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Proposing the ARCS Model of Motivating Learning and Problem-based Learning in Teaching Image Processing

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Abstract: The success key of teaching in the undergraduate engineering courses is that the teacher plays an important role in motivated students in order to make students enjoyable the class. In this study proposed the learning framework design of integrated attention, relevance, confidence, and satisfaction (ARCS) model and problem-based learning (PBL) model for driving the activity during studying the image processing. MATLAB App Designer is used as a tool for coding and graphical user interface (GUI) in purpose to support students' motivation and enhance learning efficiency. At the end of the course, students will get the real-world issue then using their knowledge to solve the problem. The expected goal after students completes the subject which using this framework is that they will have a self-Confidence in using image processing skills in the real world.

Keywords: Image processing, problem-based learning, ARCS model, engineering education

1. Introduction

Image processing course is the importance subject of Mechatronics, Computer, and electronic engineering which improves students' science, technology, engineering, and mathematics (STEM), but students play less attention in this subject. One of the reasons is that the students cannot find the relationship between the content of image processing to the real life. Therefore, the motivation is the most significant to convince students to satisfy studying in class. This is the challenge for teacher to design the learning strategy.

Traditional methods of teaching such as face-to-face learning in the classroom are helpless students' attractive in studying in this generation. This is the time to find the way to help our students to be open-mind. Students' motivated in learning contexts is the importance choice to support students learning to get better efficiency study (Pintrich, 2003). Keller (1983) proposed the motivation model which becomes one of the famous motivation models known as ARCS model. This framework consists of four factors to guild for motivation, attention (A), relevance(R), confidence(C), and satisfaction(S).

ARCS model is the basic method to help students in motivation. In addition, Problem-based learning (PBL) supports students to be more self-assured. The objective of this work is to design the learning framework in image processing course for undergraduate engineering program. The expectancy outcomes are to enhance students' motivated and self-confidence. The ARCS model is addressed as the framework for designing the motivation activity before studying in the class. The PBL approach applied to drive the last activities.

2. Literature Review

The motivation has influence for motivating students to be more interest in the subject. It has many materials to supported students' learning motivation for instant, augmented reality (AR) on project- based learning (PjBL) for pre-service teachers' motivation (Chookaew, 2017).

ARCS model framework of motivation is the basic framework that educational concept is still use. Various research use motivation-based ARCS model to help students learning achieve in many area such as, Business, Technical, STEM, English second language, Social science, Professional and vocational, and multiple (Li, 2018). In STEM subject area, ARCS model has an influence for motivation. For example, C# programing language course for first year of university was used of integrated ARCS model of motivation and PBL in order to improve learning outcomes (Chang, 2018). Flipped classroom was applied to help students' motivated based ARCS model in physics course at the university (Asiksoy, 2016). Moreover, ARCS model use for evaluated the efficiency learning motivation in quantities and qualitative of Engineering Problem Solving and Computer Tools for freshmen engineering students (Huang, 2004).

3. Methodology

The image processing class in this purpose is using ARCS model to drive the activity for helping students' motivation before going to studying in classroom. During motivation, graphical user interface (GUI) is used as a tool to interact with students for getting some idea. Moreover, teacher helps students to get more intrinsic and extrinsic motivation in order to get better studying in the classroom. When students complete studying in all units, they have to present their knowledge using PBL. Students learn in teamwork beside skill. In addition, it helps students to be more comfortable or confident to use their skill after they finish this course.

3.1 Learning Framework

This study proposes the design learning framework of teaching image processing using ARCS motivation model and PBL to drive the activities. The designed learning framework shows in Figure 1. In this design, the framework starts with using the ARCS model for motivation before students' study in the detail of each chapter. The MATLAB app design is use as a tool for encourage students' motivation. Students play with GUI to test the algorithm. The benefit of using MATLAB app design is that students can interact with the interface. After students finish all units, students have assigned to work as team in PBL activity. In this activity, students use the knowledge and skill from the studying to solve the problem. The expectation of using this framework is that students gain encouragement and be open mind before they study with teacher. In addition, students show their creative thinking ability from study through PBL activity.

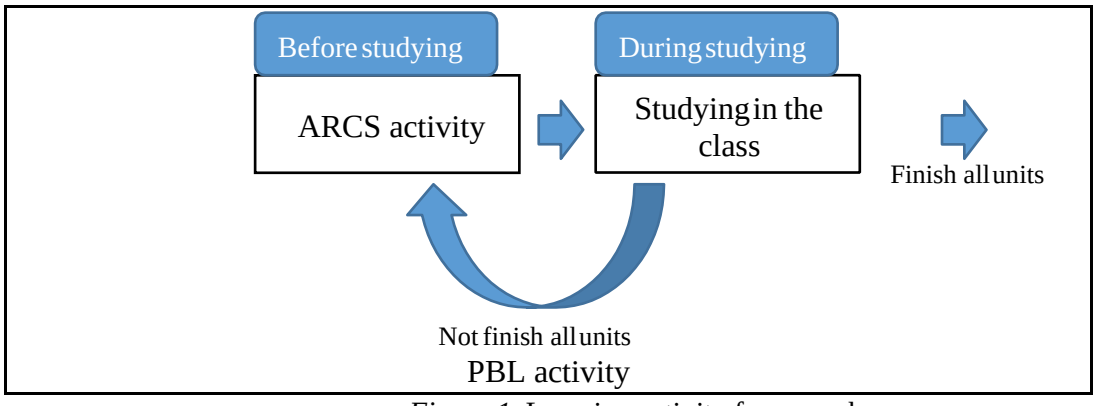


Figure 1. Learning activity framework

3.2 Learning Tool Design

MATLAB app design was used to create GUI. It uses a drag and drop for designing interface as shows in Figure 2. For image processing code, we can insert the code in the code view as in Figure 3. The benefit of using MATLAB app design for teacher is that it is easy to use for creating GUI with image processing. For students, the GUI helps to represent data information in graphic which is make sense to students to get the idea.

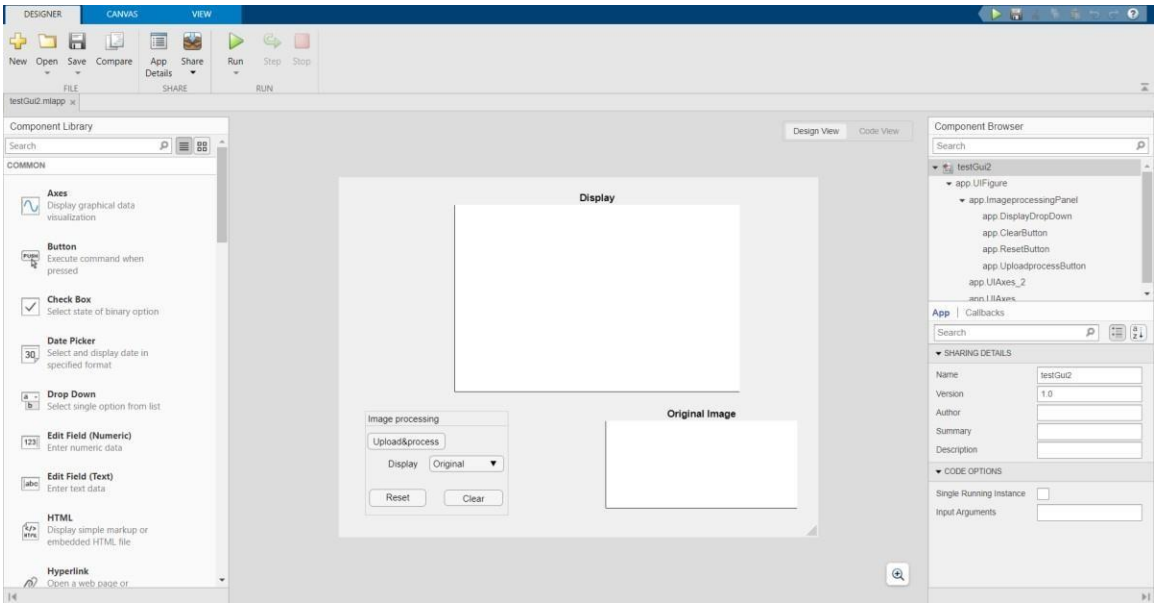


Figure 2. Design view

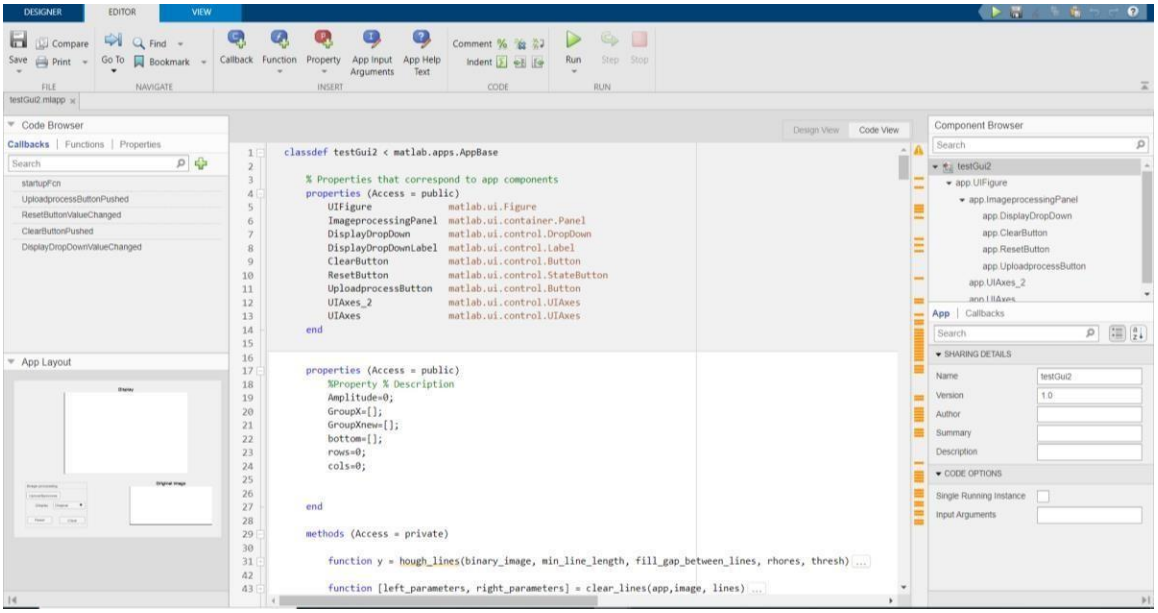


Figure 3. Code view

3.3 Design Learning Activities

The image processing course consist of the five main units which are techniques for image analysis, image transformation, image enhancement and restoration, object recognition, and applications in image processing. In this design, we start with the ARCS model of motivation using MATLAB app design for motivation before students' study in the detail of each chapter. The app design in each activity is programed by teacher. Students are only play with GUI to test the algorithm. The benefit of using MATLAB app design is that students can interact with the interface. Moreover, GUI play role with help students more attention and make sense to shows the relevance between the concept and the real world. In addition, the teacher needs to support the experience to help students to believe they can success to understand which make students more confident. The last lesson of doing motivation is to give some praise to students to make student feel satisfaction before going to studying in the detail of unit. The example of MATLAB app design in the topic of fundamental color model is show in Figure 4. In this unit, students learn how to convert image from one color model to other models such as RGB color model to grayscale model, RGB color model to Binary color model, and RGB color model to HSV color model. The example result of converted paddy field image is shown in Figure 5. After students finish all units, they have assigned to work as team in PBL activity. In this activity, students use the knowledge and skill from studying to solve the problem. • *ARCS Activity:* MATLAB app 5 units ○ Playing with GUI before study in class ○ Motivation students by teacher

- In class study for 5 unit ○ Studying in class with teacher ○ Doing the laboratory exercise
- *PBL Activity:* PBL (teamwork) ○ Brainstorm on their problem topic ○ Discussion with teacher
    - ○ Analysis ○ Evaluation
    - ○ Presentation on their topic

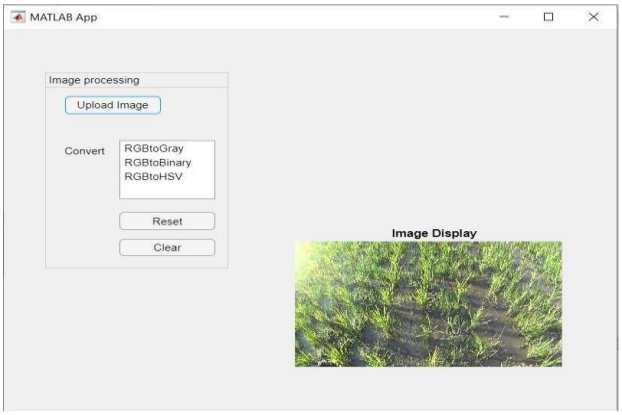
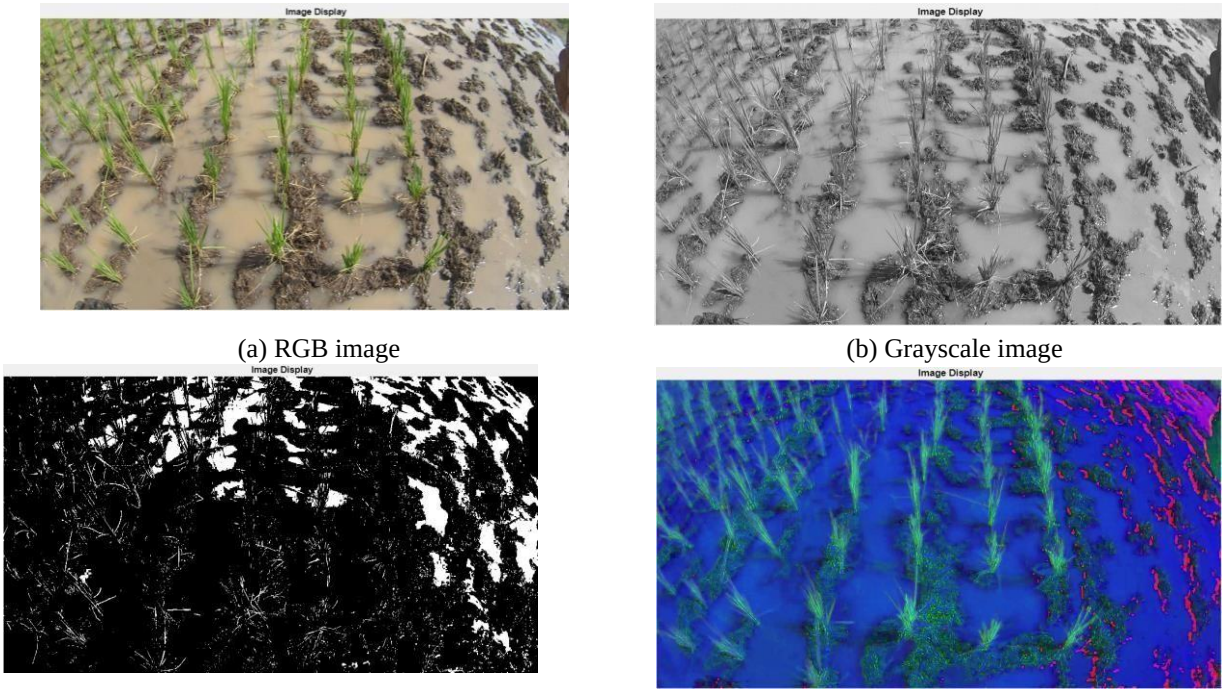


Figure 4. Fundamental color model GUI

The example of PBL of image processing course is shown in Figure 6 which is used for agricultural automobile robot application. The problem in this situation is how the robot travelling along the paddy field without damaging the crop. One solution is to use local localization by using image processing. The autonomous robot utilizes the vision system for travelling in the paddy field. Firstly, images need to pre-process. In this process, the image is cropped at the region of interest to reduce the size, then convert from RGB to grayscale image. After smoothing the grayscale image to reduce noise, the segmentation of image is applied. In this step, a binary image is created by using threshold methods such as adaptive, Otsu, and exceed green etc. The result of using exceed green is shown in Figure 6(a).

Several methods related to find the line guidance in the image such as Particle Component Analysis (PCA), Random sample consensus (RANSAC) and Hough transform can be implemented. GUI displays

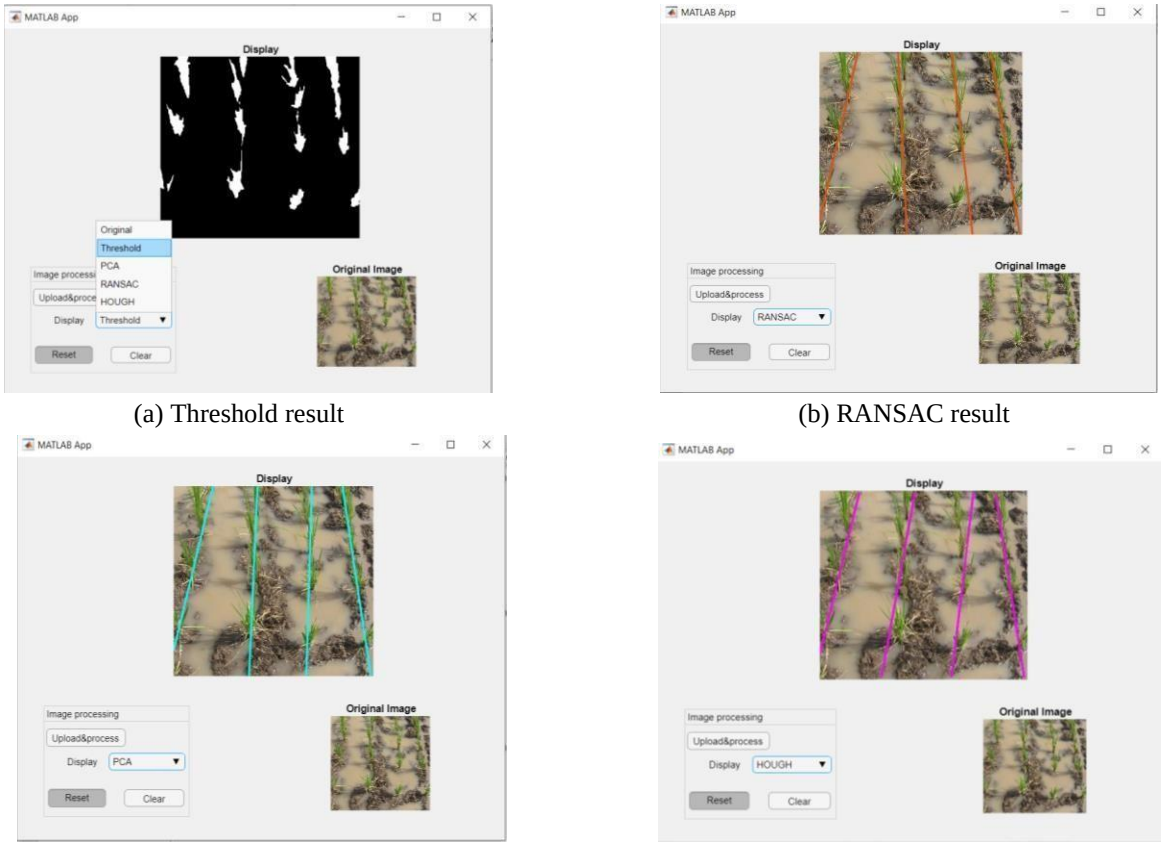
the resulting image with the estimated lines. The properties of line such as the position in image frame and the slope of each line are the output data of image processing and can be used further.



(a) RGB image (b) Grayscale image

(c) Binary image (d) HSV image

Figure 5. Example of convert color



(a) Threshold result (b) RANSAC result

(c) PCA result (d) Hough transform result

Figure 6. PBL activities

4. Conclusion and Future Work

Traditional teaching in image processing is less attractive student to study in classroom. Most students are not aware of the importance in using image processing based on the basic concept. One of the reasons is that they cannot find the relevance in real life. In this work, we purposed the ARCS model and PBL technique to encourage students in learning image processing. We expect ARCS activity will help motivate students before they are joining in the class. Students play with GUI to see the result in real world that guarantee students have the idea what they going to study in the detail. After students complete with activities-based ARCS model, the students are helped to acquire attention, relevance, confidence, and satisfaction. Then students will be happy and open mind for learning new things with teacher in the classroom. Thus, the motivation is the major point to support teaching in image processing. After students complete studying all unit, they have to explore their skill in PBL activity. In this paper, we give the example to solve on navigation by using image processing based on crop rows. This task helps students to show their skill and support their successful learning in image processing. For the future work, this design framework will be applied to the image processing course in order to evaluate students' motivation in quantities and qualitative. Moreover, the result of using PBL will be evaluated in order to measure the students' creative thinking skill compared with the group of not using ARCS activity.

Acknowledgements

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