ATTACHABLE IOT-BASED DIGITAL TWIN CONSTRUCTION FOR FACE MASK PRODUCTION LINE

Byeong Soo Kim
Department of Applied Artificial Intelligence
Seoul National University of Science&Technology
232 Gongneung-ro, Seoul, Republic of Korea
bskim@seoultech.ac.kr

Bong Gu Kang, Taehoon Kim, and Jungmin Yun
Korea National Industrial Convergence Center
Korea Institute of Industrial Technology
143 Hanggaul-ro, Ansan, Republic of Korea
{bgkang, thkim216, jmyun}@kitech.re.kr

ABSTRACT

Mask production, a necessity in the era of the Covid-19 pandemic and beyond, is an important issue, but there are cases in which it is difficult to secure production due to problems such as low proficiency of workers or inefficiency of the line design. To solve this, a digital twin of the real system is built and used for prediction and optimization. However, in reality, it is not easy for small and medium-sized enterprises (SMEs) due to the absence of established information systems, up-to-date facilities, and related experts. Therefore, this paper proposes an attachable IoT-based digital twin framework that can be applied to SMEs, and through this, a digital twin of an actual mask manufacturing line is established.

Keywords: digital twin, simulation, IoT, mask production line, small and medium-sized enterprise.

1 INTRODUCTION

The face mask market is one of the markets that has grown most explosively along with the Covid-19 pandemic, and production expansion is required due to increasing demand. However, mask production is mostly done in SMEs, and it is difficult to secure production volume due to the low proficiency of workers and difficulties in expanding facilities. The digital twin is a technology that predicts and optimizes by creating a digital replica of a real system, which can be used to increase productivity. However, it is not easy for SMEs to build a digital twin in reality due to the absence of an established information system, up-to-date facilities, and related experts (Yasin et al. 2021). Therefore, this paper builds a digital twin for a mask production line by utilizing an attachable IoT-based digital twin framework that can be applied to existing facilities of SMEs, thereby increasing productivity.

2 ATTACHABLE IOT BASED DIGITAL TWIN CONSTRUCTION

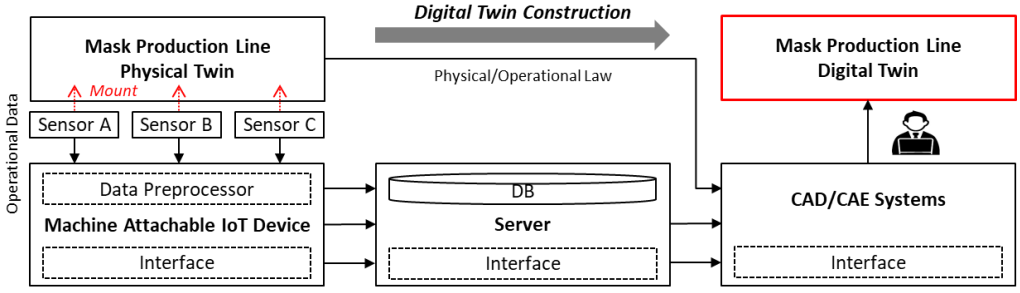

Figure 1: Attachable IoT-based digital twin construction

Figure 1 shows the overall outline of IoT-based digital twin construction. First, a digital twin of the manufacturing line is built through the abstraction of the manufacturing process/line. In addition, in order to increase the accuracy of the built digital twin, it is necessary to acquire actual process data in the operation of the line. To this end, a device for data collection and transmission including an attached IoT sensor is produced to collect data from the facility. The digital twin is completed by delivering the collected data and applying it to the digital twin model. Finally, improvements are communicated to operators through simulation-based optimization of the completed model. Through this, the inefficiency of work can be eliminated and productivity of the line can be increased (Min et al. 2019).

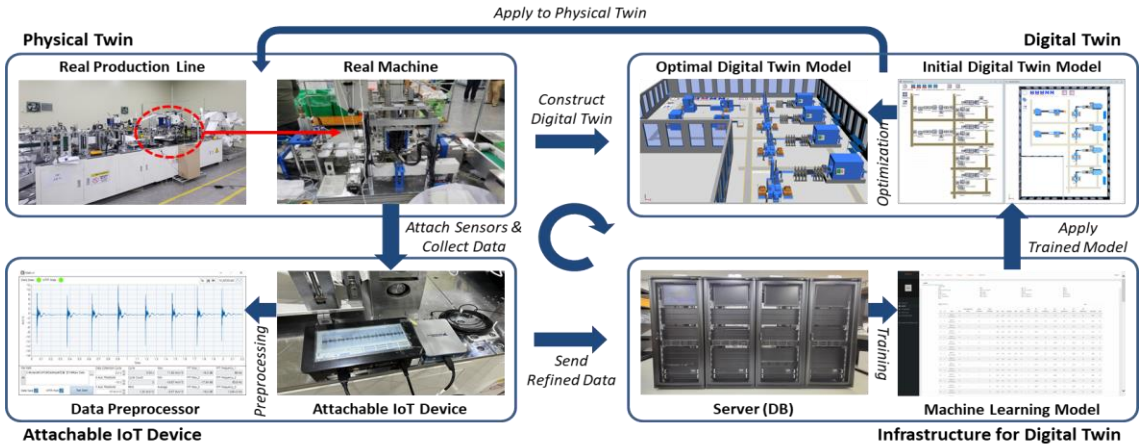

Figure 2: Result of mask production line digital twin construction

A digital twin is built by applying these series of processes to an actual mask production line. A digital twin model is built through analysis of the production line in actual operation, and sensors are attached to cutting and attachment equipment to collect data and apply it to the digital twin model. Through the simulation of this model, it helps to optimize the work assignment and improve productivity by suggesting facility reorganization. Figure 2 shows the digital twin of the mask production line completed through this process.

3 CONCLUSION

In this paper, we built a digital twin for an actual mask manufacturing line through an attachable IoT-based digital twin framework applicable to SMEs. In addition, we utilized this to improve production efficiency within small and medium-sized businesses at a low cost and within a short period of time. Based on this study, we plan to build a formalized framework that can be applied to SMEs that have difficulty constructing digital twins on their own.

REFERENCES

Min, Q., Y. Lu, Z. Liu, C. Su, and B. Wang. 2019. "Machine Learning based Digital Twin Framework for Production Optimization in Petrochemical Industry". *International Journal of Information Management* vol. 49, pp. 502–519.

Yasin, A., T. Y. Pang, C. T. Cheng, and M. Miletic. 2021. "A Roadmap to Integrate Digital Twins for Small and Medium-Sized Enterprises". *Applied Sciences* vol. 11, no. 20, p. 9479.

ACKNOWLEDGEMENT

This research was supported by Korea Institute for Advancement of Technology grant funded by the Ministry of Trade, Industry and Energy (Korea) (No. P0014286, Infrastructure development of manufacturing and service convergence using filed data) and by the National Research Foundation of Korea funded by the Korea Government (Ministry of Science and ICT) under Grant 2021R1G1A100355911.