7 Conclusion

This chapter discusses the key findings of this entire research along with the benefits. After that, the limitations of this research are presented in the second part, and finally, the chapter ends with the recommendations for future improvements of the developed integrated technology.

Key findings- The main purpose of this research was to understand the importance of object detection technology and 3D simulation in the current manufacturing industries. So, a step had been taken to integrate both these important technologies during the research to see how it can help the current manufacturing companies to automate their manufacturing processes cost-effectively. Though in the present world, manufacturing companies are already inclining towards automating their processes by allocating different types of industrial robots, it costs them a lot of money to buy and maintain it around the year. Again, small-scale manufacturing companies or start-ups cannot afford such costly industrial robots, and as such human workers are hired to do such processes manually, which increases the cycle time and ultimately affects the productivity of the company in a negative way. Furthermore, extra human resources are required for constant monitoring and tracking of all the processes in the manufacturing companies, which reduces the efficiency of the production process as human workers are prone to errors. Moreover, current manufacturing industries do not ensure 100% safety of the workers as a human employee is usually appointed for this kind of task, and they often fail to ensure if the workers are wearing the necessary protective equipment during a risky task.

To solve the above-mentioned problems, an object detection technology was built as a part of this research which can track all the processes in a manufacturing company without the need of allocation of too many resources. To test this developed technology and to analyze the pros and cons of it before applying it in real-world manufacturing companies, a 3D model was built based on a selected use case, and simulation was performed. The simulation enacted a real-world production line, and after applying the developed ODT, the result obtained was fascinating and showed true potential. It could detect all the processes going on in the simulation with 100% accuracy and identify it without any errors. Applying this technology can solve the above-mentioned human dependency on tracking all the processes and increase the efficiency of the production line. Again, a tracking menu was built to make the tracking process easier and flexible, and it will help the manufacturers to get a real-time overview of

all the processes in his/her company, solving a lot of problems. Furthermore, the developed ODT can be integrated easily in the real world from small scale to large scale manufacturing companies just by having few cameras(according to the layout requirement) embedded with the developed ODT. Moreover, it has the potential to optimize the existing production line and solve some of the major problems of current manufacturing companies like manual sorting and poor inventory management system in a cost-effective way. Again, a machine learning model was trained as a part of the demonstration to ensure the safety of the workers in the simulation by checking if they were wearing their helmets or not. The result obtained was nearly accurate and could be applied in real-world manufacturing companies to solve the problem of failing to ensure the safety of the workers all the time. The developed machine learning model can be executed through the drone camera as shown in the simulation to constantly keep an eye on the workers and help to ensure their safety during the production process.

Limitations of this research- One of the major limitations of this research is that the accuracy of detecting processes by the developed ODT largely depends on the intensity of the light in a manufacturing industry. Less intensity of light which is a common problem in most of the manufacturing industries, can decrease the accuracy of the developed ODT to a great extent. Again, as the ODT was developed based on a color feature extraction algorithm, the presence of background noise can also decrease the accuracy of detection. Moreover, the developed ODT cannot be used at a microscopic level which means that microchip-like manufacturers cannot integrate this developed technology into their production line.

Recommendations for future improvements- The developed technology has great future potential, and improvements can be made to increase its flexibility and accuracy. For example, the shape-based feature extraction algorithm can be integrated with the existing color-based model to increase the accuracy of detection. Again, a mobile application can be built with the developed status menu through which a manufacturer owner can look over the processes in real-time from any location without the need of assigning a human employee. Furthermore, a KPI dashboard can be built which can track and count the products via developed ODT. Moreover, the helmet detection model can be further trained for detecting other protective equipment of the human employees like safety goggles.