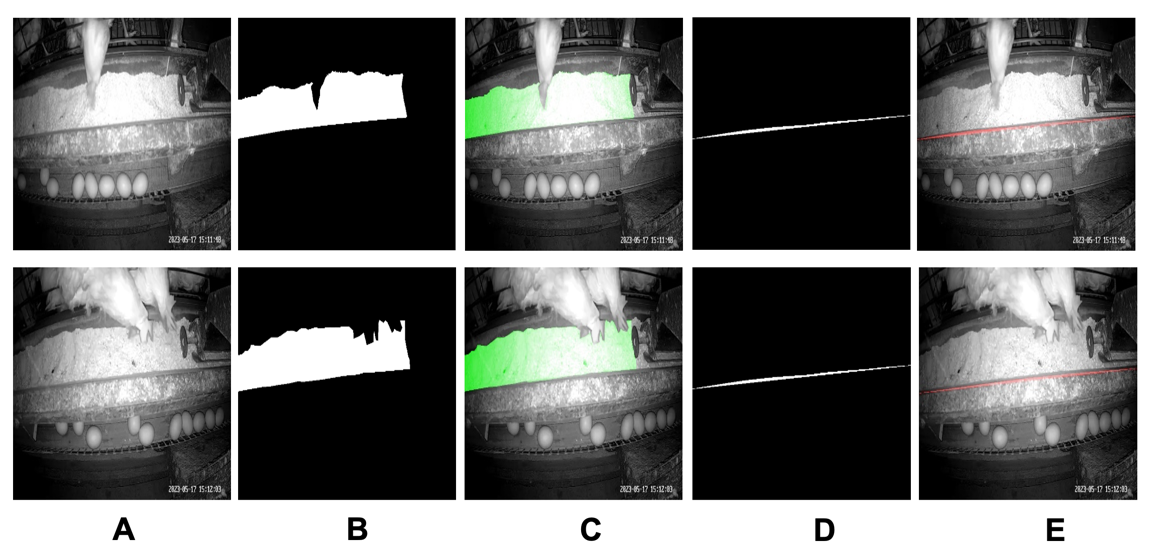
##### Supplementary



1. Feed area and feed line. A shows the original image,And B, D shows that the mask of feed area and feed line. and C, E shows that the visualization of feed are and feed line.
2. Algorithm of Health analysis Module

|  |
| --- |
| **Input:** Detection sequence *,* Track sequence: |
| =\{t\_1,t\_2,\ldots,\t\_m\} |
| Unmatched number threshold: ; |
| Compute matching: using Eq. 10-12 |
| Compute prediction using Eq. 13 |
| Compute update using Eq. 14-17 |
| 1: **While** video in progress |
| 2: **if** is |
| 3: Compute using Eq. 7-9  4: |
| 4: |
| 5: **else** |
| 6: |
|  |
| 7: **for** **do** |
| 8: |
| 9: |
| 10: Compute using Eq. 7-9 |
| 11: |
| 12: **Select**  by into |
| 13: |
| 14: **until** video finish |

1. Algorithm OF Moving normal vector method

|  |
| --- |
| **Input:** Sequence of mask area in video sequence: |
| ; |
| Current frame mask ; |
| Moving threshold: |
| Moving Detection Function |
| Cage object horizontal ordinate: |
| Feed fixed horizontal ordinate: |
| Initialed Vertical line: |
| **Output:** Well estimate feed area of each cage: |
| 1: **Procedure** |
| 2: **repeat** |
| 3: **if** <  4: |
| 4: |
| 5: **if** : |
| 6: |
| 7: |
| 8: **until** |
| 9: **end Procedure** |
| 10: **Return** |

1. Statistical testing of CKTrack and classical methods

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** |  | **Matric** | **Shapiro** | **P-value**  **(T-test)** | **P-value**  **(Nonparametric)** |
| ResNext |  | Sensitivity | 0.636470318 | - | 0.00390625 |
| **CKTrack** |  | **0.022059433** |
| ResNext |  | Specificity | 0.678435385 | - | 0.835156615 |
| **CKTrack** |  | 0.401722282 |
| ResNext |  | Precision | 0.685249746 | 0.654788 | - |
| **CKTrack** |  | 0.736854434 |
| ResNext |  | Accuracy | 0.310656816 | 0.267413 | - |
| **CKTrack** |  | 0.064519487 |
| ResNext |  | Speed | 0.328451842 | - | 0.000976563 |
| **CKTrack** |  | 0.037564632 |  |
| MobileNetV2 |  | Sensitivity | 0.307281286 | - | 0.00390625 |
| **CKTrack** |  | 0.022059433 |
| MobileNetV2 |  | Specificity | 0.136877924 | 0.55002 | - |
| **CKTrack** |  | 0.401722282 |
| MobileNetV2 |  | Precision | 0.498032033 | 0.990822 | - |
| **CKTrack** |  | 0.736854434 |
| MobileNetV2 |  | Accuracy | 0.117012478 | 0.599761 | - |
| **CKTrack** |  | 0.064519487 |
| MobileNetV2 |  | Speed | 0.043124001 | - | 0.000976563 |
| **CKTrack** |  | 0.037564632 |  |
| EfficientNet-b7 |  | Sensitivity | 0.01387128 | - | 0.00390625 |
| **CKTrack** |  | 0.022059433 |
| EfficientNet-b7 |  | Specificity | 0.279030621 | 0.55002 | - |
| **CKTrack** |  | 0.401722282 |
| EfficientNet-b7 |  | Precision | 0.055184528 | 0.852747 | - |
| **CKTrack** |  | 0.736854434 |
| EfficientNet-b7 |  | Accuracy | 0.123130299 | 0.599761 | - |
| **CKTrack** |  | 0.064519487 |
| EfficientNet-b7 |  | Speed | 0.610497773 | - | 0.000976563 |
| **CKTrack** |  | 0.037564632 |
| Deepsort |  | Sensitivity | 0.040498711 | - | 0.009765625 |
| CKTrack |  | 0.022059433 |
| Deepsort |  | Specificity | 0.892798603 | 0.983184 | - |
| **CKTrack** |  | 0.401722282 |
| Deepsort |  | Precision | 0.458195865 | 0.980987 | - |
| **CKTrack** |  | 0.736854434 |
| Deepsort |  | Accuracy | 0.095873207 | 0.822335 | - |
| **CKTrack** |  | 0.064519487 |
| Deepsort |  | Speed | 0.254999846 | - | 0.000976563 |
| **CKTrack** |  | 0.037564632 |

1. Four measurement definition

|  |  |  |
| --- | --- | --- |
| **Measure** | **Definition** | **Formula** |
| IOU\_1 | IOU for  continuous regions |  |
| : the ground truth of back-ground |
| : the ground truth of feed area |
| : the prediction of back-ground |
| : the prediction of feed area |
| IOU\_2 | IOU for  discrete instances |  |
| : the ground truth of feed line |
| : the prediction of feed line |
| IOU\_3 | IOU for  both continuous regions and discrete instances |  |
| IOU\_1: the IOU (Eq. 11) of feed area |
| IOU\_2: the IOU of feed line |
|  | Mean absolute percentage error,  which is often used to compare the accuracy of model prediction. The smaller the value,  the higher the prediction accuracy of the model. |  |
| : the real number of  residuals for each cage |
| : the prediction of  residuals for each cage |
| : the number of cages |