CLAIMS

1. A computer-implemented method for improving harvesting of crops, the method comprising:

collecting, by a processor in an edge device, data comprising at least one image of harvest at a collection point of harvest wherein the harvest comprises one or more fruits or fruit bunch;

identifying a single unit of fruit or fruit bunch in the image of harvest;

extracting, by the processor in the edge device, one or more visual features from the image of the identified single unit of fruit or fruit bunch wherein the one or more visual features relate to ripeness and harvesting operations

determining a quality grading for the harvest from the extracted one or more visual features of the single unit of fruit or fruit bunch.

generating a harvesting data model based on one or more of the images of harvest ~~in real time~~ from the edge device, the extracted one or more visual features, and the determined quality grading; and

using the harvesting data model to determine one or more operational decisions pertaining to hand movements of ~~harvester~~a worker, and correlation between fruit ripeness and time of harvest.

2. The method of claim 1 wherein the edge device is one of a smartphone or an edge--based imaging system.

3. The method of claim 1 wherein the step of determining a quality grading from the extracted one or more visual features comprises:

grading ripeness of fruit based on a number of empty sockets in a fruit bunch and color, size, and texture of fruit;

detecting quality of harvesting operations based on type of cut made, length of fruit stalk.

4. The method of claim~~s~~ 3 wherein the quality grading comprises enhancing of the ~~images and videos~~at least one image of harvest using generative adversarial network models.

5. The method of ~~any of~~ claim 1~~s 3 to 5~~ ~~wherein~~ further comprising ~~the~~ step~~s~~ of identifying one or more objects of interest and generating a set of features for each of ~~the~~ one or more objects of interest ~~comprises~~ by extracting a portion of the image~~s~~ ~~and videos of harvested produce~~ corresponding to each of the one or more objects of interest.

6. The method of ~~any of~~ claim~~s~~ ~~3 to 6~~ 5 wherein the set of features ~~for each of the one or more objects of interests~~ are selected from the group consisting of: size; shape; socket detection; wavelet-based features; and colour-based features.

7. The method of ~~any of~~ claim~~s~~ 1~~,3 to 7~~ wherein the ~~quality of harvested produce~~equality grading is determined by criterion selected from the group consisting of: ripeness grade; pest infestation; disease infestation; harvest cut quality; and one or more predefined genetic anomalies.

~~7.~~8. The method of claim 1, further comprising the step extracting one of more features from the data.

~~8.~~9. The method of any of claim~~s 1 to~~ 8~~,~~ wherein the ~~one or more~~ data ~~sources~~further comprises~~is a device comprising one or more sensors and the collected data is~~ movement and location data.

~~9.~~10. The method of claims 9 wherein the ~~extracted~~ one or more features are selected from the group consisting of: movement pattern; and location information.

~~10.~~11. The method of any of claims ~~10~~ 8-10, ~~wherein the step of extracting one or morefeatures~~ further ~~comprises~~ comprising the step of processing the extracted one or more features to determine a likely action being carried out.

~~11.~~12. The method of claim 11 wherein the step of processing the extracted one or more features is based on at least one of location data; and characteristics of a tree being harvested.

~~12.~~13. The method of any of claims 10 to 12 further comprising: comparing the ~~extracted~~ movement pattern with an ideal movement pattern stored on a database; and generating a first alert if the ~~extracted~~ movement pattern differs from the ideal movement pattern.

~~13.~~14. The method of any of claims ~~10~~ 11 to 13, further comprising:

comparing the location information of the determined likely action being carried out with an expected action at a location with the same location information; and

generating a second alert if the determined likely action being carried out differs from the expected action.

~~14.~~15. The method of any of claims 9 to 14 further comprising using the harvesting data model to predict yield at a tree level.

~~15.~~16. The method of claim 15 further comprising comparing the predicted yield to an actual yield; and determining a reason if the predicted yield differs from the actual yield.

~~16.~~17. The method of claims 15 or 16 further comprising:

quantifying an impact of worker actions based on partial dependence analysis; identifying key worker actions impacting yield; andprioritizing key worker actions.

~~17.~~18. The method of any of claims 9 to 17, further comprising:

determining one or more thresholds for worker actions based on partial dependence analysis; and

deploying the one or more thresholds on ~~the~~ a device.

~~18.~~19. A system for improving harvesting of crops, the system comprising:

at least one memory device and at least one processor, the at least one processor is operably coupled to the at least one memory device; the at least one memory device comprising instructions to be executed by the at least one processor, the instructions instruct the at least one processor to:

collect at least one image of harvest at a collection point of harvest wherein the harvest comprises one or more fruits or fruit bunch; identifying a single unit of fruit or fruit bunch in the image of harvest;

extract, by the processor in the edge device, one or more visual features from the image of the identified single unit of fruit or fruit bunch wherein the one or more visual features relate to ripeness and harvesting operations;

determine a quality grading for the harvest from the extracted one

or more visual features of the single unit of fruit or fruit bunch;.

generate a harvesting data model based on one or more of the images of harvest in real time from the edge device, the extracted one or more visual features, and the determined quality grading; and

use the harvesting data model to determine one or more operational decisions pertaining to hand movements of harvester, and correlation between fruit ripeness and time of harvest.

19.20. The system of claim 19 further comprising:

a device comprising one or more sensors, the one or more sensors configured to collect movement and location data to be processed by the processor.

20.21. A computer-readable storage medium comprising instructions to be executed with at least one memory device and at least one processor, when executing the instructions, the at least one processor configured to:

collects at least one image of harvest at a collection point of harvest wherein the harvest comprises one or more fruits or fruit bunch;

identifying identify a single unit of fruit or fruit bunch in the image of harvest;

extract one or more visual features from the image of theidentified single unit of fruit or fruit bunch wherein the one or more visual features relate to ripeness and harvesting operations;

determine a quality grading for the harvest from the extracted one or more visual features of the single unit of fruit or fruit bunch.;

generate a harvesting data model based on one or more of the images of harvest in real time from the an edge device, the extracted oneor more visual features, and the determined quality grading; and

determine ~~use~~ using the harvesting data model ~~to determine~~ one or more operational decisions pertaining to hand movements of ~~harvester~~a worker, and correlation between fruit ripeness and time of harvest.

~~21.~~22. The method of claim ~~1~~ 21 wherein the edge device is one of a smartphone or an ~~edge based~~edge-based imaging system.