

**THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:**

1. A portable device for analysing a subject body or part thereof, the device comprising:

a controller;

storage storing electronic program instructions for operating the controller; and

an input means, the input means comprising at least one sensor operable to capture at least one representation of the body or the part thereof, the at least one sensor comprising at least a camera and the at least one representation of the subject body or the part thereof comprising a visual representation captured by the camera;

wherein the controller is operable, alone and/or in cooperation with one or more remote devices, and guided by instructions of the electronic program, to:

receive input via the input means, the input comprising the at least one representation of the body or the part thereof;

process the input to conduct an analysis of the subject body or the part thereof and generate an output on the basis of the analysis, the processing comprising using at least one of a machine learning (ML) and/or artificial intelligence (AI) algorithm to estimate body composition, anthropometric variables and/or medical physiology, wherein the machine learning (ML) and/or artificial intelligence (AI) algorithm is trained using an ecologically and physically valid unified representation(s) of a human body and its anatomical structure;

the unified representation(s) of a human body and its anatomical structure being a model or analogy of the human body, and being created from a dataset of contributed details, said dataset being processed, prepared, and quality assured using anatomical landmarks of the human body estimated using at least one computer vision (CV), machine learning (ML), and/or artificial intelligence (AI) technique,

the contributed details comprising a visual representation of at least one human body contributing details to the dataset, and other respective data and/or information, including at least one medical image, of the at least one human body contributing details to the dataset,

the other respective data and/or information being registered, aligned, segmented, and matched to the visual representation of at least one human body contributing details to the dataset using anatomical landmarks of the human body estimated using the at least one CV, ML, and/or AI technique to create the unified representations of the human body and its anatomical structure; and

communicate the output

wherein the output comprises the analysis of the subject body or the part thereof; and

wherein said anatomical landmarks comprise a selected plurality of joint centres defining specific regions of interest (ROIs) in the subject body.

2. A device according to claim 1, wherein the representation of the subject body or the part thereof comprises a visual representation comprising imagery, and/or a non-visual representation, meaning data that cannot be visualised.
3. A device according to claim 1 or 2, wherein the processing comprises actions performed by at least one computer vision (CV) approach, machine learning (ML), and/or artificial intelligence (AI) model.
4. A device according to any one of the preceding claims, wherein the subject body or the part thereof being analysed belongs to a category and/or a group and/or a class, and the dataset comprises details of a plurality of different bodies or the parts thereof belonging to the same, and/or a similar, category and/or group and/or class to that of the subject body or the part thereof being analysed, the details comprising data and/or information of, associated with, and/or related to each body of the plurality of different bodies.
5. A device according to claim 4, wherein the data and/or information comprises, for each of a plurality of human participants contributing details of their respective bodies or the parts thereof to the dataset, one or more of human

videos, photos, full and/or partial body shapes or surface scans, medical imaging, body composition, anthropometry, participant characteristics, participant attributes, medical physiology, and epidemiological information, which has been collected whilst collecting, and is linked, and/or registered, and/or aligned, and/or matched to, a unified visual representation to create an ecologically and physically valid unified representation of the respective body and its anatomical structure of each participant.

6. A device according to claim 5, wherein the collecting of the details and of the representation of the respective human body or the part thereof of each participant ~~preferably~~ occurs simultaneously and in parallel.
7. A device according to claim 6, wherein additional data are collected at different time intervals to enable ~~for~~ the development of temporal modelling of participant shape and data gathered over time, and to derive statistically meaningful diagnostic trackers, and to achieve a physically meaningful risk analysis.
8. A device according to claim 5 or 6 or 7, wherein collecting of the details and of the representation of the respective body or the part thereof of each participant comprises capturing the details and the representation of the body or the part thereof of each participant contributing to the dataset in accordance with quality assurance protocols and pre-processing processes and steps.
9. A device according to claim 8, dependent on ~~claims 2 and~~claim 3, wherein the actions comprise at least one of:

analysing the collected data and imageries using advance multi-dimensional statistical techniques and/or machine learning techniques and/or AI techniques and exclude those identified as outliers;

classifying, clustering data and imageries into one or more of groups, regions, types, characteristics, and categories based on one or more labelling and/or annotation mechanism of the data type and/or an associated output linked to the data type;

estimating salient features and/or land marks including anatomically relevant land marks and/or key points and/or joint centres and/or bone links from any type of imagery of the body;

identifying and segmenting the body from cluttered backgrounds in imagery;

estimating body part segments from the imagery of the body constrained by anatomical features extracted from medical imaging and establishing regions of interest (ROI); and

extracting image or generally shape features and labelled image(s) segments and/or image clusters and estimate their correspondence with the body data.

10. A device according to any one of the preceding claims, comprising a display for displaying a user interface, wherein the controller is operable, under the guidance of the electronic program instructions, to communicate the output by displaying the output via the display depicting a visualisation of the analysis via at least one of text, images, meshes, 3D, videos, icons, virtual reality, and graphs.
11. A device according to any one of the preceding claims, wherein the subject body or the part thereof is that of an individual person, and the output comprises an estimate of the individual person's: shape, physical, and ecological characteristics and/or at least one three-dimensional (3D) shape and its associated anthropometry, body composition, and health and wellness risks.
12. A device according to any one of the preceding claims, wherein the anatomical landmarks comprise the joint centres of upper and lower limbs, the midpoint of the femoral neck, a line or plane bisecting the top level of the iliac crest and inferior border of the mandible, the level of the T12/L1 vertebrae and the inferior border of the phalanges of the feet.
- 12.13. A method for analysing a subject body or a part thereof, the method comprising:

storing electronic program instructions for controlling a controller of a portable device; and

controlling the controller, alone and/or in cooperation with one or more remote devices, via the electronic program instructions, to:

receive input via input means of the portable device, the input means comprising at least one sensor operable to capture at least one representation of the body or the part thereof, the at least one sensor comprising at least a camera and the at least one representation of the subject body or the part thereof comprising a visual representation captured by the camera, the input comprising the at least one representation of the body or the part thereof;

process the input to conduct an analysis of the body or the part thereof and generate an output on the basis of the analysis, the processing comprising using at least one of a machine learning (ML) and/or artificial intelligence (AI) algorithm to estimate body composition, anthropometric variables and/or medical physiology, wherein the machine learning (ML) and/or artificial intelligence (AI) algorithm is trained using an ecologically and physically valid unified representation(s) of a human body and its anatomical structure,

the unified representation(s) of a human body and its anatomical structure being a model or analogy of the human body, and being created from a dataset of contributed details, said dataset being processed, prepared, and quality assured using anatomical landmarks of the human body estimated using at least one computer vision (CV), machine learning (ML), and/or artificial intelligence (AI) technique,

the contributed details comprising a visual representation of at least one human body contributing details to the dataset, and other respective data and/or information, including at least one medical image, of the at least one human body contributing details to the dataset,

the other respective data and/or information being registered, aligned, segmented, and matched to the visual representation of at least one human body contributing details to the dataset using anatomical landmarks of the human body estimated using the at least one CV, ML, and/or AI technique to

create the unified representation(s) of the human body and its anatomical structure<sub>1</sub>.

wherein said anatomical landmarks comprise a selected plurality of joint centres defining specific regions of interest (ROIs) of the subject body.

~~13.~~14. A method according to claim ~~12~~13, wherein the at least one representation comprises a visual representation comprising imagery, and/or a non-visual representation, meaning data that cannot be visualised.

~~14.~~15. A method according to claim ~~12~~13 or ~~13~~14, wherein the processing comprises actions performed by at least one computer vision (CV), machine learning (ML), and/or artificial intelligence (AI) model.

~~15.~~16. A method according to any one of claims ~~12~~13 to ~~14~~15, wherein the subject body or the part thereof being analysed belongs to a category and/or a group and/or class and the dataset comprises details of a plurality of different human bodies belonging to the same, and/or a similar, category and/or group and/or class to that of the subject body or the part thereof being analysed, the details comprising data and/or information of, associated with, and/or related to each human body or parts thereof of the plurality of different human bodies.

~~16.~~17. A method according to claim ~~15~~16, wherein the data and/or information comprises, for each of a plurality of human participants contributing details of their respective bodies or the parts thereof to the dataset, one or more of human videos, photos, full and/or partial body shapes or surface scans, medical imaging, body composition, anthropometry, participant characteristics, participant attributes, medical physiology, and epidemiological information, which has been collected whilst collecting, and is linked, and/or registered, and/or aligned, and/or matched to, a respective visual representation to create an ecologically and physically valid unified representation of the respective body and its anatomical structure of each participant.

~~17.~~18. A method according to claim ~~16~~17, wherein the collecting of the details and of the representation of the respective body or the part thereof of each participant ~~preferably~~ occurs simultaneously and in parallel.

~~48.19.~~ A ~~device~~method according to claim ~~17~~18, wherein additional data are collected at different time intervals to enable the development of temporal modelling of participant shape and data gathered over time, and to derive statistically meaningful diagnostic trackers, and to achieve a physically meaningful risk analysis.

~~49.20.~~ A method according to claim ~~16 or~~ 17 or 18 ~~or~~ 19, wherein collecting of the details and of the representation of the respective body or the part thereof of each participant comprises capturing the details and the representation of the body of each participant contributing to the dataset in accordance with quality assurance protocols and pre-processing processes and steps.

~~20.21.~~ A method according to claim ~~19~~20, dependent on ~~claims 13 and 14~~claim 15, wherein the actions comprise at least one of:

analysing the collected data and imageries using advanced multi-dimensional statistical techniques and/or machine learning techniques and/or AI techniques and exclude those identified as outliers;

classifying, clustering data and imageries into one or more of groups, regions, types, characteristic~~s~~ and categories based on one or more labelling and/or annotation mechanism~~s~~ of the data type and/or an associated output linked to the data type;

estimating salient features and/or land marks including anatomically relevant land marks and/or key points and/or joint centres and/or bone links from any type of imagery of the body;

identifying and segmenting the body from cluttered backgrounds in imagery;

estimating body part segments from the imagery of the body constrained by anatomical features extracted from medical imaging and establishing regions of interest (ROI); and

extracting image or generally shape features and labelled image(s))~~.~~ segments and/or image clusters and estimate their correspondence with the body data.

- 21-22. A method according to any one of claims 4213 to 2021, comprising controlling the controller, via the electronic program instructions, to communicate the output by displaying the output via a display depicting a visualization of the analysis via at least one of text, images, meshes, 3D, videos, icons, virtual reality, and graphs.
- 22-23. A method according to any one of claims 4213 to 2021, wherein the subject body or the part thereof is that of an individual person, and the output comprises an estimate of the individual persons: shape, physical, and ecological characteristics and/or at least one three-dimensional (3D) shape and its associated anthropometry, body composition, and health and wellness risks.
24. A method according to any one of claims 13 to 23, wherein the anatomical landmarks comprise the joint centres of upper and lower limbs, the midpoint of the femoral neck, a line or plane bisecting the top level of the iliac crest and inferior border of the mandible, the level of the T12/L1 vertebrae and the inferior border of the phalanges of the feet.
- 23-25. A computer-readable storage medium on which is stored instructions that, when executed by a computing means, causes the computing means to perform a method according to any one of claims 4213 to 2224.
- 24-26. A computing means programmed to carry out a method according to any one of claims 4213 to 2224.
- 25-27. A data signal including at least one instruction being capable of being received and interpreted by a computing system, wherein the instruction implements a method according to any one of claims 4213 to 2224.
- 26-28. A system for analysing a body comprising a device according to any one of claims 1 to 4112.
- 27-29. A device according to any one of claims 1 to 4112, wherein the at least one representation of the body is in the form of numbers and/or text and/or data and/or images of any type.