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工業用機上盒與預測維護整合系統

Integrated System of Industrial Smart Machine Box and Predictive Maintenance

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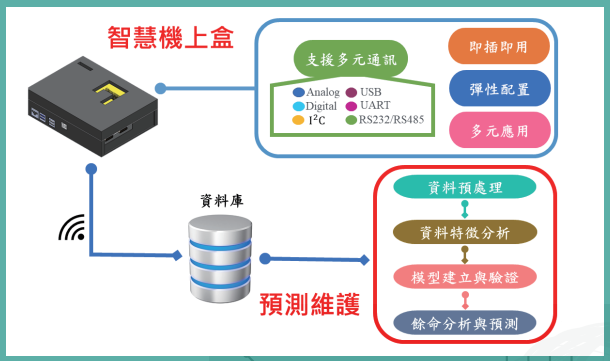
作品摘要

自動化產業的生產效益植基於加工機的妥善率，然產業對設備良率的管控仍多半停留在預防性質的定期檢修。設備的妥善與否除了與使用時間長短、操作模式、設備品質等因素直接相關外，也會受環境因素或其他不可控因素影響。在固定排程維護模式下，若設備發生故障，往往對企業造成極大的影響；輕則要花比較多的人、物力停機檢修與模組置換，重則會因突發性停機導致整個產線的待加工件就此作廢。

智慧機上盒（Smart Machine Box）是一個自動化生產裝備的資料擷取裝置，相關資料可供後續特徵擷取、建模與驗證等資料分析使用，進而得到有助生產效益優化的決策，系統整合架構如圖一所示。新型的自動化設備或許在出廠前就已經內嵌機上盒模組；然而企業考量投資效益，當面臨產業變革時，恐無法立刻汰換所有的舊型設備。舊型自動化設備多不相容於市面上的智慧機上盒，想要有效地獲取設備參數以瞭解設備使用狀況實有其困難。本作品所設計的機上盒相容於市面上主流的感測器通訊介面，包含：類比訊號、數位訊號、RS232、RS485、USB、HDMI等。另外，本作品提供感測模組即插即用與通訊介面彈性調配等功能，可有效地提升使用者操作便利性及優化通訊界面使用效率。

預測維護（Predictive Maintenance）泛指依據設備的使用狀態，藉由資料分析、建模等步驟，研判設備的健康指標與使用壽命；相關步驟依序包含：資料預處理、資料特徵分析、模型建立與驗證、健康指標產生等。資料預處理部分主要是原始資料在真正進入分析流程前，需先完成補值、編碼、濾波等工作。特徵分析部分主要是藉由關聯性分析，找出不同資料欄位相互間相依權重。模型建立主要是依據特徵分析萃取的主要特徵，參考不同的對比模型，比較哪一個模型較適合此一個案。模型還需要經過驗證，以確保其可用性。最後也是最重要的是健康指標生成，以及如何利用這些指標來推估設備的剩餘壽命。本作品主要包含智慧機上盒設計與製作、預測維護設計與實現兩個部分，相關整合方案有助於降低設備維修投入的人力與物力，提升設備的使用妥善率，進而推動產業由自動化邁入真正的智慧化。



▲ 圖一 智慧機上盒與預測性維護整合系統架構圖

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研究領域

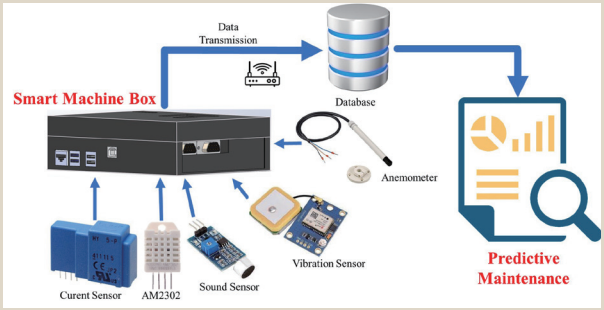
智慧型系統、機器學習、物聯網技術

Abstract

The production efficiency of automation industries relies on the reliability of manufacturing machines. However most of the management of equipment availability stays in the scheduled prevention maintenance. Equipment availability could be related to the use time, operation mode, equipment quality, environmental factor and other uncontrolled factors. Under this pre-scheduled maintenance, industries most likely pay more efforts due to equipment failures, for example more manpower and cost for equipping overhaul.

Industry machine box is a device for the automation equipment to capture data. The captured information can be used for data analysis such as feature extraction, modeling and verification. Moreover, an optimized policy can be generated to improve production efficiency. The integrated system scheme is shown in Fig. 2. New-type automation equipment may be already equipped with a machine box. During the industry progress it may not be easy to replace all old-type equipment in the same time. The proposed smart machine box is compatible to the main sensing interfaces including A/D, DIO, RS232, RS485, USB and HDMI. In addition, the plug-and-play function is provided. Also, the sensing interfaces can be easily adjustable for a desired usage.

Predictive maintenance means that the health indicator and useful life of an equipment can be obtained from data analyzing based on the equipment's operational status. The processes of predictive maintenance include data-preprocessing, feature analysis, modeling and verification. The stage of feature analysis mainly deals with the correlation analysis such that the related weights between two data categories can be obtained. In the part of modeling, a suitable model can be selected from some candidate models for a particular use case. The usability must be verified from the verification process. Finally, and most importantly, the remain useful life of an equipment can be predicted from the health indicator. The proposed system includes the development and implementation of smart machine box and predictive maintenance. The integrated solution can reduce the cost for equipping overhaul, improve the usability of equipment, and make the industry become more intelligent.



▲ Fig. 2 The structure of the integrated solution of smart machinebox and predictive maintenance