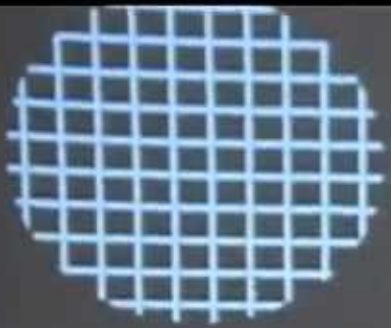
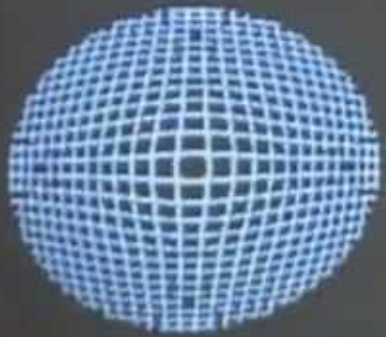
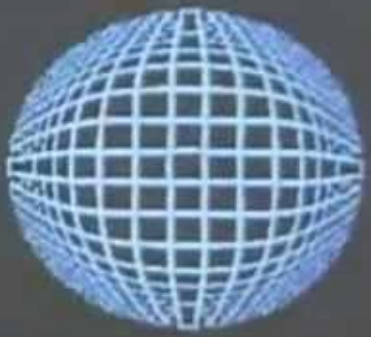


REDUCED PERIPHERAL FIELD

IN MINIFICATION REVERSE TELESCOPE





n = 200 FIELD = 512 WARP FACTOR = 2 n = 200 FIELD = 512 WARP FACTOR = 3

1
00:00:20,870 --> 00:00:18,550
hi i'm richard juday i'm the

2
00:00:22,390 --> 00:00:20,880
robotic vision manager in the tracking

3
00:00:24,950 --> 00:00:22,400
and communications division here at the

4
00:00:27,670 --> 00:00:24,960
johnson space center uh today we're in

5
00:00:31,189 --> 00:00:27,680
the hybrid vision laboratory where we do

6
00:00:33,110 --> 00:00:31,199
a combination of vision techniques we

7
00:00:34,709 --> 00:00:33,120
use laser lights we use spatialite

8
00:00:37,030 --> 00:00:34,719
modulators

9
00:00:38,950 --> 00:00:37,040
and we use a thing that we'll talk about

10
00:00:42,869 --> 00:00:38,960
some more today which is

11
00:00:44,470 --> 00:00:42,879
a image remapping technique that allows

12
00:00:46,549 --> 00:00:44,480
machine vision

13
00:00:48,950 --> 00:00:46,559

to have some of the aspects that have

14
00:00:52,069 --> 00:00:48,960
proven advantageous in the development

15
00:00:55,350 --> 00:00:52,079
of robot of human vision and other

16
00:00:57,110 --> 00:00:55,360
biological human systems

17
00:00:59,670 --> 00:00:57,120
the main function of the programmable

18
00:01:00,709 --> 00:00:59,680
remapper within the machine vision

19
00:01:03,349 --> 00:01:00,719
environment

20
00:01:05,910 --> 00:01:03,359
is to provide things like rotation and

21
00:01:07,590 --> 00:01:05,920
variance and scale in variants and you

22
00:01:08,469 --> 00:01:07,600
have some of those features built into

23
00:01:10,310 --> 00:01:08,479
your

24
00:01:11,910 --> 00:01:10,320
vision system that you're watching the

25
00:01:13,510 --> 00:01:11,920
show with

26
00:01:16,390 --> 00:01:13,520
you know what my face looks like as i

27
00:01:18,950 --> 00:01:16,400
stand here as i look as i stand closer

28
00:01:21,910 --> 00:01:18,960
or closer or closer

29
00:01:23,910 --> 00:01:21,920
you don't have to remember a different

30
00:01:26,550 --> 00:01:23,920
shape of face

31
00:01:27,830 --> 00:01:26,560
because you have a a character to your

32
00:01:28,710 --> 00:01:27,840
vision system

33
00:01:30,630 --> 00:01:28,720
that

34
00:01:32,630 --> 00:01:30,640
doesn't mind the changes of scale

35
00:01:34,710 --> 00:01:32,640
machines have more trouble with that and

36
00:01:37,830 --> 00:01:34,720
we built the programmable remapper in

37
00:01:41,030 --> 00:01:37,840
order to assist with that kind of a

38
00:01:43,109 --> 00:01:41,040

problem in machine vision now some of

39
00:01:45,830 --> 00:01:43,119
the robotic vision

40
00:01:48,710 --> 00:01:45,840
applications that the agency has

41
00:01:51,510 --> 00:01:48,720
uh would include working with

42
00:01:56,550 --> 00:01:51,520
a spacecraft in orbit we have machines

43
00:02:01,670 --> 00:01:59,429
change in viewing angle and

44
00:02:05,109 --> 00:02:01,680
and distance that

45
00:02:07,590 --> 00:02:05,119
will be required in space operations

46
00:02:10,150 --> 00:02:07,600
beyond this kind of an application

47
00:02:13,670 --> 00:02:10,160
we also intend to build vision systems

48
00:02:16,309 --> 00:02:13,680
that will land robotically on mars

49
00:02:18,229 --> 00:02:16,319
i am very turned on to the idea that i

50
00:02:20,229 --> 00:02:18,239
might be able to tell my grandkids that

51
00:02:22,550 --> 00:02:20,239
i worked on a vision system that enabled

52
00:02:25,430 --> 00:02:22,560
a robot to land on the surface of mars

53
00:02:27,670 --> 00:02:25,440
technology utilization's interest in

54
00:02:29,910 --> 00:02:27,680
this in this particular technology is

55
00:02:31,830 --> 00:02:29,920
for its application to

56
00:02:33,670 --> 00:02:31,840
some human low vision problems that's

57
00:02:35,910 --> 00:02:33,680
one of the things that the agency is

58
00:02:37,910 --> 00:02:35,920
supposed to do is develop technology

59
00:02:39,830 --> 00:02:37,920
that can be spun off into

60
00:02:42,390 --> 00:02:39,840
public application

61
00:02:44,710 --> 00:02:42,400
some of the things that can help make a

62
00:02:47,750 --> 00:02:44,720
machine see better

63
00:02:49,430 --> 00:02:47,760

we think have a solid chance

64
00:02:51,990 --> 00:02:49,440
of helping the

65
00:02:53,670 --> 00:02:52,000
person who has certain forms

66
00:02:55,910 --> 00:02:53,680
of diminished vision

67
00:02:58,949 --> 00:02:55,920
make the best use of the remaining

68
00:03:01,110 --> 00:02:58,959
function that he has it's not a cure

69
00:03:02,309 --> 00:03:01,120
it's not available next week but we

70
00:03:04,309 --> 00:03:02,319
think that

71
00:03:05,589 --> 00:03:04,319
within something on the order of five

72
00:03:08,070 --> 00:03:05,599
years

73
00:03:09,750 --> 00:03:08,080
this kind of technology the results of

74
00:03:12,550 --> 00:03:09,760
our research here

75
00:03:14,550 --> 00:03:12,560
uh can have a benefit to the

76
00:03:16,229 --> 00:03:14,560
low vision community within the within

77
00:03:19,030 --> 00:03:16,239
the the country

78
00:03:21,670 --> 00:03:19,040
uh i have formed an association here

79
00:03:23,990 --> 00:03:21,680
with uh dr david lotion

80
00:03:26,470 --> 00:03:24,000
from the university of houston's college

81
00:03:29,030 --> 00:03:26,480
of optometry

82
00:03:30,710 --> 00:03:29,040
dave came and sought out what technology

83
00:03:32,949 --> 00:03:30,720
there might be at the

84
00:03:36,149 --> 00:03:32,959
johnson space center that

85
00:03:38,229 --> 00:03:36,159
would assist him in his activities

86
00:03:40,309 --> 00:03:38,239
and this is the association that

87
00:03:42,229 --> 00:03:40,319
resulted

88
00:03:43,750 --> 00:03:42,239

hello i'm david lotion associate

89
00:03:45,110 --> 00:03:43,760
professor and assistant dean at the

90
00:03:46,470 --> 00:03:45,120
university of houston college of

91
00:03:48,470 --> 00:03:46,480
optometry

92
00:03:50,789 --> 00:03:48,480
dr richard today and i have developed a

93
00:03:53,429 --> 00:03:50,799
collaboration trying to bring some of

94
00:03:56,309 --> 00:03:53,439
this nasa technology developed using the

95
00:03:57,990 --> 00:03:56,319
remap programmable remapper to a low

96
00:03:59,750 --> 00:03:58,000
vision application

97
00:04:01,429 --> 00:03:59,760
there are many problems that individuals

98
00:04:04,070 --> 00:04:01,439
have with low vision

99
00:04:05,830 --> 00:04:04,080
these problems usually are associated

100
00:04:07,429 --> 00:04:05,840
with visual field defects that is

101
00:04:08,869 --> 00:04:07,439
regions of the world that they cannot

102
00:04:09,990 --> 00:04:08,879
see

103
00:04:12,550 --> 00:04:10,000
these can be

104
00:04:15,910 --> 00:04:12,560
mainly isolated to the central vision as

105
00:04:18,469 --> 00:04:15,920
in the case of age-related maculopathy

106
00:04:21,030 --> 00:04:18,479
or in peripheral vision as in the case

107
00:04:23,030 --> 00:04:21,040
of retinitis pigmentosa these

108
00:04:25,430 --> 00:04:23,040
individuals have problems with specific

109
00:04:27,350 --> 00:04:25,440
tasks including reading

110
00:04:30,950 --> 00:04:27,360
facial recognition

111
00:04:34,310 --> 00:04:30,960
object recognition mobility and driving

112
00:04:35,909 --> 00:04:34,320
let me give you some examples of these

113
00:04:38,790 --> 00:04:35,919

this is the back of the eye or the

114
00:04:41,110 --> 00:04:38,800
retina this individual has age-related

115
00:04:43,189 --> 00:04:41,120
maculopathy as you notice the central

116
00:04:45,030 --> 00:04:43,199
portion of the retina is affected by the

117
00:04:48,550 --> 00:04:45,040
disease process

118
00:04:50,150 --> 00:04:48,560
individuals with this disease

119
00:04:52,390 --> 00:04:50,160
have difficulty

120
00:04:54,950 --> 00:04:52,400
reading print because wherever they look

121
00:04:57,990 --> 00:04:54,960
they will see a region that is missing

122
00:05:04,950 --> 00:05:00,150
these individuals

123
00:05:06,629 --> 00:05:04,960
problem with facial recognition here you

124
00:05:08,830 --> 00:05:06,639
can see the full face a face we all

125
00:05:11,990 --> 00:05:08,840
recognize but these

126
00:05:15,110 --> 00:05:12,000
individuals may see something like this

127
00:05:19,590 --> 00:05:15,120
all the detail of the face is missing

128
00:05:24,230 --> 00:05:21,830
as as here shown with retinitis

129
00:05:25,990 --> 00:05:24,240
pigmentosa again this is the retina or

130
00:05:29,350 --> 00:05:26,000
the back of the eye

131
00:05:31,430 --> 00:05:29,360
individuals with this disease

132
00:05:33,749 --> 00:05:31,440
will not see a full

133
00:05:36,550 --> 00:05:33,759
view of the world but rather a very

134
00:05:40,629 --> 00:05:36,560
small portion

135
00:05:42,070 --> 00:05:40,639
or isolated part of the world

136
00:05:43,909 --> 00:05:42,080
what we're trying to do with the

137
00:05:46,150 --> 00:05:43,919
programmable remapper

138
00:05:48,870 --> 00:05:46,160

is take information that would normally

139
00:05:50,830 --> 00:05:48,880
fall within these defects and bring it

140
00:05:55,029 --> 00:05:50,840
into

141
00:05:59,749 --> 00:05:57,110
let me give you some examples of image

142
00:06:01,510 --> 00:05:59,759
image warping

143
00:06:04,230 --> 00:06:01,520
some of these remappings we can show you

144
00:06:06,469 --> 00:06:04,240
applications with a grid here you see a

145
00:06:08,870 --> 00:06:06,479
reduced field of a grid

146
00:06:11,670 --> 00:06:08,880
normally someone with a peripheral field

147
00:06:13,909 --> 00:06:11,680
defect would be given a a device that

148
00:06:15,830 --> 00:06:13,919
minifies the entire field this would

149
00:06:17,590 --> 00:06:15,840
allow more information to go into the

150
00:06:19,749 --> 00:06:17,600
central field where they have their

151
00:06:21,909 --> 00:06:19,759
healthy retina

152
00:06:23,189 --> 00:06:21,919
with remapping we can take the

153
00:06:23,990 --> 00:06:23,199
information

154
00:06:25,670 --> 00:06:24,000
and

155
00:06:27,350 --> 00:06:25,680
actually

156
00:06:29,990 --> 00:06:27,360
show more information in the central

157
00:06:32,390 --> 00:06:30,000
field or a larger portion larger in the

158
00:06:34,390 --> 00:06:32,400
central field and gradually go off into

159
00:06:36,710 --> 00:06:34,400
the periphery and here we can get the

160
00:06:39,270 --> 00:06:36,720
central field exactly the same size as

161
00:06:40,950 --> 00:06:39,280
our reduced field but we had more

162
00:06:43,830 --> 00:06:40,960
information in the periphery of the

163
00:06:45,670 --> 00:06:43,840

field one of the problems with

164
00:06:48,550 --> 00:06:45,680
overall minification

165
00:06:50,070 --> 00:06:48,560
is that people lose localization within

166
00:06:52,230 --> 00:06:50,080
the field and they have a hard time

167
00:06:54,070 --> 00:06:52,240
doing any kind of mobility that is

168
00:06:56,950 --> 00:06:54,080
walking

169
00:06:59,909 --> 00:06:56,960
in the case of central field defect

170
00:07:02,629 --> 00:06:59,919
the information with remapping is pulled

171
00:07:04,870 --> 00:07:02,639
outside of the central defect you can

172
00:07:07,189 --> 00:07:04,880
see here a line coming down will

173
00:07:09,350 --> 00:07:07,199
actually be remapped around

174
00:07:11,189 --> 00:07:09,360
the field effect

175
00:07:13,670 --> 00:07:11,199
notice that we don't have this

176
00:07:17,510 --> 00:07:13,680
distortion throughout the field but just

177
00:07:19,670 --> 00:07:17,520
around the defect we don't have to

178
00:07:21,270 --> 00:07:19,680
remap the entire field instead we can

179
00:07:23,029 --> 00:07:21,280
only do part of it

180
00:07:24,629 --> 00:07:23,039
here is a partial remapping where we're

181
00:07:26,870 --> 00:07:24,639
not taking all the information that

182
00:07:29,270 --> 00:07:26,880
would fall behind the defect but just

183
00:07:31,510 --> 00:07:29,280
part of that information

184
00:07:34,309 --> 00:07:31,520
now this can be applied to

185
00:07:37,189 --> 00:07:34,319
application of reading

186
00:07:39,189 --> 00:07:37,199
as you can see here information is lost

187
00:07:41,510 --> 00:07:39,199
behind the defect and it'll be difficult

188
00:07:43,830 --> 00:07:41,520

to read across the line

189
00:07:45,589 --> 00:07:43,840
by remapping we can take information

190
00:07:48,230 --> 00:07:45,599
that would normally fall with behind

191
00:07:50,390 --> 00:07:48,240
this defect and remap it outside there

192
00:07:51,749 --> 00:07:50,400
is slight distortion but the letters are

193
00:07:54,629 --> 00:07:51,759
still legible

194
00:07:57,270 --> 00:07:54,639
for example to eat you we cannot see

195
00:07:59,510 --> 00:07:57,280
this here but to eat you up the word up

196
00:08:02,070 --> 00:07:59,520
is pulled out of the defect

197
00:08:05,990 --> 00:08:02,080
this would make it easier we believe for

198
00:08:09,749 --> 00:08:07,990
we can also apply this to facial

199
00:08:11,909 --> 00:08:09,759
recognition

200
00:08:14,230 --> 00:08:11,919
individuals with the central defects

201
00:08:16,230 --> 00:08:14,240
would see we can pull the information

202
00:08:18,150 --> 00:08:16,240
out of the defect you can see here what

203
00:08:19,990 --> 00:08:18,160
happens when we do a complete remapping

204
00:08:22,230 --> 00:08:20,000
we get a lot of distortion

205
00:08:24,790 --> 00:08:22,240
however with a partial remapping we can

206
00:08:31,909 --> 00:08:24,800
get features outside of defect that may

207
00:08:35,350 --> 00:08:33,350
well let's talk about what we might be

208
00:08:37,269 --> 00:08:35,360
able to do with some

209
00:08:38,870 --> 00:08:37,279
field remapping with the machine that we

210
00:08:40,790 --> 00:08:38,880
have here dave

211
00:08:42,070 --> 00:08:40,800
suppose that a normal person's field of

212
00:08:44,310 --> 00:08:42,080
view

213
00:08:46,310 --> 00:08:44,320

were

214
00:08:48,470 --> 00:08:46,320
about that size uh

215
00:08:49,829 --> 00:08:48,480
then uh what might a person with uh with

216
00:08:51,509 --> 00:08:49,839
the pigmentosa

217
00:08:53,430 --> 00:08:51,519
retinitis pigmentosa that you were

218
00:08:55,350 --> 00:08:53,440
mentioning what might they see well

219
00:08:57,829 --> 00:08:55,360
richard obviously has a lot of forms of

220
00:08:59,190 --> 00:08:57,839
disease but they would be left with a

221
00:09:01,269 --> 00:08:59,200
central region

222
00:09:03,269 --> 00:09:01,279
of of good vision and this disease

223
00:09:05,110 --> 00:09:03,279
progresses any information that would

224
00:09:07,030 --> 00:09:05,120
fall out in the periphery here would

225
00:09:08,389 --> 00:09:07,040
actually be lost

226
00:09:09,590 --> 00:09:08,399
they just wouldn't be able to see that

227
00:09:11,590 --> 00:09:09,600
they wouldn't be able to see that they'd

228
00:09:13,110 --> 00:09:11,600
have a very restricted field of view uh

229
00:09:14,550 --> 00:09:13,120
that looks pretty severe that might be

230
00:09:16,310 --> 00:09:14,560
like looking through a

231
00:09:17,350 --> 00:09:16,320
paper towel tube

232
00:09:20,949 --> 00:09:17,360
uh

233
00:09:23,269 --> 00:09:20,959
just use a telescope turn it around

234
00:09:24,790 --> 00:09:23,279
backwards and shrink the whole the whole

235
00:09:26,630 --> 00:09:24,800
field of view into that

236
00:09:28,630 --> 00:09:26,640
that's what's done right now for the

237
00:09:30,710 --> 00:09:28,640
optical aid that we give individuals the

238
00:09:33,110 --> 00:09:30,720

one problem with that is that first of

239
00:09:34,710 --> 00:09:33,120
all they lose a lot of the resolution

240
00:09:37,590 --> 00:09:34,720
but making things so small they can't

241
00:09:39,670 --> 00:09:37,600
pick out objects in the field secondly

242
00:09:41,030 --> 00:09:39,680
there's problem with localization when

243
00:09:42,630 --> 00:09:41,040
you reduce everything and you put your

244
00:09:44,470 --> 00:09:42,640
hand into the field it's hard to tell

245
00:09:46,790 --> 00:09:44,480
where your hand is relative relative to

246
00:09:48,949 --> 00:09:46,800
objects uh and i think if i were walking

247
00:09:50,550 --> 00:09:48,959
down the hall looking through a paper

248
00:09:51,990 --> 00:09:50,560
towel too i might bump into things too

249
00:09:54,949 --> 00:09:52,000
that's true you have a lot of difficulty

250
00:09:56,949 --> 00:09:54,959
with mobility all right so uh what what

251
00:09:58,710 --> 00:09:56,959
i think i hear you saying is that in the

252
00:10:02,310 --> 00:09:58,720
center you'd like to

253
00:10:04,470 --> 00:10:02,320
maintain a fairly high resolution of the

254
00:10:05,590 --> 00:10:04,480
object that we're looking at but bring

255
00:10:07,910 --> 00:10:05,600
some of these

256
00:10:09,509 --> 00:10:07,920
picture elements that uh that used to be

257
00:10:11,590 --> 00:10:09,519
outside the

258
00:10:14,550 --> 00:10:11,600
uh the field of view because of the

259
00:10:16,150 --> 00:10:14,560
defect and then let them jam up a little

260
00:10:18,389 --> 00:10:16,160
more closely together

261
00:10:19,829 --> 00:10:18,399
so that we we have uh picture elements

262
00:10:22,069 --> 00:10:19,839
spaced widely here but but close

263
00:10:23,910 --> 00:10:22,079

together and the periphery of the

264
00:10:25,110 --> 00:10:23,920
remaining part would would that work i

265
00:10:26,870 --> 00:10:25,120
think it would work

266
00:10:28,389 --> 00:10:26,880
obviously when you jam up your your

267
00:10:30,630 --> 00:10:28,399
elements here you're going to get some

268
00:10:32,389 --> 00:10:30,640
distortion but again it won't make that

269
00:10:33,670 --> 00:10:32,399
much difference about the distortion in

270
00:10:35,030 --> 00:10:33,680
that you could tell there's an object

271
00:10:36,710 --> 00:10:35,040
out there whether you can actually tell

272
00:10:39,350 --> 00:10:36,720
what the object is is not as important

273
00:10:41,910 --> 00:10:39,360
as being able to navigate around it okay

274
00:10:44,150 --> 00:10:41,920
so the motion cues that you normally

275
00:10:46,470 --> 00:10:44,160
have if say as you walk down the hall

276
00:10:48,310 --> 00:10:46,480
and things move by you in your

277
00:10:50,069 --> 00:10:48,320
perspective uh you can see that they're

278
00:10:52,710 --> 00:10:50,079
moving without being able necessarily to

279
00:10:54,150 --> 00:10:52,720
read the sign or tell what it is

280
00:10:55,829 --> 00:10:54,160
so we might be able to retain some of

281
00:10:57,190 --> 00:10:55,839
that i think so yes all right well let's

282
00:11:01,030 --> 00:10:57,200
go give it a try i think i know how to

283
00:11:05,190 --> 00:11:03,670
what we have here is the programmable

284
00:11:08,230 --> 00:11:05,200
remapper itself

285
00:11:11,190 --> 00:11:08,240
in the box underneath the monitor it was

286
00:11:13,030 --> 00:11:11,200
manufactured at texas instruments to

287
00:11:14,470 --> 00:11:13,040
specifications laid out here at the

288
00:11:16,069 --> 00:11:14,480

johnson space center

289
00:11:19,829 --> 00:11:16,079
some of the design is there some of it

290
00:11:22,470 --> 00:11:19,839
is ours it functions by taking a video

291
00:11:25,350 --> 00:11:22,480
image as from this camera

292
00:11:27,030 --> 00:11:25,360
and that that video signal is fed into

293
00:11:28,470 --> 00:11:27,040
the remapper

294
00:11:31,590 --> 00:11:28,480
their

295
00:11:33,350 --> 00:11:31,600
coefficients that have been calculated

296
00:11:36,069 --> 00:11:33,360
offline and are

297
00:11:38,389 --> 00:11:36,079
entered into the remapper by

298
00:11:40,630 --> 00:11:38,399
floppy disks

299
00:11:42,710 --> 00:11:40,640
those coefficients are used to push

300
00:11:46,389 --> 00:11:42,720
picture elements around

301
00:11:49,190 --> 00:11:46,399
and to create a display in which a

302
00:11:51,990 --> 00:11:49,200
warping has occurred

303
00:11:54,389 --> 00:11:52,000
now after that image has been warped

304
00:11:57,110 --> 00:11:54,399
in this case it is brought back and

305
00:11:59,509 --> 00:11:57,120
displayed here to a person who

306
00:12:01,750 --> 00:11:59,519
is wearing this uh

307
00:12:04,069 --> 00:12:01,760
helmet that

308
00:12:07,670 --> 00:12:04,079
was manufactured at the

309
00:12:08,550 --> 00:12:07,680
at the university of houston

310
00:12:10,629 --> 00:12:08,560
the

311
00:12:14,069 --> 00:12:10,639
displays here show

312
00:12:15,990 --> 00:12:14,079
what the remapped image is and uh they

313
00:12:19,110 --> 00:12:16,000

are shown to the left and to the right

314
00:12:20,150 --> 00:12:19,120
eyes the same image is uh i will see

315
00:12:23,269 --> 00:12:20,160
here

316
00:12:25,350 --> 00:12:23,279
as dave will see on the monitor

317
00:12:28,230 --> 00:12:25,360
and

318
00:12:30,069 --> 00:12:28,240
so we'll now try on the lightweight

319
00:12:32,710 --> 00:12:30,079
summer version of the

320
00:12:34,790 --> 00:12:32,720
darth vader helmet should point out also

321
00:12:36,710 --> 00:12:34,800
that this version that we have built

322
00:12:38,389 --> 00:12:36,720
here is mainly for testing this is not

323
00:12:41,269 --> 00:12:38,399
going to be the low vision device that

324
00:12:42,629 --> 00:12:41,279
ultimately this will be used with

325
00:12:45,910 --> 00:12:42,639
the

326
00:12:47,269 --> 00:12:45,920
monitor or we have to set up a system

327
00:12:49,110 --> 00:12:47,279
like this so that we could do the

328
00:12:51,110 --> 00:12:49,120
testing to see how useful and how

329
00:12:53,910 --> 00:12:51,120
feasible this type of remapping will be

330
00:12:55,990 --> 00:12:53,920
for patients with low vision

331
00:12:57,269 --> 00:12:56,000
all right so what transform do you have

332
00:12:58,870 --> 00:12:57,279
put in here dave what are we looking for

333
00:13:00,550 --> 00:12:58,880
this is a full field we really haven't

334
00:13:02,870 --> 00:13:00,560
done any transform at all actually we're

335
00:13:04,470 --> 00:13:02,880
just taking the input and

336
00:13:05,750 --> 00:13:04,480
displaying it as an output we're not

337
00:13:08,310 --> 00:13:05,760
changing the transport we're not

338
00:13:10,790 --> 00:13:08,320

changing the image at all

339
00:13:13,670 --> 00:13:10,800
okay so here we are looking at some

340
00:13:15,590 --> 00:13:13,680
letters on a chart

341
00:13:17,509 --> 00:13:15,600
this is actually not remapped at all

342
00:13:19,670 --> 00:13:17,519
richard there what we're taking is the

343
00:13:22,550 --> 00:13:19,680
direct input into the into the remapper

344
00:13:23,910 --> 00:13:22,560
and it's coming out as as it goes in

345
00:13:26,629 --> 00:13:23,920
uh this would be

346
00:13:29,750 --> 00:13:26,639
simulation simulating a full field okay

347
00:13:31,269 --> 00:13:29,760
so i should regard this as my normal

348
00:13:32,790 --> 00:13:31,279
field of view as i look around the

349
00:13:34,150 --> 00:13:32,800
laboratory that's right and quite fine

350
00:13:36,949 --> 00:13:34,160
to see what we got somebody over there

351
00:13:41,910 --> 00:13:39,829
i think this might work dave

352
00:13:43,110 --> 00:13:41,920
uh all right so this is what i might see

353
00:13:44,949 --> 00:13:43,120
with the

354
00:13:48,310 --> 00:13:44,959
reduced field of view from

355
00:13:50,150 --> 00:13:48,320
the retinitis pigmentosa yes and you can

356
00:13:52,389 --> 00:13:50,160
try to look around the room and see how

357
00:13:54,230 --> 00:13:52,399
difficult it is to find objects within

358
00:13:56,389 --> 00:13:54,240
the room

359
00:13:58,870 --> 00:13:56,399
i can't see as much of that computer

360
00:13:58,880 --> 00:14:02,150
nor

361
00:14:02,160 --> 00:14:05,750
can i see near so much

362
00:14:20,710 --> 00:14:06,949
of

363
00:14:24,710 --> 00:14:23,030

all right and what is it that

364
00:14:26,949 --> 00:14:24,720
you might be able to do for us here with

365
00:14:28,550 --> 00:14:26,959
uh remapping

366
00:14:30,389 --> 00:14:28,560
this is the remapped image as i said

367
00:14:32,949 --> 00:14:30,399
this has quite a bit of remapping on it

368
00:14:34,949 --> 00:14:32,959
we have a very sharp fall off

369
00:14:36,949 --> 00:14:34,959
just to give you one example

370
00:14:38,790 --> 00:14:36,959
all right so if i want to read the words

371
00:14:40,550 --> 00:14:38,800
i can put them in the center

372
00:14:43,030 --> 00:14:40,560
but i don't lose them as they go off to

373
00:14:44,150 --> 00:14:43,040
the edge as quickly as i did the other

374
00:14:45,750 --> 00:14:44,160
time it's

375
00:14:48,550 --> 00:14:45,760
sort of like looking at a at a beach

376
00:14:54,790 --> 00:14:52,150
and uh if i go looking around the lab

377
00:14:57,030 --> 00:14:54,800
i can now see the

378
00:15:06,389 --> 00:14:57,040
computer that does not have someone

379
00:15:14,310 --> 00:15:10,069
and let's go look at a chuck over here

380
00:15:15,670 --> 00:15:14,320
well i can i can see chuck and i can see

381
00:15:20,230 --> 00:15:15,680
the computer

382
00:15:22,550 --> 00:15:20,240
if i want to

383
00:15:23,910 --> 00:15:22,560
by putting it here at the center

384
00:15:26,550 --> 00:15:23,920
or i can

385
00:15:28,069 --> 00:15:26,560
resolve chuck here as well

386
00:15:30,470 --> 00:15:28,079
and right here i have the computer and

387
00:15:32,069 --> 00:15:30,480
chuck in the same field and

388
00:15:34,230 --> 00:15:32,079

i think that find that a little easier

389
00:15:41,590 --> 00:15:34,240
to

390
00:15:43,189 --> 00:15:41,600
well this is all very well for

391
00:15:46,470 --> 00:15:43,199
for me to be looking at

392
00:15:47,910 --> 00:15:46,480
i have reasonably good vision but

393
00:15:49,910 --> 00:15:47,920
how are we going to find out if this is

394
00:15:51,910 --> 00:15:49,920
any good for people who have a real

395
00:15:53,509 --> 00:15:51,920
problem well that's our next approach

396
00:15:55,590 --> 00:15:53,519
richard is we're going to

397
00:15:57,430 --> 00:15:55,600
try to have patients try looking at

398
00:15:59,110 --> 00:15:57,440
through this device we're going to

399
00:16:00,470 --> 00:15:59,120
solicit patients from both the

400
00:16:03,269 --> 00:16:00,480
university of houston college of

401
00:16:04,629 --> 00:16:03,279
optometry and the lighthouse of houston

402
00:16:05,509 --> 00:16:04,639
these patients will have several

403
00:16:07,590 --> 00:16:05,519
different

404
00:16:09,670 --> 00:16:07,600
low vision problems and we're going to

405
00:16:11,189 --> 00:16:09,680
try to see how

406
00:16:14,629 --> 00:16:11,199
much better they can see the world with

407
00:16:18,150 --> 00:16:15,990
well it's uh

408
00:16:20,870 --> 00:16:18,160
i'm looking forward to that as a look

409
00:16:23,590 --> 00:16:20,880
around here this actually seems rather

410
00:16:25,749 --> 00:16:23,600
easy to get used to

411
00:16:27,590 --> 00:16:25,759
it'll be nice to get some

412
00:16:29,189 --> 00:16:27,600
practical experience with it as we

413
00:16:32,790 --> 00:16:29,199

stated before also

414
00:16:36,470 --> 00:16:32,800
this device will not be the final device

415
00:16:39,030 --> 00:16:36,480
this has to be reduced in size and

416
00:16:41,350 --> 00:16:39,040
obviously cosmesis in order for low fish

417
00:16:43,350 --> 00:16:41,360
low vision patients to want to wear

418
00:16:44,470 --> 00:16:43,360
something like it

419
00:16:45,990 --> 00:16:44,480
some of the

420
00:16:47,749 --> 00:16:46,000
technology that we

421
00:16:49,829 --> 00:16:47,759
are developing with the remapper has

422
00:16:51,670 --> 00:16:49,839
also been explored further for us by

423
00:16:53,990 --> 00:16:51,680
transitions research corporation they

424
00:16:57,910 --> 00:16:54,000
have built some robotic equipment that

425
00:17:03,350 --> 00:17:01,430
our objective here is to have a machine

426
00:17:05,350 --> 00:17:03,360
have some of the same kind of advantages

427
00:17:07,189 --> 00:17:05,360
in pattern recognition

428
00:17:09,350 --> 00:17:07,199
that your own

429
00:17:11,750 --> 00:17:09,360
eye brain combination does in pattern

430
00:17:13,990 --> 00:17:11,760
recognition now you're accustomed to

431
00:17:16,230 --> 00:17:14,000
looking at an object that would appear

432
00:17:18,870 --> 00:17:16,240
like so if you were looking at the front

433
00:17:21,189 --> 00:17:18,880
of a space shuttle

434
00:17:23,909 --> 00:17:21,199
but actually what goes on in the back of

435
00:17:26,230 --> 00:17:23,919
your head is that this

436
00:17:28,230 --> 00:17:26,240
uh this representation

437
00:17:29,750 --> 00:17:28,240
as you see think of it out in front of

438
00:17:33,029 --> 00:17:29,760

your of your head

439
00:17:35,350 --> 00:17:33,039
really looks more like this where the

440
00:17:37,750 --> 00:17:35,360
there's more area uh

441
00:17:41,590 --> 00:17:37,760
this corresponds to small radius near

442
00:17:43,510 --> 00:17:41,600
near the center these these uh fins are

443
00:17:45,669 --> 00:17:43,520
these locations the this is what's

444
00:17:47,110 --> 00:17:45,679
called a log polar domain where the

445
00:17:48,549 --> 00:17:47,120
logarithm of the radius is in this

446
00:17:50,310 --> 00:17:48,559
direction and the

447
00:17:51,430 --> 00:17:50,320
azimuthal angle

448
00:17:53,029 --> 00:17:51,440
is in

449
00:17:56,950 --> 00:17:53,039
the vertical direction

450
00:18:02,950 --> 00:18:00,230
there is more area in the brain uh given

451
00:18:04,789 --> 00:18:02,960
to the the center of the object now the

452
00:18:06,870 --> 00:18:04,799
advantage for pattern recognition is

453
00:18:09,830 --> 00:18:06,880
that uh as one

454
00:18:13,590 --> 00:18:09,840
were to take uh this object and were to

455
00:18:17,190 --> 00:18:13,600
rotate it or to change change size on it

456
00:18:19,590 --> 00:18:17,200
that uh as appears uh here in

457
00:18:23,190 --> 00:18:19,600
this lower diagram

458
00:18:26,470 --> 00:18:23,200
that its representation here uh in the

459
00:18:29,510 --> 00:18:26,480
log polar domain is merely a translation

460
00:18:30,870 --> 00:18:29,520
of what one sees in the

461
00:18:33,510 --> 00:18:30,880
uh

462
00:18:35,750 --> 00:18:33,520
in the upper picture so you have you

463
00:18:37,430 --> 00:18:35,760

don't have to remember and learn a

464
00:18:40,789 --> 00:18:37,440
really different representation of the

465
00:18:43,750 --> 00:18:40,799
object just that it has slid over and

466
00:18:44,870 --> 00:18:43,760
slid up compared with the

467
00:18:48,070 --> 00:18:44,880
method in which you learned it

468
00:18:53,830 --> 00:18:50,230
now in another simplistic

469
00:18:55,510 --> 00:18:53,840
application of this technology

470
00:18:58,710 --> 00:18:55,520
a centering

471
00:19:01,669 --> 00:18:58,720
algorithm is very easy to implement if

472
00:19:02,870 --> 00:19:01,679
in some of our space applications

473
00:19:04,630 --> 00:19:02,880
you need to

474
00:19:06,470 --> 00:19:04,640
track an object

475
00:19:09,430 --> 00:19:06,480
keep a camera system pointed right

476
00:19:11,029 --> 00:19:09,440
toward the toward that object then

477
00:19:14,310 --> 00:19:11,039
in this as a

478
00:19:16,710 --> 00:19:14,320
cartesian representation of that object

479
00:19:19,830 --> 00:19:16,720
you can see that in order to center this

480
00:19:23,510 --> 00:19:19,840
object you'd push on it here and let it

481
00:19:26,070 --> 00:19:23,520
uh protrude further on on on this side

482
00:19:28,390 --> 00:19:26,080
of these circles well these uh these red

483
00:19:30,070 --> 00:19:28,400
and blue circles uh if you were to take

484
00:19:30,950 --> 00:19:30,080
them over here into the

485
00:19:33,510 --> 00:19:30,960
log

486
00:19:35,270 --> 00:19:33,520
polar uh representation

487
00:19:37,430 --> 00:19:35,280
uh become

488
00:19:38,950 --> 00:19:37,440

this vertical straight line that's red

489
00:19:39,909 --> 00:19:38,960
and this vertical straight line which is

490
00:19:41,669 --> 00:19:39,919
blue

491
00:19:43,909 --> 00:19:41,679
and you see that in order to center the

492
00:19:45,750 --> 00:19:43,919
object the expression of that action

493
00:19:48,870 --> 00:19:45,760
over here becomes find the place where

494
00:19:51,029 --> 00:19:48,880
the object sticks out the farthest and

495
00:19:54,710 --> 00:19:51,039
in in a purely

496
00:19:56,710 --> 00:19:54,720
left-right sense and push to the

497
00:19:58,789 --> 00:19:56,720
left on that

498
00:20:00,870 --> 00:19:58,799
that protrusion which will have this

499
00:20:03,909 --> 00:20:00,880
matching protrusion come out when your

500
00:20:06,149 --> 00:20:03,919
two highest protrusions are

501
00:20:08,470 --> 00:20:06,159
the right distance on this chart which

502
00:20:09,590 --> 00:20:08,480
is about like so separated from each

503
00:20:11,190 --> 00:20:09,600
other

504
00:20:12,549 --> 00:20:11,200
then that object is

505
00:20:14,630 --> 00:20:12,559
is centered

506
00:20:17,110 --> 00:20:14,640
and that's the algorithm that is

507
00:21:04,549 --> 00:20:17,120
implemented in the version of the

508
00:21:07,590 --> 00:21:06,310
okay what should be happening now is

509
00:21:10,549 --> 00:21:07,600
that the

510
00:21:11,669 --> 00:21:10,559
robot is looking for

511
00:21:15,029 --> 00:21:11,679
the

512
00:21:17,590 --> 00:21:15,039
uh

513
00:21:19,590 --> 00:21:17,600

docking target bears just the right kind

514
00:21:22,230 --> 00:21:19,600
of resemblance to

515
00:21:24,710 --> 00:21:22,240
what it has been told to look for

516
00:21:26,710 --> 00:21:24,720
uh when it finds that place

517
00:21:29,510 --> 00:21:26,720
uh

518
00:21:30,870 --> 00:21:29,520
it will align itself to be on the axis

519
00:21:35,590 --> 00:21:30,880
of the

520
00:21:38,070 --> 00:21:35,600
all all done visually now as a

521
00:21:40,630 --> 00:21:38,080
machine vision process

522
00:21:42,870 --> 00:21:40,640
and we'll then uh dock with

523
00:21:46,710 --> 00:21:42,880
the uh

524
00:21:50,950 --> 00:21:48,470
okay it's looking for the places where

525
00:21:52,870 --> 00:21:50,960
the bulges that result from

526
00:21:53,909 --> 00:21:52,880
the fact that the

527
00:21:56,830 --> 00:21:53,919
uh

528
00:22:00,149 --> 00:21:56,840
box is not a sphere but is instead a

529
00:22:02,310 --> 00:22:00,159
cylinder where those

530
00:22:05,029 --> 00:22:02,320
bulges appear at the right orientation

531
00:22:12,630 --> 00:22:05,039
in its field of view

532
00:22:12,640 --> 00:22:27,750
okay

533
00:22:32,149 --> 00:22:29,909
what we have here is

534
00:22:34,789 --> 00:22:32,159
the video the same as you would expect

535
00:22:36,549 --> 00:22:34,799
to see it with uh with your eyes

536
00:22:37,909 --> 00:22:36,559
of the video camera looking at the

537
00:22:40,390 --> 00:22:37,919
docking target

538
00:22:43,590 --> 00:22:40,400

in the top you have the

539
00:22:46,710 --> 00:22:43,600
representation of that object as the

540
00:22:49,590 --> 00:22:46,720
robot sees it and this looks very much

541
00:22:51,590 --> 00:22:49,600
like what the part of the what what this

542
00:22:53,990 --> 00:22:51,600
image would look like in

543
00:22:55,909 --> 00:22:54,000
in the back of your head in the in the

544
00:22:58,390 --> 00:22:55,919
brain now we'll give the thing a bit of

545
00:23:00,789 --> 00:22:58,400
a offset just to make the problem harder

546
00:23:03,350 --> 00:23:00,799
and we will set we will tell the

547
00:23:06,789 --> 00:23:03,360
object tell the tracking system

548
00:23:08,470 --> 00:23:06,799
now just to to go dock with the uh

549
00:23:10,149 --> 00:23:08,480
with this target

550
00:23:11,430 --> 00:23:10,159
okay well here we'll we'll start the

551
00:23:12,950 --> 00:23:11,440
demonstration

552
00:23:25,270 --> 00:23:12,960
the

553
00:23:27,270 --> 00:23:25,280
just to make this a little more

554
00:23:29,430 --> 00:23:27,280
easy for us to see

555
00:23:30,470 --> 00:23:29,440
now what what we are seeing is this is

556
00:23:32,070 --> 00:23:30,480
the

557
00:23:33,750 --> 00:23:32,080
uh what we call a cartesian

558
00:23:35,190 --> 00:23:33,760
representation of this object it's the

559
00:23:37,669 --> 00:23:35,200
television image

560
00:23:39,590 --> 00:23:37,679
in much the same

561
00:23:41,909 --> 00:23:39,600
form as you're accustomed to looking at

562
00:23:44,870 --> 00:23:41,919
it yourself but what's happening in the

563
00:23:46,549 --> 00:23:44,880

back of your head is more nearly like

564
00:23:47,990 --> 00:23:46,559
what we see in the

565
00:23:50,789 --> 00:23:48,000
upper region

566
00:23:52,470 --> 00:23:50,799
where this is the uh

567
00:23:55,990 --> 00:23:52,480
the log polar

568
00:23:56,950 --> 00:23:56,000
uh version of this uh uh of this lower

569
00:23:59,350 --> 00:23:56,960
image

570
00:24:01,430 --> 00:23:59,360
now what the robot is doing is it's

571
00:24:03,350 --> 00:24:01,440
because this is a cylinder uh it has

572
00:24:05,110 --> 00:24:03,360
bumps on it compared with uh what it

573
00:24:06,230 --> 00:24:05,120
would look like if it were

574
00:24:23,350 --> 00:24:06,240
a

575
00:24:24,390 --> 00:24:23,360
it's jumping it's lowering until the uh

576
00:24:26,630 --> 00:24:24,400
the bumps

577
00:24:28,950 --> 00:24:26,640
have mostly disappeared

578
00:24:32,149 --> 00:24:28,960
and now it's coming in uh on a straight

579
00:24:33,909 --> 00:24:32,159
on approach to the to the docking cart

580
00:24:36,070 --> 00:24:33,919
and so you're looking at