



1  
00:00:43,020 --> 00:00:41,040  
Daunte to an eight-legged walking

2  
00:00:46,319 --> 00:00:43,030  
machine is shown here during field

3  
00:00:49,020 --> 00:00:46,329  
trials with its action sped up named for

4  
00:00:51,180 --> 00:00:49,030  
a 14th century Italian poet this 20th

5  
00:00:53,670 --> 00:00:51,190  
century robot has been designed to

6  
00:00:57,240 --> 00:00:53,680  
withstand and report on its journey to

7  
00:00:59,520 --> 00:00:57,250  
the floor of a volcano NASA sponsored a

8  
00:01:02,130 --> 00:00:59,530  
team from Carnegie Mellon University to

9  
00:01:04,070 --> 00:01:02,140  
build Dante a robot designed to

10  
00:01:07,889 --> 00:01:04,080  
withstand Earth's harshest conditions

11  
00:01:11,400 --> 00:01:07,899  
its goal proved up technology to explore

12  
00:01:14,100 --> 00:01:11,410  
distant planets remotely controlled from

13  
00:01:15,050 --> 00:01:14,110

80 miles away the robot was able to

14

00:01:27,980 --> 00:01:15,060

explore

15

00:01:29,630 --> 00:01:27,990

a fundamental purpose that our program

16

00:01:31,999 --> 00:01:29,640

is interested in is is the robotics

17

00:01:34,100 --> 00:01:32,009

technology itself in the ability of a

18

00:01:36,050 --> 00:01:34,110

robotic instrument to go and do this

19

00:01:37,940 --> 00:01:36,060

type of mission in a harsh unstructured

20

00:01:46,899 --> 00:01:37,950

environment that can deliver a science

21

00:01:52,520 --> 00:01:49,660

scientists an anchorage 80 miles away

22

00:01:55,010 --> 00:01:52,530

from their remote location controllers

23

00:01:57,529 --> 00:01:55,020

use the computer-generated image created

24

00:02:00,410 --> 00:01:57,539

by a laser scanner to track its movement

25

00:02:02,419 --> 00:02:00,420

educate yes having accomplished one

26

00:02:04,380 --> 00:02:02,429

short-term goal with the successful

27

00:02:06,390 --> 00:02:04,390

descent in the bomb

28

00:02:08,850 --> 00:02:06,400

the robot team hopes to apply the

29

00:02:11,820 --> 00:02:08,860

lessons learned to NASA's long-term

30

00:02:13,800 --> 00:02:11,830

plans for the future our hope is that a

31

00:02:15,180 --> 00:02:13,810

lot of that will find its way into

32

00:02:17,250 --> 00:02:15,190

future planetary missions that's

33

00:02:19,350 --> 00:02:17,260

obviously where NASA's interest lies is

34

00:02:21,060 --> 00:02:19,360

we want to take this and move it out to

35

00:02:56,170 --> 00:02:21,070

the surface of other heavenly bodies the

36

00:03:00,729 --> 00:02:58,809

Daunte to an eight-legged walking

37

00:03:07,089 --> 00:03:00,739

machine is shown here during field

38

00:03:10,089 --> 00:03:07,099

trials with its action sped up named for

39

00:03:12,339 --> 00:03:10,099

a 14th century Italian poet this 20th

40

00:03:14,679 --> 00:03:12,349

century robot has been designed to

41

00:03:21,950 --> 00:03:14,689

withstand and report on its journey to

42

00:03:27,770 --> 00:03:24,530

Nasr sponsored a team from Carnegie

43

00:03:30,050 --> 00:03:27,780

Mellon University to build Dante a robot

44

00:03:32,780 --> 00:03:30,060

designed to withstand Earth's harshest

45

00:03:41,320 --> 00:03:32,790

conditions its goal proved out

46

00:03:46,940 --> 00:03:44,480

remotely controlled from 80 miles away

47

00:03:53,530 --> 00:03:46,950

robot was able to investigate the inner

48

00:04:01,640 --> 00:03:57,140

of steaming vents surrounded by sheer

49

00:04:03,230 --> 00:04:01,650

walls and fractured there's everything

50

00:04:06,500 --> 00:04:03,240

from pebbles to car-sized boulders

51  
00:04:08,000 --> 00:04:06,510  
rolling down all day long we tried to

52  
00:04:10,640 --> 00:04:08,010  
pick a descent course that would protect

53  
00:04:29,900 --> 00:04:10,650  
insulate the machine from most of the

54  
00:04:35,909 --> 00:04:33,029  
one of the robots function was division

55  
00:04:38,159 --> 00:04:35,919  
levels of volcanic gases this

56  
00:04:40,860 --> 00:04:38,169  
information gives Mike deepness of the

57  
00:04:44,189 --> 00:04:40,870  
Alaska Volcano Observatory an idea of

58  
00:04:46,320 --> 00:04:44,199  
how active the crater might be it has

59  
00:04:49,770 --> 00:04:46,330  
gas sensors onboard as a software sensor

60  
00:04:52,189 --> 00:04:49,780  
at carbon dioxide sensors and so that's

61  
00:04:55,740 --> 00:04:52,199  
going to give us a real close in view

62  
00:05:08,520 --> 00:04:55,750  
and sampling of what the fumaroles are

63  
00:05:10,890 --> 00:05:08,530

made of if you are in the wrong place at

64

00:05:13,290 --> 00:05:10,900

the wrong time the person standing next

65

00:05:14,730 --> 00:05:13,300

to you will die and you won't and so

66

00:05:17,070 --> 00:05:14,740

it's a matter of you have to ask that

67

00:05:19,830 --> 00:05:17,080

question why are you going in to that

68

00:05:21,149 --> 00:05:19,840

zone is it necessary for you to go into

69

00:05:29,300 --> 00:05:21,159

that zone can you do that same

70

00:05:35,520 --> 00:05:32,190

because of the ever-present danger of an

71

00:05:37,770 --> 00:05:35,530

explosion scientists monitored seismic

72

00:05:43,500 --> 00:05:37,780

activity and kept constant radio contact

73

00:05:45,930 --> 00:05:43,510

with the team on the crater rim in 1993

74

00:05:49,440 --> 00:05:45,940

the first donned a robot attempted to

75

00:05:51,840 --> 00:05:49,450

explore Mount Erebus in Oaxaca when its

76  
00:05:54,810 --> 00:05:51,850  
fiber-optic communications cable snapped

77  
00:05:57,630 --> 00:05:54,820  
the mission was cut short but according

78  
00:06:00,840 --> 00:05:57,640  
to CMU's John bears the mission taught

79  
00:06:02,820 --> 00:06:00,850  
them some valuable lesson we looked at

80  
00:06:05,820 --> 00:06:02,830  
the experience from daunting one which

81  
00:06:07,320 --> 00:06:05,830  
taught us an awful lot about what would

82  
00:06:09,210 --> 00:06:07,330  
work what wouldn't work what was

83  
00:06:11,190 --> 00:06:09,220  
appropriate for the environment what was

84  
00:06:13,290 --> 00:06:11,200  
appropriate for the terrain what was

85  
00:06:14,850 --> 00:06:13,300  
appropriate to take on in a year and

86  
00:06:19,980 --> 00:06:14,860  
then we came here and looked at the

87  
00:06:22,650 --> 00:06:19,990  
volcano to improve its systems major

88  
00:06:25,560 --> 00:06:22,660

design changes had to be made quickly to

89

00:06:27,390 --> 00:06:25,570

keep the project on schedule it was done

90

00:06:31,020 --> 00:06:27,400

with the help of experts in laser

91

00:06:37,100 --> 00:06:31,030

technology telecommunications computer

92

00:06:42,210 --> 00:06:39,900

after power was supplied to the robot

93

00:06:43,350 --> 00:06:42,220

from a generator and all communications

94

00:06:47,040 --> 00:06:43,360

links were set

95

00:06:56,000 --> 00:06:47,050

Dante was ready I think we're ready to

96

00:07:10,550 --> 00:06:59,160

the eight-legged crap began its assault

97

00:07:23,499 --> 00:07:14,370

at 90 metres special rubber snowshoes

98

00:07:29,839 --> 00:07:26,839

ultimately Dandi spent 3 and 1/2 days

99

00:07:32,540 --> 00:07:29,849

traversing the nearly 700 feet down to

100

00:07:48,520 --> 00:07:32,550

the crater floor an area covered with

101  
00:07:53,749 --> 00:07:51,260  
information from onboard video cameras

102  
00:07:58,520 --> 00:07:53,759  
and sensors was relayed the assent light

103  
00:08:04,130 --> 00:08:01,610  
from their remote location controllers

104  
00:08:07,090 --> 00:08:04,140  
use the concur generated image created

105  
00:08:09,950 --> 00:08:07,100  
by a laser scanner to track its movement

106  
00:08:12,050 --> 00:08:09,960  
in addition they had a computer display

107  
00:08:14,510 --> 00:08:12,060  
that was in effect the robots dashboard

108  
00:08:17,600 --> 00:08:14,520  
that gave them information and feedback

109  
00:08:18,830 --> 00:08:17,610  
from all the onboard sensor systems told

110  
00:08:20,390 --> 00:08:18,840  
them when the legs were in contact when

111  
00:08:23,120 --> 00:08:20,400  
the ground what angle the legs were

112  
00:08:24,440 --> 00:08:23,130  
positioned at what attitude the body had

113  
00:08:27,190 --> 00:08:24,450

with respect to gravity in the ground

114

00:08:30,650 --> 00:08:27,200

that sort of information

115

00:08:34,459 --> 00:08:30,660

David Lavery is manager of NASA's Teller

116

00:08:37,159 --> 00:08:34,469

robotics program Dante also incorporates

117

00:08:40,430 --> 00:08:37,169

virtual reality technology developed at

118

00:08:43,120 --> 00:08:40,440

NASA Ames Research Center the system

119

00:08:45,680 --> 00:08:43,130

gives the user a feeling of being there

120

00:08:48,260 --> 00:08:45,690

what it is is a pair of cameras that are

121

00:08:51,770 --> 00:08:48,270

set at the human ocular distance roughly

122

00:08:54,230 --> 00:08:51,780

that and then those cameras frames from

123

00:08:57,260 --> 00:08:54,240

those images are sequenced back at the

124

00:09:00,170 --> 00:08:57,270

operator station using a special monitor

125

00:09:05,810 --> 00:09:00,180

and a special glasses so that the human

126  
00:09:08,150 --> 00:09:05,820  
is able to perceive some depth this same

127  
00:09:11,660 --> 00:09:08,160  
technology has been tested in a number

128  
00:09:14,360 --> 00:09:11,670  
of applications by NASA Martian Rover

129  
00:09:17,210 --> 00:09:14,370  
prototypes and underwater explorers have

130  
00:09:22,379 --> 00:09:17,220  
been operated remotely using 3d visual

131  
00:09:28,150 --> 00:09:25,059  
artificial intelligence allowed dumpee

132  
00:09:31,269 --> 00:09:28,160  
to navigate on its own a lot of what we

133  
00:09:33,910 --> 00:09:31,279  
learned had to do with how much autonomy

134  
00:09:36,369 --> 00:09:33,920  
can be used onboard a robot given our

135  
00:09:38,379 --> 00:09:36,379  
current level of technology to navigate

136  
00:09:40,900 --> 00:09:38,389  
through the extremely rugged terrain

137  
00:09:42,939 --> 00:09:40,910  
that we saw inside the crater we had a

138  
00:09:45,249 --> 00:09:42,949

capability for at least half of the

139

00:09:46,809 --> 00:09:45,259

descent to basically turn on all of the

140

00:09:48,780 --> 00:09:46,819

onboard intelligence on the robot and

141

00:09:51,069 --> 00:09:48,790

let it do its own thing

142

00:09:53,889 --> 00:09:51,079

although the extremely treacherous

143

00:09:56,530 --> 00:09:53,899

terrain impeded Dante's climb from the

144

00:09:59,049 --> 00:09:56,540

crater all science and technology

145

00:10:00,759 --> 00:09:59,059

objectives were completed indicating

146

00:10:04,059 --> 00:10:00,769

that the crater will probably remain

147

00:10:06,429 --> 00:10:04,069

inactive it proved that exploring

148

00:10:10,629 --> 00:10:06,439

dangerous terrain was possible using

149

00:10:13,480 --> 00:10:10,639

unaided robotic technology CMU graduate

150

00:10:16,869 --> 00:10:13,490

student Demetrius apostille Ovilus it's

151  
00:10:18,730 --> 00:10:16,879  
becoming almost like a life goal every

152  
00:10:21,519 --> 00:10:18,740  
single person who got involved in in

153  
00:10:24,280 --> 00:10:21,529  
both projects has made their decisions

154  
00:10:27,730 --> 00:10:24,290  
to try to make something happen and make

155  
00:10:29,919 --> 00:10:27,740  
it known to the outside world having

156  
00:10:31,660 --> 00:10:29,929  
accomplished one short-term goal with

157  
00:10:34,329 --> 00:10:31,670  
the successful descent into mount

158  
00:10:36,939 --> 00:10:34,339  
spurred the robot team hopes to apply

159  
00:10:40,119 --> 00:10:36,949  
the lessons learned to NASA's long-term

160  
00:10:42,129 --> 00:10:40,129  
plans for the future our hope is that a

161  
00:10:43,449 --> 00:10:42,139  
lot of that will find its way into

162  
00:10:45,549 --> 00:10:43,459  
future planetary missions that's

163  
00:10:47,530 --> 00:10:45,559

obviously where NASA's interest lies is

164

00:10:49,389 --> 00:10:47,540

we want to take this and move it out to

165

00:10:57,340 --> 00:10:49,399

the surface of other heavenly bodies to

166

00:11:52,560 --> 00:11:12,090

you

167

00:11:52,570 --> 00:13:06,100

just get the wires out we can use them

168

00:13:10,509 --> 00:13:08,619

in addition they had a computer display

169

00:13:13,299 --> 00:13:10,519

that was in effect the robots dashboard

170

00:13:16,359 --> 00:13:13,309

that gave them information and feedback

171

00:13:17,619 --> 00:13:16,369

from all the onboard sensor systems told

172

00:13:19,350 --> 00:13:17,629

them when the legs were in contact when

173

00:13:22,150 --> 00:13:19,360

the ground what angle the legs were

174

00:13:23,919 --> 00:13:22,160

positioned at what what attitude the

175

00:13:28,119 --> 00:13:23,929

body had with respect to gravity in the

176

00:13:30,939 --> 00:13:28,129

ground that sort of information a lot of

177

00:13:33,699 --> 00:13:30,949

what we learned had to do with how much

178

00:13:36,100 --> 00:13:33,709

autonomy can be used on board a robot

179

00:13:38,259 --> 00:13:36,110

given our current level of technology to

180

00:13:40,720 --> 00:13:38,269

navigate through the extremely rugged

181

00:13:43,030 --> 00:13:40,730

terrain that we saw inside the crater we

182

00:13:45,369 --> 00:13:43,040

had a capability for at least half of

183

00:13:46,809 --> 00:13:45,379

the descent to basically turn on all of

184

00:13:50,759 --> 00:13:46,819

the onboard intelligence on the robot

185

00:13:55,509 --> 00:13:53,590

and our hope is that a lot of that will

186

00:13:57,039 --> 00:13:55,519

find its way into future planetary

187

00:13:58,780 --> 00:13:57,049

missions that's obviously where NASA's

188

00:14:00,939 --> 00:13:58,790

interest lies is we want to take this

189

00:14:03,280 --> 00:14:00,949

and move it out to the surface of other