Software Requirements Specification

for

Quality Analysis using Image Processing of Real Time Data in Industry 4.0

Version 1.1 approved

Prepared by: Zohair Lokhandwala & Sibte Abbas

SZABIST

1st Dec 2019

Table of Contents

Table of Contents ii

Revision History ii

1. Introduction 1

1.1 Purpose 1

1.2 Document Conventions 1

1.3 Intended Audience and Reading Suggestions 1

1.4 Product Scope 1

1.5 References 1

2. Overall Description 2

2.1 Product Perspective 2

2.2 Product Functions 2

2.3 User Classes and Characteristics 2

2.4 Operating Environment 2

2.5 Design and Implementation Constraints 2

2.6 User Documentation 2

2.7 Assumptions and Dependencies 3

3. External Interface Requirements 3

3.1 User Interfaces 3

3.2 Hardware Interfaces 3

3.3 Software Interfaces 3

3.4 Communications Interfaces 3

4. System Features 3

4.1 System Feature 1 3

5. Other Nonfunctional Requirements 5

5.1 Performance Requirements 5

5.2 Safety Requirements 6

5.3 Security Requirements 6

5.4 Software Quality Attributes 6

5.5 Business Rules 6

Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Date** | **Reason For Changes** | **Version** |
| ERD | 1st Dec | Update in ERD | 1.1 |
|  |  |  |  |

# Introduction

## Purpose

The aim of this document is to present a complete description about our Image Processing system. To be specific, this document is going to describe functionality, external interfaces, performance, attributes and the design constraints of the system which is going to be developed. This document is intended for users of the system only.

## Document Conventions

This Document was created based on the IEEE template for System Requirement Specification Documents. It uses font style Times New Roman for headings and Arial for body and follows the size 14 and 11 respectively.

## Intended Audience and Reading Suggestions

This document is intended for quality assurance engineers, programmers, researchers and developers who are interested in working on the project by further developing it or fixing bugs.

## Product Scope

The following system will be developed to make this whole process to be made automated, accurate and fast image processing system which could identify surface defects of gear, select gear with required dimensions (Gold plating) and count the number of teeth.

## References

Lashari, Haque & Ranjha, Himat. (2014). Gear Measurement Using Image Processing in Matlab. International Journal of Innovative Technology and Exploring Engineering (IJITEE). Volume-3. 43-47.

Truong, Mai & Kim, Sanghoon. (2017). Automatic image thresholding using Otsu’s method and entropy weighting scheme for surface defect detection. Soft Computing. 10.1007/s00500-017-2709-1.

Mavi, A., & Kaur, M. (2012). Identify Defects in Gears Using Digital Image Processing. *Int. Journal of Engineering Research and Development*, *1*, 49-55.

Gadelmawla, E. S. (2011). Computer vision algorithms for measurement and inspection of spur gears. *Measurement*, *44*(9), 1669-1678.

IEEE Template for System Requirement Specification Documents:

<https://goo.gl/nsUFwy>

# Overall Description

## Product Perspective

## 

## Product Functions

* The camera will capture the photos and send it to the server.
* Our system will fetch the images from the server.
* Our system will count the number of teeth of the gear
* Check the size of the gear
* Check the surface roughness

## User Classes and Characteristics

This system will be used by the operator of the gear hobbing machine to check the quality of each and every gear in real time.

## Operating Environment

This system will be developed on Python using the OpenCV library. It will require a computer and an internet connection to operate.

## Design and Implementation Constraints

The functionality of our system is constrained by data provided via the cameras on the machine.

## User Documentation

An SRS, SDS, and STD will be provided along with this project.

## Assumptions and Dependencies

The internet should be up and running all the time so the data can be uploaded to the sever. Our System relies on the cameras functioning properly and would shut down if that were not the case

# External Interface Requirements

## User Interfaces

The GUI in the form of web app will be used for data visualization through which the quality of the gears will be displayed in the form of graph or table.

## Hardware Interfaces

The user will interact with a keyboard and a mouse if he is using a computer to type information and move the cursor. User can also interact using a touch screen if he/she is using a tablet or a mobile phone. Camera will be used for capturing images. Raspberry Pi acts as an intermediate device for sending the data collected from these units to the server for further processing.

## Software Interfaces

We have chosen Python language with PyCharm IDE and SQL database to implement our project because of its more interactive support and save the reports.

## Communications Interfaces

UDP/TCP client-server module will provide the communication between our hardware device and our system. Data will be sent to server using UDP module and response data is received by TCP module.

# System Features

## System Feature 1

|  |  |
| --- | --- |
| Use-Case # | Uc-001 |
| Description | Camera will capture the images |
| Pre-Condition | Camera should be powered on |
| Use-Case | |  |  | | --- | --- | | Camera will capture the images | Image captured into the camera | |
| Post-Condition | Data will be uploaded to the servers. |

|  |  |
| --- | --- |
| Use-Case # | Uc-002 |
| Description | Data will be uploaded onto the server |
| Pre-Condition | Image should be captured and the camera is connected to the server. |
| Use-Case | |  |  | | --- | --- | | Data uploaded on server | Images saved on server | |
| Post-Condition | System will fetch data from the server |

|  |  |
| --- | --- |
| Use-Case # | Uc-003 |
| Description | System will fetch image |
| Pre-Condition | System should be connected to cloud |
| Use-Case | |  |  | | --- | --- | | Images ready to be processed | Images will be opened into the system | |
| Post-Condition | Image will be processed |

|  |  |
| --- | --- |
| Use-Case # | Uc-004 |
| Description | Noise removal of the images |
| Pre-Condition | Image should in process |
| Use-Case | |  |  | | --- | --- | | Noise Removal | It will remove the noise from the image | |
| Post-Condition | Output image with noise removed |

|  |  |
| --- | --- |
| Use-Case # | Uc-005 |
| Description | Convert image into greyscale |
| Pre-Condition | Image should be in process |
| Use-Case | |  |  | | --- | --- | | Conversion to greyscale | The image will be converted into greyscale. | |
| Post-Condition | Output image into greyscale |

|  |  |
| --- | --- |
| Use-Case # | Uc-006 |
| Description | Setting threshold |
| Pre-Condition | Image should be converted into greyscale |
| Use-Case | Set Threshold value | Threshold value will be set |
| Post-Condition | Threshold value adjusted |

|  |  |
| --- | --- |
| Use-Case # | Uc-007 |
| Description | Conversion to Binary |
| Pre-Condition | Image should be in grayscale format |
| Use-Case | Converting image to Binary | Image will be converted into binary form |
| Post-Condition | Image converted into binary |

|  |  |
| --- | --- |
| Use-Case # | Uc-008 |
| Description | Calculating Teeth’s of gear |
| Pre-Condition | Image should be in binary format |
| Use-Case | |  |  | | --- | --- | | Calculating number of teeth of gear using edge detection algorithms | Report will be generated | |
| Post-Condition | Number of teeth |

|  |  |
| --- | --- |
| Use-Case # | Uc-009 |
| Description | Calculating size of gear |
| Pre-Condition | Image should be in binary format |
| Use-Case | Calculating size of gear | Report will be generated |
| Post-Condition | Diameter of the gear in float |

|  |  |
| --- | --- |
| Use-Case # | Uc-0010 |
| Description | Calculate Surface roughness |
| Pre-Condition | Image should in binary form |
| Use-Case | |  |  | | --- | --- | | Calculating surface roughness of gear | Report will be generated | |
| Post-Condition |  |

# Other Nonfunctional Requirements

## Performance Requirements

Image processing should be optimized so it should not take time more than 2 seconds. Web server should not process every frame and should determine whether process or not the frame. System should work real-time which means there should be an acceptable time delay such as max 4-5 seconds between request and response. For desired performance, image capturing, transferred data size, speed of connection, response time, processing speed must be considered.

## Safety Requirements

Voltage levels on device should be adjusted. Noise or heat produced by the device should be minimized.

## Security Requirements

Streaming the device camera on web makes security measurements crucial. Accessing and interacting with the streaming web server should be controlled and any misusage should be prevented. User authorization and data encryption are important security requirements of the project. User stream should not be available to anyone who is not authorized by the user of the device. System should store user data on database securely and set access permissions to these data’s carefully.

## Software Quality Attributes

Availability Requirement: The internet should be up and running 24 hours.

Security Requirement: All communications between the system’s data server and clients will be encrypted.

Portability Requirement: The web application can be run on multiple browsers.

Performance Requirement: The web application will be light weight so it can be tun on slow internet connection as well.

## Business Rules

Since the product shall be used in the industry sector therefore the user using the product must abide by the laws & rules of that organization.