HmwkCheck: A Homework Auto-Checking System based on Arithmetic Operation Recognition using Smartphones

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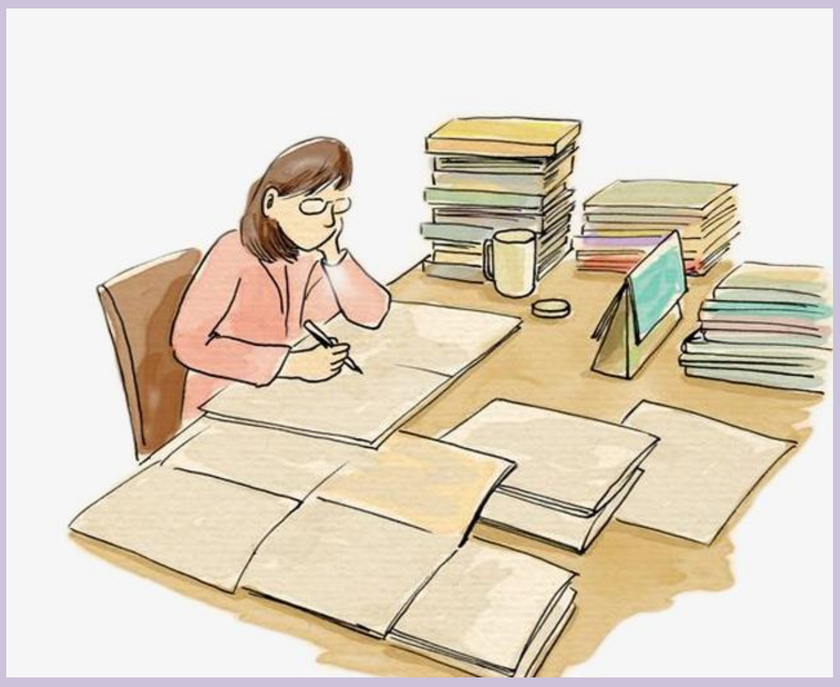
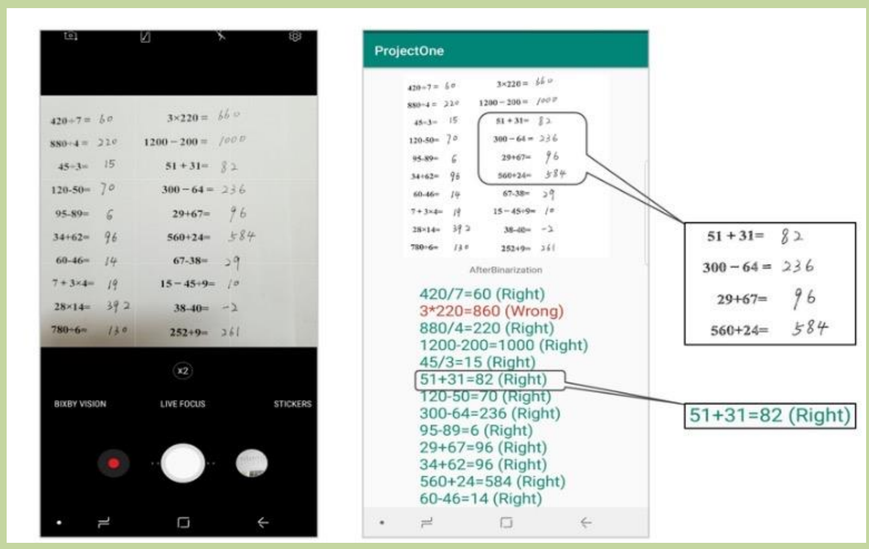
Background

Homework is often adopted in education and it can be used to evaluate the teaching quality of teachers and learning quality of students. However, correcting the homework manually can be time and labor consuming, especially for the homework assigned towards a larger number of students frequently. In addition, the existing approaches ask users to upload the picture via the Internet, which may lead to leakage of user privacy.



Our System

We propose HmwkCheck, a homework auto-checking system based on arithmetic operation recognition using smartphones.



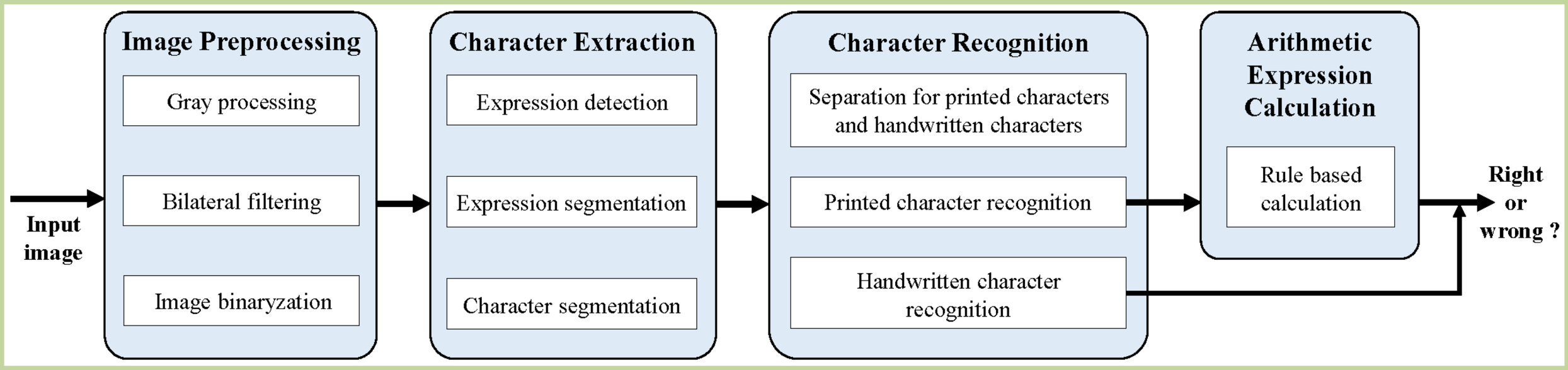
The main functional components of the HmwkCheck system:

1): ***Image Preprocessing*** is used to convert the raw image into a binary image through grayscale, filtering and binarization operations;

2): ***Character Extraction*** extracts the characters from the binary image via detecting the arithmetic expression and separating each character with projection segmentation method;

3): ***Character Recognition*** uses two CNNs to recognize handwritten characters and printed characters respectively;

4): ***Arithmetic Expression Calculation*** uses the rules of four arithmetic operations to calculate the answer based on the recognized printed numerals and operators, and then compares the calculated answer with the handwritten one.



Performance

To evaluate the performance of HmwkCheck, we invite 20 volunteers to perform our experiment and each volunteer calculated all the 40 expressions in a piece of paper and wrote the answers. We use the A4-sized white paper and Samsung Note 8 smartphone to take pictures and the result shows that HmwkCheck can recognize characters efficiently.