

Contents

| | |
|--|------|
| Abstract | iii |
| Contents | xiii |
| 1 Introduction | 1 |
| 1.1 Motivation | 1 |
| 1.2 Objectives. | 3 |
| 1.3 Main contributions. | 4 |
| 1.4 Outline. | 5 |
| 2 Extraction and clustering of facial features | 7 |
| 2.1 Introduction | 8 |
| 2.2 Theoretical background. | 11 |
| 2.2.1 Mathematical morphological operators | 11 |
| 2.2.2 Principal Component Analysis | 13 |
| 2.2.3 K-means clustering | 18 |
| 2.2.4 t-Distributed Stochastic Neighbor Embedding. | 22 |
| 2.2.5 Facial landmarks detection | 25 |
| 2.3 Database | 34 |

| | |
|---|-----|
| 2.4 Automatic facial feature extraction | 35 |
| 2.4.1 Facial landmarks detection | 37 |
| 2.4.2 Feature masks creation | 38 |
| 2.4.3 Eyebrow extraction | 40 |
| 2.4.4 Eye extraction | 44 |
| 2.4.5 Nose extraction | 48 |
| 2.4.6 Mouth extraction | 51 |
| 2.4.7 Jawline extraction | 53 |
| 2.4.8 Distances extraction. | 54 |
| 2.5 Facial features clustering | 55 |
| 2.5.1 Automatic internal features clustering. | 59 |
| 2.5.2 Automatic jawlines clustering | 60 |
| 2.5.3 Distances clustering | 60 |
| 2.6 Results. | 61 |
| 2.6.1 Asian. | 63 |
| 2.6.2 Black. | 67 |
| 2.6.3 Latino | 71 |
| 2.6.4 White | 74 |
| 2.7 Validation of the procedure | 78 |
| 2.8 Conclusions. | 81 |
| | |
| 3 Generation of facial social impressions | 85 |
| 3.1 Introduction | 86 |
| 3.1.1 Psychological Reverse Correlation Methods | 87 |
| 3.1.2 Reverse Correlation Methods in the Context of Face Space models | 88 |
| 3.1.3 Limitations | 88 |
| 3.1.4 Our method. | 89 |
| 3.2 Theoretical background. | 90 |
| 3.2.1 Genetic Algorithms | 90 |
| 3.2.2 Image seamless cloning | 96 |
| 3.3 Generation of facial social impressions | 104 |
| 3.3.1 Social trait assessment of the facial feature clusters | 105 |
| 3.3.2 Optimization of the face evaluation function. | 106 |
| 3.3.3 Implementation of the face generation system | 109 |

| | |
|--|-----|
| 3.4 Results | 115 |
| 3.4.1 The social traits model | 115 |
| 3.4.2 How facial features affect social impressions | 116 |
| 3.4.3 Generation of faces that convey certain social impressions | 124 |
| 3.5 Validation of the face generator | 128 |
| 3.5.1 Social trait validation | 130 |
| 3.5.2 Face validation | 136 |
| 3.6 Conclusions | 141 |
| 4 Conclusions | 143 |
| Merits | 147 |
| Appendices | 149 |
| A Clustering results | 151 |
| B Taxonomies | 173 |
| Bibliography | 207 |