Final Report

COP 3503 Team Project

December 2, 2014

Team # 14

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Project Overview

Our program takes in the location of an image of coins, processes that image and returns the dollar amount of the coins in the image. It also offers the user information about each captured coin. The system is useful and important because it applies digital image processing to a real-world problem: "how much change do I have?" The program takes advantage of some of the tools built into OpenCV and performs various processes to identify individual coins and then determine their denomination.

Object Oriented Programming was leveraged in such a way as to allow us to represent individual coins and store all relevant data with them. A data class handles the orchestration of our various processing functions and stores an array of processed coins which can then be queried by the user. Most of the image processing is done using static functions which reside within the src/image directory. The functions responsible for determining the denomination of each coin are spread between src/image and coin.cpp.As of December 6th, the program is capable of correctly identifying coins in our test image (Fig 1) with 75% accuracy.

Fig 1: ideal image of coins used for testing/benchmarking

Lessons Learned

The level of complexity involved in writing this code was significant and there were several hurdles that were overcome by the group, each resulting in a learning experience. For many this was the first time working collaboratively which presented some challenges. Additionally the use of OpenCV further complicated the development process. The fact that there were several operating systems being used by the team necessitated the use of Cmake which each member had to learn to use. All of these challenges are likely to be seen again in future classes and in industry so it was a valuable experience to deal with them now.

Figuring out how to manage code being written and changed by 6 people was one of the first things addressed during group meetings. Early on it was decided that git and GitHub.com would be used to manage the code. Conveniently, some of the team had worked

with git before and were therefore able to teach the others how the system worked. The peer teaching process served to better ingrain knowledge of the git system for those who already knew it while introducing the others to a new and powerful tool. There were a few hick-ups throughout the development process but ultimately git proved to be a perfect tool for the job.

Installation of OpenCV proved to be the single greatest hurdle for beginning the development phase of the project. Figuring out how to get it installed on the individual computers of each developer was not a trivial process. A major setback was the lack of good documentation for how to get OpenCV up for development use. The lesson learned here is that when packaging software for use by the public, good installation documentation is a must.

The final stumbling block was the fact that between the six developers, Windows, Linux and Mac computers were all represented. This became an issue when linking to the appropriate OpenCV libraries, as each OS installs the shared libraries in a separate locations. The solution was to use Cmake to manage library linking and build structure of the project. No one in the team was familiar with Cmake so the team had to learn that on the fly. Ultimately this was a worthwhile effort as it allowed seamless compilation on any operating system used by the team.

Ultimately, learning to effectively work together was the greatest and most rewarding challenge. Reviewing the code of others and getting feedback from team members was a fantastic learning experience and the process of arguing for or against a particular implementation of a function was insightful for the whole group. It was challenging to troubleshoot issues that would arise from changes that others had made in their code but that definitely emphasized the importance of the planning phase. Overall, the team functioned very well as a whole and most obstacles were overcome with minimal friction.

Future Work

An exciting characteristic of our project is the potential for future improvements and expansion of the base code that was developed. Essentially the code generated for this project could serve as the building block for a much more ambitious project. Several potential avenues for future development include:
- Improvement in the accuracy of the coin detection and identification algorithms
- Addition of dollar bill identification
- Development of a GUI to make the project more usable
- Porting to Android and iOS devices for use with a phones camera
- Incorporation into commercial grade money counting systems

This project has many potential real-world applications and could provide a more convenient way for individuals to count loose change or a powerful and quick way for commercial users to count large volumes of currency.