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Weight based gender segregation of silk moths in cocoon stages with sex detection using AI & ML concepts

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Abstract
The work presented in this paper gives a brief idea about the weight based gender segregation of silk moths in cocoon stage. Mathematical modelling of the sensor is also carried out with the concept of silk moth sex identification.
Keywords : Silk, Sensor, Model, Weight.

1. Introduction

Silk moth sex identification and its automation is one of the important processes in the sericulture industry because sex identification can assist in effectively separating the male and female moths in early stages of silkworm seed production process which could avoid unregulated mating process and automation enhances the precision and mass production. The gender detection and separation methods are done based on the average weight of the cocoon during pupa stage using weighing machines manually or based on size and physical structure of matured moths are handpicked by experts before they can mate. This conventional method of gender detection and separation prone to increase in error rate, time consumption, labor and decrease in production rate and quality of eggs.

In the proposed system, high precision weighing sensor with microcontroller detects the accurate weights of the individual training samples and the K-Means linear regression model can able to accurately fix the threshold for statistically varying physical weights in nature. Then based on the threshold the test samples are segregated into male and female cocoons.

The linear regression model can identify the threshold from the set of physical weights of individual training samples and system can able to segregates 700 to 800 samples per hour which increases the rate of segregation process and accuracy tremendously compared to traditional segregation techniques by approximately 95%.

The proposed sorting methods can be used in segregation of any light weight objects and accuracy can be improved using artificial intelligence and machine learning algorithms.

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2. Methodology

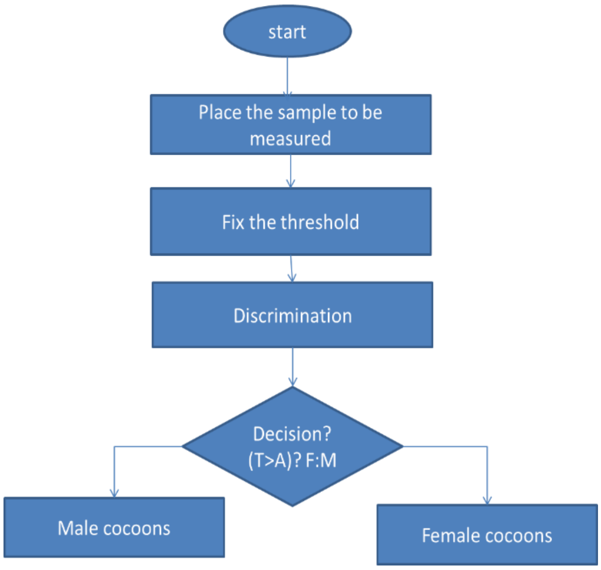

Fig. 1 : flow chart of project

3. Block diagram

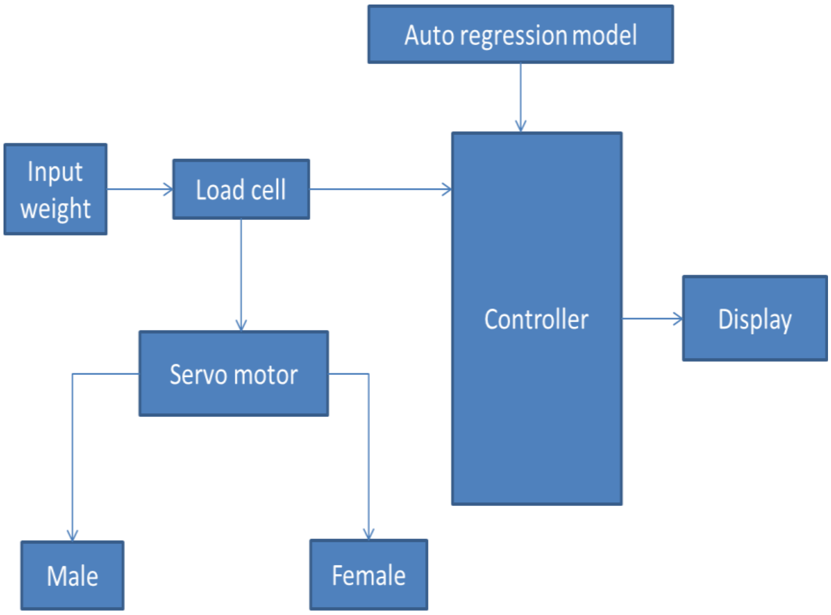

Fig. 2 : Overall block diagram

4. K-Means Clustering

k-means clustering is a method of vector quantization, originally from signal processing that is popular for cluster analysis in data mining. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. The problem is computationally difficult (NP-hard); however, there are efficient heuristic algorithms that are commonly employed and converge quickly to a local optimum. These are usually similar to the expectation-maximization algorithm for mixtures of Gaussian distributions via an iterative refinement approach employed by both k-means and Gaussian mixture modeling. Additionally, they both use cluster centers to model the data; however, k-means clustering tends to find clusters of comparable

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spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

The algorithm has a loose relationship to the k-nearest neighbor classifier, a popular machine learning technique for classification that is often confused with k-means due to the k in the name. One can apply the 1-nearest neighbor classifier on the cluster centers obtained by k-means to classify new data into the existing clusters. This is known as nearest centroid classifier or Roccio algorithm. Given a set of observations (x1, x2, …, xn), where each observation is a d-dimensional real vector, k-means clustering aims to partition the n observations into k (≤ n) sets S = {S1, S2, …, Sk} so as to minimize the within-cluster sum of squares (WCSS) (i.e. variance). Formally, the objective is to find:

arg min $\sum \|X - \mu i\|$ 2 = arg $min \sum |Si| var\ Si$

where μi is the mean of points in Si. This is equivalent to minimizing the pairwise squared deviations of points in the same cluster:

arg $min \sum$ 1/2$|Si| \sum \|X - Y\|$^2

Equivalence can be deduced from identity is given by

$\sum \|X - \mu i\|$ 2 = $k\ x{\in}si \sum X{\neq}y{\in}s(X - \mu i)(\mu i - y)$

Because the total variance is constant, this is also equivalent to maximizing the sum of squared deviations between points in different clusters (between-cluster sum of squares, BCSS), which follows easily from the law of total variance.

5. Conclusions

We are concluding that the proposed system can segregate genders of the silks moth in cocoon stage with acceptable accuracy and speed compared to traditional methods. The statistical approaches for calculating the average weight of the training samples for two different sex as threshold for variety of cocoon seeds is highly reliable. The high precision sensors with microcontrollers are fast enough to process the algorithm and reached segregation rate and accuracy of about 95%.

6. Future scope

The proposed sorting methods can be used in segregation of any light weight objects and large number of samples and accuracy can be improved using artificial intelligence and machine learning algorithms.

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