

# DIGITAL CHECKLIST PROCESS AUTOMATION FOR MACHINERY WITH ANIMATED EFFECTS

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## Abstract

Checklist is a standard list of necessary steps developed for a job which is repeated on several needs. Checklists are used in many work domains and play a vital role to improve the consistency and efficiency in various criteria. Checklists become mandatory in companies to take action and complete the tasks in a successful manner and make the machine to be in a standard condition. In this paper, the checklist is implemented for machinery (vacuum lifter). The proposed digital checklist automation is created to easily communicate with the users with animated effects and supports the user to execute the method in an easier and faster way. This makes the proposed method to effectively operate the machine. It is proved experimentally that the jobs of the users are operated easily minimizing down the time.

**Keywords:** checklist, digital automation, animation, vacuum lifter.

## 1. INTRODUCTION

Checklists helps to be more organized and it assures that the user never skips any steps in the process that has to be evaluated. They make the work easier and effective one. Checklists play a main role in many academic disciplines, and are considered to utilize within their own area to afford added benefits. The simple shopping lists used in daily life and to broad pre-flight applications, people use the checklist device for guiding and to verify their actions and activities. The use of checklists has also been a highly beneficial need. Checklists are a type of informational fact that develops the activities and decisions in routine works. The study by Furulund and Molokken-Ostvold [1], focussed in demonstrating the usefulness of checklists and experience data in increasing the estimation accuracy. They found that the projects with checklists used during estimation have relatively accurate estimates as compared to the projects in which checklists were not used.

The definition of a checklist [2] gives the overall clarity. Jorgensen [7] proposed a software cost management process framework and a preliminary checklist that represents the structure of the framework. He specified that the proposed preliminary checklist should be customized only to consider the relevant issues. Similarly, Passing and Shepperd [6] performed an experiment with student subjects and examined how the usage of checklists and group discussions supports the expert estimation. It was known that the checklists have improved the consistency and the transparency of size and effort estimates of the process. Further, it was also found that the usage of checklist increased the confidence in their estimation.

This paper illustrates the digital checklist process automation with animated effects, is created to minimize the manual time taken and to check the functioning and the performance of the machine using the proposed method. The method is implemented using two different categories.

In category 1, the method is applied with checklists for the machine, vacuum lifter. The machine operates to move the object from one place to another with no extra human power. In vacuum based lifting techniques, suction pad is placed over the object to be lifted [15]. In category 2, the user inputs by capturing the input of a test result to check the working condition of soldering.

The paper is organized as follows. In section 2, the works related of this paper are discussed. Section 3 explains the proposed method of digital checklist automation. Section 4 discusses the various experimental results and the performance evaluation of the method. Finally, the conclusion and the future work of the proposed method are presented in Section 5.

## 2. RELATED WORKS

Checklists play a major role in several applications which is widely used to avoid human error, to improve safety and to improve the estimation accuracy. A properly designed checklist should be suitable to the level that they are specified clearly, to be given in simple format and to satisfy the user needs.

Checklists have a massive performance in wide range of disciplines, such as health care, aviation, inspection, manufacturing, quality control, product manufacturing and so on, where safety and accuracy are significant and also to reduce human errors [2]. Extensively the staff members are trained to use a checklist prior to its first use [12]. Checklists have become a standard operating procedure in the aviation industry after the crash of the Boeing Model 299 during the trial demonstration in 1935 [4]. Checklists supports inspectors, reviewers and all categories of people to systematically evaluate or to apply the software for being inspected [5].

Checklist is a necessary tool used essentially in every area, and Gawande [3] explains the concept of how the complex tasks are split down into smaller tasks to improve the rate of checklists. Further, experts can skip certain unwanted tasks which are not needed for a long period. A process to develop and evaluate estimation checklists for agile teams and to assess the necessity of the checklists for improving the expert estimation process is discussed in [8]. The checklists designed are to be integrated with the existing system and its operations are checked on its feasibility. If there are reconsiderations, iterations can be done on checklists until it satisfies all the needs of the system [10]. The approval of the checklist differs in terms of the benefits and using a simple checklists will be a beneficiary one [9]. The checklists designed for an organization will be based on the application of the system [13].

The facts and the decisions that are carried out in real time can be designed as checklists. In [14], different categories of checklist items are discussed and examples are provided for the items which should be included in checklists and also the items that should be avoided from the checklists. This gives the support in designing the checklists. The observations on [11], indicates the various methods applied in different types of evaluation of the checklist. It also provides few ideas for the good design of the checklists. An evaluation checklist improves the consistency of the checklists and it provides the reviewers with practice, or guides at the process of evaluation. A trolley turning and lifting mechanism is proposed in [16], in order to make unloading easier. This mechanism is more effective for the materials can be unloaded in various

directions, which reduces the time and effort of work rate and performs with less human work. Two techniques [6], checklists and group discussions are suggested, which improves the human evaluation and found that checklists develop the reliability and simplicity of the system.

### 3. PROPOSED METHODOLOGY

The proposed digital checklist automation is designed to minimize the manual time taken and to check the functioning and performance of the machine. The machine processed in this method is done using vacuum lifter.

#### 3.1 PROCESS AUTOMATION

In this method, the digital checklist is implemented by identifying the key check points to be checked before and after the work process execution. The below mentioned process are identified by closely monitoring and the same is being designed as a digital checklist process. This method captures the input of the user about the current standard working condition of the machine (Vacuum Lifter). Two categories are considered in the proposed method. 'Category 1' specifies that the user can input with 'Yes' or 'No' type for the machine vacuum lifter. 'Category 2' allows the user input by capturing the input of a test result to check the working condition of soldering.

##### 3.1.1 Category 1

The Category 1 indicates the user to input the data with 'Yes' or 'No' type for the machine vacuum lifter. This category consists of the following check lists as listed below:

- Lifting handle and pad
- Vacuum hose
- Vacuum barrel joint
- Vacuum pump
- Lifter handle switch
- Horizontal arm
- Power on switch
- Vacuum hose from pump to barrel
- Vacuum pressure gauge

The procedural steps of the process automation are explained below. The part of the image is being encircled for the user to easily identify the machinery part. The user should process all the 9 checklists. If not, the method waits until all the checklists are being processed. The 'not processed checklists' are highlighted to the user that it has to be processed. After all the checklists are processed, only then the user can operate the machinery.

- Lifting handle and pad: Check for lifting handle and pad for dirt. It is seen through eyes and cleaned.
- Vacuum hose: Check if the vacuum hose is connected properly. It is checked through eyes and ears, for checking any leakage exists in the hose.

- Vacuum barrel joint: Check for barrel joints.
- Vacuum pump: Check for vacuum pump
- Lifter handle switch : Check for Lifter handle switch
- Horizontal arm: Check for Horizontal arm
- Power on switch: Check for Power on switch
- Vacuum hose from pump to barrel: Check for Vacuum hose from pump to barrel
- Vacuum pressure gauge: Check for vacuum pressure gauge.

Each of the above mentioned checklists should be processed by the user with his details and the machine details. The process is done with animation effects for the user to undergo the process in an easier manner.

The checklist is checked with the image of the vacuum lifter part, check sheet containing the detail of date and time, machine name and serial number and also the user details with name, shift and status.

### 3.1.2 Category 2

The ‘Category 2’ allows the user to input by capturing the input of a test result and to check the working condition of soldering tool tip.

The check sheet for soldering contains the details of date and time, soldering station number and machine serial number. The soldering cartridge type is selected from the list of options and the temperature for soldering is applied as +10 or -10 degree with its current temperature highlighted.

## 4. EXPERIMENTAL RESULTS

The proposed method was implemented using React as Front End and MySQL as Back End in NodeJS Environment.

This section gives the experimental results of the proposed animated digital checklist automation with various checklist process details. The checklist process explains the user to check for what and where, by animated process. Once the user finds satisfied, that the standard condition specified is attained, he approves the process by clicking “Yes”. If the standard condition is not up to the standard, then he physically checks and cleans and does the corrective action to bring it to standard condition, and then approves by clicking “Yes”. If the standard condition is not attainable, he presses “No”. This action in turns gets reflected at the maintenance department and to the management immediately. Then the machine condition is recovered by the maintenance department and allowed / approved for production. Due to this closed and efficient method of checklist process, the efficiency is improved significantly.

The experimentation was performed with two different categories. Fig. 4.1 to 4.3 shows the design screen of three different checklist of category 1.

Fig. 4.1 Lifting Handle and Pad Checklist



Fig. 4.2 Vacuum Hose Checklist



Fig. 4.3 Vacuum Pressure Gauge Checklist



Fig. 4.4 shows the report in which the status of the checklist of each user is checked simultaneously. If the checklist is not undergone by the particular user, it has to be performed immediately by the user, after recovered by the maintenance department.

Fig. 4.4 Report of Vacuum Lifter Checklist

Sl. No.	Date & Time	Machine Name	Ass. ID No.	Employee Name	Shift	Chk 1	Chk 2	Chk 3	Chk 4	Chk 5	Chk 6	Chk 7	Chk 8	Chk 9	Chk 10	Chk Charge Name
1	22/05/21, 14:11	Vacuum Lifter	NGL021001	Suresh Krishnasamy	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K
2	22/05/21, 14:11	Vacuum Lifter	NGL021002	Shanghvi B	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K
3	22/05/21, 14:11	Vacuum Lifter	NGL021003	Narasimhan B	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K
4	22/05/21, 14:11	Vacuum Lifter	NGL021004	Prasad	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K
5	22/05/21, 14:11	Vacuum Lifter	NGL021005	PillaiChin	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K
6	22/05/21, 14:11	Vacuum Lifter	NGL021006	Aradh	Shift 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Venkatesh K

Fig. 4.5 shows the input screen of soldering tool tip of category 2. Here the user selects the soldering cartridge type for which the particular temperature is displayed with +10 or -10 degrees and to check the working condition.

Fig. 4.5 Soldering Tool Tip Temperature

Fig. 4.6 shows the report of soldering tool tip temperature of category 2.

Fig. 4.6 Report of Soldering Tool Tip Temperature

Sl. No.	Date & Time	Machine Name	Ass. ID No.	Employee Name	Shift	Cartridge Used	Actual Temp	Chk Charge Name
1	24/05/21, 19:40	Soldering Station	NGL021002	Suresh Krishnasamy	Shift 1	STTC 117	400	Venkatesh
2	24/05/21, 19:40	Soldering Station	NGL021003	Rahul	Shift 1	STTC 117	411	Venkatesh
3	24/05/21, 19:40	Soldering Station	NGL021007	Narasimhan	Shift 1	STTC 160	397	Venkatesh
4	24/05/21, 19:40	Soldering Station	NGL021008	Shanghvi	Shift 1	STTC 182	379	Venkatesh
5	24/05/21, 19:40	Soldering Station	NGL021009	Suresh	Shift 1	STTC 198	392	Venkatesh
6	24/05/21, 19:40	Soldering Station	NGL021005	Raja	Shift 1	STTC 206	427	Venkatesh

#### 4.1 Benefits of the Method

The digital checklist automation helps the user to easily identify the problems in the machine simply by looking into the process areas to be checked. The method also supports the user who is unknown of the equipment process.

By implementing this method, the efforts of the user are being minimized. The animated digital checklist helps the management to get work done easily with the help of unskillful users and also attracts the user to involve in their job. By providing animated explanation, the language barrier of the user is also being taken care.

## 5. CONCLUSIONS AND FUTURE WORK

In this paper, a technique using digital checklist automation is discussed. Here the images of the machinery parts and the animated effects help the user to execute the method easily. The method act as an easy user interface. It is proved experimentally that the communication method is simple and easiest way for the users. This method increases the performance and efficiency of the user. The animation method also helps the user to take up the task easily.

In the proposed method, the checklist automation is done for vacuum lifter. The future work is that the automation shall be implemented for several other machinery to perform the process easily. Further extensions can be done on this work by adding more checklists and with various animated effects.

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