Claims

1. A sensor system for a container ~~(such as a bin)~~, the system comprising:
an emitter of a detection radiation into the container;
a receiver of reflected radiation arranged to produce a signal based on received reflected radiation, wherein the received reflected radiation is produced by reflection or similar of contents of the container;
a processor for interpreting the signal and preparing a transmission signal;
a transmitter of the transmission signal;
wherein the emitter, receiver, processor and transmitter are housed within a package that is integrally formed in a hinged lid of the container.

2. The system according to claim 1, wherein the system further comprises a power source for powering at least one of the emitter, receiver, processor and transmitter; wherein the power source is also housed in the package.

3. The system according to claim 1 ~~or 2~~, wherein the system further comprises another sensor inside the package for detecting a property of the lid.~~,~~

~~4. The system according to claim 3,~~ wherein the property comprises~~is~~ acceleration and/or orientation and/or movement.

~~5. The system according to claim 4, wherein the sensor comprises an accelerometer.~~

~~6.~~4. The system according to ~~any one of~~ claim~~s~~ 2 or 3~~to 5~~, wherein the package comprises a heat shield for shielding one or more of the emitter, receiver, processor, transmitter and power source from the heat of plastic moulding the package into the lid.

~~7. The system according to any one of claims 1 to 6, wherein the emitter looks through an aperture into the interior of the container.~~

~~8.~~5. The system according to any one of claims 1 to ~~4~~6, wherein the emitter is covered by a layer, and the system is configured for the emitter to emit~~s~~ radiation that passes through the layer.

9. The system according to any one of claims 1 to 8, wherein the system is not visible from the exterior nor the interior of the container.

10.6. The system according to any one of claims 1 to 9, wherein the system is sealed in the lid of the container.

11.7. The system according to any one of claims 1 to 610, wherein the emitter is capable of emitting radar and/or is capable of emitting a plurality of types of radiation one and/or is capable of emitting laser for a LIDAR detector.

12. A method comprising:
emitting detection radiation into a container from a lid of the container;
receiving a reflection of the emitted radiation from contents of the container at a portion of the lid of the container;
interpreting the received reflection;
transmitting a signal representing the interpreted received reflection,
wherein the emission and/or received refection is from behind a layer that covers an emitter and/or transmitter and the layer is transparent to the radiation.

13. The method of claim 12, wherein the emission scans the contents of an area on the surface of the contents by a beam traversing the area.

14.8. The systemmethod according to any one of claims 1 to 713, wherein the interpretation is to determine the level of the contents in the container and the type of contents of the container.

15. A device for fill volume detection comprising a package having a body fully enclosed within a lid hingedly attached to a container which receives contents within a void within the container; within the body: a first emitter for emitting a first sensing energy, a first detector for detecting a reflection of the first sensing energy, and a wireless transmitter for transmitting a signal based on the reflection, wherein the emitted first sensing energy and the reflection pass through a portion of the lid.

16. A sensor system for detection of waste levels in a bin, the system comprising:
a package at least in part having a radio frequency transparent material;

an emitter of a radio frequency detection radiation into a container through the radio transparent material;
a receiver of reflected radio frequency radiation through the radio transparent material, the receiver arranged to produce a signal based on received reflected radiation, wherein the received reflected radiation is produced by reflection or similar of contents of the container;
a processor for interpreting the signal.

17. The system according to claim 16, wherein the processor generates a transmission signal based on the interpreted reflection signal and a transmitter transmits the transmission signal.

18. The system according to claim 16 or 17, wherein the processor for interpreting the signal operates substantially as a radar processor.

19. The system according to any one of claims 16 to 18, wherein the emitter is a radar emitter that scans across any contents of the bin by a beam traversing an area inside the bin.

20. The system according to claim 19, wherein the receiver is a radar receiver that receives radar reflections from the scan across any contents of the bin.

21. The system according to any one of claims 16 to 19, wherein system further comprises a power source for powering at least one of the emitter, receiver, processor and transmitter; wherein the power source, emitter, receiver, processor and transmitter are housed in the package.

22. The system according to claim 21, wherein the package is formed inside a lid of the bin.

23. The system according to any one of claims 16 to 22, wherein further comprising another sensor for detecting a property of the lid.

24. The system according to any one of claims 16 to 23, wherein the emitter emits the radiation through a layer of the lid that is transparent to the radio frequency emission.

~~25. The system according to any one of claims 16 to 24, wherein further comprises another emitter capable of emitting another type of radiation.~~

~~26. The system according to any one of claims 16 to 19, wherein the radiation is configured to scan the inside of the container.~~

~~27.~~9. The system according to ~~any one of~~ claim~~s~~ 8~~16 to 19~~, wherein the processor is configured to determine the type of material inserted into the container based on the reflected radio frequency radiation.

~~28.~~10. The system according to ~~any one of~~ claim~~s~~ 8~~16 to 19~~, wherein the processor is configured to determine the density of the material of a deposited article and/or the thickness and/or characteristic (spectral) reflective properties based on the received reflected radiation.

~~29.~~11. The system according to claim 10~~27~~, wherein the scanning of the inside of the container is such that the shape or a dimension of an article inserted can be determined.

~~30. A method comprising:~~
~~emitting radio frequency detection radiation into a container;~~
~~receiving a reflection of the emitted radiation from contents of the container;~~
~~interpreting the received reflection;~~
~~transmitting a signal representing the interpreted received reflection.~~

~~31. The method according to claim 30, comprising determining a contents level of the contents in the container, wherein the determining includes scanning the contents of an area on the surface of the contents by the radio frequency emission traversing the area.~~

~~32. The method according to claim 30 or 31, wherein the processor determines the contents level by determining a contour profile of the surface of the contents of the container.~~

~~33. The method according to any one of claims 30 to 32, wherein the processor determines the contents of the container by detecting the type of material of an article inserted/deposited into the container.~~

~~34. The method according to any one of claims 30 to 32, wherein the method comprises aggregating of a plurality of the reflections of scans/sweeps traversing the area and determining the density and or thickness of the material in the container that allows for internal cavity of the container and material measurement.~~

~~35. The method according to claim 34, wherein the material measurement comprises time of drop.~~

~~36. The method according to claim 34, wherein the material measurement comprises shape of article determination, wherein the radio frequency detection radiation is radar.~~

~~37. The method according to any one of claims 30 to 36, wherein the processor sends determinations as to fill level and/or contents (material type and/or article type) and/or events to a server.~~

~~38. A sensor system for determination of content in a bin, the system comprising:~~
~~an emitter of a detection radiation into a container;~~
~~a receiver of reflected radiation arranged to produce a signal based on received reflected radiation, wherein the received reflected radiation is produced by reflection or similar of contents of the container;~~
~~a processor for interpreting the signal to determine contents of the bin.~~

~~39. The system according to claim 38, wherein the system further comprises a transmitter for transmitting a representation of the interpretation.~~

~~40. The system according to claim 38 or 39, wherein the emitter is capable of emitting radar.~~

~~41. The system according to any one of claims 38 to 40, wherein the emitter is capable of emitting a laser beam for a LIDAR detector.~~

~~42. The system according to any one of claims 38 to 41, wherein the emitter is capable of emitting a plurality of types of radiation.~~

~~43. The system according to any one of claims 38 to 42, wherein the radiation is reflected and the reflection signal is processed to determine the type or types of contents in the container.~~

~~44. The system according to any one of claims 38 to 43, wherein the scanning traversing an area is repeated over time so that the type of contents of the container is progressively determined.~~

~~45. The system according to any one of claims 38 to 44, wherein the processor is configured to determine the type of material inserted into the container.~~

~~46. The system according to claim 45, wherein emitted radiation is radar and the type of material is determined according to the reflection.~~

~~47. The system according to any one of claims 38 to 46, wherein the radiation is radio frequency radiation and the interpreting determines the density of the material of a deposited article and/or the thickness and/or characteristic (spectral) reflective properties.~~

~~48. The system according to claim 47, wherein the scanning of the inside of the container is such that the shape of an article inserted can be determined.~~

~~49. The system according to any one of claims 38 to 48, wherein a dimension of the article in the container can be determined.~~

~~50. A method comprising:~~
~~emitting detection radiation into a container;~~
~~receiving a reflection of the emitted radiation from contents of the container;~~
~~interpreting the received reflection to determine the contents of the container.~~

~~51. The method according to claim 50, wherein the method further comprises transmitting a signal representing the interpreted received reflection.~~

~~52. The method according to claim 50 or 51, comprising determining a contents level of the contents in the container.~~

~~53. The method according to any one of claims 50 to 52, comprising determining a contour profile of the surface of the contents of the container.~~

~~54. The method according to any one of claims 50 to 53, comprising determining the contents of the container by detecting the type of material of an article inserted/deposited into the container.~~

~~55. The method according to any one of claims 50 to 54, wherein the method comprises aggregating of a plurality of the reflections of scans/sweeps and determining the density and or thickness of the material in the container that allows for internal cavity of the container and material measurement.~~

~~56. The method according to claim 55, wherein the material measurement comprises radar sensing.~~

~~57. The method according to claim 55, wherein the material measurement comprises time of drop.~~

~~58.~~12. The~~A sensor~~ system according to any one of claims 1 to 11 ~~for waste containers, the system~~ further comprising:

~~an emitter of a detection radiation into a container;~~

~~a receiver of reflected radiation arranged to produce a signal based on received reflected radiation, wherein the received reflected radiation is produced by reflection or similar of contents of the container;~~

~~a processor for interpreting the signal;~~

a processor for using a model or similar to determine an event has occurred in relation to the container.

~~59. The system according to claim 58, wherein the radiation is configured to scan the inside of the container by traversing the radiation over an area of the inside of the container.~~

~~60. The system according to claim 58 or 59, wherein the radiation is reflected and the reflection signal is processed to determine information to be input into the model.~~

~~61.~~13. The system according to ~~any one of~~ claim~~s~~ 12~~58 to 60~~, wherein the model is configured to determine the type of material inserted into the container.

~~62. The system according to any one of claims 58 to 61, wherein the model is configured to determine the density of the material of a deposited article and/or the thickness and/or characteristic (spectral) reflective properties.~~

~~63. The system according to any one of claims 58 to 62, wherein the model determined the type of material deposited into the container.~~

~~64. The system according to any one of claims 58 to 63, wherein the model is used determine characteristic of the article or the material that the article is made of based on the radiation being radio frequency radiation.~~

~~65. A sensor system for waste containers, the system comprising: an emitter of a detection radiation into a container; a receiver of reflected radiation arranged to produce a signal based on received reflected radiation, wherein the received reflected radiation is produced by reflection or similar of contents of the container; a processor for interpreting the signal; a processor for using a model or similar to determine an event has occurred in relation to the container, wherein the model is a behavioural model that rejects false positives.~~

~~66. The system according to any one of claims 58 to 65, wherein the system comprises a further sensor and the model is able to determine one or more of the following based on input from the further sensor: whether the lid has been left open, whether the bin has been moved to an irregular location, whether the bin has been tipped or fallen over.~~

~~67. The system according to any one of claims 58 to 66, wherein the model uses information on the material of each article and/or the article type and the time of deposit of the article into the container and/or event occurring to other containers to determine or assist in determining the type of event occurring or more details of the event occurring on/in/to the container.~~

~~68. The system according to any one of claims 58 to 67, wherein the processor receives a location signal, such as GPS.~~

~~69. The system according to any one of claims 58 to 68, wherein further sensors detect properties of the surrounds of the container and make data reflecting that available to the processor/model.~~

~~70. The system according to any one of claims 58 to 69, wherein the model employs an ongoing learning / artificial intelligence (AI) algorithm.~~

~~71. The system according to claim 70, wherein the model applies data available to it to decide what is being inserted into the container or other event occurring to the container and whether to do something about that event.~~

~~72. The system according to any one of claims 70 to 71, wherein the AI algorithm is trained using external data.~~

~~73.~~14. The system according to ~~any one of~~ claim~~s~~ 12~~70 to 72~~, wherein the model comprises an AI algorithm that learns one or more of: household waste disposal habits, street rubbish disposal habits, event disposal habits ~~etc~~.

~~74. A method comprising:~~
~~emitting detection radiation into a container;~~
~~receiving a reflection of the emitted radiation from contents of the container;~~
~~interpreting the received reflection using a model implemented by a processor of the container;~~
~~transmitting a signal representing the interpreted received reflection.~~

~~75. The method according to claim 74, wherein the model is based on learning repeated behaviours and identifying unusual behaviours.~~

~~76. The method according to claim 74 or 75, wherein the model determines the contents level by determining a contour profile of the surface of the contents of the container.~~

~~77. The method according to any one of claims 74 to 76, wherein the model determines the contents of the container by detecting the type of material of an article inserted/deposited into the container.~~

~~78. The method according to any one of claims 74 to 77, wherein the method comprises aggregating of a plurality of the reflections of scans/sweeps made over time and the model determining the density and or thickness of the material in the container that allows for internal cavity of the container and material measurement.~~

~~79. The method according to claim 77, wherein the material measurement comprises radar sensing.~~

~~80. The method according to claim 77, wherein the material measurement comprises time of drop.~~

~~81. The method according to claim 77, wherein the material measurement comprises shape of article determination.~~

15. A method comprising:
emitting radio frequency detection radiation into a container;
receiving a reflection of the emitted radiation from contents of the container;
interpreting the received reflection to determine the contents of the container by detecting the type of material of an article inserted/deposited into the container;
transmitting a signal representing the interpreted received reflection.