1. Introduction

This section gives a scope description and overview of everything included in this SRS document. Also, the purpose for this document is described and a list of abbreviations and definitions is provided.

1.1 Purpose

The purpose of this document is to give a detailed description of the requirements for the “IIT Indore Industry 4.0 Cyber Twin System” (ISW) software. It will illustrate the purpose and complete declaration for the development of system. It will also explain system constraints, interface and interactions with other external applications. This document is primarily intended to be proposed to a customer for its approval and a reference for developing the first version of the system for the development team.

1.2 Scope [TODO]

The “ISW” is a Cyber Physical System that provides Manual Interface for Machines such as 3D Printers, CNC Milling etc. with ability to adapt new Generic Machines. It provides user-friendly interface to input the current state of the Machine. Only Authenticated Machines as determined by the ISW Server are allowed to log-in.

The Machine States are stored in a local server for Analytic Purpose and for Predicting the Failure of certain Machine/Tool using Machine Learning Algorithms such as Neural Networks.

1.3 Definitions, acronyms, and abbreviations

|  |  |
| --- | --- |
| Terms | Definitions |
| User | Someone who interacts with the Computer which is dedicated to a specific Machine |
| Industrialist | Any Industry Person who interacts with the Main ISW Server |
| Seller | Any Person who wishes to sell specific Machine Parts |
| States | The Different States of a Machine in Manual Interface |
| CPS | Cyber Physical Systems |
| Industry 4.0 | Current trend of automation and data exchange in manufacturing technologies incorporating CPS |
| Web Portal | A Web Application that provides the Manual Interface for a Machine |
| Stakeholder | Any Person who has interaction with the system who is not a developer |
| ML | Machine Learning |
| DEP | Dependency |
| TAG | A unique, persistent identifier contained in a PLanguage statement [2] |
| GIST | A short, simple description of the concept contained in a PLanguage statement [2] |
| MUST | The minimum level required to avoid failure contained in a PLanguage statement [2] |
| PLAN | The level at which good success can be claimed contained in a PLanguage statement [2] |
| WISH | A desirable level of achievement that may not be attainable through available means contained in a PLanguage statement [2] |
| DEFINED | The official definition of a term contained in a PLanguage statement [2] |

1.4 References

[1] IEEE Software Engineering Standards Committee, “IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications”, October 20, 1998.

[2] Competitive Engineering, Tom Gilb

1.5 Overview

The remainder of this document includes three chapters and appendixes TODO. The second one provides an overview of the system functionality and system interaction with other systems. This chapter also introduces different types of stakeholders and their interaction with the system. Further, the chapter also mentions the system constraints and assumptions about the product.

The third chapter provides the requirements specification in detailed terms and a description of the different system interfaces. Different specification techniques are used in order to specify the requirements more precisely for different audiences. The fourth chapter deals with the prioritization of the requirements. It includes a motivation for the chosen prioritization methods and discusses why other alternatives were not chosen.

The Appendixes in the end of the document include the all results of the requirement prioritization and a release plan based on them

2. General Description

This section will give an overview of the whole cyber physical system. The system will be explained in its context to show how the system interacts with other systems and introduce the basic functionality of it. It will also describe what type of stakeholders that will use the system and what functionality is available for each type. At last, the constraints and assumptions for the system will be presented.

2.1 Product Perspective

The Cyber Physical System is a cluster of various Machines that operate under a centralized main server (“ISW”). Each Machine is associated with its own local Server that logs the different states of the Machine namely the Process its undergoing, which components have failed and status of the operator.

Each Machine provides its own user-friendly Manual Interface on its local server where the operator can enter the current state of the Machine.

Each Local Server incorporates an Analytic Engine that is capable of taking decentralized decisions for the Machine and perform their tasks as autonomously as possible. The Local Server specific to a machine for e.g. 3D Printers, CNC Milling etc. also maintains its own database which logs the previous states of the Machine.

The Analytic Engine performs various Machine Learning (ML) Algorithms to predict the failure of a Machine by taking in various sensor provided Inputs of Temperature, Vibrations, Stress/Strain etc. along with the states of the Machines taken directly from the user for which input cannot be taken from sensors.

The Prediction of the Analytic Engine is then sent to the Main Server(“ISW”) which provides the platform for different tasks such as putting up a notice for different parts that are required so that interested sellers might contact.

2.2 Product Functions

The Manual User Interface (web @Elaborate) will provide various options to select the current Machine State. The Operator needs to manually enter the Data here as no sensors are available to detect the states defined in this Interface. Other Data are collected via sensors and fed to the Analytic Engine.

The Selected States are stored in a database of the Computer dedicated to a specific Machine. The Manual Interface must be accessible via Desktop as well as Mobile Browsers to facilitate the ease of operation.

The Analytic Engine performs various ML Algorithms on the data…

//TODO

2.3 User Characteristics

There are mainly three types of user that interact with the system: Operator, the Industry Person and the Buyer/Seller.

Operator will have access to the Local system dedicated to a Machine. Operator can access the Manual Interface by logging into the system and hence can change the state of the Machine. None of the users is expected to have any technical know-how of the working of the software.

Other Users are not part of Local Server interaction. Instead, they directly interact with the main ISW Server. Industry Person can look up information of each machine such as Current Process and which Machines are about to or already have failed.

2.4 General Constraints

The Internet Connection / Availability of LAN is a major constraint for this Software. Since Data is fetched from the Main Server and sent back to the same, it is crucial that there is Connectivity between the Servers.

The Web Portal on the Local Machine is also constrained by the Capacity of the Main Server. Requests from various Machines may be forced to queue which increases the fetch / write time affecting Performance.

2.5 Assumptions and Dependencies

One Assumptions about the product is that it will always be used on Server Grade Hardware that has ability to process parallel data fast. The Manual Interface will be accessible both from Mobile Phones and a Dedicated Desktop associated with each Machine.

The Manual Interface will make use of latest technologies which require a modern compatible browser associated with it. It is assumed that such condition is always met and the Computers have minimum hardware specification to run the latest browsers.

Since it is a web-based portal it is intended to be Operating System independent.

3. Specific Requirements

3.2 Functional Requirements

3.2.1 Manual Interface

3.2.1.1 Log-In Page

The Local Machine allows only Authenticated Users to login. Each User or Machine has its own Profile Created in the Main ISW Server. In order to use the Manual Interface,

* User-Id
* Password

must be entered in the Login-Form.

Scenario: On Successful Login

Given the user is logged in,

The Manual Interface is presented

Scenario: Login Failed Due to Incorrect User-Id and/or Password

A warning is displayed stating incorrect Credentials and asks for login-info again.

3.2.1.2 Manual Interface

Each Machine has a dedicated Server that collects information about the Machine and stores the data locally as well as sends it to the main ISW Server. The Manual Interface allows to choose states of the Machine that cannot be taken via sensors such as Availability of Operator and Failure of a Certain Components.

The States are pre-defined (before deployment) but can be extended to every Machine. The States are majorly categorized as

* Active
* Failure
* Idle

Only a Single state can be selected at a time. The Active Modes / Failure Modes are specific to each Machine, the data of which is collected from the Client before-hand. The Category “Idle” also contains several sub categories such as ‘Operator Busy’, ‘Operator Unavailable’ as well as Machine specific states such as ‘No Raw Materials’ etc.

It Provides a *Generic Template* which can be customized for different Machines.

Scenario: ON SELECT STATE:

Given the User is logged in,

And a Valid State is Selected,

The Currently selected state is stored on the Local Machine’s Database.

And the same is sent to the ISW Server.

3.2.1.3 Analytic Engine

The Analytic Engine is local to each Machine’s dedicated server. It Performs k-Nearest Neighbour Pattern Recognition Algorithm to Analyse the Stored **States** and predict the failure of a certain Machine Part based on the recent Machine **States**.

DEP : Manual Interface