

PALMPRINT RECOGNITION WITH THREE DIMENSIONAL FEATURES

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Abstract

In this paper, I will find features for authentication in the existing 3-D palmprint database. The features shall be stable in samples of a single person over time and distinguishable among samples of different people.

An identification process based on the features will be proposed.

The process will go through 8,000 samples in the database to be checked for stability and error rate.

Acknowledgements

I would like to thank the Math department for providing the original documentclass file that this class is based upon. I would like to thank my parents, without whom my life would not be possible. I would also like to thank my advisor, my dissertation committee, and my research collaborators because every graduate student needs to do so. And finally, I thank the members of my research group, to whom I leave this template to save you some of the trouble I had to go through getting my dissertation to compile in L^AT_EX.

Don't forget to ask your advisor if your work was sponsored by a grant that needs to be acknowledged in this section.

To my parents.

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Chapter 1

Introduction

Palmprint has been increasingly recognized as unique and stable biometric characteristics for personal authentication. In the past decade, various methods based on two dimensional (2-D) palmprint have been studied in depth. The 2-D recognition techniques have proved to achieve high accuracy [2].

In recent years, three dimensional (3-D) palmprint recognition devices emerge and are quite promising because of the additional depth information gathered.

Although the devices has been out for more than two years, most previous matching algorithms treat 3-D information as a supplement to 2-D texture images and used joint matching techniques to increase accuracy [1,5,6,7,8]. Authentication with only the 3-D information has not been thoroughly studied. The amount of useful information carried by the 3-D data is still under investigation.

There are two major challenges:

* 3-D devices, compared to 2-D ones, are lower in resolution. * The depth values are susceptible to movements of human hands and are therefore less stable than 2-D texture information of palmprints.

David et al. explore a 3-D palmprint recognition approach by exploiting the 3-D structural information of the palm surface [6, 8]. The structured light imaging

is used to acquire the 3-D palmprint data, from which several types of unique features, including mean curvature image, Gaussian curvature image, and surface type, are extracted. A fast feature matching and score-level fusion strategy is proposed for palmprint matching and classification. Wei et al. propose an efficient joint 2D and 3D palmprint matching scheme [5]. The principal line features and palm shape features are extracted and used to accurately align the palmprint, and a couple of matching rules are defined to efficiently use the 2D and 3D features for recognition. The experiments show that the proposed scheme can greatly improve the performance of palmprint verification. Wei et al. also present an efficient scheme for 3-D palmprint recognition [1]. They extract both line and orientation features after calculating and enhancing the mean-curvature image of the 3-D palmprint data. The two types of features are then fused at either score level or feature level for the final 3-D palmprint recognition.

Existing work has been done to utilize the 3-D information for palmprint classification and sorting. The global features proposed for that purpose are fast in matching speed but low in accuracy compared to 2-D techniques.

The major contribution of this paper would be a set of features that can increase the recognition performance of palmprint verification.

Chapter 2

Related Work

Everyone needs a chapter about related work, so here is a placeholder.

2.1 Tables

Tables are also quite important. Any table that can fit entirely on one page can be a floating table. If a table is longer and will span multiple pages, a long table can be inserted in-line with the text. This is demonstrated in Table ??, and explained in Appendix ??.

Tables that fit on one page use normal floating figures. Keep the 'p' placement option (in addition to 'h' and 't') so that if the float cannot fit in-line with the document text, it can be on a separate page by itself immediately after it is placed. Without the 'p' option, the float may get pushed to the end of the chapter, along with all other floats in the chapter that follow it.

Table ?? lists the various options for publishing your dissertation, with costs, as of 2010. You will have to bring a check for the appropriate amount, made out to “Princeton University Library”, when you submit your bound dissertation copies to Mudd Library, along with the appropriate forms and the electronic copy of your dissertation burned to a CD (not a DVD) as a single PDF file. (See [?].)

Traditional publishing is cheaper initially and lets you earn royalties if the publisher sells many copies of your dissertation. However, most of us won't have a best-seller dissertation and most likely won't earn royalties anyway. Instead, by choosing open access publishing, your dissertation will be available online for free to anyone who is interested. I strongly advocate for open access, to maximize the impact of your research.

Your dissertation is protected by copyright regardless of whether or not you have the copyright registered. However, registration establishes a public record of your copyright claim [?]. ProQuest will submit the copyright registration for an extra fee (about \$55). Alternatively, you can register it yourself at the Copyright Office's website for only \$35: <http://www.copyright.gov/eco/>.

Table 2.1: Thesis publishing options [?], as of May 2010.

Publishing Method	Publishing Fee	Diploma Fee	Copyright Registration Fee	Total
Traditional Publishing				
Traditional without copyright registration	65	15	–	80
Traditional with copyright registration	65	15	55	135
Open Access				
Open access without copyright registration	160	15	–	175
Open access with copyright registration	160	15	55	230

2.2 Figures

Everyone needs floating figures in their dissertation.

As shown in Figure ??, the Mudd Library dissertation requirements [?] specify additional options for formatting the title page. For example, if your thesis has multiple volumes, or to indicate the proper formatting for a master's thesis.

Appendix B

TITLE OF DOCTORAL DISSERTATION [OR MASTER'S THESIS]

Volume (if more than one bound volume)

Legal Name of Author

A DISSERTATION [OR THESIS]
PRESENTED TO THE FACULTY
OF PRINCETON UNIVERSITY
IN CANDIDACY FOR THE DEGREE
OF DOCTOR OF PHILOSOPHY [OR MASTER OF ARTS]

RECOMMENDED FOR ACCEPTANCE
BY THE DEPARTMENT OF [OR PROGRAM IN]
[NAME OF DEPARTMENT OR PROGRAM]
[Adviser: John Doe]

Month* Year

*(The month must be the one when the degree will be granted by the Board of Trustees.
Usually, the only acceptable months are January, April, June, September and November)

Figure 2.1: Sample title page layout [?]

Chapter 3

Methodology

The idea is to extract one or more features from the 3-D information as classifiers. Together with existing classifiers found in existing work in related fields [3,4,9], the new features will be combined to achieve a high performance classifier for personal authentication using Support Vector Machine (SVM).

The sample data has already been collected. There are 8,000 samples from 400 different palms with both hands. Samples of a palm are collected in two separate sessions with an average interval of one month.

![A 3-D palmprint sample](fig/sample.png "A 3-D palmprint sample")

![Contour view of the Region of Interest (ROI)](fig/roi_ontour.png "Contour view of the Region of Interest (ROI)")

![Surface view of ROI](fig/roi.png "Surface view of ROI")

Experiments will be done using Matlab.

1. Extract features from each palmprint sample.
2. A subset of samples will be chosen as test set.
3. Train an authentication model based on the rest of samples.
4. Verify the samples in the test set with the trained model against their true identities.
5. Discuss the performance of the model.

Chapter 4

Conclusion

In this work, we explain how to use the puthesis.cls class file and the accompanying template.

4.1 Future Work

Future work should include options in the template for a masters thesis or an undergraduate senior thesis. It should also support running headings in the headers using the ‘headings’ pagestyle. The print mode and proquest mode included in the template might also be candidates to include in the class itself.

Appendix A

Implementation Details

Appendices are just chapters, included after the `\appendix` command.

A.1 Switching Formats

When switching `printmode` on and off (see Section ??), you may need to delete the output `.aux` files to get the document code to compile correctly. This is because the `hyperref` package is switched off for `printmode`, but this package inserts extra tags into the contents lines in the auxiliary files for PDF links, and these can cause errors when the package is not used.

A.2 Long Tables

Long tables span multiple pages. By default they are treated like body text, but we want them to be single spaced all the time. The class therefore defines a new command, `\tablespacing`, that is placed before a long table to switch to single spacing when the rest of the document is in double spacing mode. Another command, `\bodyspacing`, is placed after the long table to switch back to double spacing. Normal

tables using `tabular` automatically use single spacing and do not require the extra commands.

When the documentclass is defined with the ‘`singlespace`’ option, these commands are automatically adjusted to stay in single spacing after the long table.

Make sure there is always at least one blank line after the `\bodyspacing` command before the end of the file.

Some times long tables do not format correctly on the first pass. If the column widths are wrong, try running the \LaTeX compiler one or two extra times to allow it to better calculate the column widths.

If you want your long table to break pages at a specific point, you can insert the command `\pagebreak[4]`, to tell \LaTeX that it really should put a page break there. `\pagebreak[2]` gives it a hint that this is a good place for a page break, if needed. If there’s a row that really should not be broken across a page, use `*`, which will usually prevent a pagebreak.

A.3 Booktabs

The booktabs package is included to print nicer tables. See the package documentation [?] for more details and motivation. Generally, all vertical lines are removed from the tables for a better visual appearance (so don’t put them in), and better spacing and line thicknesses are used for the horizontal rules. The rules are defined as `\toprule` at the top of the table, `\midrule` in between the heading and the body of the table (or between sections of the table), and `\bottomrule` at the end of the table. `\cmidrule` can be used with the appropriate options to have a rule that spans only certain columns of the table.

A.4 Bibliography and Footnotes

The bibliography and any footnotes can also be single spaced, even for the electronic copy. The template is already setup to do this.

Bibliography entries go in the .bib file. As usual, be sure to compile the \LaTeX code, then run BibTeX, and then run \LaTeX again.

To cite websites and other electronically accessed materials, you can use the ‘@electronic’ type of BibTeX entry, and use the ‘howpublished’ field to include the URL of the source material.

The formatting of bibliography entries will be done automatically. Usually the titles are changed to have only the first word capitalized. If you’d prefer to have your original formatting preserved, place the title in an extra set of curly braces, i.e., “title = {{My title has an AcroNyM that should stay unchanged}},”.

A.5 Figures and Tables

The captions of figures and tables take an optional parameter in square brackets, specifying the caption text to be used in the Table of Contents. The regular caption in curly braces is used for the table itself.

Generally captions for tables are placed above the table, while captions for figures are placed below the figure.

Appendix B

Printing and Binding

B.1 Printing

For the library copies of your dissertation, you must use archival quality printing and binding. This means acid-free paper, containing at least 25% cotton fiber. Triangle Repocenter on Nassau Street in Princeton offers both 25% cotton paper and 100% cotton paper. Most people choose the 25% cotton paper, and this is generally recommended by the binders. The 100% copy paper is somewhat thicker and the extra expense is unnecessary.

Triangle offers online submission of your printing and binding order at: <http://triangleprinceton.com/collegiatebinding/thesis/>. If you request binding from them, they will deliver the paper copies to Smith-Shattuck Bookbinding for you and allow you to pick up the completed copies at their store on Nassau Street. The whole process takes 2-3 business days, but check with them in advance during the busy thesis-printing season in April and May.

Currently, your printed and bound dissertation copies can be single spaced. Only the electronic copy submitted to ProQuest must be double spaced. All copies must be printed single-sided, with specific margins.

B.2 Binding

An archival-quality sewn binding is required for the library copies of your dissertation. Smith-Shattuck Bookbinding is highly recommended, and is used by most students. Triangle Repocenter will send your copies there for you, greatly simplifying the process, but you can call Smith-Shattuck with special requests.

The “library standard” sewn binding is sufficient for the copies to be sent to Mudd Library. It uses a black buckram cloth cover, which is the most popular option. For extra copies for yourself and your family members, you can choose “buckram roundback binding”, which adds decorative lines on the spine, and printing of the title and author on the front cover. For a small additional fee, you can include the Princeton University shield on the front cover and a ribbon bookmark. Leather covers are also available. See Smith-Shattuck’s website for more details at: <http://www.thesisbookbinding.com/>.