UNIVERSITI TEKNOLOGI MARA

AN AUGMENTED REALITY REAL-TIME CLOUD-BASED REMOTE MONITORING ALGORITHM FOR A MANUFACTURING SYSTEM

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Postgraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Conventional AR-IoT applications only specialize in the localized area for the on-site application and not applicable for a remote monitoring system. Referring to the Industrial Revolution 4.0 visions, complication in implementation to the industrial processes is one of the biggest challenges. Therefore, in this research, the first objective is to develop an algorithm for a remote AR-IoT monitoring system. The algorithm was designed by utilizing C++ and C# coding language. The algorithm's validity was proven by applying it to a simple material handling process which is a colour sorting conveyor. This goes to the second objective of this research, in which to apply the algorithm to an App called "AR-Simulasi", where it will be used to monitor the conveyor system. The colour sorting process sorts out coloured cubes consisting of three different colours: red, blue, and yellow. AR-Simulasi remote monitoring consisting of simulation of the virtual conveyor that synchronized with the actual conveyor. This was achieved through data transfer using Amazon Web Service (AWS-IoT) cloud connection. From within the actual conveyor process, there was an IoT communication between smart sensors and microcontroller, ESP32. The virtual AR conveyor would receive the information from ESP32 through AWS-IoT cloud service and perform the virtual process in real-time. The AR remote monitoring system was then exported as an Android app named "AR-Simulasi". Several essential data were imposed on the AR interface in the textual form, such as the coloured cube count. From the data obtained, the efficiency of the AR-Simulasi was then calculated. The third objective is to evaluate the efficiency of the AR-Simulasi App. The efficiency was analysed in terms of time delay in data transfer between two mediums during the monitoring process, which were the actual and the virtual conveyor process. The relationships among accuracy and efficiency for object interaction and data transfer were investigated. The analysis was done by collecting multiple sets of timestamps data during the AR remote monitoring for the colour sorting conveyor. The value of time delay was calculated, and the average value obtained was 224ms. Referring to the Global Network Organization for Network Latency tolerance, any IoT devices with a time delay of less than 250ms were successful and reliable for further utilization. The results reveal that AR-Simulasi is a reliable application to be used due to the positive results in the efficiency analysis. Thus, resulting in the efficiency of the novel AR-IoT remote monitoring algorithm. This research contributes to existing knowledge of AR-IoT onto the growing area of research scopes by exploring more usage of AR and IoT for remote manufacturing monitoring.

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