

WHAT IS CLAIMED IS:

1. A computer-implemented method of identifying a vehicle in a toll system, the method comprising:
 - accessing image data for a vehicle transacting with a toll system;
 - obtaining first vehicle identifier data from the accessed image data for the transacting vehicle;
 - accessing a set of records that includes first vehicle identifier data for vehicles;
 - executing, using at least one processing device, an algorithm to:
 - compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records, and
 - identify a set of matching vehicle candidates from the vehicles having records in the set of records, wherein the identified set of matching vehicle candidates excludes at least one vehicle having a record in the set of records; and
 - selecting, from the set of matching vehicle candidates, a vehicle candidate as corresponding to the transacting vehicle by:
 - accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,
 - accessing second vehicle identifier data for a vehicle candidate in the set of matching vehicle candidates,
 - comparing, using the at least one processing device, the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of matching vehicle candidates, and
 - identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data.
2. The method of claim 1, wherein the first vehicle identifier data comprises license plate data.

3. The method of claim 2, wherein the algorithm comprises a loosened license plate reading algorithm, and wherein the loosened license plate reading algorithm includes loosened license plate matching criteria or a lowered license plate read confidence threshold to enable generation of a larger set of matching vehicle candidates relative to a license plate reading algorithm designed to identify a single and best vehicle candidate match.
4. The method of claim 3, wherein the license plate reading algorithm comprises an algorithm that reads a license plate number of a target vehicle from an image of the target vehicle and compares the license plate number read from the image to known license plate numbers of vehicles to identify a set of matching vehicle candidates for the target vehicle.
5. The method of claim 3, wherein the license plate reading algorithm has been intentionally modified to generate a larger set of matching vehicle candidates by lowering the read confidence threshold used by the algorithm to determine whether a read result is designated as corresponding to a matching vehicle candidate.
6. The method of claim 3, wherein the license plate reading algorithm has been intentionally modified to generate a larger set of matching vehicle candidates by requiring a license plate number of a candidate vehicle to match only a subset or a lesser number of characters in the license plate number of a target vehicle for the candidate vehicle to be included in the set of matching vehicle candidates.
7. The method of claim 1, wherein the second vehicle identifier comprises vehicle fingerprint data for the transacting vehicle, the vehicle fingerprint data for the transacting vehicle being based on the accessed image data for the transacting vehicle and the vehicle fingerprint data for the transacting vehicle being a set of data artifacts corresponding to a visual signature that is deemed unique to the transacting vehicle.
8. The method of claim 1, wherein comparing the first vehicle identifier data for the first vehicle with the first vehicle identifier data for vehicles in the set of records includes searching a

vehicle record database for records that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle.

9. The method of claim 8, wherein comparing the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records includes performing an extended search of the vehicle record database for records that include first vehicle identifier data that nearly match the first vehicle identifier data obtained for the transacting vehicle, the extended search being conditioned on no vehicle identification records being found that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle.

10. The method of claim 8,
wherein comparing the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records includes comparing the first vehicle identifier data using predetermined matching criteria, and
further comprising changing the predetermined matching criteria to increase the number of vehicles in the identified set of vehicles.

11. The method of claim 10, wherein changing the predetermined matching criteria to increase the number of vehicles in the identified set of vehicles is conditioned on a failure to identify any vehicles in the set of vehicles as the transacting vehicle based on results of the comparison of second vehicle identifier data.

12. The method of claim 1,
further comprising accessing laser signature data,
wherein the laser signature data comprises data obtained by using a laser to scan the transacting vehicle.

13. The method of claim 12, wherein the laser signature data includes one or more of an overhead electronic profile of the transacting vehicle, an axle count of the transacting vehicle, and a 3D image of the transacting vehicle.

14. The method of claim 12,
further comprising comparing the laser signature data for the transacting vehicle with
laser signature data for vehicles in the set of records, and
wherein identifying a set of vehicles from the vehicles having records in the set of
records includes identifying the set of vehicles based on the results of the comparison of the first
vehicle identifier data and the results of the comparison of the laser signature data or the
inductive signature data.
15. The method of claim 1,
further comprising accessing inductive signature data,
wherein the inductive signature data comprises data obtained through use of a
loop array over which the transacting vehicle passes.
16. The method of claim 15, wherein the inductive signature data includes one or
more of an axle count of the transacting vehicle, a type of engine of the transacting vehicle, and a
vehicle type or class for the transacting vehicle.
17. The method of claim 15,
further comprising comparing the inductive signature data for the transacting vehicle with
inductive signature data for vehicles in the set of records, and
wherein identifying a set of vehicles from the vehicles having records in the set of
records includes identifying the set of vehicles based on the results of the comparison of the first
vehicle identifier data and the results of the comparison of the inductive signature data.
18. The method of claim 1, wherein identifying the vehicle candidate in the set of matching
vehicle candidates as the transacting vehicle includes identifying the vehicle candidate as the
transacting vehicle if the comparison of the second vehicle identifier data for the transacting
vehicle with the second vehicle identifier data for the vehicle candidate in the set of matching
vehicle candidates indicates a match having a confidence level that exceeds a confidence
threshold.

19. The method of claim 18, wherein identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle includes identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle without human intervention if the confidence level of the match exceeds a first confidence threshold.

20. The method of claim 19, wherein identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle includes identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle if the confidence level of the match is less than the first confidence threshold but greater than a second confidence threshold and a human operator confirms the match.

21. The method of claim 20, further comprising enabling the human operator to confirm or reject the match by:

enabling the human operator to perceive the accessed image data for the transacting vehicle,

enabling the human operator to perceive one or more reference images associated with the vehicle candidate, and

enabling the human operator to interact with a user interface to indicate rejection or confirmation of the match.

22. The method of claim 20, wherein identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle includes identifying the vehicle candidate as the transacting vehicle if the confidence level of the match is less than the first and second confidence thresholds and a human operator manually identifies the vehicle candidate as the transacting vehicle by accessing the image data for the transacting vehicle and the record for the vehicle candidate in the set of records.

23. The method of claim 1, wherein identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle includes identifying the vehicle candidate based on vehicle identification number (VIN), laser signature, inductive signature, and image data.

24. The method of claim 1, wherein identifying a set of matching vehicle candidates based on the results of the comparison of the license plate data comprises identifying multiple vehicle candidates as corresponding to the transacting vehicle based on the results of the comparison of the first vehicle identifier data.

25. An apparatus for identifying a vehicle in a toll system, the apparatus comprising:
an image capture device configured to capture image data for a vehicle transacting with a toll system; and

one or more processing devices communicatively coupled to each other and to the image capture device and configured to:

access the image data for the transacting vehicle;

obtain first vehicle identifier data from the accessed image data for the transacting vehicle;

access a set of records that includes first vehicle identifier data for vehicles;

execute, using at least one processing device, an algorithm to:

compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records, and

identify a set of matching vehicle candidates from the vehicles having records in the set of records, wherein the identified set of matching vehicle candidates excludes at least one vehicle having a record in the set of records; and

select, from the set of matching vehicle candidates, a vehicle candidate as corresponding to the transacting vehicle by:

accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,

accessing second vehicle identifier data for a vehicle candidate in the set of matching vehicle candidates,

comparing, using the at least one processing device, the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of matching vehicle candidates, and

identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data.

26. An article comprising a machine-readable medium storing machine-executable instructions that, when applied to a machine, cause the machine to perform operations comprising:

- accessing image data captured by an image capture device, the image data corresponding to a vehicle transacting with a toll system;

- obtaining first vehicle identifier data from the accessed image data for the transacting vehicle;

- accessing a set of records that includes first vehicle identifier data for vehicles;

- executing an algorithm to:

 - compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records; and

 - identify a set of matching vehicle candidates from the vehicles having records in the set of records, wherein the identified set of matching vehicle candidates excludes at least one vehicle having a record in the set of records; and

- selecting, from the set of matching vehicle candidates, a vehicle candidate as corresponding to the transacting vehicle by:

 - accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,

 - accessing second vehicle identifier data for a vehicle candidate in the set of matching vehicle candidates,

 - comparing, using the at least one processing device, the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of matching vehicle candidates, and

 - identifying the vehicle candidate in the set of matching vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data.

What is claimed is:

1. A computer-implemented method of identifying a vehicle in a toll system, the method comprising:

- accessing image data for a vehicle transacting with a toll system;

- obtaining first vehicle identifier data from the accessed image data for the transacting vehicle;

- accessing a set of records that includes first vehicle identifier data for vehicles;

- executing, using at least one processing device, an algorithm to:

 - compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records, and

 - identify a set of vehicle candidates from the vehicles having records in the set of records, wherein the identified set of vehicle candidates excludes at least one vehicle having a record in the set of records; and

 - selecting, from the set of vehicle candidates, a vehicle candidate as

corresponding to the transacting vehicle by:

 - accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,

 - accessing second vehicle identifier data for a vehicle candidate in the set of vehicle candidates,

 - comparing, using the at least one processing device, the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of vehicle candidates, and

 - identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data,

wherein executing the algorithm to compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records includes:

 - searching a vehicle record database for records that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle, and

 - performing an extended search of the vehicle record database for records that include first vehicle identifier data that nearly match the first vehicle identifier data obtained for the transacting vehicle, the extended search being conditioned

on no vehicle identification records being found that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle.

2. The method of claim 1,
wherein comparing the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records includes comparing the first vehicle identifier data using predetermined matching criteria, and
further comprising changing the predetermined matching criteria to increase the number of vehicles in the identified set of vehicles.
3. The method of claim 2, wherein changing the predetermined matching criteria to increase the number of vehicles in the identified set of vehicles is conditioned on a failure to identify any vehicles in the set of vehicles as the transacting vehicle based on results of the comparison of second vehicle identifier data.
4. The method of claim 1,
further comprising accessing laser signature data,
wherein the laser signature data comprises data obtained by using a laser to scan the transacting vehicle.
5. The method of claim 4, wherein the laser signature data includes one or more of an overhead electronic profile of the transacting vehicle, an axle count of the transacting vehicle, and a 3D image of the transacting vehicle.
6. The method of claim 4,
further comprising comparing laser signature data for the transacting vehicle with laser signature data for vehicles in the set of records, and
wherein identifying a set of vehicles from the vehicles having records in the set of records includes identifying the set of vehicles based on the results of the comparison of the first vehicle identifier data and the results of the comparison of the laser signature data.
7. The method of claim 1,
further comprising accessing inductive signature data,

wherein the inductive signature data comprises data obtained through use of a loop array over which the transacting vehicle passes.

8. The method of claim 7, wherein the inductive signature data includes one or more of an axle count of the transacting vehicle, a type of engine of the transacting vehicle, and a vehicle type or class for the transacting vehicle.

9. The method of claim 7,
further comprising comparing laser signature data for the transacting vehicle with laser signature data for vehicles in the set of records, and
wherein identifying a set of vehicles from the vehicles having records in the set of records includes identifying the set of vehicles based on the results of the comparison of the first vehicle identifier data and the results of the comparison of the inductive signature data.

10. The method of claim 1, wherein identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle includes identifying the vehicle candidate as the transacting vehicle if the comparison of the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of vehicle candidates indicates a match having a confidence level that exceeds a confidence threshold.

11. The method of claim 10, wherein identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle includes identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle without human intervention if the confidence level of the match exceeds a first confidence threshold.

12. The method of claim 11, wherein identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle includes identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle if the confidence level of the match is less than the first confidence threshold but greater than a second confidence threshold and a human operator confirms the match.

13. The method of claim 12, further comprising enabling the human operator to confirm or reject the match by:

enabling the human operator to perceive the accessed image data for the transacting vehicle,

enabling the human operator to perceive one or more reference images associated with the vehicle candidate, and

enabling the human operator to interact with a user interface to indicate rejection or confirmation of the match.

14. The method of claim 12, wherein identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle includes identifying the vehicle candidate as the transacting vehicle if the confidence level of the match is less than the first and second confidence thresholds and a human operator manually identifies the vehicle candidate as the transacting vehicle by accessing the image data for the transacting vehicle and the record for the vehicle candidate in the set of records.

15. The method of claim 1, wherein identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle includes identifying the vehicle candidate based on vehicle identification number (VIN), laser signature, inductive signature, and image data.

16. The method of claim 1, wherein the second vehicle identifier comprises vehicle fingerprint data for the transacting vehicle, the vehicle fingerprint data for the transacting vehicle being based on the accessed image data for the transacting vehicle.

17. An apparatus for identifying a vehicle in a toll system, the apparatus comprising:
an image capture device configured to capture image data for a vehicle transacting with a toll system; and

one or more processing devices communicatively coupled to each other and to the image capture device and configured to:

access the image data for the transacting vehicle;

obtain first vehicle identifier data from the accessed image data for the transacting vehicle;

access a set of records that includes first vehicle identifier data for vehicles;

execute an algorithm to:

compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records, and

identify a set of vehicle candidates from the vehicles having records in the set of records, wherein the identified set of vehicle candidates excludes at least one vehicle having a record in the set of records; and
select, from the set of vehicle candidates, a vehicle candidate as corresponding to the transacting vehicle by:

accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,

accessing second vehicle identifier data for a vehicle candidate in the set of vehicle candidates,

comparing the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of vehicle candidates, and

identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data,

wherein the one or more processing devices being configured to execute an algorithm to compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records comprises the one or more processing devices being configured to:

search a vehicle record database for records that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle, and

perform an extended search of the vehicle record database for records that include first vehicle identifier data that nearly match the first vehicle identifier data obtained for the transacting vehicle, the extended search being conditioned on no vehicle identification records being found that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle.

18. A computer-readable storage device storing software comprising instructions executable by one or more computers which, upon such execution, cause the one or more computers to perform operations comprising:

accessing image data captured by an image capture device, the image data corresponding to a vehicle transacting with a toll system;

obtaining first vehicle identifier data from the accessed image data for the transacting vehicle;

accessing a set of records that includes first vehicle identifier data for vehicles;

executing an algorithm to:

compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records, and

identify a set of vehicle candidates from the vehicles having records in the set of records, wherein the identified set of vehicle candidates excludes at least one vehicle having a record in the set of records; and

selecting, from the set of vehicle candidates, a vehicle candidate as corresponding to the transacting vehicle by:

accessing second vehicle identifier data for the transacting vehicle, the second vehicle identifier data being data for identifying a vehicle that is distinct from first vehicle identifier data,

accessing second vehicle identifier data for a vehicle candidate in the set of vehicle candidates,

comparing the second vehicle identifier data for the transacting vehicle with the second vehicle identifier data for the vehicle candidate in the set of vehicle candidates, and

identifying the vehicle candidate in the set of vehicle candidates as the transacting vehicle based on results of the comparison of second vehicle identifier data,

wherein executing the algorithm to compare the first vehicle identifier data for the transacting vehicle with the first vehicle identifier data for vehicles in the set of records includes:

searching a vehicle record database for records that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle, and

performing an extended search of the vehicle record database for records that include first vehicle identifier data that nearly match the first vehicle identifier data obtained for the transacting vehicle, the extended search being conditioned on no vehicle identification records being found that include first vehicle identifier data that exactly match the first vehicle identifier data obtained for the transacting vehicle.