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IMAGE PROCESSING (CSE-4019)

J-COMPONENT

PROJECT REPORT

Time Reader

Analogue to Digital Clock Conversion Application

Submitted by

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1. INTRODUCTION:

1.1 OBJECTIVE:

The main objective for the following project is to create an application toolkit for converting Analogue Clock to Digital Clock that focuses on customization and has the ability to interchange algorithms, whilst bringing forth unique outputs all while accounting for datasets of various types and sources.

The main goal for this project is for us to make an application toolkit which can use multiple algorithms to successfully convert an analogue clock to digital one and read the data within it. The main object here being a clock is a variable, but the concepts we learn will always be constant hence, the objective is to learn as much about image processing as possible.

I aim to create application that accounts for all potential permutations and

Combinations when choosing the following parameters:

- Input Type

- Process Type

- Output Type

1.2 MOTIVATION:

All three team members are planning on joining an Image Processing Project for the upcoming Google Summer of Code. The topic we chose is not only related to the said project, but also helps us understand and navigate various concepts in the field of Image Processing.

- This topic can even justify what was told to us at the beginning of J Component class i.e. to represent something new and challenging in a topic that we choose. Not only can we easily change variables in this project, but we can also easily add new sections in accordance with the suggestions given to us. This is not only flexible, but also provides us with a perfect atmosphere to practice and showcase our skills with respect to Image processing.

1.3 BACKGROUND:

The idea behind this project is Technical report on Edge detection using Sobel Operator, which gives the technical overview of using Sobel Operator in view of Image Processing, Sobel is the first Operator we will be exploring in the case of Clock conversion. This also explains the scope for Sobel Edge Detection and the potential applications that are possible. Edge detection is truly a step that is required in order to process the data for datasets consisting of real-life images.

2. PROJECT DESCRIPTION AND GOALS:

While the Idea to combine a clock and image processing might seem like two unrelated things, it is quite the opposite and not unconventional as it sounds. Image Processing has been used in multiple use cases from identifying and detecting cancer to readily segregating and analysing multiple images in parallel. The clock, while a variable, is a very strong starting source as it can come in various shapes and forms, while also having a common image that defines an analogue clock. Given how there are more than thousands of variations when it comes to clocks, the complexity of the project can really exceed that of most of the projects in theory.

This is not counting the fact that datasets can not only be in the form of a drawing or a figure, but also in the form of images taken from the real world where the conditions can vary hugely so the medium or the environment within which you measure is also very varied. In the case of many Image Processing projects used in hospitals, the main dataset consists of a CT-scan or an X-ray or sets that pertain to a single environment, but in this case the medium and the source of datasets can be as varied and complex as needed.

This really sums up one of the factors at which this project excels, tailoring and customization; with so many limitless options to choose from on top of which you have an algorithm you have so many variables and so many concepts that needs learning, exactly serving our main goal which is not only to provide an application toolkit which you can customize and incorporate into your own projects, but also to learn as much about image processing as possible

Example of Variables in Project:

Dataset Type + Algorithm/Library = Output type

Dataset can be:

- Real-life Image, Drawing (hand drawn and computer drawn)

- Within each of them, the clock can range from basic to completely unique model

Algorithm/Process: (Example of some that WILL be used in project)

- EMgu CV/OpenCV

- Sobel Edge Detection

- MVVM/WPF Output can be either in from of Refined Drawing (or) Reading (or) New Clock

3. TECHNICAL SPECIFICATIONS:

Programming platform we used is MATLAB with following 2 tool-kits:

1. Image processing toolkit
2. Statistics and machine learning toolkit

The PC we used has:

1. Intel I5 10^{th} gen.
2. Windows 10 (64 bit)

4. DESIGN APPROACH AND DETAILS:

4.1 MATERIALS AND METHODS:

We aim to create application that accounts for all potential permutations and

Combinations when choosing the following parameters:

- Input Type
- Process Type
- Output Type

Process Type for the most part will be decided based on input and output, while it is not possible to describe methodology for all permutations. Below is the methodology for the following combination.

Real-Life Image + Sobel = Reading

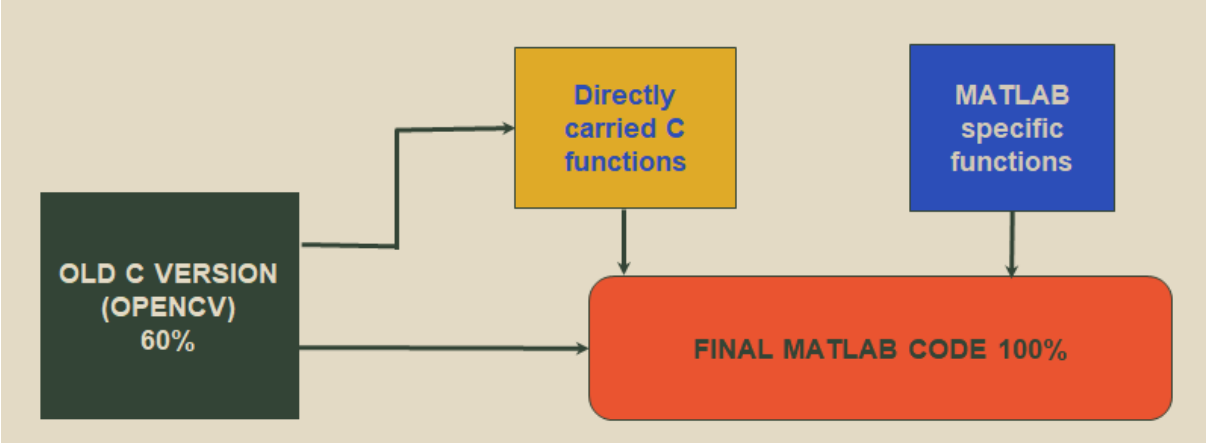
Here Sobel is predetermined based on the input and output. For this we will do the following steps:

- Set an image variable
- Set a debug variable
- Read the Image

- Find the centre of the clock using Sobel Edge Detection

- Get the clock drawing applying Hough line (number of times applied is directly proportional to resultant accuracy)

- Determine angle between lines to get the value of the clock.



4.2 CONSTRAINTS ALTERNATIVES AND TRADEOFFS

The trade-offs can be seen as:

1. The accuracy for the methods we used to get time is low when the input images are off angle (images not taken from directly being in-front of clock) and/or when the clock's background (the patterns,images and textures on face of clock behind hands of clock) are camouflaging the hands of clock.

5. SCHEDULE TASKS AND MILESTONES:

	Review 1	Review 2	Review 3
Have at least 3 processes	**x**	**X (1-2 processes)**	**√ (2-4 processes)**
Have implementation	**x**	**√ (For a select few)**	**√ (All+Integration)**
Dataset supported	**x**	**√ (Computer generated)**	**√ (All datatypes +1 additional device)**

6. RESULT AND DISCUSSION

For the testing part of the following project we approximately selected around 120 images of clocks belonging to the following 4 categories namely computer generated images(total of 30 images) , real life images(total of 30 images), Angled images(total of 30 images) and noised images(total of 30 images). That is equal ratios of all the 4 types of images.

TYPES OF IMAGES	NUMBER OF IMAGES
computer generated	30 images
real life images	30 images
Angled images	30 images
noised images	30 images

After testing almost all the 120 images of all types we found out that the computer generated images gives 100% accuracy because all the 30 out of 30 images could be converted accurately. Coming to real life images they showed approximately 70% accuracy that is nearly 21 out of 30 images could be converted to digital pattern accurately. In the case of angles images we came to know that they have the least accuracy in converting the data with around 46 % accuracy, that is 14 out of 30 images were accurate and remaining noisy images resulted in about 53% of accuracy with 16 out of 30 images getting converted accurately. From this we can conclude that the highest accuracy can be observed for computer generated images as they do not have any interruptions and impressions on them and images taken from certain angles have the least accuracy because the hands of the clocks couldn’t be detected accurately due to the tilt in the position of the images.