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授与した学位	博　士
専攻分野の名称	工　学
学位授与番号	博甲第　　６２５９　　号
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学位授与の要件	自然科学研究科　　産業創成工学専攻 （学位規則第４条第１項該当）
学位論文の題目	A Study of Raspberry Pi Applications to Calligraphy Learning and Air-Conditioning Guidance Systems （書道学習および空調ガイダンスシステムへの Raspberry Pi アプリケーションの研究）
論文審査委員	教授　船曳　信生　　教授　田野　哲　　教授　野上　保之

学位論文内容の要旨

In this thesis, I study two practical application systems using *Raspberry Pi* in real world. First, the application of *Raspberry Pi* to the *calligraphy learning assistant system (CLAS)* is studied. It aims to assist self-learning of *calligraphy*. Using the *projection mapping*, *CLAS* directly projects a letter writing video of a teacher on the paper. Then, a learner is able to learn the stroke order and writing speed. Besides, the *letter portion practice function* is incorporated to allow a learner to repeat practicing hard portions. In the implementation, I adopt a portable projector and open-source software. Through applications to international students from Japan, China, Myanmar, Indonesia, Bangladesh, and Kenya, I confirm the effectiveness in improving *calligraphy* skills for novice students.

Second, the application of *Raspberry Pi* to the *air-conditioning guidance system (AC-Guide)* is studied. It aims to encourage the proper use of air-conditioning in a room by sending alarm messages of turning on/off them. *AC-Guide* periodically samples the temperature and humidity in the room to calculate the *discomfort index (DI)*, and observes the AC usage. The outdoor DI is also calculated by obtaining the weather data from *openweathermapAPI*. By referencing to the message decision table, the system outputs a voice and an email alarm message to the registered persons. In the implementation, I adopt a temperature/humidity sensor, a USB web camera, a USB speaker, and an open-source software. Through applications at two rooms in Okayama University, I confirm the correctness of the alarm messages.

These studies found that the implemented *Raspberry Pi* application systems require a small cost both for the hardware and software and the short developing period, and yet, exhibit the acceptable performances for practical use.

This thesis is organized as follows:

In Chapter 1, I introduce the background, motivation and the contributions of the study in this thesis.

In Chapter 2, I discuss the background technologies related to this thesis, including *Raspberry Pi 3 Model B+*, *Python*, and the developing process of Raspberry applications.

In Chapter 3, I present the study of the application of *Raspberry Pi* to the *calligraphy learning assistant system* with the implementations and the evaluations.

In Chapter 4, I present the study of the application of *Raspberry Pi* to the *air-conditioning guidance system* with the implementations and the evaluations.

In Chapter 5, I review relevant works in literature.

Finally, in Chapter 6, I conclude this thesis with some future works.

論文審査結果の要旨

In this thesis, the applicant studied two practical application systems using Raspberry Pi in real world.

Firstly, the applicant studied the application of Raspberry Pi to the calligraphy learning assistant system (CLAS) that assists self-learning of calligraphy. Using projection mapping technology, CLAS directly projects a letter writing video by a teacher on the paper. Then, a learner is able to learn the stroke order and writing speed. Besides, the letter portion practice function is incorporated to allow learner to repeat practicing hard portions. In the implementation, a portable projector and open-source software were adopted. Through applications to international students from Japan, China, Myanmar, Indonesia, Bangladesh, and Kenya, the effectiveness in improving calligraphy skills for novice students were confirmed.

Secondly, the applicant studied the application of Raspberry Pi to the air-conditioning guidance system (AC-Guide) that encourages the proper use of air-conditioning in a room by sending alarm messages of turning on/off them. It periodically samples the temperature and humidity in the room to calculate the discomfort index (DI), and observes the AC use. In addition to this indoor DI, outdoor DI is calculated by obtaining the weather data from *openweathermapAPI*. By referencing to message decision table, AC-Guide outputs a voice alarm message and an email alarm message to the registered persons. In implementation, a temperature/humidity sensor, a USB Web camera, and a USB speaker, and open-source software were adopted. Through applications to two rooms in Okayama University, the correctness of the alarm messages were confirmed.

From them, it was concluded that for a Raspberry Pi application, the required cost is low, the developing period is short, and the performance is acceptable for practical use.

The applicant has published one journal paper, two international conference papers, and five national conference papers to present the contributions.

From the overall evaluation of this thesis, the applicant has satisfied the qualification condition for the doctor degree in Engineering from the Graduate School of Natural Science and Technology at Okayama University.