Algorithm 1 Marie Curie Genetic Algorithm Overview

Let $NUM\_GENS = 100$ represent the number of generations to evolve
Let $POP\_SIZE = 100$ represent the size of the total population
Let $NBPG = 50$ represent the number of new candidates to breed every generation
Let S_{min} and S_{max} represent the vectors of servo limits
Let L_R represent the landmarks in the reference image
Let $P = \{C_i, i \in \{0, 1, .., POP\_SIZE\}\}$ where each C_i is a candidate expression
for $i \in \{0, 1, .., POP\_SIZE - 1\}$ **do**
    Initialize $C_i.chromosome$ to $\mathcal{U}(\boldsymbol{S_{min}}, \boldsymbol{S_{max}})$
    Score each candidate s.t. $C_i.score = mc\_score()$
end for
for $g \in \{0, 1, .., NUM\_GENS\}$ **do**
    Let $N = \{N_i, i \in \{0, 1, .., NBPG\}\} = mc\_breed\_new(NBPG)$ be the set of new candidates for this gen
    Score N s.t. $N_i.score = mc\_score(N_i.chromosome, L_R)$
    Set $C = C \cup N$
    Remove the $NBPG$ elements with the lowest score from C
end for
return $C_{opt} = min(C)$

Algorithm 2 MC Score Algorithm (mc_score(X, L'_R))

Let $M = 68$ be the number of landmarks recognized in an image
Let $D = 2$ be the dimensionality of a single landmark
Let $L \in R^{M,N}$ represent the raw pixel valued landmarks
Let L'_R be the reference landmarks to score against
Let X be the chromosome to score
Actuate X on the face using the Maestro Controller
Capture an image, I_C, of the face
Get the bounding box B of the face
Detect the center of a rectangular bounding box, $B_C = [x, y] \in \mathbb{R}^2$ of the face
Detect raw landmarks $L_C = dlib\_predictor(I_C).landmarks$
Calculate new "centered" landmarks $L_C^C = L_C - (\mathbf{1} \otimes B_C)$
Calculate the horizontal scaling by $x_s = B_{Right} - B_{C,x}$
Calculate the vertical scaling by $y_s = B_{Bottom} - B_{C,y}$
Get normalized landmarks $L'_C = L_C^C \oslash (\mathbf{1} \otimes [x_s, y_s])$
Calculate difference in corresponding landmarks $L_D = L'_R - L'_C$
return $\|L_D\|_F = \sqrt{tr(L_D^T L_D)}$ where $L_D^T L_D$ is the Gramian matrix of L_D and the diagonal elements of $L_D^T L_D$ represent the euclidean distance error of each landmark

Algorithm 3 MC Breed New (mc_breed_new(num_to_breed))

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