

## PERSONAL INFORMATION:

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## EDUCATION

March 2012: Completed the requirements to obtain a BSC in computer science and engineering from Obafemi Awolowo University, Ile-Ife, Nigeria.

**Undergraduate thesis:** "Classification of Uppercase Yoruba Letters using Bayesian Decision Theory under a Decision Tree."

Advised by a former Marie Curie research fellow, Dr Odetunji A. Odejobi.

## DISCOVERIES AND RE-DISCOVERIES

In early 2012, I re-discovered Voronoi diagrams and their use for template reduction in k-NN classifiers.

## HONORS AND AWARDS

Third best graduating student, of over five hundred graduating students, in the 2000 graduating class at Igbobi college, Yaba, Lagos, Nigeria.

## RESEARCH INTERESTS

Computer vision, machine learning, mathematics, algorithms and natural language processing.

## JOURNAL PUBLICATIONS

Ibraheem, A.O. (2014) "ALIAS: Application of Least Inertia Axis for Skeleton Extraction in Handwritten Character Images." **Accepted with Revisions** to Elsevier's *Journal of Visual Comm. and Image Representation*.

Ibraheem A. O. (2014). "A Shrinking Effect and Loss of Injectivity in Principal Component Analysis: Two Theorems and their Proofs. In Preparation for *Journal of Machine Learning Research*.

## CONFERENCE PUBLICATIONS

Ibraheem, A.O. and Odejobi O.A. (2011) "Exploiting Handwritten Character Recognition Systems in African languages Documentation and Education." Presented Orally at *AfLaT 2011*.

*Abstract of presentation slides is available at <http://aflat.org/biblio>*

## FAMILIAR CONCEPTS AND METHODS

*Shape Representation:* Shape contexts, multi-scale curvature methods (CSS, TAR and MCC), diffeomorphisms, signed distance score, Zernike moments, orthogonal Fourier-Mellin moments, Hu invariants, Affine Moment Invarriants, Shock graphs and Medial Axis Transform.

*Classifiers:* Bayesian classifiers, decision trees, SVM, ANN, HMM, CRF, maximum entropy, and nearest neighbor rule.

*Segmentation methods:* Region Competition and Mumford-Shah algorithms, Shi-Malik normalized graph cuts Ohlander-Ohta recursive algorithm, Haralick's region growers, isodata clustering, and k-means clustering.

*Data reduction methods:* PCA, SVD and Voronoi diagrams.

## PICTORIAL OVERVIEW OF MY SAMPLE PROJECTS

### MY PLATE NUMBER RECOGNITION SYSTEM IN ACTION



Fig. 1: (Left) An input plate number image to my plate number recognition system. (Right) The output from the system. **Notice the red boxes output by the system.** They indicate that my system **successfully automatically** detected where the letters of the plate number are; the system is neither fooled by the "GOD BLESS NIGERIA," nor by the "HONDA." **My system knows exactly what it is looking for.**

### MY THEOREM ABOUT ORTHOGONAL MATRICES AND PRINCIPAL COMPONENT ANALYSIS (PCA).

(A paper on this work is underway)

**Theorem 1:** Let  $A$  be any  $n$  by  $n$  orthogonal matrix, and let  $B$  be a matrix obtained by discarding at least one row of  $A$ . Then, for any three vectors  $\bar{x}, x_i$  and  $x_j$  all belonging to  $R^n$ , the pair of transformations,  $y_i = A(x_i - \bar{x})$  and  $y_j = A(x_j - \bar{x})$ , satisfies  $|y_i - y_j| = |x_i - x_j|$ , which preserves pairwise distances; whereas the pair of transformations,  $y_i^* = B(x_i - \bar{x})$  and  $y_j^* = B(x_j - \bar{x})$ , satisfies the inequality  $|y_i^* - y_j^*| \leq |x_i - x_j|$ , which tends to shrink pairwise distances.

**Remark 1:** The above theorem applies to PCA, since all PCA maps are either of the form  $y = A(x - \bar{x})$  or  $y = B(x - \bar{x})$ .

### AN ASPECT OF MY UNDERGRADUATE PROJECT: THE PSEUDO-DIACRITIC PROBLEM

(We Presented this work at AfLaT 2011 in Addis Ababa, Ethiopia).

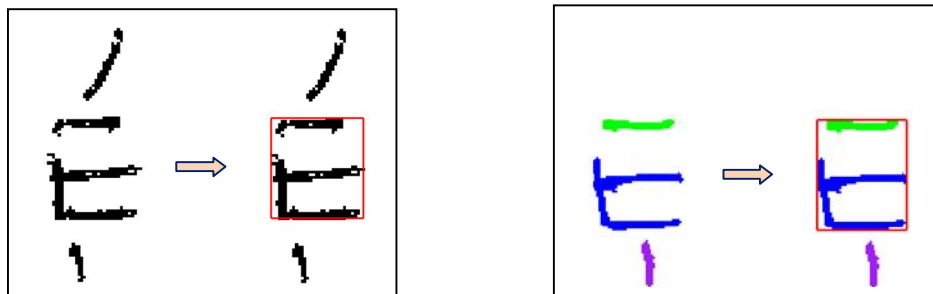


Fig 2: (Left) Our system is able to automatically cut out the "E" from the diacritic marks. (Right) Despite how the green stroke (which we call a **pseudo-diacritic**) is competing to be classified as a diacritic mark, our system is still able to automatically cut out the "E" perfectly. The interesting thing is that our system does **not** employ binary morphological closing because doing so can introduce fresh problems.

## ACADEMIC AND PROFESSIONAL EXPERIENCE/ACTIVITIES

- May 2012 – Jan. 2013: Designated by Dr Odejobi to serve as **mentor** on the following two undergraduate theses: "Design and Implementation of a Fingerprint Recognition System;" and "Automatic Person Identification via Speech."
- April 2011 – Feb. 2012: Designated by Dr. Odejobi to serve as a **mentor** on the following two theses: "Recognition of Handwritten Lowercase Yoruba Letters using Nearest Neighbor Classifier and Orthogonal Fourier- Mellin Moment;" and "Development of a Pattern Recognition System for Faces with Tribal Marks."

## PROJECTS AND RESEARCH WORK

- Feb. 2014: Contrived a novel algorithm for dynamic space warping of 2-d shapes in  $O(N^2)$  time.
- Late 2013 - Feb 2014: Stated and Proved two theorems about Principal Component Analysis.
- Mid 2013 – Feb 2014: Formulated three constrained optimization problems whose global minima are measures of shape similarity, and whose minimum "points" are diffeomorphisms that establish correspondences between shapes.
- August 2013 – Dec. 2013: Developed a novel method, called compact shape trees, for matching 2-d shapes; also, developed a novel theory and algorithm (based on Calculus and differential geometry) for sampling shape boundaries in a scale and rotation invariant manner.
- April 2013 – June 2013: Developed an end-to-end plate number recognition system; **a first in Nigeria !**
- Oct. 2012 – March 2013: Developed a novel algorithm (termed ALIASE) for the vectorization of line drawings.
- April 2011 – August 2011: For a client, programmed an artificial neural networks-based system, in MATLAB, for the prediction of certain parameters of a refrigeration system.
- March 2010 – March 2011: For my undergraduate project, I read books, designed techniques, and wrote programs that culminated in a character recognition system for my native Yoruba characters.

## PROGRAMMING LANGUAGES and TOOLS

MATLAB, Java, C++ , and LATEX.

## NATURAL LANGUAGES

Good spoken and written English, intermediate Arabic, and native command of Yoruba.

## REFEREES

Dr Odetunji A. Odejobi (PhD, University of Aston, UK). Senior Lecturer, Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria. Email: [oodejobi@oauife.edu.ng](mailto:oodejobi@oauife.edu.ng)

Dr Musodiq Bello (PhD, University of Houston, USA). Computer vision researcher, GE Healthcare, USA. Email: [mobello@gmail.com](mailto:mobello@gmail.com)

Dr. Suraj O. Ajadi (PhD, Obafemi Awolowo University, Nigeria). Senior Lecturer in Mathematics and Head of Mathematics Department, Obafemi Awolowo University, Nigeria. Email: [sajadi@oauife.edu.ng](mailto:sajadi@oauife.edu.ng)