
O NOD 1
46

1
00:00:04,230 --> 00:00:02,389
[Music]

2
00:00:05,829 --> 00:00:04,240
nasa's jet propulsion laboratory

3
00:00:08,549 --> 00:00:05,839
presents

4
00:00:10,310 --> 00:00:08,559
the lecture a series of talks by

5
00:00:12,230 --> 00:00:10,320
scientists and engineers who are

6
00:00:14,910 --> 00:00:12,240
exploring our planet

7
00:00:22,870 --> 00:00:14,920
our solar system and all that lies

8
00:00:26,070 --> 00:00:24,630
hello everyone and a very pleasant

9
00:00:28,390 --> 00:00:26,080
evening to you wherever you may be

10
00:00:30,550 --> 00:00:28,400
welcome to another remote edition

11
00:00:31,910 --> 00:00:30,560
of our von garman series i am brian

12
00:00:33,910 --> 00:00:31,920
white from jpl's office of

13
00:00:35,110 --> 00:00:33,920

communications and educations and before

14
00:00:36,870 --> 00:00:35,120
we go any further

15
00:00:38,709 --> 00:00:36,880
we want to acknowledge the firefighters

16
00:00:40,709 --> 00:00:38,719
working hard and risking their lives up

17
00:00:43,350 --> 00:00:40,719
and down the entire west coast

18
00:00:44,150 --> 00:00:43,360
the bobcat fire is right here in jpl's

19
00:00:45,750 --> 00:00:44,160
backyard

20
00:00:47,430 --> 00:00:45,760
and we are grateful for their

21
00:00:49,270 --> 00:00:47,440
unrelenting efforts

22
00:00:50,950 --> 00:00:49,280
and on that note we do ask that if we

23
00:00:52,389 --> 00:00:50,960
have any technical issues

24
00:00:55,029 --> 00:00:52,399
please stick with us tonight as we get

25
00:00:58,470 --> 00:00:55,039
them sorted out tonight's talk

26
00:01:00,630 --> 00:00:58,480
visualizing space exploration ar vr

27
00:01:01,830 --> 00:01:00,640
and emerging tech will show the leaps

28
00:01:03,510 --> 00:01:01,840
that have been made

29
00:01:05,910 --> 00:01:03,520
in developing missions and our ability

30
00:01:08,149 --> 00:01:05,920
to tell the nasa jpl story to you

31
00:01:09,429 --> 00:01:08,159
the public as always i want to remind

32
00:01:11,350 --> 00:01:09,439
you that this is your

33
00:01:12,469 --> 00:01:11,360
space program they're going to be a lot

34
00:01:14,789 --> 00:01:12,479
of links that you can

35
00:01:16,310 --> 00:01:14,799
you can go explore today we're going to

36
00:01:17,429 --> 00:01:16,320
be adding those to the chat into the

37
00:01:19,510 --> 00:01:17,439
video description

38
00:01:20,950 --> 00:01:19,520

uh you'll get a chance to be involved in

39
00:01:22,390 --> 00:01:20,960
those we also want to be involved in the

40
00:01:23,190 --> 00:01:22,400
conversation so if you're watching this

41
00:01:25,990 --> 00:01:23,200
on youtube

42
00:01:27,190 --> 00:01:26,000
or facebook live ask questions in the

43
00:01:29,270 --> 00:01:27,200
chat box in our

44
00:01:30,310 --> 00:01:29,280
chat box and our diligent social media

45
00:01:32,310 --> 00:01:30,320
team will bring

46
00:01:33,749 --> 00:01:32,320
in as many of those as we can if you

47
00:01:35,429 --> 00:01:33,759
don't see the chat box go ahead and

48
00:01:36,230 --> 00:01:35,439
reload your page and it should be right

49
00:01:37,990 --> 00:01:36,240
there

50
00:01:39,429 --> 00:01:38,000
now tonight helping us out with

51
00:01:41,510 --> 00:01:39,439
questions will be my colleague from

52
00:01:44,870 --> 00:01:41,520
jpl's public services office

53
00:01:46,550 --> 00:01:44,880
nikki weirich hi i'm nikki hi brian

54
00:01:48,149 --> 00:01:46,560
thanks for having me tonight i'm excited

55
00:01:50,710 --> 00:01:48,159
for all your questions and i'm excited

56
00:01:52,550 --> 00:01:50,720
for our wonderful speakers

57
00:01:54,230 --> 00:01:52,560
awesome thank you for joining us tonight

58
00:01:55,749 --> 00:01:54,240
it's going to be great to have you

59
00:01:58,069 --> 00:01:55,759
we've got two speakers tonight working

60
00:02:00,870 --> 00:01:58,079
essentially two sides of the same coin

61
00:02:03,109 --> 00:02:00,880
first up will be sasha somoshana the

62
00:02:03,990 --> 00:02:03,119
deputy lead of the ops lab here at nasa

63
00:02:05,670 --> 00:02:04,000

jpl

64
00:02:07,670 --> 00:02:05,680
she's a creative technologist with a

65
00:02:08,710 --> 00:02:07,680
passion for combining art and science

66
00:02:10,469 --> 00:02:08,720
into her work

67
00:02:12,630 --> 00:02:10,479
helping to create software that

68
00:02:13,830 --> 00:02:12,640
incorporates innovative forms of

69
00:02:16,790 --> 00:02:13,840
visualization to aid

70
00:02:18,710 --> 00:02:16,800
scientists engineers and astronauts in

71
00:02:20,470 --> 00:02:18,720
transforming their workflow

72
00:02:21,990 --> 00:02:20,480
and leveraging that same experiential

73
00:02:23,830 --> 00:02:22,000
technology to educate

74
00:02:25,190 --> 00:02:23,840
and inspire the public to engage in

75
00:02:26,869 --> 00:02:25,200
steam

76
00:02:28,869 --> 00:02:26,879
she will be followed by jason craig

77
00:02:30,150 --> 00:02:28,879
technical manager and producer of nasa's

78
00:02:31,430 --> 00:02:30,160
eye software

79
00:02:34,550 --> 00:02:31,440
and he's been creating scientific

80
00:02:37,110 --> 00:02:34,560
visualizations at jpl for over 15 years

81
00:02:38,710 --> 00:02:37,120
beginning with rendered cgi animations

82
00:02:41,110 --> 00:02:38,720
and progressing to real-time

83
00:02:42,550 --> 00:02:41,120
3d simulations while working closely

84
00:02:44,150 --> 00:02:42,560
with scientists and engineers from

85
00:02:46,390 --> 00:02:44,160
dozens of missions

86
00:02:47,430 --> 00:02:46,400
but first our first speaker she loves

87
00:02:49,430 --> 00:02:47,440
all things digital

88
00:02:51,670 --> 00:02:49,440

animal sound emitting cosmic and views

89
00:02:56,229 --> 00:02:51,680
the world through xr colored glasses

90
00:02:58,229 --> 00:02:56,239
please welcome sasha samoshina hi sasha

91
00:03:00,309 --> 00:02:58,239
hi brian thank you so much for having me

92
00:03:02,149 --> 00:03:00,319
tonight this is so exciting it's truly a

93
00:03:04,229 --> 00:03:02,159
dream come true for me to have a

94
00:03:06,229 --> 00:03:04,239
von carmen lecture and in such great

95
00:03:07,670 --> 00:03:06,239
company with jason craig

96
00:03:09,589 --> 00:03:07,680
we're very happy to have you what do you

97
00:03:12,710 --> 00:03:09,599
got for us tonight

98
00:03:14,710 --> 00:03:12,720
all right well let's get started um so

99
00:03:16,949 --> 00:03:14,720
as you gave the introduction i'm the

100
00:03:19,110 --> 00:03:16,959
deputy lead of the ops lab

101
00:03:21,190 --> 00:03:19,120
now i think i should explain what that

102
00:03:23,190 --> 00:03:21,200
is what is the ops lab so

103
00:03:25,030 --> 00:03:23,200
we are a group of software developers

104
00:03:26,869 --> 00:03:25,040
designers and creatives that have been

105
00:03:30,470 --> 00:03:26,879
incubating and innovating new

106
00:03:32,550 --> 00:03:30,480
technologies since 2003 at jpl

107
00:03:35,030 --> 00:03:32,560
in terms of where we are in jpl we're in

108
00:03:37,030 --> 00:03:35,040
the engineering and science directorate

109
00:03:38,710 --> 00:03:37,040
and specifically in the planning and

110
00:03:41,270 --> 00:03:38,720
execution systems section

111
00:03:43,830 --> 00:03:41,280
so that means we work on software for

112
00:03:46,070 --> 00:03:43,840
directly for engineers and scientists

113
00:03:48,149 --> 00:03:46,080

we focus on very research-based design

114
00:03:49,430 --> 00:03:48,159
and development to truly solve seemingly

115
00:03:51,190 --> 00:03:49,440
unsolvable problems

116
00:03:53,750 --> 00:03:51,200
for our scientists engineers and

117
00:03:55,429 --> 00:03:53,760
innovators and we're constantly growing

118
00:03:57,110 --> 00:03:55,439
and focusing on collaboration and how to

119
00:03:59,270 --> 00:03:57,120
make our work more accessible

120
00:04:00,789 --> 00:03:59,280
to not only the people that we work with

121
00:04:03,429 --> 00:04:00,799
and at other agencies

122
00:04:05,350 --> 00:04:03,439
or other people at the agency of nasa

123
00:04:07,270 --> 00:04:05,360
but to the public in general

124
00:04:09,030 --> 00:04:07,280
and so today i will be taking you

125
00:04:10,869 --> 00:04:09,040
through some of those projects

126
00:04:12,470 --> 00:04:10,879
now i'm going to be using some

127
00:04:14,470 --> 00:04:12,480
terminology today

128
00:04:16,789 --> 00:04:14,480
that is a little bit different for some

129
00:04:19,590 --> 00:04:16,799
people so i sort of want to explain that

130
00:04:21,110 --> 00:04:19,600
augmented reality versus virtual reality

131
00:04:23,030 --> 00:04:21,120
what is the difference so

132
00:04:24,790 --> 00:04:23,040
in augmented reality you have the

133
00:04:27,670 --> 00:04:24,800
physical and the virtual combined

134
00:04:28,070 --> 00:04:27,680
and my lab mainly focuses on working in

135
00:04:30,150 --> 00:04:28,080
that

136
00:04:31,510 --> 00:04:30,160
realm we work with the microsoft

137
00:04:32,870 --> 00:04:31,520
hololens which i'll bring out and show

138
00:04:34,870 --> 00:04:32,880

you a little bit later

139
00:04:36,629 --> 00:04:34,880
and we also like to incorporate that

140
00:04:38,310 --> 00:04:36,639
into the utilitarian work of

141
00:04:39,909 --> 00:04:38,320
using tablets and phones so something

142
00:04:41,749 --> 00:04:39,919
within your own reach something that

143
00:04:41,990 --> 00:04:41,759
jason and i collaborated on and that he

144
00:04:43,830 --> 00:04:42,000
will

145
00:04:45,350 --> 00:04:43,840
address a little bit later as well

146
00:04:46,310 --> 00:04:45,360
virtual reality is when you're fully

147
00:04:48,310 --> 00:04:46,320
immersed and

148
00:04:50,310 --> 00:04:48,320
you use sensory equipment to get around

149
00:04:51,110 --> 00:04:50,320
the cool guy terms for those are ar and

150
00:04:52,710 --> 00:04:51,120
vr

151
00:04:54,870 --> 00:04:52,720
i might slip up and actually actually

152
00:04:57,350 --> 00:04:54,880
use those but now you're all in my club

153
00:05:00,390 --> 00:04:57,360
with me so we can do it together

154
00:05:01,189 --> 00:05:00,400
so the ops lab has a ton of different

155
00:05:03,590 --> 00:05:01,199
projects

156
00:05:05,110 --> 00:05:03,600
and here is just a little bit of a look

157
00:05:07,510 --> 00:05:05,120
of those we do a lot of

158
00:05:09,189 --> 00:05:07,520
robotics work we work a lot with mars

159
00:05:11,590 --> 00:05:09,199
visualization but today

160
00:05:12,950 --> 00:05:11,600
we are going to be focusing on two

161
00:05:14,790 --> 00:05:12,960
specific projects

162
00:05:16,150 --> 00:05:14,800
protospace which is the project that i

163
00:05:19,350 --> 00:05:16,160

lead at jpl

164
00:05:21,110 --> 00:05:19,360
and in the ops lab and picard which is

165
00:05:22,870 --> 00:05:21,120
procedure instruction and collaborative

166
00:05:26,230 --> 00:05:22,880
assistance for remote direction

167
00:05:27,110 --> 00:05:26,240
yes i did do that which is a specific

168
00:05:29,670 --> 00:05:27,120
procedure

169
00:05:31,189 --> 00:05:29,680
uh tool built from protospace that is

170
00:05:33,110 --> 00:05:31,199
made to help

171
00:05:35,749 --> 00:05:33,120
astronauts and other people in science

172
00:05:37,990 --> 00:05:35,759
and engineering do procedural work

173
00:05:39,590 --> 00:05:38,000
now let's start with protospace

174
00:05:41,590 --> 00:05:39,600
protospace is a 3d

175
00:05:43,350 --> 00:05:41,600
cad visualization tool there's another

176
00:05:45,749 --> 00:05:43,360
big vocab board there cad

177
00:05:47,590 --> 00:05:45,759
computer aided design cad is something

178
00:05:49,670 --> 00:05:47,600
that our mechanical engineers

179
00:05:52,150 --> 00:05:49,680
use to create their very very

180
00:05:54,550 --> 00:05:52,160
complicated designs for spacecraft

181
00:05:56,870 --> 00:05:54,560
and protospace helps take those and put

182
00:06:01,270 --> 00:05:56,880
them into the real world at full scale

183
00:06:04,150 --> 00:06:01,280
both using this device the hololens so

184
00:06:05,350 --> 00:06:04,160
as i said augmented reality so when i

185
00:06:07,510 --> 00:06:05,360
put this on

186
00:06:08,550 --> 00:06:07,520
you can still see my eyes and i can

187
00:06:10,629 --> 00:06:08,560
still see you

188
00:06:12,710 --> 00:06:10,639

but if i wanted to have protospace on i

189
00:06:13,189 --> 00:06:12,720
could simulate a spacecraft over you

190
00:06:14,469 --> 00:06:13,199
which

191
00:06:16,390 --> 00:06:14,479
i don't know what spacecraft would

192
00:06:17,110 --> 00:06:16,400
actually be small enough to fit on my

193
00:06:18,790 --> 00:06:17,120
screen

194
00:06:19,990 --> 00:06:18,800
but let me show you a little preview of

195
00:06:21,670 --> 00:06:20,000
what something through the eye of the

196
00:06:23,029 --> 00:06:21,680
hololens would look like

197
00:06:24,870 --> 00:06:23,039
i'm going to just speak through this

198
00:06:27,670 --> 00:06:24,880
video so bear with me

199
00:06:29,270 --> 00:06:27,680
so protospace is as i said a 3d cad

200
00:06:30,629 --> 00:06:29,280
visualization system

201
00:06:32,070 --> 00:06:30,639
this is what you see through the eye of

202
00:06:34,950 --> 00:06:32,080
the hololens you can work

203
00:06:36,790 --> 00:06:34,960
collaboratively with people all around

204
00:06:38,070 --> 00:06:36,800
the world both in the same location or

205
00:06:39,909 --> 00:06:38,080
in different locations

206
00:06:42,070 --> 00:06:39,919
looking at the same model and seeing it

207
00:06:43,270 --> 00:06:42,080
in full scale our mechanical engineers

208
00:06:45,110 --> 00:06:43,280
are really used to just

209
00:06:47,029 --> 00:06:45,120
working inside 2d in the computer all

210
00:06:48,950 --> 00:06:47,039
the time when they're able to see their

211
00:06:51,510 --> 00:06:48,960
vision fully come to life

212
00:06:52,710 --> 00:06:51,520
in the room with other people they're

213
00:06:55,189 --> 00:06:52,720

really able to

214
00:06:56,710 --> 00:06:55,199
solve and see problems before they even

215
00:06:59,589 --> 00:06:56,720
machine one part of the

216
00:07:01,430 --> 00:06:59,599
spacecraft part or subsystem so we have

217
00:07:03,430 --> 00:07:01,440
a web component as well so if you're not

218
00:07:03,990 --> 00:07:03,440
able to join the hololens you can join

219
00:07:06,390 --> 00:07:04,000
in on

220
00:07:07,350 --> 00:07:06,400
the web and that's really useful because

221
00:07:09,189 --> 00:07:07,360
for people that

222
00:07:11,749 --> 00:07:09,199
are not having the computers that can

223
00:07:13,510 --> 00:07:11,759
like take all the energy to spin around

224
00:07:14,150 --> 00:07:13,520
a cad model they're actually able to do

225
00:07:17,110 --> 00:07:14,160
that

226
00:07:18,710 --> 00:07:17,120
from the web and so this tool is used in

227
00:07:19,589 --> 00:07:18,720
a lot of different sessions and has

228
00:07:22,950 --> 00:07:19,599
several tools

229
00:07:24,150 --> 00:07:22,960
you can move a model you can rotate a

230
00:07:26,390 --> 00:07:24,160
model

231
00:07:27,510 --> 00:07:26,400
you can create a cross section in a

232
00:07:29,670 --> 00:07:27,520
model to see

233
00:07:31,350 --> 00:07:29,680
what's going on inside there and you can

234
00:07:32,710 --> 00:07:31,360
scale a model up and down so

235
00:07:34,070 --> 00:07:32,720
if the model's too big to fit in the

236
00:07:35,029 --> 00:07:34,080
room you can make it small enough to

237
00:07:37,990 --> 00:07:35,039
work on

238
00:07:39,670 --> 00:07:38,000

so this is kind of a really kind of

239
00:07:40,550 --> 00:07:39,680
technology that we're using a lot

240
00:07:43,350 --> 00:07:40,560
including

241
00:07:44,070 --> 00:07:43,360
taking virtual things and matching them

242
00:07:45,990 --> 00:07:44,080
up to

243
00:07:47,749 --> 00:07:46,000
actual things so this is where the

244
00:07:49,029 --> 00:07:47,759
procedural work with picard comes along

245
00:07:49,909 --> 00:07:49,039
where you can do a step-by-step

246
00:07:52,070 --> 00:07:49,919
procedure

247
00:07:53,270 --> 00:07:52,080
virtually instead of doing it by reading

248
00:07:55,189 --> 00:07:53,280
a piece of paper

249
00:07:56,950 --> 00:07:55,199
we worked really closely with the iss

250
00:07:57,589 --> 00:07:56,960
and scott kelly which i'll get into in a

251
00:07:58,950 --> 00:07:57,599
second

252
00:08:03,029 --> 00:07:58,960
and i'll show you how that sort of

253
00:08:05,270 --> 00:08:03,039
procedural work grew into a more robust

254
00:08:07,350 --> 00:08:05,280
effect as of late with the vital

255
00:08:08,869 --> 00:08:07,360
ventilators for the jpl emergency

256
00:08:11,430 --> 00:08:08,879
ventilator project

257
00:08:12,309 --> 00:08:11,440
so let's get started with kind of

258
00:08:15,350 --> 00:08:12,319
unpacking

259
00:08:18,629 --> 00:08:15,360
a little bit of what i just said there

260
00:08:20,390 --> 00:08:18,639
as i said scott kelly used our picard

261
00:08:22,550 --> 00:08:20,400
procedural device formerly known

262
00:08:24,309 --> 00:08:22,560
known as sidekick on the international

263
00:08:27,189 --> 00:08:24,319

space station or the iss

264
00:08:28,790 --> 00:08:27,199
another cool acronym so here we see a

265
00:08:29,830 --> 00:08:28,800
mock-up of what we did when we did our

266
00:08:31,670 --> 00:08:29,840
first experiment

267
00:08:32,870 --> 00:08:31,680
this was something where scott kelly

268
00:08:35,509 --> 00:08:32,880
actually took

269
00:08:37,350 --> 00:08:35,519
um we sent hololenses up to the space

270
00:08:37,909 --> 00:08:37,360
station and scott kelly was able to don

271
00:08:39,909 --> 00:08:37,919
one

272
00:08:41,670 --> 00:08:39,919
and go through a really simple procedure

273
00:08:43,750 --> 00:08:41,680
without reading any paper

274
00:08:45,509 --> 00:08:43,760
or looking at any screens everything he

275
00:08:48,070 --> 00:08:45,519
needed was on a heads-up display

276
00:08:50,230 --> 00:08:48,080
on this device he also had a mission

277
00:08:51,750 --> 00:08:50,240
control remote assistance person guiding

278
00:08:54,470 --> 00:08:51,760
him through the steps and so this was

279
00:08:56,389 --> 00:08:54,480
our first sort of foray

280
00:08:57,750 --> 00:08:56,399
into seeing how can we do this kind of

281
00:09:00,389 --> 00:08:57,760
work without having

282
00:09:02,230 --> 00:09:00,399
uh people present in the room a lot of

283
00:09:03,509 --> 00:09:02,240
remote work which is very relevant right

284
00:09:06,389 --> 00:09:03,519
now

285
00:09:07,509 --> 00:09:06,399
that brings us to the next step to the

286
00:09:09,509 --> 00:09:07,519
nemo mission or

287
00:09:10,710 --> 00:09:09,519
nasa extreme environment mission

288
00:09:13,269 --> 00:09:10,720

operations

289
00:09:14,790 --> 00:09:13,279
now nasa extreme mission environment uh

290
00:09:15,829 --> 00:09:14,800
nasa extreme environment mission

291
00:09:18,230 --> 00:09:15,839
operations

292
00:09:19,910 --> 00:09:18,240
is a very very cool mission that happens

293
00:09:22,470 --> 00:09:19,920
every year

294
00:09:23,190 --> 00:09:22,480
it is something that takes place uh

295
00:09:26,550 --> 00:09:23,200
underneath

296
00:09:27,990 --> 00:09:26,560
the water uh in the keys uh outside of

297
00:09:31,110 --> 00:09:28,000
florida excuse me

298
00:09:31,990 --> 00:09:31,120
nemo stands for the the cool acronym for

299
00:09:34,070 --> 00:09:32,000
this is nemo

300
00:09:36,070 --> 00:09:34,080
and so this mission sends a group of

301
00:09:37,910 --> 00:09:36,080
astronauts engineers and scientists to

302
00:09:40,630 --> 00:09:37,920
live in the aquarius habitat

303
00:09:41,110 --> 00:09:40,640
the world's only undersea station in the

304
00:09:46,470 --> 00:09:41,120
world

305
00:09:47,990 --> 00:09:46,480
so for up to three weeks at a time they

306
00:09:50,310 --> 00:09:48,000
go on these really cool missions

307
00:09:52,230 --> 00:09:50,320
um the aquarius habitat is a really

308
00:09:53,670 --> 00:09:52,240
convincing surrounding for space analog

309
00:09:55,990 --> 00:09:53,680
mission and exploration

310
00:09:56,870 --> 00:09:56,000
and so we were able to participate using

311
00:09:59,910 --> 00:09:56,880
picard

312
00:10:01,430 --> 00:09:59,920
uh with this amazing group of scientists

313
00:10:03,190 --> 00:10:01,440

and astronauts or

314
00:10:04,949 --> 00:10:03,200
aquanauts as they're called because

315
00:10:05,910 --> 00:10:04,959
they're astronauts underwater how cool

316
00:10:07,670 --> 00:10:05,920
is that

317
00:10:09,990 --> 00:10:07,680
uh and they were doing a lunar analog

318
00:10:13,030 --> 00:10:10,000
mission and were able to use picard

319
00:10:15,030 --> 00:10:13,040
during that time so they actually

320
00:10:16,310 --> 00:10:15,040
executed one procedure each person

321
00:10:19,350 --> 00:10:16,320
trained and executed

322
00:10:21,269 --> 00:10:19,360
only using our ar platform and so that

323
00:10:23,590 --> 00:10:21,279
proved with some data research

324
00:10:25,670 --> 00:10:23,600
that it is actually in certain ways a

325
00:10:26,470 --> 00:10:25,680
lot better than doing things on paper

326
00:10:28,310 --> 00:10:26,480
however

327
00:10:29,509 --> 00:10:28,320
there's a still kind of a learning

328
00:10:30,790 --> 00:10:29,519
trajectory where

329
00:10:32,630 --> 00:10:30,800
you know software can get better

330
00:10:34,710 --> 00:10:32,640
hardware can get better but this is how

331
00:10:37,509 --> 00:10:34,720
we do science this is how we grow

332
00:10:38,550 --> 00:10:37,519
and so from this research we actually

333
00:10:41,590 --> 00:10:38,560
had a really

334
00:10:45,030 --> 00:10:41,600
interesting uh opportunity which

335
00:10:46,630 --> 00:10:45,040
you know albeit a sad world that we

336
00:10:47,910 --> 00:10:46,640
lived in in march where all this came

337
00:10:49,269 --> 00:10:47,920
down and jpl

338
00:10:51,030 --> 00:10:49,279

and the innovative people that lived

339
00:10:52,150 --> 00:10:51,040
there tried to figure out well how do we

340
00:10:54,790 --> 00:10:52,160
make this better

341
00:10:55,509 --> 00:10:54,800
so really really amazing innovation team

342
00:10:57,509 --> 00:10:55,519
including

343
00:10:58,949 --> 00:10:57,519
the director at office our wonderful

344
00:10:59,990 --> 00:10:58,959
engineers and scientists all put their

345
00:11:02,150 --> 00:11:00,000
heads together

346
00:11:04,069 --> 00:11:02,160
and decided that they were going to work

347
00:11:06,310 --> 00:11:04,079
on creating a ventilator

348
00:11:07,829 --> 00:11:06,320
an emergency ventilator that could be

349
00:11:10,389 --> 00:11:07,839
licensed and produced

350
00:11:11,670 --> 00:11:10,399
very easily and cheaply for licensees

351
00:11:13,590 --> 00:11:11,680
across the world

352
00:11:14,790 --> 00:11:13,600
and so i was brought in with our

353
00:11:16,630 --> 00:11:14,800
protospace team

354
00:11:18,470 --> 00:11:16,640
to figure out how could we create

355
00:11:19,030 --> 00:11:18,480
instructions that could be used really

356
00:11:21,110 --> 00:11:19,040
easily

357
00:11:23,030 --> 00:11:21,120
for both assembling the ventilators and

358
00:11:25,430 --> 00:11:23,040
also using the ventilators

359
00:11:27,030 --> 00:11:25,440
and you know it was a little bit of a

360
00:11:27,990 --> 00:11:27,040
head scratcher at first i was thinking

361
00:11:29,590 --> 00:11:28,000
we were thinking virtual

362
00:11:31,430 --> 00:11:29,600
reality augmented reality but then we're

363
00:11:33,190 --> 00:11:31,440

thinking wait no first research

364
00:11:35,430 --> 00:11:33,200
so after talking through our one with

365
00:11:36,790 --> 00:11:35,440
our wonderful jplers that we're already

366
00:11:39,269 --> 00:11:36,800
working on the project

367
00:11:39,910 --> 00:11:39,279
we got data on how best to do this kind

368
00:11:42,310 --> 00:11:39,920
of work

369
00:11:44,069 --> 00:11:42,320
and so here are some pictures of some of

370
00:11:45,430 --> 00:11:44,079
the team members that helped out and

371
00:11:47,269 --> 00:11:45,440
they're wonderful and i just want to

372
00:11:50,389 --> 00:11:47,279
give them a big thumbs up

373
00:11:53,030 --> 00:11:50,399
and hello out there you're watching um

374
00:11:54,870 --> 00:11:53,040
so the first uh video that you'll see is

375
00:11:55,430 --> 00:11:54,880
an assembly procedure module that we

376
00:11:57,350 --> 00:11:55,440
made

377
00:11:58,790 --> 00:11:57,360
this is a step-by-step procedure on the

378
00:12:00,389 --> 00:11:58,800
right you see the cad model

379
00:12:02,710 --> 00:12:00,399
of the assembly step for making the

380
00:12:04,150 --> 00:12:02,720
ventilator each sub-assembly first is

381
00:12:06,230 --> 00:12:04,160
put together and then you put the whole

382
00:12:08,389 --> 00:12:06,240
thing into the ventilator box

383
00:12:10,069 --> 00:12:08,399
this way you could click on any part of

384
00:12:11,750 --> 00:12:10,079
it turn it around in 360

385
00:12:13,750 --> 00:12:11,760
degree space in any browser you could

386
00:12:15,990 --> 00:12:13,760
cache it and do it without the internet

387
00:12:17,590 --> 00:12:16,000
you could also see a video on the left

388
00:12:18,069 --> 00:12:17,600

if you needed clear instructions on how

389
00:12:19,990 --> 00:12:18,079
to work

390
00:12:21,190 --> 00:12:20,000
things you could definitely just open

391
00:12:23,350 --> 00:12:21,200
that up and watch it

392
00:12:24,870 --> 00:12:23,360
so language is not quite the barrier

393
00:12:27,350 --> 00:12:24,880
here because it's very visual

394
00:12:30,310 --> 00:12:27,360
however if you are caching it on a

395
00:12:32,629 --> 00:12:30,320
browser you can also do some translation

396
00:12:34,069 --> 00:12:32,639
so now as we're having licensees begin

397
00:12:35,030 --> 00:12:34,079
to assemble these things we're going to

398
00:12:37,269 --> 00:12:35,040
see how

399
00:12:39,110 --> 00:12:37,279
positive the feedback can be or what we

400
00:12:40,470 --> 00:12:39,120
can work on to make this better but

401
00:12:42,310 --> 00:12:40,480
this is a way to take something

402
00:12:43,350 --> 00:12:42,320
astronauts we're using underneath the

403
00:12:45,910 --> 00:12:43,360
ocean to train

404
00:12:48,069 --> 00:12:45,920
and take it right into jpl and then

405
00:12:50,710 --> 00:12:48,079
across the world and across the nation

406
00:12:52,629 --> 00:12:50,720
in an emergency situation and some for

407
00:12:55,750 --> 00:12:52,639
the other side of those things

408
00:12:58,629 --> 00:12:55,760
we worked on the operational side so we

409
00:13:00,629 --> 00:12:58,639
first started with just finding any

410
00:13:02,550 --> 00:13:00,639
respiratory therapists any nurses any

411
00:13:05,269 --> 00:13:02,560
doctors that we knew and talking to them

412
00:13:07,350 --> 00:13:05,279
about how best to do this we had these

413
00:13:08,470 --> 00:13:07,360

ideas of fancy and flights of fancy on

414
00:13:09,990 --> 00:13:08,480
how we were going to use augmented

415
00:13:11,350 --> 00:13:10,000
reality to look at the face of the

416
00:13:12,150 --> 00:13:11,360
ventilator and all these things would

417
00:13:13,509 --> 00:13:12,160
pop up

418
00:13:15,030 --> 00:13:13,519
sounds cool and i think we should do

419
00:13:16,230 --> 00:13:15,040
something like that at some point but

420
00:13:18,069 --> 00:13:16,240
not for this project

421
00:13:20,069 --> 00:13:18,079
for this particular project we learned

422
00:13:21,509 --> 00:13:20,079
in our design team who is amazing got

423
00:13:22,710 --> 00:13:21,519
all the data to know

424
00:13:24,069 --> 00:13:22,720
they just want something simple

425
00:13:25,430 --> 00:13:24,079
something mobile something they can

426
00:13:26,710 --> 00:13:25,440
click through that'll take them right to

427
00:13:28,389 --> 00:13:26,720
where they need to be

428
00:13:29,910 --> 00:13:28,399
so through design work that was

429
00:13:32,069 --> 00:13:29,920
previously done by

430
00:13:33,750 --> 00:13:32,079
a wonderful team in communications we

431
00:13:35,670 --> 00:13:33,760
were able to create this

432
00:13:37,590 --> 00:13:35,680
website that is a mobile-friendly

433
00:13:39,430 --> 00:13:37,600
website that just takes you through

434
00:13:40,790 --> 00:13:39,440
to what you need to know immediately

435
00:13:42,150 --> 00:13:40,800
again you can cache it

436
00:13:43,670 --> 00:13:42,160
you're probably not going to use it when

437
00:13:45,110 --> 00:13:43,680
you're in emergency situation but if you

438
00:13:47,030 --> 00:13:45,120

need to you can get there

439
00:13:49,829 --> 00:13:47,040
and again we have the videos with our

440
00:13:51,590 --> 00:13:49,839
wonderful hand model michelle easter

441
00:13:53,269 --> 00:13:51,600
who shows you how to use the ventilator

442
00:13:54,470 --> 00:13:53,279
in real life so really answering those

443
00:13:56,870 --> 00:13:54,480
questions that

444
00:13:59,110 --> 00:13:56,880
um you might not be able to answer

445
00:14:01,590 --> 00:13:59,120
without actually seeing someone do it

446
00:14:02,230 --> 00:14:01,600
and so that brings me kind of back to a

447
00:14:04,069 --> 00:14:02,240
point of

448
00:14:05,829 --> 00:14:04,079
thinking of all of this together i know

449
00:14:08,230 --> 00:14:05,839
i just said a lot of things

450
00:14:09,269 --> 00:14:08,240
kind of quickly about this trajectory of

451
00:14:11,110 --> 00:14:09,279
how virtu

452
00:14:13,110 --> 00:14:11,120
how augmented reality can really help

453
00:14:16,150 --> 00:14:13,120
people remotely work together

454
00:14:18,389 --> 00:14:16,160
i think in this time we are specifically

455
00:14:20,310 --> 00:14:18,399
needing more innovation in this world

456
00:14:22,470 --> 00:14:20,320
and you know sometimes

457
00:14:24,069 --> 00:14:22,480
expensive hardware is is too much to

458
00:14:26,069 --> 00:14:24,079
take so you have to kind of pivot and

459
00:14:28,069 --> 00:14:26,079
work together to think of new solutions

460
00:14:29,189 --> 00:14:28,079
and i like to think of the ops lab and

461
00:14:31,670 --> 00:14:29,199
the protospace team

462
00:14:33,750 --> 00:14:31,680
and everyone at jpl being very very

463
00:14:36,389 --> 00:14:33,760

quick to pivot and do those things

464
00:14:37,110 --> 00:14:36,399
so also you know this work needs to be

465
00:14:39,350 --> 00:14:37,120
taken and

466
00:14:41,030 --> 00:14:39,360
ported to the public and how are you

467
00:14:42,949 --> 00:14:41,040
going to make it better and how can you

468
00:14:43,990 --> 00:14:42,959
kind of be the next generation of brains

469
00:14:45,990 --> 00:14:44,000
to think through this sort

470
00:14:47,990 --> 00:14:46,000
of thing so that's where the

471
00:14:50,550 --> 00:14:48,000
collaboration with jason comes along

472
00:14:52,949 --> 00:14:50,560
jason's team made a wonderful product a

473
00:14:54,710 --> 00:14:52,959
very long time ago which was beyond its

474
00:14:57,110 --> 00:14:54,720
time called spacecraft 3d

475
00:14:58,069 --> 00:14:57,120
that product was taken and ported to a

476
00:15:00,550 --> 00:14:58,079
new ar

477
00:15:02,230 --> 00:15:00,560
version called spacecraft ar which jason

478
00:15:04,069 --> 00:15:02,240
will show you where you can download

479
00:15:05,910 --> 00:15:04,079
but it's sort of a proto space light so

480
00:15:06,629 --> 00:15:05,920
you can take a model download it and

481
00:15:08,629 --> 00:15:06,639
with a friend

482
00:15:10,710 --> 00:15:08,639
collaborate on doing different things to

483
00:15:12,310 --> 00:15:10,720
model sizing it up sizing it down

484
00:15:14,389 --> 00:15:12,320
putting it all around your apartment

485
00:15:15,189 --> 00:15:14,399
taking selfies with it which is pretty

486
00:15:17,430 --> 00:15:15,199
fun

487
00:15:18,389 --> 00:15:17,440
um and so this shows you how something

488
00:15:20,069 --> 00:15:18,399

like this can

489
00:15:21,750 --> 00:15:20,079
something that's an engineering tool can

490
00:15:23,829 --> 00:15:21,760
be taken and ported

491
00:15:24,870 --> 00:15:23,839
into a more of a lightweight usability

492
00:15:28,870 --> 00:15:24,880
tool for

493
00:15:31,749 --> 00:15:28,880
children and and you know i should say

494
00:15:33,430 --> 00:15:31,759
not just children adults anyone i mean i

495
00:15:35,430 --> 00:15:33,440
pull this out all the time and show

496
00:15:37,590 --> 00:15:35,440
everyone because i think it's the most

497
00:15:38,629 --> 00:15:37,600
incredible trick you can get get out of

498
00:15:41,749 --> 00:15:38,639
your pocket

499
00:15:44,870 --> 00:15:41,759
um and so with that i just want to say

500
00:15:46,629 --> 00:15:44,880
thank you and i want to kind of

501
00:15:49,269 --> 00:15:46,639
bring it back to brian and see if we

502
00:15:51,749 --> 00:15:49,279
have any questions out there for me

503
00:15:52,790 --> 00:15:51,759
yeah lots of people are very interested

504
00:15:54,629 --> 00:15:52,800
in this and i love how you caught

505
00:15:56,310 --> 00:15:54,639
yourself there because i nerd myself out

506
00:15:58,389 --> 00:15:56,320
all the time i'm like oh yeah this is

507
00:16:00,150 --> 00:15:58,399
very important jpl stuff

508
00:16:02,230 --> 00:16:00,160
and it's anybody can get some of these

509
00:16:03,269 --> 00:16:02,240
things and share it with everybody but

510
00:16:04,710 --> 00:16:03,279
nikki how's

511
00:16:06,790 --> 00:16:04,720
what's uh what's everybody saying out

512
00:16:08,310 --> 00:16:06,800
there what do they want to know

513
00:16:09,910 --> 00:16:08,320

yeah so people online are really

514
00:16:11,590 --> 00:16:09,920
connecting to what you're talking about

515
00:16:13,269 --> 00:16:11,600
um we've got a great question

516
00:16:15,350 --> 00:16:13,279
you talked a bit about vital and how

517
00:16:16,790 --> 00:16:15,360
that's really impacted what jpl's been

518
00:16:18,629 --> 00:16:16,800
doing in the community

519
00:16:19,990 --> 00:16:18,639
and we've got a question here from

520
00:16:22,230 --> 00:16:20,000
shannon online

521
00:16:23,030 --> 00:16:22,240
uh shannon wants to know how do ar vr

522
00:16:24,790 --> 00:16:23,040
programs

523
00:16:29,189 --> 00:16:24,800
and visualizations help us look

524
00:16:33,670 --> 00:16:31,670
that's a very good question uh there are

525
00:16:36,870 --> 00:16:33,680
many projects that we worked on

526
00:16:38,550 --> 00:16:36,880
that do visualize earth data at one

527
00:16:40,069 --> 00:16:38,560
point we did open source some of those

528
00:16:42,150 --> 00:16:40,079
projects so people could pull them into

529
00:16:45,030 --> 00:16:42,160
a unity file and use them yourself

530
00:16:46,710 --> 00:16:45,040
i think that actually jason will speak

531
00:16:49,350 --> 00:16:46,720
to a lot of those tools

532
00:16:50,230 --> 00:16:49,360
and there don't have to be ar or vr they

533
00:16:52,629 --> 00:16:50,240
can actually be

534
00:16:54,710 --> 00:16:52,639
web which i think is kind of the more

535
00:16:56,710 --> 00:16:54,720
easily accessible tool for everyone

536
00:16:57,749 --> 00:16:56,720
around the world so i actually will wait

537
00:17:00,230 --> 00:16:57,759
on that question

538
00:17:01,910 --> 00:17:00,240

and have jason blow your minds with some

539
00:17:03,509 --> 00:17:01,920
of the work that he's doing

540
00:17:07,350 --> 00:17:03,519
that might help you find those tools a

541
00:17:11,590 --> 00:17:09,510
great so we've got another question from

542
00:17:12,470 --> 00:17:11,600
damien on youtube who wants to talk

543
00:17:15,029 --> 00:17:12,480
specifically

544
00:17:16,230 --> 00:17:15,039
you referenced the astronauts on the iss

545
00:17:18,150 --> 00:17:16,240
and this question is

546
00:17:20,390 --> 00:17:18,160
is vr being considered to help

547
00:17:22,710 --> 00:17:20,400
astronauts cope with isolation

548
00:17:25,029 --> 00:17:22,720
during future long duration missions in

549
00:17:27,829 --> 00:17:25,039
space

550
00:17:30,230 --> 00:17:27,839
that is an excellent excellent question

551
00:17:32,549 --> 00:17:30,240
and yes the answer is yes so

552
00:17:35,110 --> 00:17:32,559
there are a plethora of studies being

553
00:17:36,950 --> 00:17:35,120
done you know at jpl we focus on robotic

554
00:17:38,710 --> 00:17:36,960
missions and it's a delight and i should

555
00:17:41,830 --> 00:17:38,720
say thank you to the human

556
00:17:44,150 --> 00:17:41,840
human robotic mission systems um

557
00:17:45,750 --> 00:17:44,160
group to give us funding to help us kind

558
00:17:47,110 --> 00:17:45,760
of be connected with jsc

559
00:17:49,750 --> 00:17:47,120
and other people that are doing the

560
00:17:53,270 --> 00:17:49,760
human factors work but at johnson

561
00:17:54,310 --> 00:17:53,280
space center jsc we have so many studies

562
00:17:56,150 --> 00:17:54,320
that are being done

563
00:17:57,669 --> 00:17:56,160

that are both training astronauts and

564
00:17:58,710 --> 00:17:57,679
also seeing how they'll cope with

565
00:18:01,590 --> 00:17:58,720
certain things

566
00:18:06,150 --> 00:18:01,600
um both for lunar exploration as well as

567
00:18:10,150 --> 00:18:08,549
and we've got time for one more question

568
00:18:11,990 --> 00:18:10,160
nikki before we move on to our next

569
00:18:15,190 --> 00:18:12,000
speaker

570
00:18:15,990 --> 00:18:15,200
great so this question comes from dan on

571
00:18:17,830 --> 00:18:16,000
youtube

572
00:18:22,230 --> 00:18:17,840
uh dan wants to know are you developing

573
00:18:26,310 --> 00:18:24,789
well that's also a great question uh

574
00:18:28,070 --> 00:18:26,320
that's one of my dreams i think we

575
00:18:30,789 --> 00:18:28,080
should take a stab at it but

576
00:18:32,470 --> 00:18:30,799
actually no because also at jpl we

577
00:18:34,549 --> 00:18:32,480
really really think about leveraging

578
00:18:36,549 --> 00:18:34,559
technology that's already been made

579
00:18:37,830 --> 00:18:36,559
so if it's already been made and it's

580
00:18:39,430 --> 00:18:37,840
useful and we

581
00:18:41,590 --> 00:18:39,440
test it why would we make something that

582
00:18:43,110 --> 00:18:41,600
already exists we found a lot of great

583
00:18:44,710 --> 00:18:43,120
industry partners out there and we

584
00:18:47,110 --> 00:18:44,720
cherish those partners so

585
00:18:48,950 --> 00:18:47,120
at this point nothing out there doesn't

586
00:18:53,750 --> 00:18:48,960
scratch the itch for the things that we

587
00:18:57,590 --> 00:18:55,669
thank you sasha um those are all great

588
00:18:59,270 --> 00:18:57,600

questions and a lot of it does kind of

589
00:19:00,150 --> 00:18:59,280
lead to our next topic so it's a good

590
00:19:02,549 --> 00:19:00,160
segue to

591
00:19:05,510 --> 00:19:02,559
the state of kansas's number one son

592
00:19:07,830 --> 00:19:05,520
jason craig how you doing jason

593
00:19:09,110 --> 00:19:07,840
hey brian hey you're up there too i

594
00:19:11,270 --> 00:19:09,120
don't know it's odd that there's two

595
00:19:12,549 --> 00:19:11,280
kansans here but hey that's great

596
00:19:14,470 --> 00:19:12,559
that's right you can come anywhere and

597
00:19:16,950 --> 00:19:14,480
work at nasa yeah

598
00:19:18,630 --> 00:19:16,960
yeah what do you got for us tonight well

599
00:19:20,549 --> 00:19:18,640
i want to say thanks to sasha first of

600
00:19:21,590 --> 00:19:20,559
all for setting me up so nicely and the

601
00:19:24,150 --> 00:19:21,600
ops lab is just

602
00:19:25,350 --> 00:19:24,160
always doing super cool stuff that vital

603
00:19:27,909 --> 00:19:25,360
stuff is just amazing

604
00:19:29,830 --> 00:19:27,919
just amazing um so i want to tell

605
00:19:31,590 --> 00:19:29,840
everyone about a whole lot of free

606
00:19:33,590 --> 00:19:31,600
cool things you can have and we're going

607
00:19:35,990 --> 00:19:33,600
to start with spacecraft ar

608
00:19:37,190 --> 00:19:36,000
so you saw those gifs that sasha was

609
00:19:38,870 --> 00:19:37,200
showing

610
00:19:40,870 --> 00:19:38,880
but you can just go ahead and get it on

611
00:19:43,190 --> 00:19:40,880
your phone right now if you want to well

612
00:19:45,350 --> 00:19:43,200
maybe listen to us first then do it

613
00:19:48,430 --> 00:19:45,360

but i want to start with the home page

614
00:19:50,710 --> 00:19:48,440
so the homepage for my group is

615
00:19:51,190 --> 00:19:50,720
eyes.nasa.gov and there's a bunch of

616
00:19:54,150 --> 00:19:51,200
links

617
00:19:55,750 --> 00:19:54,160
at the jpl homepage and you can follow

618
00:19:57,909 --> 00:19:55,760
along with what i'm doing

619
00:19:59,909 --> 00:19:57,919
but from eyes you can link to a lot of

620
00:20:01,350 --> 00:19:59,919
it so as you can see

621
00:20:02,789 --> 00:20:01,360
it's right here there's a lot of stuff

622
00:20:04,549 --> 00:20:02,799
going on but i want to start with the

623
00:20:06,149 --> 00:20:04,559
mobile apps down here

624
00:20:08,549 --> 00:20:06,159
so you click on here if you need the

625
00:20:10,149 --> 00:20:08,559
link to them we have two apps

626
00:20:11,590 --> 00:20:10,159
one is earth now which tells you the

627
00:20:12,950 --> 00:20:11,600
latest about earth

628
00:20:15,029 --> 00:20:12,960
and the one we just talked about is

629
00:20:17,190 --> 00:20:15,039
spacecraft ar you can get it right now

630
00:20:19,510 --> 00:20:17,200
on your iphone or your android

631
00:20:21,350 --> 00:20:19,520
and have fun you can put the rover on

632
00:20:23,669 --> 00:20:21,360
your kitchen floor you can go outside

633
00:20:25,990 --> 00:20:23,679
and see how big voyager is it's nuts

634
00:20:27,510 --> 00:20:26,000
all you need is a horizontal surface and

635
00:20:31,029 --> 00:20:27,520
you're good

636
00:20:33,190 --> 00:20:31,039
but i want to show you our real-time 3d

637
00:20:34,390 --> 00:20:33,200
simulations that we do it's free to the

638
00:20:35,909 --> 00:20:34,400

world

639
00:20:38,950 --> 00:20:35,919
taxpayers paid for it you may as well

640
00:20:40,310 --> 00:20:38,960
see what we're doing out there in space

641
00:20:42,630 --> 00:20:40,320
first i want to show you this cool

642
00:20:43,830 --> 00:20:42,640
little website called deep space network

643
00:20:45,990 --> 00:20:43,840
now

644
00:20:47,990 --> 00:20:46,000
this is so simple yet it's amazingly

645
00:20:51,430 --> 00:20:48,000
popular it tells you who is phoning

646
00:20:52,390 --> 00:20:51,440
home from space right now so if you look

647
00:20:55,669 --> 00:20:52,400
here you can see

648
00:20:57,350 --> 00:20:55,679
m20 means mars 2020 that's our new rover

649
00:20:58,549 --> 00:20:57,360
on the way to mars and it is actually

650
00:21:01,190 --> 00:20:58,559
talking to spain

651
00:21:02,310 --> 00:21:01,200
right now you look in california oh this

652
00:21:06,149 --> 00:21:02,320
is good timing

653
00:21:09,110 --> 00:21:06,159
voyager 1 launched 43 years ago

654
00:21:11,110 --> 00:21:09,120
is still talking to us so voyager 1 is

655
00:21:12,470 --> 00:21:11,120
phoning home from way out there

656
00:21:14,230 --> 00:21:12,480
and then canberra looks like nothing

657
00:21:17,430 --> 00:21:14,240
right now so deep space network now

658
00:21:18,149 --> 00:21:17,440
pretty cool all right but i want to show

659
00:21:22,549 --> 00:21:18,159
you

660
00:21:24,789 --> 00:21:22,559
do

661
00:21:25,669 --> 00:21:24,799
on your phone so you can see where

662
00:21:28,950 --> 00:21:25,679
everything is

663
00:21:31,590 --> 00:21:28,960

right now so it is called the orrery

664
00:21:33,190 --> 00:21:31,600
is solar system interactive and you can

665
00:21:34,070 --> 00:21:33,200
go anywhere in the solar system this is

666
00:21:37,350 --> 00:21:34,080
a real-time

667
00:21:38,870 --> 00:21:37,360
3d simulation of most of our live

668
00:21:40,950 --> 00:21:38,880
missions out there so i'm going to start

669
00:21:44,070 --> 00:21:40,960
with mars

670
00:21:47,029 --> 00:21:44,080
so when we go to mars you can right away

671
00:21:48,230 --> 00:21:47,039
you can click and drag move it around

672
00:21:49,669 --> 00:21:48,240
see what's going on i'm going to

673
00:21:52,549 --> 00:21:49,679
maximize that too

674
00:21:54,870 --> 00:21:52,559
so this is mars right now look at all

675
00:21:56,789 --> 00:21:54,880
the stuff we have going on

676
00:21:57,990 --> 00:21:56,799
we have a lot of orbiters we have a

677
00:22:00,950 --> 00:21:58,000
couple landers and another

678
00:22:02,870 --> 00:22:00,960
one on the way so let me just pick one

679
00:22:05,510 --> 00:22:02,880
here's mars reconnaissance orbiter

680
00:22:06,630 --> 00:22:05,520
double click on the label and then you

681
00:22:09,750 --> 00:22:06,640
go

682
00:22:12,630 --> 00:22:09,760
so there it is and i'm streaming in

683
00:22:13,669 --> 00:22:12,640
hd tile textures at the bottom this is

684
00:22:15,510 --> 00:22:13,679
all accurate

685
00:22:17,830 --> 00:22:15,520
this is literally where it is this very

686
00:22:20,549 --> 00:22:17,840
second that's how fast it's going

687
00:22:22,149 --> 00:22:20,559
that's its actual size you can compare

688
00:22:24,149 --> 00:22:22,159

the size right here

689
00:22:25,590 --> 00:22:24,159
so let's compare it there it is compared

690
00:22:27,190 --> 00:22:25,600
to juno

691
00:22:31,830 --> 00:22:27,200
another big mission but let's give you a

692
00:22:35,270 --> 00:22:34,310
there is a person so there's our little

693
00:22:38,070 --> 00:22:35,280
person right there

694
00:22:39,350 --> 00:22:38,080
that's how big this spacecraft is but

695
00:22:41,350 --> 00:22:39,360
i'm going to close that

696
00:22:42,950 --> 00:22:41,360
so you can just wander around and see

697
00:22:44,549 --> 00:22:42,960
what's cool out there now we talked

698
00:22:47,430 --> 00:22:44,559
about the iss earlier

699
00:22:48,870 --> 00:22:47,440
so let's go look at it international

700
00:22:50,549 --> 00:22:48,880
space station i'll try not to do

701
00:22:52,310 --> 00:22:50,559
acronyms we're just kind of addicted to

702
00:22:54,950 --> 00:22:52,320
it at nasa

703
00:22:56,149 --> 00:22:54,960
so iss let's go look at it this thing is

704
00:22:58,070 --> 00:22:56,159
so cool

705
00:22:59,669 --> 00:22:58,080
and this will be another live shot of it

706
00:23:02,070 --> 00:22:59,679
right now

707
00:23:03,110 --> 00:23:02,080
so there it is and we're going to stream

708
00:23:06,549 --> 00:23:03,120
in the really

709
00:23:08,070 --> 00:23:06,559
cool textures below the hd textures

710
00:23:09,750 --> 00:23:08,080
so the space station has been up there

711
00:23:10,950 --> 00:23:09,760
for 20 years there's been people inside

712
00:23:13,750 --> 00:23:10,960
it for that long

713
00:23:15,350 --> 00:23:13,760

this is again where it is right now

714
00:23:17,110 --> 00:23:15,360
that's where it's so it's solar panels

715
00:23:19,350 --> 00:23:17,120
track the sun

716
00:23:20,710 --> 00:23:19,360
you can see the sun back there really

717
00:23:22,230 --> 00:23:20,720
cool stuff

718
00:23:23,750 --> 00:23:22,240
and you can you can search anywhere on

719
00:23:25,510 --> 00:23:23,760
the search tab so if you're interested

720
00:23:27,190 --> 00:23:25,520
in something in particular

721
00:23:28,870 --> 00:23:27,200
that's out there right now you can just

722
00:23:31,350 --> 00:23:28,880
type it so if you want to see

723
00:23:32,710 --> 00:23:31,360
voyager let's see how far out that thing

724
00:23:42,390 --> 00:23:32,720
is

725
00:23:44,230 --> 00:23:42,400
back there

726
00:23:45,990 --> 00:23:44,240
but there it is there's a gold record we

727
00:23:47,750 --> 00:23:46,000
told aliens how to find us

728
00:23:49,669 --> 00:23:47,760
where to look for us it's all written on

729
00:23:52,789 --> 00:23:49,679
the gold record carl sagan did that

730
00:23:54,710 --> 00:23:52,799
really cool stuff so that's our solar

731
00:23:56,549 --> 00:23:54,720
system interactive but you can actually

732
00:23:59,029 --> 00:23:56,559
access this through very

733
00:24:02,070 --> 00:23:59,039
large nasa main websites you can get it

734
00:24:04,789 --> 00:24:02,080
from nasa's solarsystem.nasa.gov site

735
00:24:06,310 --> 00:24:04,799
solar system exploration it's just this

736
00:24:07,750 --> 00:24:06,320
icon right here

737
00:24:10,230 --> 00:24:07,760
you click on that you go to the same

738
00:24:13,950 --> 00:24:10,240

thing in a similar way

739
00:24:16,149 --> 00:24:13,960
you can check up on earth so at

740
00:24:18,310 --> 00:24:16,159
climate.nasa.gov

741
00:24:20,470 --> 00:24:18,320
you can see how our earth is doing right

742
00:24:23,029 --> 00:24:20,480
now now we are all in california

743
00:24:23,669 --> 00:24:23,039
so we are experiencing some fires very

744
00:24:26,470 --> 00:24:23,679
near us

745
00:24:28,070 --> 00:24:26,480
right now the air is not so good so

746
00:24:31,590 --> 00:24:28,080
let's keep an eye on that

747
00:24:33,350 --> 00:24:31,600
let's see how the air is so i'm going to

748
00:24:36,710 --> 00:24:33,360
click on that little icon and now we go

749
00:24:40,070 --> 00:24:38,149
so when you go to eyes on the earth you

750
00:24:42,470 --> 00:24:40,080
see our earth fleet

751
00:24:44,390 --> 00:24:42,480
we have a lot of earth satellites most

752
00:24:46,549 --> 00:24:44,400
people don't know that

753
00:24:48,630 --> 00:24:46,559
and we have the latest event hurricane

754
00:24:51,430 --> 00:24:48,640
but this is

755
00:24:53,830 --> 00:24:51,440
earth yesterday so this is a global

756
00:24:57,430 --> 00:24:53,840
mosaic of earth yesterday

757
00:25:01,669 --> 00:24:59,830
yeah so this is the one that's right

758
00:25:04,230 --> 00:25:01,679
near where we are

759
00:25:05,669 --> 00:25:04,240
that's the one that's going right now so

760
00:25:07,430 --> 00:25:05,679
let's take a closer look at that let's

761
00:25:10,630 --> 00:25:07,440
go to vital signs

762
00:25:12,870 --> 00:25:10,640
let's go to carbon monoxide so

763
00:25:14,230 --> 00:25:12,880

nasa's fleet has a whole lot of really

764
00:25:16,549 --> 00:25:14,240
cool instruments up there that can

765
00:25:18,470 --> 00:25:16,559
detect things like carbon monoxide

766
00:25:19,750 --> 00:25:18,480
which is what you get when you get any

767
00:25:23,830 --> 00:25:19,760
when you light a match

768
00:25:26,149 --> 00:25:23,840
any kind of fire will give off co

769
00:25:27,990 --> 00:25:26,159
so let me animate this data here look at

770
00:25:30,549 --> 00:25:28,000
those plumes of carbon monoxide

771
00:25:32,390 --> 00:25:30,559
first of all the amazon has a lot of

772
00:25:33,990 --> 00:25:32,400
slash and burn fires going

773
00:25:36,230 --> 00:25:34,000
you know we think our fires are bad but

774
00:25:38,070 --> 00:25:36,240
look the amazon is still worse

775
00:25:40,310 --> 00:25:38,080
but here are our fires so that's not

776
00:25:42,070 --> 00:25:40,320
fire that's the smoke

777
00:25:44,630 --> 00:25:42,080
and the smoke we're detecting is carbon

778
00:25:47,669 --> 00:25:44,640
monoxide so you can see the dates

779
00:25:51,269 --> 00:25:49,510
and you can see it starts in socal all

780
00:25:53,590 --> 00:25:51,279
the way up the west coast

781
00:25:54,310 --> 00:25:53,600
and all of our smoke goes all over the

782
00:25:55,990 --> 00:25:54,320
place

783
00:25:57,669 --> 00:25:56,000
so it the jet stream picked it up and

784
00:26:00,070 --> 00:25:57,679
pushed it to the east coast

785
00:26:01,909 --> 00:26:00,080
and it didn't stop there it actually

786
00:26:04,549 --> 00:26:01,919
went to europe

787
00:26:05,669 --> 00:26:04,559
so we really are one world there really

788
00:26:08,070 --> 00:26:05,679

aren't any boundaries

789
00:26:12,149 --> 00:26:08,080
so we have to keep an eye on earth see

790
00:26:13,669 --> 00:26:12,159
what's going on uh also carbon dioxide

791
00:26:15,350 --> 00:26:13,679
surface temperature now this one is

792
00:26:16,870 --> 00:26:15,360
pretty easily graspable

793
00:26:19,669 --> 00:26:16,880
here's a three day average of what the

794
00:26:24,390 --> 00:26:22,149
this blue line is the freezing line so

795
00:26:25,830 --> 00:26:24,400
everything inside there is 32

796
00:26:28,070 --> 00:26:25,840
degrees fahrenheit or zero degrees

797
00:26:29,190 --> 00:26:28,080
celsius or below so it's good to see

798
00:26:33,110 --> 00:26:29,200
that greenland is

799
00:26:35,029 --> 00:26:33,120
is still frozen uh antarctica

800
00:26:36,149 --> 00:26:35,039
it's got a nice big ring around it so

801
00:26:38,310 --> 00:26:36,159
that's good

802
00:26:40,950 --> 00:26:38,320
but you can go back in time and see how

803
00:26:43,029 --> 00:26:40,960
this line shrinks and jumps around

804
00:26:44,710 --> 00:26:43,039
but you can hover over this see what the

805
00:26:47,029 --> 00:26:44,720
temperature is

806
00:26:48,230 --> 00:26:47,039
so check out earth we have a lot of

807
00:26:51,669 --> 00:26:48,240
stuff here

808
00:26:53,750 --> 00:26:51,679
uh soil moisture sea level variation

809
00:26:55,029 --> 00:26:53,760
total precipitation even the field of

810
00:26:56,950 --> 00:26:55,039
gravity itself

811
00:26:59,029 --> 00:26:56,960
you can actually see how gravity is

812
00:27:01,269 --> 00:26:59,039
fluctuating over time

813
00:27:02,870 --> 00:27:01,279

we measure the fluctuating fluctuating

814
00:27:03,510 --> 00:27:02,880
field of gravity which is amazing that's

815
00:27:06,310 --> 00:27:03,520
the grace

816
00:27:07,269 --> 00:27:06,320
fo grace follow-on mission actually

817
00:27:10,630 --> 00:27:07,279
detects

818
00:27:11,990 --> 00:27:10,640
changes in mass from above

819
00:27:13,750 --> 00:27:12,000
it's it's an incredible mission i don't

820
00:27:15,750 --> 00:27:13,760
have time to explain it but look it up

821
00:27:17,750 --> 00:27:15,760
so greenland here this means that

822
00:27:19,830 --> 00:27:17,760
greenland is losing water

823
00:27:22,230 --> 00:27:19,840
because there's less mass mass is

824
00:27:23,750 --> 00:27:22,240
gravity the less mass you have

825
00:27:25,750 --> 00:27:23,760
the less gravity you pull that

826
00:27:28,470 --> 00:27:25,760
spacecraft down and over

827
00:27:30,470 --> 00:27:28,480
that's how grace works it's amazing okay

828
00:27:33,510 --> 00:27:30,480
i gotta move on to some other products

829
00:27:35,750 --> 00:27:33,520
so let's go to exoplanets

830
00:27:36,549 --> 00:27:35,760
everybody loves exoplanets there's

831
00:27:38,950 --> 00:27:36,559
thousands

832
00:27:39,990 --> 00:27:38,960
of planets out there not in our solar

833
00:27:42,070 --> 00:27:40,000
system

834
00:27:43,630 --> 00:27:42,080
this is really mind-boggling so you just

835
00:27:45,269 --> 00:27:43,640
click on here again at

836
00:27:48,470 --> 00:27:45,279
exoplanets.nasa.gov

837
00:27:52,149 --> 00:27:48,480
or the links in the jpl site

838
00:27:52,470 --> 00:27:52,159

and here we go every little gold thing

839
00:27:55,430 --> 00:27:52,480
here

840
00:27:57,830 --> 00:27:55,440
is an exoplanet we have found we have

841
00:27:59,669 --> 00:27:57,840
found exoplanets in other

842
00:28:01,750 --> 00:27:59,679
systems in our galaxy this is pretty

843
00:28:05,909 --> 00:28:01,760
cool now let me let me pull way out for

844
00:28:10,470 --> 00:28:08,950
there's the galaxy

845
00:28:13,190 --> 00:28:10,480
so look we've been looking in one

846
00:28:15,110 --> 00:28:13,200
direction for some time

847
00:28:16,789 --> 00:28:15,120
then of course you've got the center the

848
00:28:17,750 --> 00:28:16,799
center of the galaxy so let's go back

849
00:28:21,269 --> 00:28:17,760
here

850
00:28:22,870 --> 00:28:21,279
so if we go back home to our sun

851
00:28:25,190 --> 00:28:22,880
and you look out at what we've found you

852
00:28:26,950 --> 00:28:25,200
can click on any single one of these

853
00:28:29,029 --> 00:28:26,960
any one of these and you can zip over

854
00:28:29,669 --> 00:28:29,039
and look at it now we can't take

855
00:28:32,870 --> 00:28:29,679
pictures of

856
00:28:34,070 --> 00:28:32,880
exoplanets we can we know generally what

857
00:28:35,029 --> 00:28:34,080
they're going to look like but look at

858
00:28:36,710 --> 00:28:35,039
this

859
00:28:39,110 --> 00:28:36,720
there's a blob out there all those

860
00:28:41,110 --> 00:28:39,120
exoplanet systems

861
00:28:44,870 --> 00:28:41,120
that's because our kepler mission stared

862
00:28:46,070 --> 00:28:44,880
in space for two plus years in one area

863
00:28:47,669 --> 00:28:46,080

and i'm gonna show you the kepler

864
00:28:48,950 --> 00:28:47,679
mission this is it right here that's the

865
00:28:52,070 --> 00:28:48,960
spacecraft

866
00:28:54,950 --> 00:28:52,080
it stared in this direction for so long

867
00:28:55,990 --> 00:28:54,960
it resolved to the actual ccd chip on

868
00:28:59,269 --> 00:28:56,000
the telescope

869
00:29:02,549 --> 00:28:59,279
so let me just pick one here kepler

870
00:29:04,549 --> 00:29:02,559
whatever 663 never never seen it before

871
00:29:05,590 --> 00:29:04,559
so you go in here and you can look at

872
00:29:07,990 --> 00:29:05,600
the exoplanet

873
00:29:09,909 --> 00:29:08,000
you can look at the star let's go in at

874
00:29:13,430 --> 00:29:09,919
the system here

875
00:29:16,630 --> 00:29:13,440
it's a kind of a neptune-like gas giant

876
00:29:18,070 --> 00:29:16,640
and this is uh an estimated

877
00:29:19,590 --> 00:29:18,080
look of it it's all procedurally

878
00:29:21,190 --> 00:29:19,600
generated we don't know what it looks

879
00:29:23,669 --> 00:29:21,200
like but we have a guess we kind of know

880
00:29:24,950 --> 00:29:23,679
if it's rocky a super earth or what not

881
00:29:27,269 --> 00:29:24,960
now you may have heard of our most

882
00:29:28,710 --> 00:29:27,279
famous one called trappist

883
00:29:30,070 --> 00:29:28,720
so just search for whatever you want

884
00:29:33,070 --> 00:29:30,080
let's go look at trappist there's a

885
00:29:36,389 --> 00:29:33,080
whole bunch of earth-like planets only

886
00:29:38,549 --> 00:29:36,399
41 light years away

887
00:29:40,070 --> 00:29:38,559
so this is super exciting now that's too

888
00:29:43,830 --> 00:29:40,080

far at the speed of light for

889
00:29:45,990 --> 00:29:43,840
us as far as we know but

890
00:29:47,190 --> 00:29:46,000
this is a really close neighbor so all

891
00:29:50,070 --> 00:29:47,200
of these

892
00:29:52,630 --> 00:29:50,080
these ones here like e trappist 1e i

893
00:29:55,909 --> 00:29:52,640
like to say that's earth

894
00:29:58,789 --> 00:29:55,919
it could have water so right now

895
00:30:00,310 --> 00:29:58,799
we don't know but we have some data that

896
00:30:01,669 --> 00:30:00,320
leads us to think that we can do it we

897
00:30:03,190 --> 00:30:01,679
can actually get one or two pixel

898
00:30:04,389 --> 00:30:03,200
spectrum on this to see what stuff is

899
00:30:06,070 --> 00:30:04,399
made of

900
00:30:07,830 --> 00:30:06,080
but anyway you can check it out there's

901
00:30:09,190 --> 00:30:07,840
all these cool things hubble spitzer

902
00:30:11,350 --> 00:30:09,200
tests

903
00:30:13,190 --> 00:30:11,360
but i've got to show you more stuff

904
00:30:15,350 --> 00:30:13,200
actually

905
00:30:16,950 --> 00:30:15,360
so let's switch now i'm going to go to

906
00:30:21,190 --> 00:30:16,960
the older version that you see

907
00:30:25,590 --> 00:30:24,230
and it is uh called eyes on the earth

908
00:30:27,029 --> 00:30:25,600
but it's eyes on the solar system and

909
00:30:29,669 --> 00:30:27,039
it's a little video game you install and

910
00:30:31,269 --> 00:30:29,679
it has so many more things

911
00:30:32,789 --> 00:30:31,279
it has a lot more power because

912
00:30:33,110 --> 00:30:32,799
everything else is on your phone this is

913
00:30:42,789 --> 00:30:33,120

not

914
00:30:43,190 --> 00:30:42,799
home page so you just go to the home

915
00:30:45,110 --> 00:30:43,200
page

916
00:30:46,710 --> 00:30:45,120
and launch advanced eyes on the solar

917
00:30:47,669 --> 00:30:46,720
system and you can do what i'm doing but

918
00:30:51,590 --> 00:30:47,679
that requires

919
00:30:54,070 --> 00:30:51,600
a pc mac laptop or desktop no tablets

920
00:30:55,909 --> 00:30:54,080
no phones but it gets really really

921
00:31:00,870 --> 00:30:55,919
detailed and i'll show you that here

922
00:31:04,789 --> 00:31:02,630
jason so this is one that anybody can

923
00:31:05,350 --> 00:31:04,799
get anywhere as long as they have those

924
00:31:07,190 --> 00:31:05,360
right

925
00:31:08,870 --> 00:31:07,200
they're at school if they're at a

926
00:31:11,590 --> 00:31:08,880
library they can download it

927
00:31:12,149 --> 00:31:11,600
because it's free and it's for everyone

928
00:31:15,350 --> 00:31:12,159
okay

929
00:31:16,870 --> 00:31:15,360
so you should now see it on your screen

930
00:31:18,789 --> 00:31:16,880
this is advanced eyes on the solar

931
00:31:21,590 --> 00:31:18,799
system so i'm gonna go straight to

932
00:31:23,190 --> 00:31:21,600
a super cool event that nobody really

933
00:31:25,590 --> 00:31:23,200
you wouldn't believe it happened

934
00:31:26,230 --> 00:31:25,600
part of what i want to do is show the

935
00:31:28,389 --> 00:31:26,240
public

936
00:31:29,909 --> 00:31:28,399
what we're doing because absolutely most

937
00:31:32,230 --> 00:31:29,919
people don't know like

938
00:31:33,110 --> 00:31:32,240

a tenth of what we do nasa is incredible

939
00:31:35,029 --> 00:31:33,120
i learn stuff

940
00:31:37,190 --> 00:31:35,039
every day there's so many cool things

941
00:31:37,830 --> 00:31:37,200
just at jpl jet propulsion laboratory

942
00:31:40,470 --> 00:31:37,840
going on

943
00:31:42,149 --> 00:31:40,480
and there's so many nasa centers there's

944
00:31:43,190 --> 00:31:42,159
an infinite amount of things to learn

945
00:31:44,789 --> 00:31:43,200
and find out but

946
00:31:47,269 --> 00:31:44,799
i want to show you a really awesome

947
00:31:50,149 --> 00:31:47,279
event that happened in 2015.

948
00:31:51,909 --> 00:31:50,159
we had a spacecraft called cassini which

949
00:31:52,630 --> 00:31:51,919
is an amazing spacecraft that never

950
00:31:54,549 --> 00:31:52,640
failed

951
00:31:56,870 --> 00:31:54,559
it was out there 20 plus years and it

952
00:32:01,029 --> 00:31:56,880
did something amazing on october 28th

953
00:32:02,710 --> 00:32:01,039
2015 and here you can see it basically

954
00:32:04,470 --> 00:32:02,720
we wanted to know what's going on with

955
00:32:08,149 --> 00:32:04,480
this moon of saturn

956
00:32:11,190 --> 00:32:08,159
so there's saturn and right on this side

957
00:32:13,190 --> 00:32:11,200
is a moon called enceladus and it is

958
00:32:16,389 --> 00:32:13,200
doing something very strange

959
00:32:19,509 --> 00:32:16,399
it is spewing something into space

960
00:32:21,990 --> 00:32:19,519
24 7. i mean geysers

961
00:32:24,149 --> 00:32:22,000
they they we call them plumes geysers so

962
00:32:25,509 --> 00:32:24,159
this is the actual speed and we actually

963
00:32:26,389 --> 00:32:25,519

i'm going to pause it because it goes so

964
00:32:28,389 --> 00:32:26,399
fast

965
00:32:29,509 --> 00:32:28,399
we actually took our multi-billion

966
00:32:33,509 --> 00:32:29,519
dollar spacecraft

967
00:32:35,909 --> 00:32:33,519
and flew it into these ice crystals

968
00:32:37,590 --> 00:32:35,919
because we need to know what it's made

969
00:32:40,470 --> 00:32:37,600
of this has huge

970
00:32:40,950 --> 00:32:40,480
huge cool ramifications so we are really

971
00:32:42,950 --> 00:32:40,960
close

972
00:32:44,470 --> 00:32:42,960
in this program you right click you

973
00:32:45,190 --> 00:32:44,480
measure distance you click on the other

974
00:32:47,750 --> 00:32:45,200
object

975
00:32:48,549 --> 00:32:47,760
and you can bring up how far away it is

976
00:32:50,549 --> 00:32:48,559
so

977
00:32:52,070 --> 00:32:50,559
if you can see that it's only 28 miles

978
00:32:53,990 --> 00:32:52,080
from the surface

979
00:32:55,269 --> 00:32:54,000
and we actually pointed our spectrometer

980
00:32:57,430 --> 00:32:55,279
right into this stuff

981
00:32:58,950 --> 00:32:57,440
because we need to know is this water

982
00:33:00,710 --> 00:32:58,960
and if it's water does it have some

983
00:33:02,549 --> 00:33:00,720
extra special ingredients so let me go

984
00:33:05,110 --> 00:33:02,559
back to playing this

985
00:33:06,470 --> 00:33:05,120
so we did analyze the risk there was a

986
00:33:09,350 --> 00:33:06,480
very slight

987
00:33:10,630 --> 00:33:09,360
danger to spacecraft which is nuts so we

988
00:33:11,430 --> 00:33:10,640

waited more to the end of the mission to

989
00:33:13,669 --> 00:33:11,440
get this close

990
00:33:15,269 --> 00:33:13,679
and we flew it straight through these

991
00:33:17,830 --> 00:33:15,279
plumes

992
00:33:18,389 --> 00:33:17,840
and the amazing result is it's 99

993
00:33:21,590 --> 00:33:18,399
percent

994
00:33:25,509 --> 00:33:21,600
water but even better than that

995
00:33:27,909 --> 00:33:25,519
it's one percent organics so

996
00:33:30,470 --> 00:33:27,919
that means something incredible if you

997
00:33:32,630 --> 00:33:30,480
have organics you have energy

998
00:33:33,590 --> 00:33:32,640
you have water we believe there can be

999
00:33:36,950 --> 00:33:33,600
life

1000
00:33:40,630 --> 00:33:36,960
so this moon which has an icy crust

1001
00:33:42,630 --> 00:33:40,640
it covers a subsurface ocean of water

1002
00:33:45,029 --> 00:33:42,640
which can be more water than earth has

1003
00:33:46,870 --> 00:33:45,039
europa is the same kind of deal

1004
00:33:49,190 --> 00:33:46,880
and we found out that there's ammonia

1005
00:33:50,549 --> 00:33:49,200
and other organics in there

1006
00:33:52,230 --> 00:33:50,559
so it's just like the bottom of the

1007
00:33:54,710 --> 00:33:52,240
atlantic ocean the mid-atlantic ridge

1008
00:33:56,710 --> 00:33:54,720
and those smoker vents

1009
00:33:58,470 --> 00:33:56,720
you have the tidal forces from saturn

1010
00:33:59,430 --> 00:33:58,480
pushing that water out of that ocean

1011
00:34:03,190 --> 00:33:59,440
through these little

1012
00:34:04,950 --> 00:34:03,200
cracks in the ice and it's continuous

1013
00:34:06,870 --> 00:34:04,960

saturn is so big it's a lot of

1014
00:34:08,470 --> 00:34:06,880
gravitational tidal forces

1015
00:34:09,909 --> 00:34:08,480
so we want to go back there this we

1016
00:34:13,589 --> 00:34:09,919
didn't know this at

1017
00:34:15,990 --> 00:34:13,599
all we had to go fly out there to see it

1018
00:34:17,430 --> 00:34:16,000
while we were already there we did not

1019
00:34:19,589 --> 00:34:17,440
know hubble couldn't see it

1020
00:34:20,950 --> 00:34:19,599
nothing could see it and then we

1021
00:34:22,470 --> 00:34:20,960
actually flew through it so that's

1022
00:34:24,629 --> 00:34:22,480
enceladus that's an incredible story

1023
00:34:26,230 --> 00:34:24,639
that's an incredible mission

1024
00:34:28,230 --> 00:34:26,240
you can do all kinds of cool things here

1025
00:34:31,589 --> 00:34:28,240
in the top right like you can watch the

1026
00:34:33,829 --> 00:34:31,599
rover land on mars in the

1027
00:34:39,270 --> 00:34:33,839
curiosity curiosity land on mars which

1028
00:34:42,629 --> 00:34:41,190
so we actually did a crazy procedure but

1029
00:34:43,349 --> 00:34:42,639
actually i'm out of time please check

1030
00:34:45,909 --> 00:34:43,359
that out

1031
00:34:46,710 --> 00:34:45,919
on your own uh you can actually let me

1032
00:34:49,990 --> 00:34:46,720
just do the

1033
00:34:51,349 --> 00:34:50,000
cliff notes version we put an suv on the

1034
00:34:53,510 --> 00:34:51,359
surface of mars

1035
00:34:54,950 --> 00:34:53,520
back in 2012 and we're going to do it

1036
00:34:56,389 --> 00:34:54,960
again whoops

1037
00:34:59,030 --> 00:34:56,399
you can get dizzy with this stuff i'll

1038
00:35:00,870 --> 00:34:59,040

try not to do that

1039
00:35:03,190 --> 00:35:00,880
also turn it right side up so we

1040
00:35:04,630 --> 00:35:03,200
actually landed on mars like this

1041
00:35:07,109 --> 00:35:04,640
this is going to happen again in

1042
00:35:09,670 --> 00:35:07,119
february which is really amazing

1043
00:35:10,230 --> 00:35:09,680
so please check this out on your own we

1044
00:35:12,069 --> 00:35:10,240
actually

1045
00:35:13,430 --> 00:35:12,079
free flew something by remote control

1046
00:35:14,790 --> 00:35:13,440
from pasadena

1047
00:35:17,750 --> 00:35:14,800
to land on mars and we're going to do it

1048
00:35:20,790 --> 00:35:17,760
again in february so super cool

1049
00:35:22,470 --> 00:35:20,800
okay i think i am just about out of time

1050
00:35:24,310 --> 00:35:22,480
here

1051
00:35:26,710 --> 00:35:24,320
so thank you very much i'm going to send

1052
00:35:28,710 --> 00:35:26,720
it back to brian

1053
00:35:30,470 --> 00:35:28,720
well we got a lot of great information

1054
00:35:32,150 --> 00:35:30,480
in there and

1055
00:35:33,430 --> 00:35:32,160
everybody's asking questions so nikki

1056
00:35:35,990 --> 00:35:33,440
what's going on what do they want to

1057
00:35:36,000 --> 00:35:39,589
sure we've got a great question

1058
00:35:43,670 --> 00:35:41,990
we've got a great question uh from

1059
00:35:45,829 --> 00:35:43,680
justin on facebook who asks

1060
00:35:47,829 --> 00:35:45,839
considering we have tools which develop

1061
00:35:49,750 --> 00:35:47,839
applications such as flight simulators

1062
00:35:51,589 --> 00:35:49,760
or google earth using satellites

1063
00:35:52,790 --> 00:35:51,599

are there any plans to do something

1064
00:35:55,190 --> 00:35:52,800
similar with

1065
00:35:57,109 --> 00:35:55,200
any other planets to dive deeper and to

1066
00:36:01,349 --> 00:35:57,119
try to see what kind of minerals or

1067
00:36:05,750 --> 00:36:02,870
oh absolutely that's basically what our

1068
00:36:08,310 --> 00:36:05,760
missions do we can derive some of those

1069
00:36:09,510 --> 00:36:08,320
things from orbit so for example mars

1070
00:36:11,270 --> 00:36:09,520
reconnaissance orbiter

1071
00:36:12,630 --> 00:36:11,280
kind of detected signatures that implied

1072
00:36:14,310 --> 00:36:12,640
water on mars

1073
00:36:16,470 --> 00:36:14,320
this is a long time ago and now we know

1074
00:36:18,310 --> 00:36:16,480
there's quite a bit you know good amount

1075
00:36:18,790 --> 00:36:18,320
of water on mars but it detected it in

1076
00:36:21,270 --> 00:36:18,800
the mid

1077
00:36:23,430 --> 00:36:21,280
latitudes um so that's part of the

1078
00:36:26,230 --> 00:36:23,440
reason we go to mars is to see that but

1079
00:36:26,950 --> 00:36:26,240
it's it's hard it's much better to get

1080
00:36:28,310 --> 00:36:26,960
there first

1081
00:36:30,150 --> 00:36:28,320
to detect these kind of things there's

1082
00:36:32,230 --> 00:36:30,160
only so much we can do remotely

1083
00:36:33,270 --> 00:36:32,240
but yes that's that's all missions that

1084
00:36:34,950 --> 00:36:33,280
leave our planet

1085
00:36:37,030 --> 00:36:34,960
are going to find out a lot about the

1086
00:36:37,670 --> 00:36:37,040
signature that's quantum mechanics

1087
00:36:40,310 --> 00:36:37,680
that's uh

1088
00:36:42,470 --> 00:36:40,320

spectrum it is a crucial crucial part of

1089
00:36:45,589 --> 00:36:42,480
science

1090
00:36:47,109 --> 00:36:45,599
very cool that's great um we've got

1091
00:36:50,310 --> 00:36:47,119
another question from amal

1092
00:36:53,750 --> 00:36:50,320
on facebook who asks can we find comets

1093
00:36:54,630 --> 00:36:53,760
on eyes yes absolutely there's a full

1094
00:36:57,430 --> 00:36:54,640
comments

1095
00:36:58,870 --> 00:36:57,440
section in the video game eyes which you

1096
00:36:59,670 --> 00:36:58,880
can't do on your phone it's laptop or

1097
00:37:01,190 --> 00:36:59,680
desktop

1098
00:37:02,470 --> 00:37:01,200
so you just click on the comments i

1099
00:37:04,069 --> 00:37:02,480
don't know if you can switch back over

1100
00:37:06,870 --> 00:37:04,079
to it

1101
00:37:07,990 --> 00:37:06,880
but uh they'll come up here so there's a

1102
00:37:10,390 --> 00:37:08,000
whole lot of comments out

1103
00:37:12,950 --> 00:37:10,400
there so there's haley's comment there's

1104
00:37:23,670 --> 00:37:12,960
siding spring

1105
00:37:25,589 --> 00:37:23,680
yeah we gotta we you can do comments yes

1106
00:37:29,109 --> 00:37:25,599
one last question nikki before we bring

1107
00:37:33,910 --> 00:37:32,150
sure so uh sunisa on twitter is asking

1108
00:37:36,550 --> 00:37:33,920
if uh you all can stream

1109
00:37:41,910 --> 00:37:36,560
a vr 180 camera so we can finally all

1110
00:37:46,470 --> 00:37:44,310
uh yeah that's a kind of flight hardware

1111
00:37:48,950 --> 00:37:46,480
that probably won't make it on

1112
00:37:50,550 --> 00:37:48,960
um it's tough it's tough to get that

1113
00:37:52,470 --> 00:37:50,560

kind of hardware on a really expensive

1114
00:37:54,790 --> 00:37:52,480
mission that would be cool though

1115
00:37:55,990 --> 00:37:54,800
but we do we do have cameras you can

1116
00:37:57,589 --> 00:37:56,000
when the rover lands you're going to

1117
00:37:58,550 --> 00:37:57,599
watch it go through the atmosphere from

1118
00:38:00,870 --> 00:37:58,560
a couple different

1119
00:38:02,390 --> 00:38:00,880
cameras the scent cam there's one on the

1120
00:38:05,349 --> 00:38:02,400
descent stages one it's

1121
00:38:06,069 --> 00:38:05,359
it's really cool stuff so yeah our juno

1122
00:38:09,030 --> 00:38:06,079
mission

1123
00:38:10,790 --> 00:38:09,040
just put one visual camera on it uh

1124
00:38:13,349 --> 00:38:10,800
almost as an afterthought because the

1125
00:38:13,910 --> 00:38:13,359
science was so important so those kind

1126
00:38:15,430 --> 00:38:13,920
of things

1127
00:38:17,430 --> 00:38:15,440
even though i love them and we all love

1128
00:38:20,390 --> 00:38:17,440
them the science usually takes

1129
00:38:23,510 --> 00:38:22,470
very cool um i want to bring sasha back

1130
00:38:24,550 --> 00:38:23,520
in here

1131
00:38:25,990 --> 00:38:24,560
just because there's a question i have

1132
00:38:27,750 --> 00:38:26,000
for both of you and when i was growing

1133
00:38:28,470 --> 00:38:27,760
up these were not jobs that i thought

1134
00:38:32,310 --> 00:38:28,480
you could have

1135
00:38:33,910 --> 00:38:32,320
with nasa how did you get to do

1136
00:38:35,750 --> 00:38:33,920
what you do it looks like it brings you

1137
00:38:37,270 --> 00:38:35,760
both so much passion so much joy and

1138
00:38:40,550 --> 00:38:37,280

you're so passionate about it

1139
00:38:43,589 --> 00:38:42,230
well i'll take a crack at that first

1140
00:38:46,230 --> 00:38:43,599
baby jason uh

1141
00:38:47,750 --> 00:38:46,240
well i think that i have always had a

1142
00:38:49,349 --> 00:38:47,760
career trajectory

1143
00:38:51,510 --> 00:38:49,359
that looked at combining the

1144
00:38:53,670 --> 00:38:51,520
intersectionalities of art and science

1145
00:38:54,710 --> 00:38:53,680
and then that became in my professional

1146
00:38:56,550 --> 00:38:54,720
world

1147
00:38:57,829 --> 00:38:56,560
web development and design which then

1148
00:39:01,270 --> 00:38:57,839
turned into immersive

1149
00:39:03,910 --> 00:39:01,280
media i think that if

1150
00:39:06,230 --> 00:39:03,920
you have a creative kind of brain and

1151
00:39:09,109 --> 00:39:06,240
you're trying to find a way to sort of

1152
00:39:09,910 --> 00:39:09,119
use it uh jpl seemed to be a very good

1153
00:39:11,109 --> 00:39:09,920
place for me

1154
00:39:13,109 --> 00:39:11,119
i actually started out in the

1155
00:39:15,030 --> 00:39:13,119
communications department where jason is

1156
00:39:16,710 --> 00:39:15,040
and then sort of went back into my

1157
00:39:20,390 --> 00:39:16,720
software world but

1158
00:39:22,630 --> 00:39:20,400
i come from this place of really wanting

1159
00:39:24,390 --> 00:39:22,640
to work at a place that gives back and

1160
00:39:25,829 --> 00:39:24,400
looks at a bigger picture i used to work

1161
00:39:26,790 --> 00:39:25,839
at the field museum of natural history

1162
00:39:29,109 --> 00:39:26,800
in chicago

1163
00:39:30,310 --> 00:39:29,119

which really taught me a lot about

1164
00:39:32,230 --> 00:39:30,320
valuing

1165
00:39:33,990 --> 00:39:32,240
what we have here on earth and how you

1166
00:39:35,349 --> 00:39:34,000
can make a job that's bigger than just

1167
00:39:38,470 --> 00:39:35,359
yourself through design

1168
00:39:41,109 --> 00:39:38,480
and development so

1169
00:39:41,990 --> 00:39:41,119
basically i say if you see that job

1170
00:39:44,390 --> 00:39:42,000
description that you

1171
00:39:46,310 --> 00:39:44,400
really want you should just apply and go

1172
00:39:48,230 --> 00:39:46,320
for it because that's how i began

1173
00:39:50,230 --> 00:39:48,240
my career at jpl which seemed like a

1174
00:39:52,230 --> 00:39:50,240
dream come true at the time

1175
00:39:53,510 --> 00:39:52,240
and still is i should say it still is a

1176
00:39:56,630 --> 00:39:53,520
dream come true

1177
00:39:59,750 --> 00:39:56,640
but i worked for it so cool yeah

1178
00:40:02,550 --> 00:39:59,760
and jason how about you

1179
00:40:03,430 --> 00:40:02,560
um i was in i was astrophysics uh that

1180
00:40:05,430 --> 00:40:03,440
was my major

1181
00:40:06,790 --> 00:40:05,440
and then i got into software development

1182
00:40:09,589 --> 00:40:06,800
uh 3d modeling

1183
00:40:11,349 --> 00:40:09,599
rendering and animation so it turned out

1184
00:40:13,510 --> 00:40:11,359
that when i started at jpl they were

1185
00:40:15,109 --> 00:40:13,520
looking to really improve the quality

1186
00:40:17,030 --> 00:40:15,119
of the animations make them hollywood

1187
00:40:18,550 --> 00:40:17,040
level so because i was working on a 3d

1188
00:40:21,030 --> 00:40:18,560

package that did that

1189
00:40:22,150 --> 00:40:21,040
plus i had the physics i was a good fit

1190
00:40:24,230 --> 00:40:22,160
for it

1191
00:40:25,750 --> 00:40:24,240
so i would say just kind of follow your

1192
00:40:28,150 --> 00:40:25,760
passion but a real good

1193
00:40:29,030 --> 00:40:28,160
idea for getting into jpl is to do an

1194
00:40:30,550 --> 00:40:29,040
internship

1195
00:40:35,510 --> 00:40:30,560
when you're an undergrad i never did

1196
00:40:38,550 --> 00:40:37,030
yeah i would like to say actually

1197
00:40:40,550 --> 00:40:38,560
internships are key

1198
00:40:42,309 --> 00:40:40,560
i think interning early on and when

1199
00:40:44,630 --> 00:40:42,319
you're in college while you're still

1200
00:40:49,190 --> 00:40:44,640
having the opportunity to learn is

1201
00:40:52,630 --> 00:40:50,470
all right folks so we have time for a

1202
00:40:53,670 --> 00:40:52,640
few more questions from your online

1203
00:40:57,990 --> 00:40:53,680
questions

1204
00:41:01,510 --> 00:40:59,910
yeah so we've got quite a few people who

1205
00:41:04,470 --> 00:41:01,520
are asking about how these

1206
00:41:06,069 --> 00:41:04,480
tools can be applied in an online

1207
00:41:08,309 --> 00:41:06,079
education setting especially

1208
00:41:10,230 --> 00:41:08,319
in remote places but specifically with

1209
00:41:13,349 --> 00:41:10,240
online education

1210
00:41:19,589 --> 00:41:15,829
so during this time we've actually found

1211
00:41:25,349 --> 00:41:23,030
we found a lot of a lot of uh kind of

1212
00:41:26,630 --> 00:41:25,359
success in these times with remote

1213
00:41:28,550 --> 00:41:26,640

learning which is

1214
00:41:29,990 --> 00:41:28,560
so difficult to kind of fill the

1215
00:41:32,069 --> 00:41:30,000
curriculum in the same way

1216
00:41:33,190 --> 00:41:32,079
there are several things that have been

1217
00:41:36,790 --> 00:41:33,200
created at jpl

1218
00:41:37,670 --> 00:41:36,800
for public use including spacecraft ar

1219
00:41:39,870 --> 00:41:37,680
but also

1220
00:41:41,349 --> 00:41:39,880
access mars which you can go to

1221
00:41:45,109 --> 00:41:41,359
accessmars.com and

1222
00:41:47,349 --> 00:41:45,119
rove around curiosity's path and sort of

1223
00:41:49,349 --> 00:41:47,359
understand this immersive world that

1224
00:41:51,349 --> 00:41:49,359
scientists study geology in

1225
00:41:53,829 --> 00:41:51,359
um and so those things are really easily

1226
00:41:55,750 --> 00:41:53,839
accessible because they're web-based um

1227
00:41:57,589 --> 00:41:55,760
i wish there was something that we could

1228
00:41:58,390 --> 00:41:57,599
do that could even be more accessible

1229
00:42:01,190 --> 00:41:58,400
but i would say

1230
00:42:02,950 --> 00:42:01,200
i'll pass it on to jason to sort of uh

1231
00:42:04,630 --> 00:42:02,960
give the whole world of

1232
00:42:08,230 --> 00:42:04,640
all of the modules that you make that

1233
00:42:09,910 --> 00:42:08,240
are available for people to use

1234
00:42:12,069 --> 00:42:09,920
yeah so one of the reasons we're moving

1235
00:42:13,270 --> 00:42:12,079
to the web is because it just opens it

1236
00:42:14,950 --> 00:42:13,280
up for so many people

1237
00:42:17,190 --> 00:42:14,960
because when we had a video game it

1238
00:42:18,790 --> 00:42:17,200

required laptop or desktop

1239
00:42:20,309 --> 00:42:18,800
and then chromebooks wouldn't work so

1240
00:42:21,510 --> 00:42:20,319
that's no good for educators so being

1241
00:42:23,750 --> 00:42:21,520
web-based

1242
00:42:25,030 --> 00:42:23,760
is crucial so all of our web links a lot

1243
00:42:27,510 --> 00:42:25,040
of them are on the

1244
00:42:28,950 --> 00:42:27,520
announcement for this talk and basically

1245
00:42:30,790 --> 00:42:28,960
if you have a topic

1246
00:42:32,150 --> 00:42:30,800
about space that you like you can find

1247
00:42:33,190 --> 00:42:32,160
the appropriate eyes product to

1248
00:42:34,710 --> 00:42:33,200
visualize it

1249
00:42:36,390 --> 00:42:34,720
and i've always found that visuals

1250
00:42:38,069 --> 00:42:36,400
really cut through to people

1251
00:42:40,470 --> 00:42:38,079
so when they see it it helps them

1252
00:42:41,670 --> 00:42:40,480
understand and you can actually teach

1253
00:42:44,630 --> 00:42:41,680
physics you can teach

1254
00:42:44,950 --> 00:42:44,640
orbital mechanics you can teach so many

1255
00:42:46,390 --> 00:42:44,960
different

1256
00:42:48,150 --> 00:42:46,400
quantum mechanics you can teach so many

1257
00:42:49,270 --> 00:42:48,160
things from space and it's also very

1258
00:42:51,109 --> 00:42:49,280
inspiring

1259
00:42:53,030 --> 00:42:51,119
kind of a bigger deal is to inspire

1260
00:42:54,790 --> 00:42:53,040
people and when you see

1261
00:42:56,150 --> 00:42:54,800
everything nasa has accomplished it's

1262
00:42:59,030 --> 00:42:56,160
deeply inspiring

1263
00:43:02,150 --> 00:42:59,040

so that by itself is a great thing for

1264
00:43:06,069 --> 00:43:04,710
i also want to kind of piggyback off of

1265
00:43:08,870 --> 00:43:06,079
that and say

1266
00:43:10,390 --> 00:43:08,880
because of the innovation of the younger

1267
00:43:13,109 --> 00:43:10,400
generations too

1268
00:43:13,990 --> 00:43:13,119
you know where doing things at a certain

1269
00:43:17,829 --> 00:43:14,000
level of

1270
00:43:18,870 --> 00:43:17,839
design the generations before us can

1271
00:43:20,390 --> 00:43:18,880
look at it and say like hey

1272
00:43:21,990 --> 00:43:20,400
we can actually figure out how to do

1273
00:43:24,230 --> 00:43:22,000
this more efficiently and so

1274
00:43:25,589 --> 00:43:24,240
then i look to them too to say hey we

1275
00:43:28,470 --> 00:43:25,599
figured out this thing and

1276
00:43:30,790 --> 00:43:28,480
i'd be like come work at jpl with us so

1277
00:43:33,910 --> 00:43:30,800
that's a very exciting back and forth

1278
00:43:38,470 --> 00:43:35,910
very cool nikki we've got time for one

1279
00:43:40,950 --> 00:43:38,480
last question from the audience

1280
00:43:41,750 --> 00:43:40,960
great so we've actually got an inspiring

1281
00:43:44,630 --> 00:43:41,760
learner here

1282
00:43:46,309 --> 00:43:44,640
toga kisu on youtube asked how do i

1283
00:43:50,550 --> 00:43:46,319
start learning how to use vr

1284
00:43:53,109 --> 00:43:50,560
programs cool

1285
00:43:54,150 --> 00:43:53,119
it's a really great question i think

1286
00:43:56,950 --> 00:43:54,160
right now there

1287
00:43:58,550 --> 00:43:56,960
are a lot of online modules for sort of

1288
00:44:01,190 --> 00:43:58,560

beginning to dip your toe

1289
00:44:01,910 --> 00:44:01,200
into how vr works i would say the

1290
00:44:04,309 --> 00:44:01,920
baseline

1291
00:44:05,270 --> 00:44:04,319
is learning how to program and there are

1292
00:44:07,910 --> 00:44:05,280
different programming

1293
00:44:09,270 --> 00:44:07,920
programming programming languages you

1294
00:44:10,069 --> 00:44:09,280
can learn depending on what your

1295
00:44:11,750 --> 00:44:10,079
interests are

1296
00:44:13,190 --> 00:44:11,760
and you know i'm happy to talk more

1297
00:44:14,550 --> 00:44:13,200
offline about that that would be more

1298
00:44:16,630 --> 00:44:14,560
than just one answer

1299
00:44:17,829 --> 00:44:16,640
but there are also really great groups

1300
00:44:20,710 --> 00:44:17,839
you know i

1301
00:44:22,470 --> 00:44:20,720
have mentored girls in tech and groups

1302
00:44:25,430 --> 00:44:22,480
in the bay area where

1303
00:44:26,710 --> 00:44:25,440
young women and children are already

1304
00:44:29,030 --> 00:44:26,720
learning these skills

1305
00:44:30,470 --> 00:44:29,040
through really simple modules and so

1306
00:44:32,390 --> 00:44:30,480
even google has

1307
00:44:34,309 --> 00:44:32,400
really great ways to kind of piece

1308
00:44:36,710 --> 00:44:34,319
together visual things to learn how

1309
00:44:38,870 --> 00:44:36,720
code works and from that you can kind of

1310
00:44:39,829 --> 00:44:38,880
figure out if immersive is the way you

1311
00:44:42,470 --> 00:44:39,839
want to go

1312
00:44:44,150 --> 00:44:42,480
and in terms of very lightweight first

1313
00:44:46,230 --> 00:44:44,160

kind of level you can mess around with

1314
00:44:48,710 --> 00:44:46,240
photogrammetry and putting that into

1315
00:44:50,069 --> 00:44:48,720
a 360 world and then putting that to a

1316
00:44:52,550 --> 00:44:50,079
program and you know

1317
00:44:54,390 --> 00:44:52,560
modeling some things so um there are a

1318
00:44:56,630 --> 00:44:54,400
lot of online resources right now that

1319
00:44:58,710 --> 00:44:56,640
can really sort of help you be inspired

1320
00:45:01,910 --> 00:44:58,720
and hold your hand to the right path

1321
00:45:05,829 --> 00:45:03,670
yeah i'd like to add that some of the

1322
00:45:09,589 --> 00:45:05,839
stuff we're using is publicly available

1323
00:45:13,190 --> 00:45:09,599
it's an open uh sdk so for spacecraft ar

1324
00:45:15,109 --> 00:45:13,200
uses google's ar core and apple's ar kit

1325
00:45:16,390 --> 00:45:15,119
so this is we actually switched to that

1326
00:45:18,870 --> 00:45:16,400
from our previous

1327
00:45:19,990 --> 00:45:18,880
uh augmented reality app because it's

1328
00:45:22,390 --> 00:45:20,000
open source

1329
00:45:24,470 --> 00:45:22,400
so you can go there and start your own

1330
00:45:27,270 --> 00:45:24,480
app of augmented reality

1331
00:45:29,109 --> 00:45:27,280
um and then don't don't stop there just

1332
00:45:30,550 --> 00:45:29,119
the internet has so much it's just

1333
00:45:32,309 --> 00:45:30,560
there's no end to what you can learn and

1334
00:45:36,230 --> 00:45:32,319
do so just don't just

1335
00:45:38,950 --> 00:45:36,240
dive in yeah and i should mention that

1336
00:45:41,030 --> 00:45:38,960
there are resources for all of our open

1337
00:45:43,109 --> 00:45:41,040
source material at least for jpl so

1338
00:45:45,510 --> 00:45:43,119

maybe we can put that link somewhere for

1339
00:45:48,309 --> 00:45:45,520
people to kind of see where those repos

1340
00:45:49,829 --> 00:45:48,319
are maybe after the talk

1341
00:45:51,750 --> 00:45:49,839
very cool i think we'll try to do that

1342
00:45:53,510 --> 00:45:51,760
after the talk um

1343
00:45:54,950 --> 00:45:53,520
great answers great wisdom from both of

1344
00:45:55,829 --> 00:45:54,960
them but that's all the time we have for

1345
00:45:59,030 --> 00:45:55,839
tonight

1346
00:46:01,190 --> 00:45:59,040
join us next month for galaxy of horrors

1347
00:46:03,270 --> 00:46:01,200
terrifying real planets where we'll do a

1348
00:46:05,670 --> 00:46:03,280
deep dive into our spooky universe

1349
00:46:08,230 --> 00:46:05,680
just in time for halloween i would like

1350
00:46:09,990 --> 00:46:08,240
to thank our speakers sasha samoshina

1351
00:46:11,829 --> 00:46:10,000
jason craig for sharing their evening

1352
00:46:12,630 --> 00:46:11,839
and their expertise and their passion

1353
00:46:14,309 --> 00:46:12,640
with us

1354
00:46:15,910 --> 00:46:14,319
thank you to nikki christopher and the

1355
00:46:17,430 --> 00:46:15,920
entire crew that keep things going

1356
00:46:19,990 --> 00:46:17,440
behind the scenes here

1357
00:46:22,870 --> 00:46:20,000
and a huge thank you to all of you who

1358
00:46:26,829 --> 00:46:22,880
take the time to join us every month

1359
00:46:31,150 --> 00:46:26,839
stay safe stay kind and we'll see you in