1
00:00:04,789 --> 00:00:02,389
the station's robotic crew member

2
00:00:06,869 --> 00:00:04,799
robonaut's getting some upgrades today

3
00:00:08,549 --> 00:00:06,879
here to tell us more about what's taking

4
00:00:10,390 --> 00:00:08,559
place where we've come from and where

5
00:00:13,030 --> 00:00:10,400
we're going with the first humanoid

6
00:00:14,390 --> 00:00:13,040
robot in space uh dr ron diffler the

7
00:00:16,630 --> 00:00:14,400
principal investigator and the project

8
00:00:18,390 --> 00:00:16,640
manager for robonaut 2. ron first off

9
00:00:19,670 --> 00:00:18,400
thanks so much for joining me today and

10
00:00:21,349 --> 00:00:19,680
if you could set the stage a little bit

11
00:00:22,950 --> 00:00:21,359
so robonaut's been on board for a few

12
00:00:24,310 --> 00:00:22,960
years what what's the work that's been

13
00:00:25,910 --> 00:00:24,320

going on what have you guys been doing

14
00:00:28,790 --> 00:00:25,920
with with it on board it's my pleasure

15
00:00:30,550 --> 00:00:28,800
to be here today dan um since we've had

16
00:00:32,310 --> 00:00:30,560
the robot on space station

17
00:00:33,750 --> 00:00:32,320
after we completed our checkouts the

18
00:00:35,990 --> 00:00:33,760
first thing we did was we said hello to

19
00:00:37,590 --> 00:00:36,000
the world using american sign language

20
00:00:39,270 --> 00:00:37,600
moved on for some

21
00:00:41,750 --> 00:00:39,280
crew interaction shaking hands with

22
00:00:43,670 --> 00:00:41,760
commander dan bolden on dan

23
00:00:46,229 --> 00:00:43,680
burbank at the time

24
00:00:48,229 --> 00:00:46,239
since then we've been using the task

25
00:00:49,510 --> 00:00:48,239
board and trying out many of the

26
00:00:51,830 --> 00:00:49,520
different things that we previously

27
00:00:54,630 --> 00:00:51,840
tested on the ground working with knobs

28
00:00:57,029 --> 00:00:54,640
and switches buttons

29
00:00:59,110 --> 00:00:57,039
various other interfaces

30
00:01:01,270 --> 00:00:59,120
most recently we've moved on to working

31
00:01:03,189 --> 00:01:01,280
with tools and soft goods soft because

32
00:01:04,789 --> 00:01:03,199
being very important especially

33
00:01:07,270 --> 00:01:04,799
when the robot's ultimate goal is to

34
00:01:08,550 --> 00:01:07,280
work um eva working with soft goods or

35
00:01:10,230 --> 00:01:08,560
things you find throughout the space

36
00:01:13,190 --> 00:01:10,240
station those soft goods things like

37
00:01:15,030 --> 00:01:13,200
space blankets etc etc

38
00:01:17,030 --> 00:01:15,040

um our most recent activity was working

39
00:01:18,870 --> 00:01:17,040
with tele operation that is one of the

40
00:01:20,950 --> 00:01:18,880
astronauts tom marshburn put on a

41
00:01:22,710 --> 00:01:20,960
collection of virtual reality gear and

42
00:01:25,030 --> 00:01:22,720
controlled the robot inside the station

43
00:01:26,710 --> 00:01:25,040
simulating it as if we were outside and

44
00:01:28,390 --> 00:01:26,720
he caught our first free-floating object

45
00:01:30,390 --> 00:01:28,400
which is very exciting to us

46
00:01:32,230 --> 00:01:30,400
so kind of like the world's coolest

47
00:01:34,950 --> 00:01:32,240
video game taking place in space right

48
00:01:37,109 --> 00:01:34,960
now absolutely so and

49
00:01:39,429 --> 00:01:37,119
obviously robonaut

50
00:01:41,030 --> 00:01:39,439
created to be kind of a another set of

51
00:01:43,270 --> 00:01:41,040
helping hands to the astronauts on board

52
00:01:44,710 --> 00:01:43,280
the station and

53
00:01:45,990 --> 00:01:44,720
it needs more than just hands and needs

54
00:01:47,510 --> 00:01:46,000
some legs too so you guys have been

55
00:01:50,069 --> 00:01:47,520
developing these climbing legs for the

56
00:01:51,510 --> 00:01:50,079
robot absolutely um you can only do so

57
00:01:52,870 --> 00:01:51,520
much if you're fixed on a stanchion

58
00:01:55,030 --> 00:01:52,880
which is what we've been on for the last

59
00:01:56,870 --> 00:01:55,040
couple of years with the addition of

60
00:01:59,030 --> 00:01:56,880
legs we'll be able to go mobile matter

61
00:02:00,950 --> 00:01:59,040
of fact here you can see in the video

62
00:02:02,789 --> 00:02:00,960
this is our ground unit for robonaut

63
00:02:05,109 --> 00:02:02,799

actually our certification ground unit

64
00:02:07,670 --> 00:02:05,119
and there it is practicing climbing and

65
00:02:09,109 --> 00:02:07,680
in this case we took a truss system put

66
00:02:10,869 --> 00:02:09,119
it on our air bearing floor which is

67
00:02:13,110 --> 00:02:10,879
kind of like an air hockey table except

68
00:02:14,550 --> 00:02:13,120
in reverse the um the whatever is

69
00:02:16,790 --> 00:02:14,560
floating on top of it's emitting a thin

70
00:02:19,190 --> 00:02:16,800
layer of air so it can float

71
00:02:21,190 --> 00:02:19,200
we are using our grippers to then move

72
00:02:23,030 --> 00:02:21,200
that back and forth simulating as if the

73
00:02:24,949 --> 00:02:23,040
actual robot works climbing through the

74
00:02:26,550 --> 00:02:24,959
station and we've had very good results

75
00:02:28,710 --> 00:02:26,560
with that as you can even see during

76
00:02:31,190 --> 00:02:28,720
this video so they definitely don't look

77
00:02:32,949 --> 00:02:31,200
like traditional legs so while the upper

78
00:02:34,949 --> 00:02:32,959
body does have a lot of resemblance to a

79
00:02:36,390 --> 00:02:34,959
human because we do a lot of human-like

80
00:02:38,790 --> 00:02:36,400
motions with the upper body performing

81
00:02:40,309 --> 00:02:38,800
human-like tasks well in space you don't

82
00:02:41,670 --> 00:02:40,319
use your human legs the way you would

83
00:02:43,509 --> 00:02:41,680
use them on the ground that's right so

84
00:02:45,030 --> 00:02:43,519
we were not as it um

85
00:02:47,030 --> 00:02:45,040
we were not we didn't adhere to the

86
00:02:49,110 --> 00:02:47,040
human form when it didn't make any sense

87
00:02:50,390 --> 00:02:49,120
in the case of space you want legs that

88
00:02:52,550 --> 00:02:50,400

are going to give you more of a climbing

89
00:02:54,630 --> 00:02:52,560
capability than a walking capability so

90
00:02:56,630 --> 00:02:54,640
they're longer legs with more

91
00:02:58,710 --> 00:02:56,640
degrees of freedom greater flexibility

92
00:03:00,790 --> 00:02:58,720
for us to be able to reach from one hand

93
00:03:02,309 --> 00:03:00,800
rail to another and over maybe a little

94
00:03:04,550 --> 00:03:02,319
bit larger distances than you might

95
00:03:06,229 --> 00:03:04,560
normally expect okay now the legs have

96
00:03:07,750 --> 00:03:06,239
been up there for a couple of months now

97
00:03:09,509 --> 00:03:07,760
but we can't just throw them on we have

98
00:03:10,630 --> 00:03:09,519
to get robonaut ready first so what are

99
00:03:12,229 --> 00:03:10,640
some of the upgrades that have been

100
00:03:14,390 --> 00:03:12,239
taking place and what are some of the

101
00:03:16,550 --> 00:03:14,400
upgrades that are taking place this week

102
00:03:18,550 --> 00:03:16,560
so um a few weeks ago we finished the

103
00:03:20,550 --> 00:03:18,560
upgrades to the torso

104
00:03:23,430 --> 00:03:20,560
when robotic was originally built we did

105
00:03:25,670 --> 00:03:23,440
not have legs in mind

106
00:03:27,350 --> 00:03:25,680
so we had to go inside and increase and

107
00:03:30,789 --> 00:03:27,360
modify the infrastructure to support

108
00:03:32,470 --> 00:03:30,799
lake support all the wiring we also

109
00:03:34,309 --> 00:03:32,480
replaced our computer system because now

110
00:03:36,229 --> 00:03:34,319
we have more joints to control so we

111
00:03:38,309 --> 00:03:36,239
need more computer power

112
00:03:39,670 --> 00:03:38,319
we made all those changes and actually

113
00:03:41,589 --> 00:03:39,680

here you can also see an additional

114
00:03:43,670 --> 00:03:41,599
change we made on the robot which was we

115
00:03:45,350 --> 00:03:43,680
upgraded the helmet we learned on the

116
00:03:46,869 --> 00:03:45,360
ground that there were ways to improve

117
00:03:48,630 --> 00:03:46,879
our vision system by making

118
00:03:50,550 --> 00:03:48,640
modifications to the helmet so we

119
00:03:52,229 --> 00:03:50,560
included that as part of the upgrades to

120
00:03:53,670 --> 00:03:52,239
increase our overall capability doing a

121
00:03:55,670 --> 00:03:53,680
little brain surgery that's right

122
00:03:58,949 --> 00:03:55,680
there's astronaut steve swanson making

123
00:04:02,070 --> 00:03:58,959
modifications to the helmet

124
00:04:04,869 --> 00:04:02,080
so um we upgraded the body

125
00:04:06,390 --> 00:04:04,879
put all the all the latch all the hooks

126
00:04:09,429 --> 00:04:06,400
we needed so that when we attach the

127
00:04:11,589 --> 00:04:09,439
legs we can connect everything together

128
00:04:13,429 --> 00:04:11,599
here you see the legs they were sent up

129
00:04:15,750 --> 00:04:13,439
folded up and they actually have

130
00:04:18,550 --> 00:04:15,760
handrails our protocol on space station

131
00:04:20,310 --> 00:04:18,560
is that one leg must always be engaged

132
00:04:22,390 --> 00:04:20,320
no free floating robots on inside the

133
00:04:23,749 --> 00:04:22,400
space station so you see two handrails

134
00:04:26,950 --> 00:04:23,759
that will be used in part of the

135
00:04:29,189 --> 00:04:26,960
assembly process so we will on

136
00:04:30,150 --> 00:04:29,199
astronaut steve swanson will unfold the

137
00:04:33,110 --> 00:04:30,160
legs

138
00:04:35,749 --> 00:04:33,120

and then remove the up the body from its

139
00:04:37,670 --> 00:04:35,759
stanchion and attach those to the top of

140
00:04:39,189 --> 00:04:37,680
the legs basically put the bottom half

141
00:04:41,430 --> 00:04:39,199
and the top half together to give us a

142
00:04:42,469 --> 00:04:41,440
full-size robot inside the space station

143
00:04:44,629 --> 00:04:42,479
okay

144
00:04:46,150 --> 00:04:44,639
and i think we have some more images uh

145
00:04:48,150 --> 00:04:46,160
so you mentioned it's been on a

146
00:04:50,230 --> 00:04:48,160
stanchion a lot and i think we have

147
00:04:51,430 --> 00:04:50,240
another picture um so what so what are

148
00:04:52,629 --> 00:04:51,440
we looking at right here that's the

149
00:04:54,469 --> 00:04:52,639
interface

150
00:04:56,629 --> 00:04:54,479
at the top of the legs that will mate

151
00:04:58,469 --> 00:04:56,639
with a matching interface that we

152
00:05:00,390 --> 00:04:58,479
recently installed with the torso

153
00:05:01,590 --> 00:05:00,400
upgrades and the two can be put together

154
00:05:03,510 --> 00:05:01,600
and there you can actually see some

155
00:05:05,029 --> 00:05:03,520
guide pins there and when it's all put

156
00:05:06,629 --> 00:05:05,039
together it'll look just like that

157
00:05:08,950 --> 00:05:06,639
certification robot we have on the

158
00:05:11,430 --> 00:05:08,960
ground and be able to start moving

159
00:05:12,790 --> 00:05:11,440
between handrail to hand rail which is

160
00:05:14,469 --> 00:05:12,800
one of the ways we'll move on the inside

161
00:05:15,990 --> 00:05:14,479
of the space station and it won't have

162
00:05:17,590 --> 00:05:16,000
to worry about those straps either

163
00:05:19,029 --> 00:05:17,600

because it's right you don't need the

164
00:05:20,870 --> 00:05:19,039
straps in space since you'll be able to

165
00:05:23,350 --> 00:05:20,880
uh there'll be no gravity and you'll be

166
00:05:24,950 --> 00:05:23,360
essentially weightless so when are you

167
00:05:26,870 --> 00:05:24,960
guys expecting what are you hoping to

168
00:05:28,870 --> 00:05:26,880
get the legs attached uh currently we're

169
00:05:31,110 --> 00:05:28,880
doing some preparation work both today

170
00:05:33,189 --> 00:05:31,120
and tomorrow our goal is to attach the

171
00:05:35,189 --> 00:05:33,199
legs on thursday and then button

172
00:05:36,710 --> 00:05:35,199
everything up on friday and then we'll

173
00:05:38,150 --> 00:05:36,720
do what we call a power soap we just

174
00:05:39,830 --> 00:05:38,160
turn on electronics and make sure

175
00:05:41,830 --> 00:05:39,840
everything is behaving the way we expect

176
00:05:42,790 --> 00:05:41,840
it to yep

177
00:05:44,710 --> 00:05:42,800
and then

178
00:05:46,310 --> 00:05:44,720
once that's out of the way

179
00:05:48,629 --> 00:05:46,320
first steps one

180
00:05:51,110 --> 00:05:48,639
well there'll be a couple of more

181
00:05:52,390 --> 00:05:51,120
stages between now and first steps we

182
00:05:54,230 --> 00:05:52,400
have to be sure that

183
00:05:55,990 --> 00:05:54,240
all these things been put together are

184
00:05:57,830 --> 00:05:56,000
checked out properly so we'll have more

185
00:06:00,469 --> 00:05:57,840
or less the equivalent of stretching

186
00:06:02,469 --> 00:06:00,479
over the next two activities we have on

187
00:06:04,070 --> 00:06:02,479
space station and then in the november

188
00:06:05,909 --> 00:06:04,080

december time frame we will take our

189
00:06:07,189 --> 00:06:05,919
first step and go from one of our

190
00:06:09,510 --> 00:06:07,199
handrails that we're currently mounted

191
00:06:12,390 --> 00:06:09,520
to to a next to the next handrail and

192
00:06:14,230 --> 00:06:12,400
then just to close us out big picture

193
00:06:15,670 --> 00:06:14,240
once robonaut's mobile what what are you

194
00:06:18,070 --> 00:06:15,680
guys really hoping that it's going to be

195
00:06:20,390 --> 00:06:18,080
able to accomplish well we have put the

196
00:06:22,790 --> 00:06:20,400
robot in the best laboratory anywhere

197
00:06:24,710 --> 00:06:22,800
for preparing ourselves for eventual eva

198
00:06:26,550 --> 00:06:24,720
activities space walking space climbing

199
00:06:28,870 --> 00:06:26,560
type of activities so we're going to use

200
00:06:30,950 --> 00:06:28,880
the space station as a laboratory for

201
00:06:33,110 --> 00:06:30,960
climbing and learn all about

202
00:06:35,189 --> 00:06:33,120
climbing inside the space station where

203
00:06:37,670 --> 00:06:35,199
we have the advantage as we're learning

204
00:06:39,749 --> 00:06:37,680
things if some issues come up the crew's

205
00:06:41,029 --> 00:06:39,759
there to help us and as opposed to being

206
00:06:42,950 --> 00:06:41,039
on the outside of station where if

207
00:06:44,469 --> 00:06:42,960
you're learning things there's there are

208
00:06:46,309 --> 00:06:44,479
a lot more consequences to what's going

209
00:06:47,510 --> 00:06:46,319
on so that'll be the great laboratory

210
00:06:49,189 --> 00:06:47,520
for us to develop our climbing

211
00:06:50,870 --> 00:06:49,199
capabilities so that when we have a

212
00:06:52,150 --> 00:06:50,880
robot on the outside space station we're

213
00:06:54,150 --> 00:06:52,160

well prepared

214
00:06:56,150 --> 00:06:54,160
all right well exciting time for

215
00:06:58,469 --> 00:06:56,160
robonaut on board the station getting

216
00:07:00,309 --> 00:06:58,479
ready to get those legs on and not too

217
00:07:02,150 --> 00:07:00,319
distant future takes those first steps

218
00:07:04,390 --> 00:07:02,160
really exciting stuff dr ron diffler

219
00:07:05,990 --> 00:07:04,400
again project manager for robonaut

220
00:07:07,670 --> 00:07:06,000
thanks so much for joining me today here

221
00:07:10,309 --> 00:07:07,680
inside the control room giving us an