Data types, names and ranges were assigned to each tag.

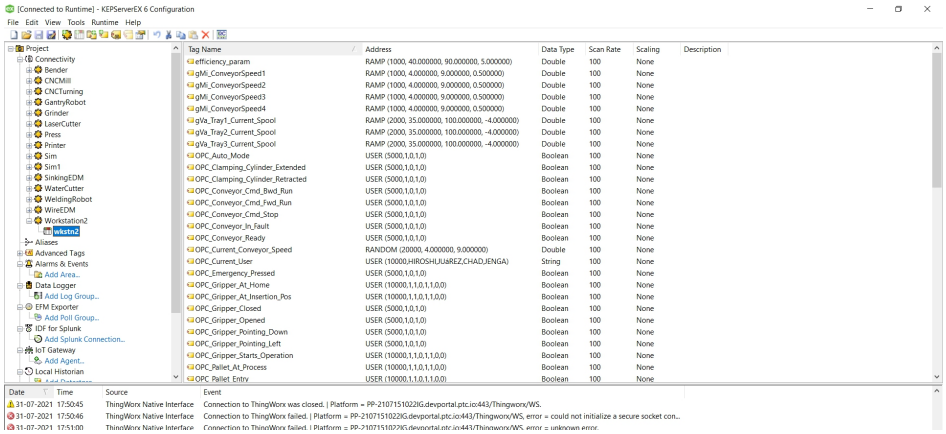

Fig 3: Kepware server, where the data is simulated

Workstation 2 Thing

The workstation thing would consist of 2 components, a thing template that would contain the basic properties that are required for each workstation, not just mine. It would include current user, conveyor speed and so on. The thing template would consist of specific objects that are not necessarily present in every station such as a camera to find valve location or a mechanism for spool insertion. A thing was created that would utilize both these facilities to create a unique thing for workstation 2. I created alerts according to the parameters. Some parameters, if varied, would require the operator's attention.

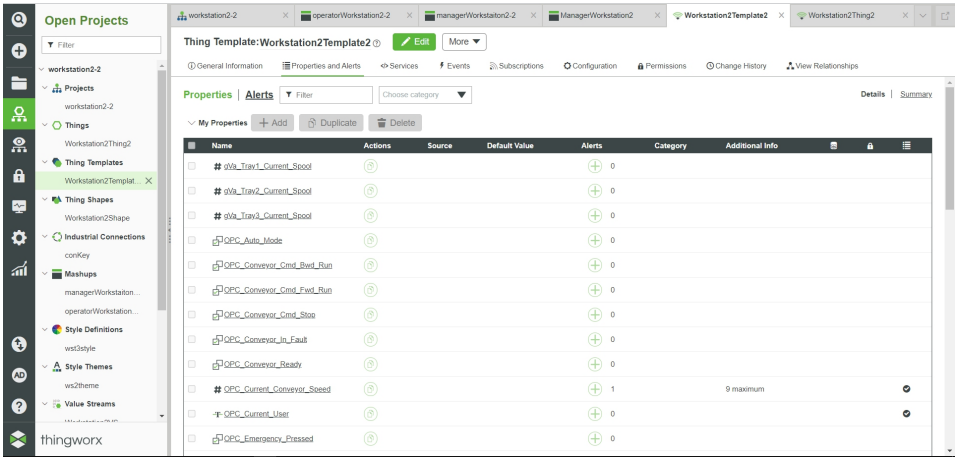

Fig 4: Thing which will be used for workstation 2 Connections

Connection

Thingworx can be connected to the server by entering the information about the Thingworx server and providing a unique key. On the other side, In Thingworx, an application key, and a value stream thing needs to be created. The value stream will help link Kepware to Thingworx. The OPC quick client will then start sending the data according to the tag's specification. In Thingworx, these data tags need to be bound to the thing for workstation 2 and it has to be specified if the historic data for that tag is required.

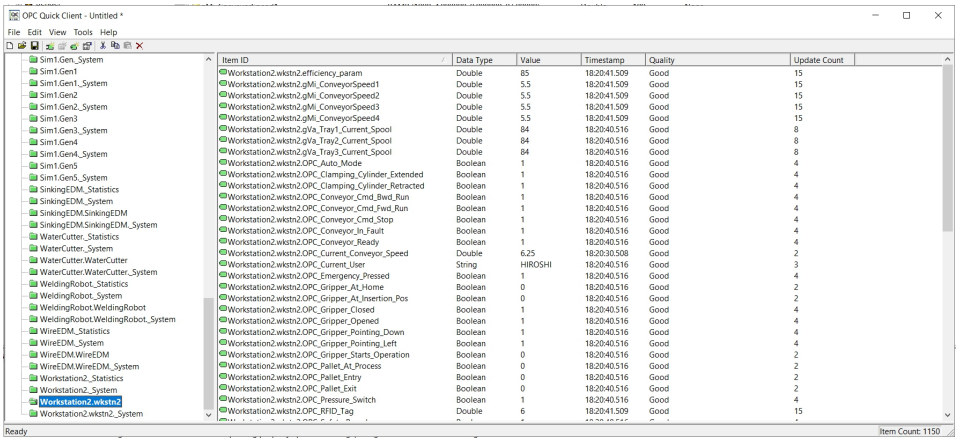

Fig 5: OPC quick client for connecting information to Thingworx

Design

THe design was an iterative process where each iteration improved upon the previous one in terms of functionality. The original design was created in Adobe XD which is a tool used for prototype UI designs . Important tags were identified and grouped together according to their functionality. tags for Other types of displaying information such as charts and tables were also defined. After the first set of feedback, I started to work on the actual design in Thingworx. The first set was impractical in many ways and was changed to fit the constraints of the Thingworx software. After fixing the position for the widget I started working on the design aspect.

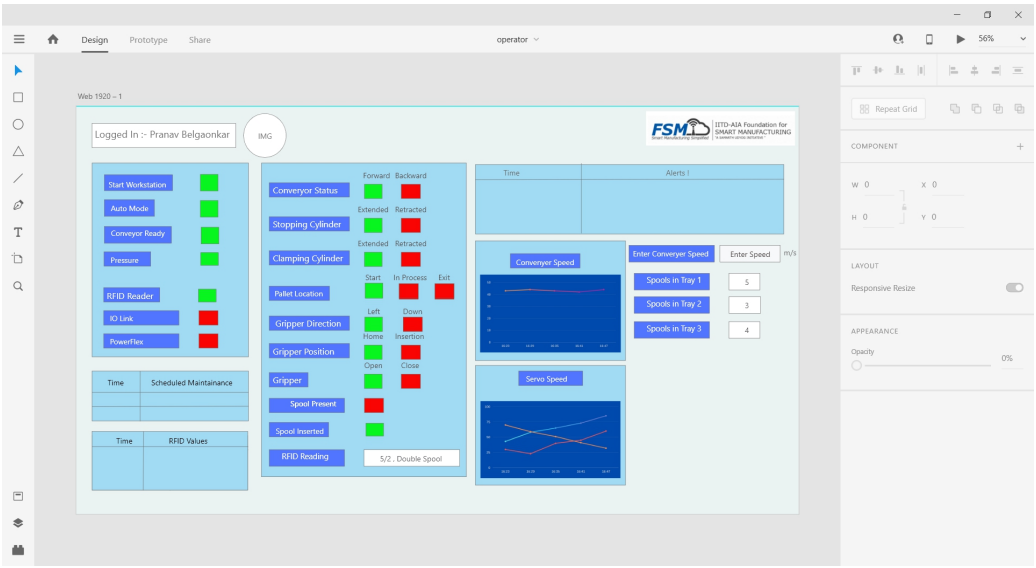

Fig 6: operator design in Adobe XD

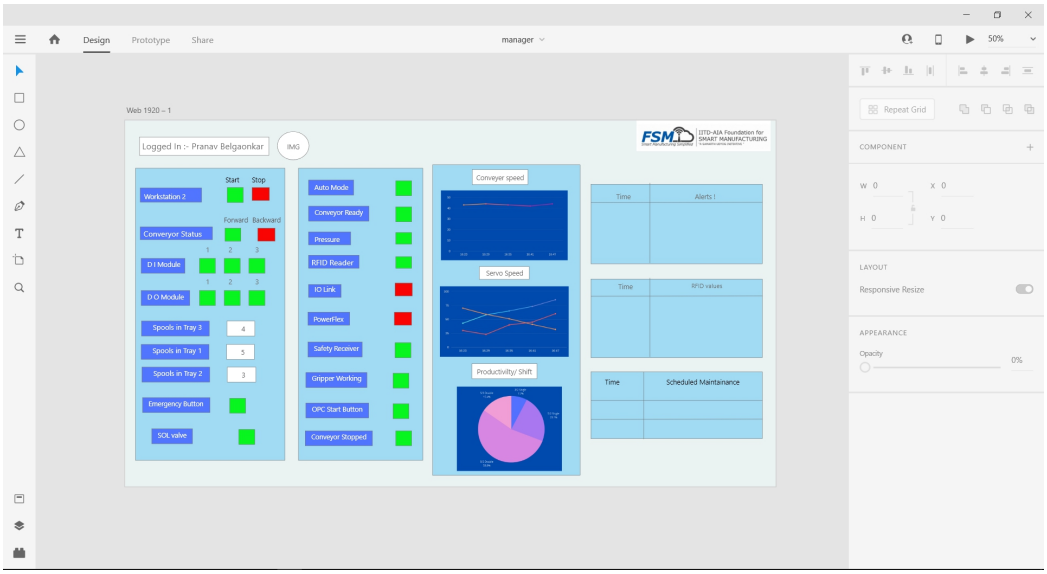

Fig 7: Manager design in Adobe XD

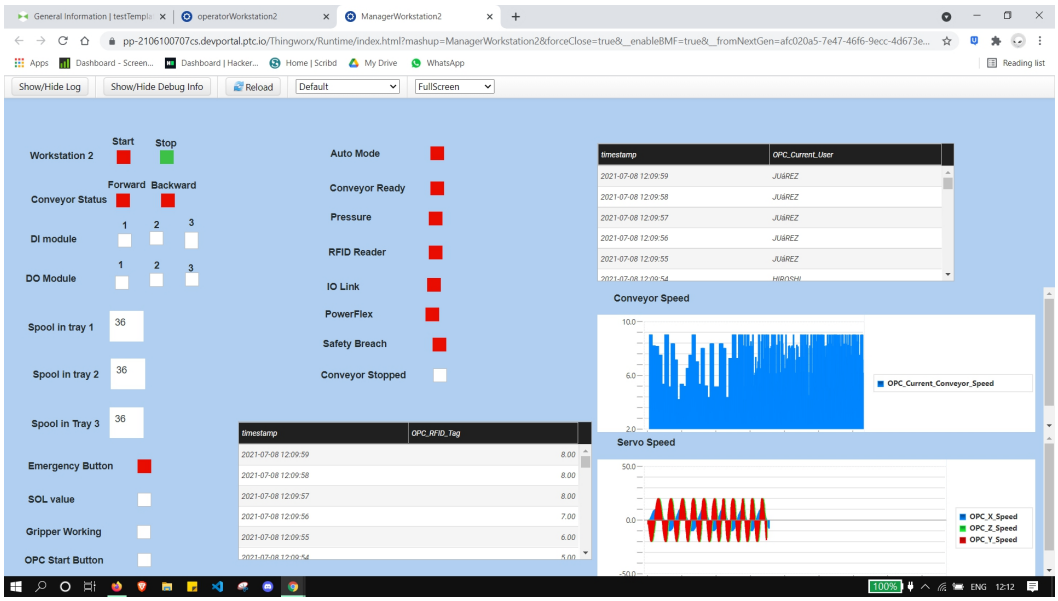

Fig 8: 1st manager dashboard

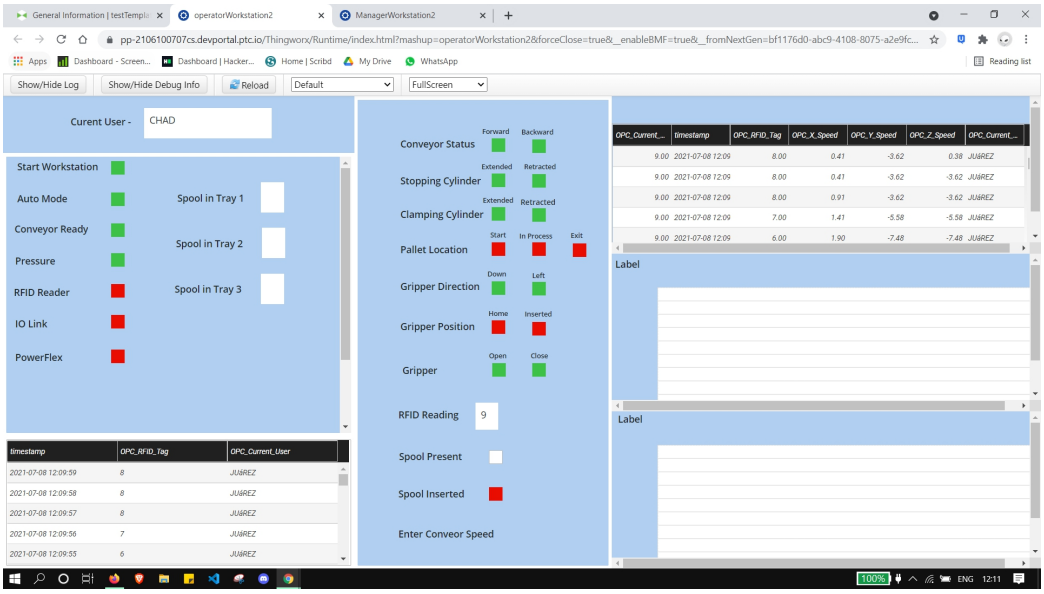

Fig 9: 1st operator dashboard

I created a theme that will be applied to all the containers. A style element was created that would be applied to labels that were placed as headers. A few other changes were made to the text for labels.
Finally data was bound to the shapes, tables , and charts using getpropertyvalues for realtime data, queryAlertHisotry for alert history and queryPropertyHistory for Historic data. A lot of effort went into adjusting each and every panel to make sure that they line up and look perfect in the final dashboard.

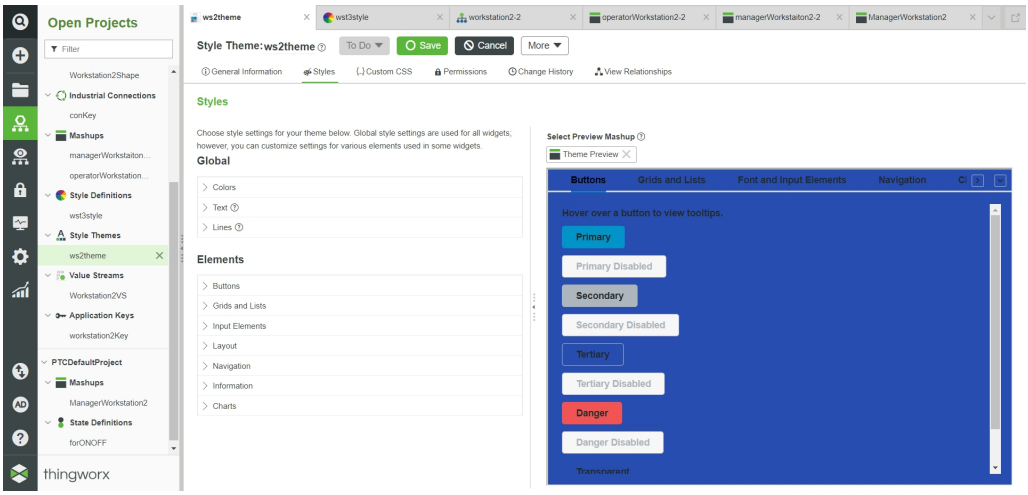

Fig 10: Theme for the dashboard design

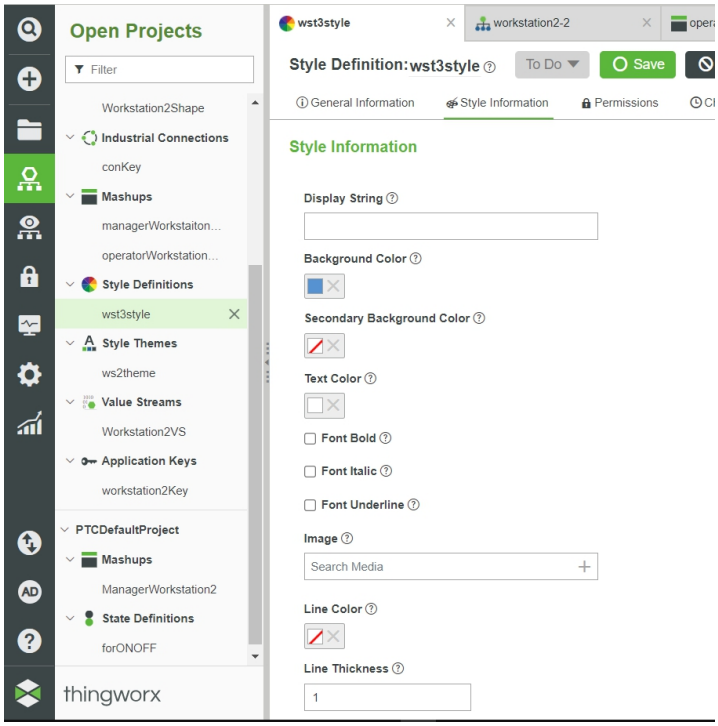

Fig 11: style for panels

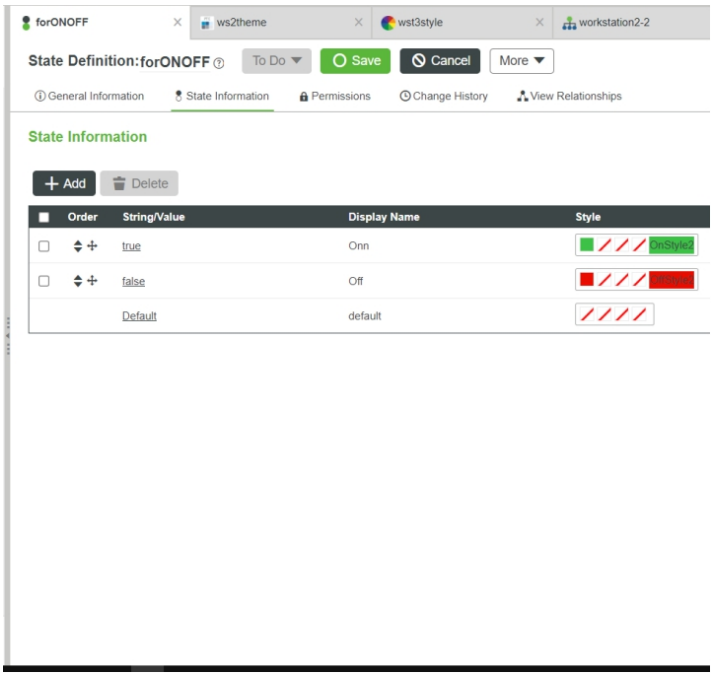

Fig 12: style for shape widget (to turn it on and off)

6. Final Deliverable

The final deliverable consists of a complete monitoring solution for the users along with partitions that will customize the experience for each user according to each user. The person will be able to view all the information that is required to manage workstation 2. Notifications will be created when unusual behaviour is detected.

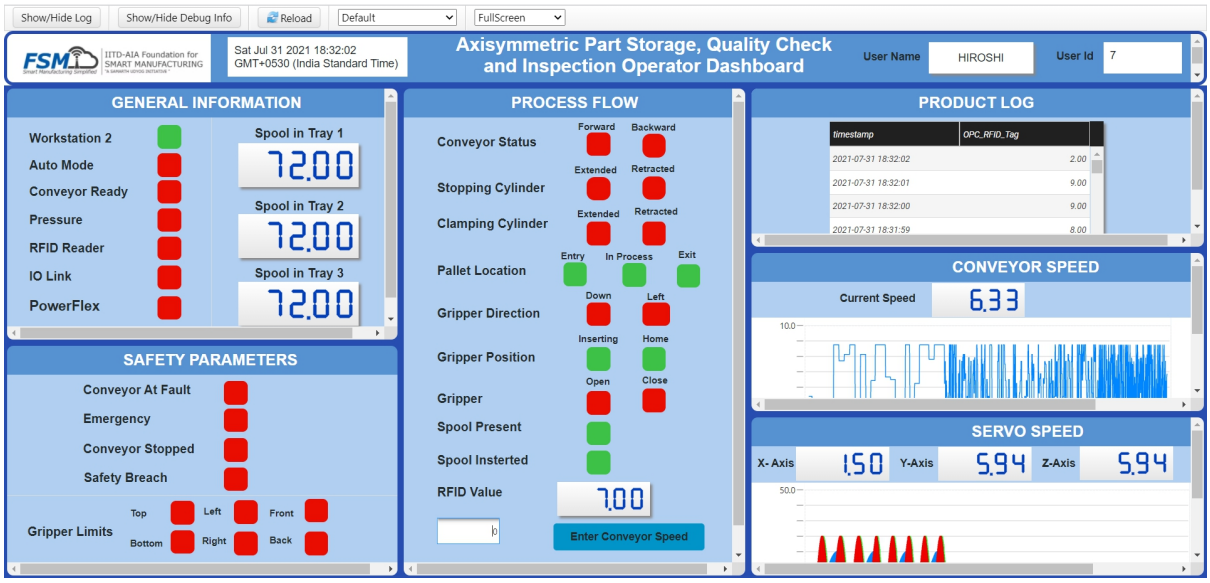

Fig 13: Operator Dashboard

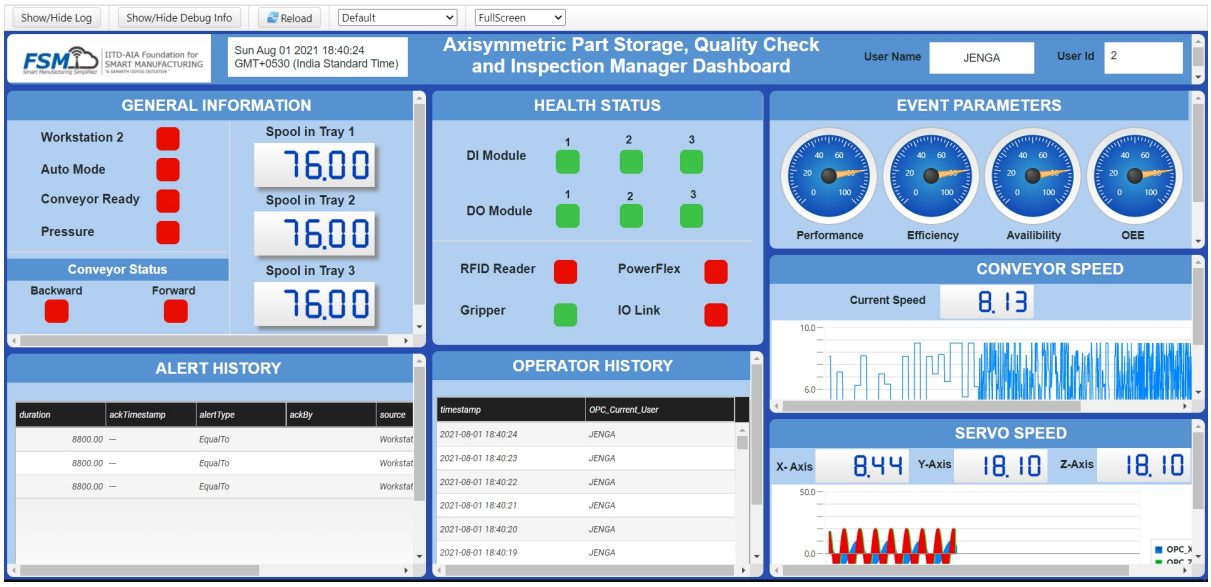

Fig 14: Manager Dashboard

7. Innovation in Implementation

A lot of time and effort went into deciding the design of the dashboard. The objective was to create a dashboard that will contain the maximum information that I can cram in a browser window without the dashboard looking too crowded or unreadable and would contain a certain flow the same way in the same way that the actual process was taking place. A lot of experimentation was required to make sure that the tags were grouped to similar tags. For example, all the safety parameters were grouped together away from general information and to a place where the user would be able to see them clearly. A lot of effort also went into deciding how they should be displayed. As I mentioned above the speed data would be useless if no context was provided whether the speed was appropriate or not. The same thought process was applied to components such as RFID values and operator history. A little use of CSS was done to enhance the look of the dashboard. While a skeleton was being created that would later be made into a dashboard, I researched to add style so as to not make it bland and unattractive to the viewer's eyes.

That was also an iterative process of trying and rejecting colours and various placement of panels along the white, skeleton dashboard.

8. Scalability to Solve Industrial Problem

Any company that has useful data about its machines and wants to display it will be able to do so. Each aspect of the machine or the factory can be displayed. The sensors can send the data over the internet to the server. The Server will then send the data to the dashboard. The organization can create dashboards and alerts according to their convenience. They can assign specific people who make the dashboards and others who will be able to view them. Permissions can be given to each user depending on his role in the organization.

9. References

https://www.fsmskills.in/my/

https://support.ptc.com/help/thingworx_hc/thingworx_8_hc/en/index.html#page/ThingWorx/Help/Best_Practices_for_Developing_Applications/visualization_widgets.html

https://www.youtube.com/watch?v=zzMUdzZRYqk&pp=sAQA