

AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in the application:

1. (Currently Amended) A humanoid robot, comprising:
 - an upper region including at least: (i) a head, (ii) a torso, (iii) an arm having: (a) an elbow assembly, (b) a forearm assembly, and (c) a wrist assembly having a wrist pivot axis and a wrist yaw axis, and wherein the forearm assembly includes:
 - a forearm frame that includes: (i) a forearm axis that is substantially centered within an extent of the forearm frame, (ii) both a first plane that extends through said forearm axis and a second plane that extends through the forearm axis, wherein said first plane is oriented perpendicular to the second plane to define four distinct quadrants, (iii) a proximal mounting portion including a proximal end coupled to an extent of the elbow assembly, (iv) a distal mounting portion including a distal end coupled to an extent of the wrist assembly,
 - a first plurality of actuators coupled to the proximal mounting portion and arranged radially around the forearm axis, ~~wherein a portion of at least one actuator of the first plurality of actuators is positioned within each of the four quadrants of said forearm frame,~~ and wherein a first actuator contained in the first plurality of actuators: (a) is in contact with a first tendon, ~~(b) is positioned in a first quadrant of the four quadrants,~~ and ~~(c)~~(b) includes a first tendon departure region,
 - a second plurality of actuators coupled to the distal mounting portion and arranged radially around the forearm axis, wherein a portion of at least one actuator of the second plurality of actuators is positioned within each of the four quadrants of said forearm frame, and wherein a second actuator contained in the second plurality of actuators: (a) is in contact with a second tendon, (b) is positioned in a second quadrant of the four quadrants, and wherein the second quadrant is diagonally opposed to the first quadrant, and (c) includes a second tendon departure region, and

wherein the first tendon departure region is at a first distance from the wrist assembly and the second tendon departure region is at a second distance from the wrist assembly, and wherein the first distance is not equal to the second distance;

an end effector having a knuckle assembly, a proximal assembly, and a medial assembly, and wherein a third tendon is routed: (i) below an extent of the knuckle assembly, (ii) above an extent of the proximal assembly, and (iii) below an extent of the medial assembly;

a lower region spaced apart from the upper region and including a pair of legs; and,

a central region interconnecting the upper region and the lower region.

2. Canceled
3. (Previously Presented) The humanoid robot of claim 1, wherein the forearm frame further includes a medial mounting portion that is positioned between the proximal mounting portion and the distal mounting portion, and wherein said forearm assembly further includes a third plurality of actuators coupled to the medial mounting portion and arranged radially around the forearm axis thereby causing a portion of at least one actuator of the third plurality of actuators to be positioned within each of the four quadrants of the said forearm frame.
4. (Currently Amended) The humanoid robot of claim 3, ~~further comprising an end effector with~~ wherein the end effector includes a finger with an metacarpophalangeal (MCP) joint, and wherein a third actuator contained in the third plurality of actuators is in contact with a third tendon that is configured to control linear movement of the finger about the MCP joint.
5. (Previously Presented) The humanoid robot of claim 1, wherein the first actuator has a first peak torque value and the second actuator has a second peak torque value that is greater than the first peak torque value.
6. (Previously Presented) The humanoid robot of claim 1, wherein the first tendon has a first total curvature in an uncurled state, and the second tendon has a second total curvature that is greater than the first total curvature in the uncurled state.

7. (Currently Amended) The humanoid robot of claim 1, ~~further comprising an~~
wherein the end effector ~~[[having]]~~ has a housing and a finger assembly, and
[[~~(ii)~~]] further comprising a carpal tunnel-like structure positioned forward
of at least one of the wrist pivot axis or the wrist yaw axis and configured to guide
the first and second tendons from the forearm assembly, through the wrist
assembly, and to a base of the housing.
8. Canceled.
9. (Currently Amended) The humanoid robot of claim 1, ~~further comprising an~~
wherein the end effector includes ~~[[with]]~~ more than ~~20~~16 actuated degrees of
freedom.
10. (Previously Presented) The humanoid robot of claim 1, further comprising a
biasing member coupled to the first tendon.
11. (Currently Amended) A humanoid robot, comprising:
an upper region including: (i) a head, (ii) a torso, (iii) an arm coupled to
the torso and including: (a) a forearm assembly, (b) a wrist assembly coupled to
the forearm assembly and having a wrist pitch axis, and (c) an end effector
coupled to the wrist assembly, and wherein said end effector includes:
an index finger assembly having a metacarpophalangeal (MCP)
joint, and wherein said index finger assembly is configured to experience
lateral movement about said MCP joint,
a middle finger assembly positioned proximate to the index finger
assembly with a knuckle assembly, a proximal assembly, and a medial
assembly,
a ring finger assembly positioned proximate to the middle finger
assembly,
a little finger assembly positioned proximate to the ring finger
assembly,
a thumb assembly,
a housing coupled to the index finger, middle finger, ring finger,
little finger, and thumb assemblies, and wherein said housing includes:

a first interior wall extent,

a second interior wall extent positioned a first distance from the first interior wall extent, and wherein the first distance resides within a first plane that is configured to be substantially parallel with the wrist pitch axis,

a third interior wall extent,

a fourth interior wall extent positioned a second distance from the third interior wall extent, and wherein: (i) the second distance resides with a second plane that is substantially parallel with the first plane,

~~a fifth interior wall extent,~~

~~a sixth interior wall extent positioned a third distance from the fifth interior wall extent, and wherein: (i) the third distance resides with a third plane that is substantially parallel with the first plane, and~~

~~wherein: (i) the third distance is both: (a) less than the first distance, and (b) greater than the second distance is less than 45% of the first distance, and (ii) the second distance is positioned between the first and third distances;~~

a first plurality of tendons coupled to at least the index finger assembly and a second plurality of tendons coupled to the middle finger assembly, and wherein the first and second plurality of tendons are positioned between: (i) the first and second interior wall extents, and (ii) the third and fourth interior wall extents, and (iii) the fifth and sixth interior wall extents; and

at least one tendon of the second plurality of tendons is routed: (i) below an extent of the knuckle assembly, (ii) above an extent of the proximal assembly, and (iii) below an extent of the medial assembly;

~~a lower region spaced apart from the upper region and including a pair of legs; and,~~

~~a central region interconnecting the upper region and the lower region.~~

12. (Previously Presented) The humanoid robot of claim 11, wherein the wrist assembly comprises:

a housing coupling component;

a pitch component coupled to the housing coupling component and the housing of the end effector and configured to provide up-and-down movement of the end effector, and wherein the pitch component only extends across a partial width of the housing of the end effector; and

a yaw component coupled to the housing coupling component and a base structure that is configured to be coupled to the forearm assembly.

13. (Original) The humanoid robot of claim 12, wherein the pitch component includes a cable guide configured to route at least one tendon of the first or second plurality of tendons around a portion of the pitch component.
14. (Previously Presented) The humanoid robot of claim 11, further comprising a carpal tunnel-like structure configured to guide the first or second plurality of tendons from the forearm assembly to the housing of the end effector, wherein the carpal tunnel-like structure is positioned between the first interior wall extent and the second interior wall extent and secures an extent of a sheath that surround the first or second plurality of tendons.
15. (Previously Presented) The humanoid robot of claim 11, further comprising a first plurality of actuators positioned in the forearm assembly and having a first peak torque, and a second plurality of actuators that are positioned rearward of the first plurality of actuators and have a second peak torque that is greater than the first peak torque.
16. (Currently Amended) A humanoid robot, comprising:
 - an upper region including: (i) a head, (ii) a torso, (iii) an arm coupled to the torso, the arm including: (a) a forearm assembly having an actuator and a first tendon, (b) a wrist assembly coupled to the forearm assembly, and (c) an end effector coupled to the wrist assembly, and wherein the wrist assembly includes:
 - a left base member,
 - a right base member,
 - a rotational axis that extends between the left and right base members,

a carpal tunnel-like structure directly coupled to the end effector and having an opening formed therein configured to receive an extent of the first tendon, and

wherein a centroid of the opening formed in the carpal tunnel-like structure does not reside on the rotational axis; and

an end effector coupled to the wrist assembly and including a knuckle assembly, a proximal assembly, and a medial assembly, and wherein the first tendon is routed: (i) below an extent of a knuckle assembly, (ii) above an extent of a proximal assembly, and (iii) below an extent of a medial assembly; ~~and a lower region spaced apart from the upper region and including a pair of legs; and, a central region interconnecting the upper region and the lower region.~~

17. (Previously Presented) The humanoid robot of claim 16, further comprising a structure that includes a curvilinear outer surface that is in contact with the first tendon and is configured to change the direction of said first tendon.
18. (Previously Presented) The humanoid robot of claim 16, further comprising a biasing member coupled to the first tendon.
19. (Previously Presented) The humanoid robot of claim 16, further comprising a second tendon that extends through the carpal tunnel-like structure and has a second total curvature that is less than a first total curvature of the first tendon in the uncurled state.
20. (Previously Presented) The humanoid robot of claim 19, wherein an application of force or a frequency of use that is associated with the second tendon is greater than an application of force or a frequency of use associated with the first tendon.
21. (Previously Presented) The humanoid robot of claim 16, further comprising a glove that substantially encases the end effector.
22. Canceled
23. Canceled
24. (Previously Presented) The humanoid robot of claim 1, further comprising an end effector and a glove that substantially encases the end effector, and at least a portion of the wrist assembly.

25. (Currently Amended) The humanoid robot of claim 1, further comprising:
 - an end effector coupled to the wrist assembly and having a housing, and wherein said housing includes:
 - a first interior wall extent,
 - a second interior wall extent positioned a first distance from the first interior wall extent, and wherein the first distance resides within a first plane that is configured to be substantially parallel with the wrist pitch axis,
 - a third interior wall extent,
 - a fourth interior wall extent positioned a second distance from the third interior wall extent, and wherein: (i) the second distance resides with a second plane that is substantially parallel with the first plane,
 - ~~a fifth interior wall extent,~~
 - ~~a sixth interior wall extent positioned a third distance from the fifth interior wall extent, and wherein: (i) the third distance resides with a third plane that is substantially parallel with the first plane, and~~
 - wherein: (i) ~~the third distance is both: (a) less than the first distance, and (b) greater than the second distance~~ is less than 45% of the first distance, and (ii) ~~the second distance is positioned between the first and third distances[;]].~~
26. (Previously Presented) The humanoid robot of claim 1, further comprising a finger assembly with a knuckle assembly having an enclosure, and wherein said enclosure includes a guide slot: (i) formed in a top member of said enclosure, and (ii) configured to receive a portion of the second tendon.
27. (Previously Presented) The humanoid robot of claim 26, wherein the finger assembly further includes a member: (i) positioned near a distal end of the finger assembly, and (ii) having a top guide slot formed in said member, and said top guide slot is configured to receive a portion of the second tendon.

- 28. (Previously Presented) The humanoid robot of claim 1, further comprising a finger assembly having a member, and wherein the first tendon includes a distal end that is directly coupled to the member.
- 29. Canceled
- 30. (Previously Presented) The humanoid robot of claim 11, wherein the index finger assembly and the middle finger assembly are interchangeable.
- 31. (Previously Presented) The humanoid robot of claim 30, further comprising a glove that substantially encases the end effector, the wrist assembly, and a portion of the forearm assembly.
- 32. (Previously Presented) The humanoid robot of claim 11, wherein the index finger assembly includes a curvilinear outer surface formed within a slot that is in contact with a first tendon contained in the first plurality of tendons and is configured to change the direction of said first tendon.
- 33. (Previously Presented) The humanoid robot of claim 16, wherein the end effector includes a finger assembly having a member, and wherein the first tendon includes a distal end that is directly coupled to the member.