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An aerial photograph of a construction site, showing a large, flat, sandy area with numerous tire tracks. In the lower right, a blue truck is pulling a trailer loaded with earth. The background shows a large, curved embankment or excavation site. A large, white, L-shaped graphic is positioned in the top right corner of the image.

AI vision and its use in health and safety

12th July 2023

presien.com

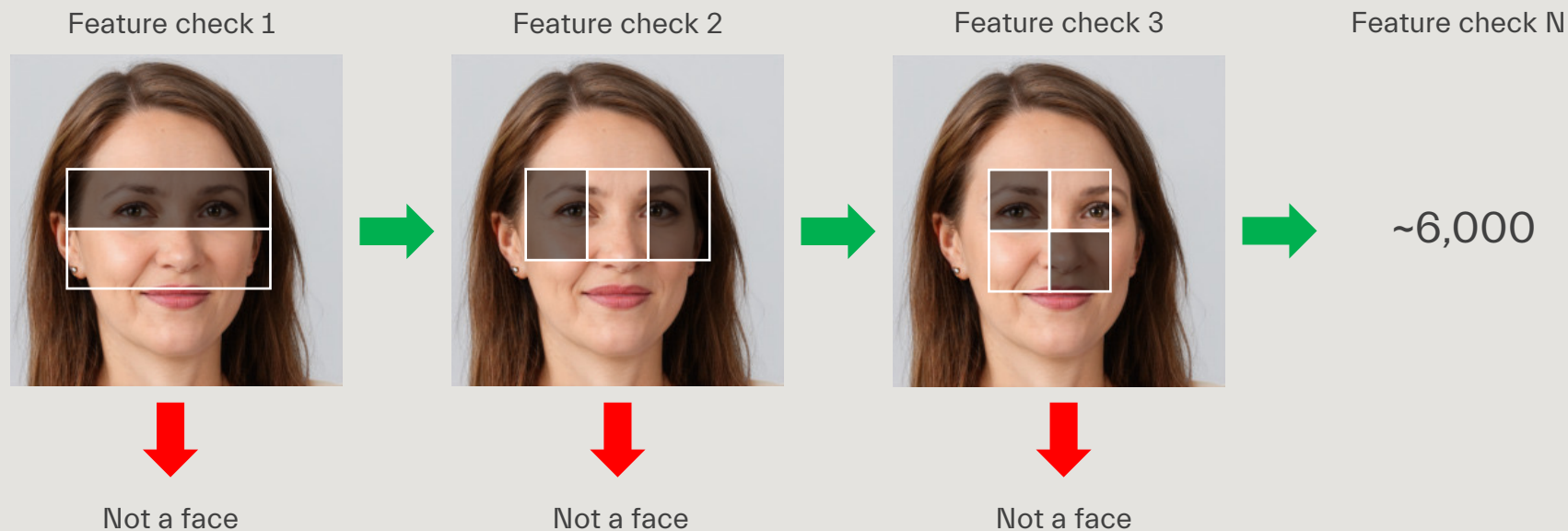


A crash course on AI vision



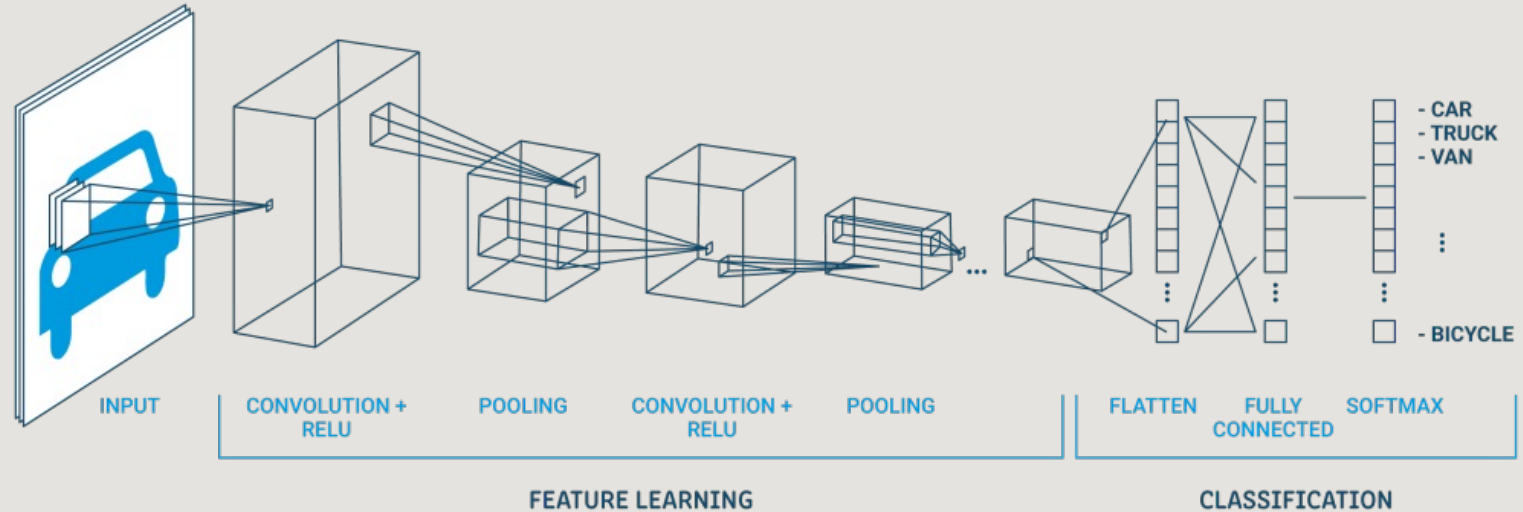
Viola-Jones Algorithm

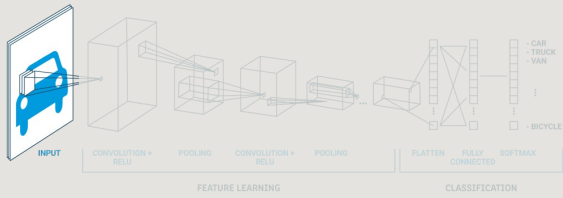
Binary degenerate decision tree



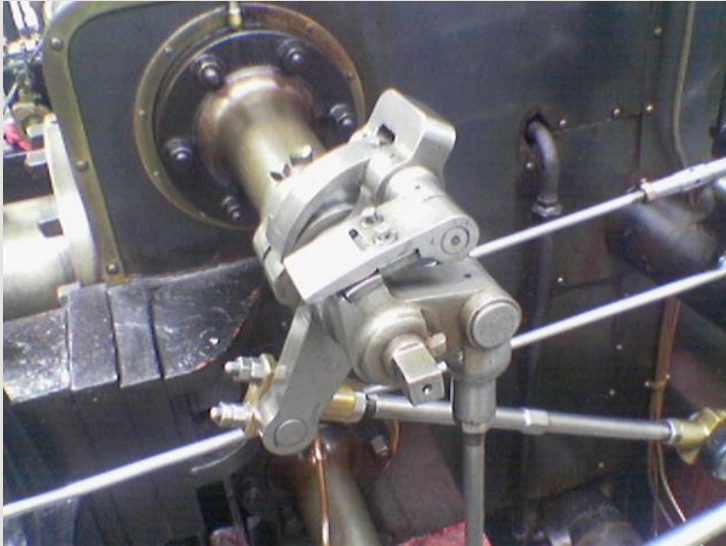


Deep Convolutional Neural Networks (D-CNN)





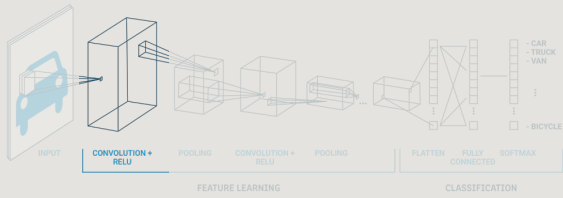
Step 1 Convert to pixel values



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78 72 85 167 202 189 113 84 64 48 39 39 34
122 112 121 180 198 199 151 130 107 88 69 55 37
12 8 19 102 157 103 28 23 13 6 11 22 28
105 132 133 172 219 172 113 95 94 84 74 39 44
136 148 150 183 215 186 149 137 131 121 112 74 68
22 39 53 114 178 81 38 30 21 12 13 8 13
132 109 148 196 220 163 108 84 62 82 59 56 50
155 138 165 195 218 180 143 129 113 128 107 102 87
32 20 84 154 182 84 45 28 8 14 6 14 15
117 86 149 220 213 159 105 82 79 66 53 51 45
147 124 164 216 212 175 141 128 126 115 105 100 88
29 14 92 185 172 95 51 33 19 14 11 12 11
82 95 191 218 206 159 97 82 64 57 49 42 28
122 129 193 214 206 177 134 125 107 104 96 84 63
26 35 149 183 159 106 46 38 25 20 18 15 8
71 129 200 220 203 147 87 46 23 24 16 19 14
109 152 201 217 205 166 125 59 33 34 20 16 13
25 77 161 184 152 96 37 31 17 21 15 18 13
72 150 197 221 174 122 103 18 16 16 17 16 19
104 167 196 218 185 146 136 16 15 14 15 13 16

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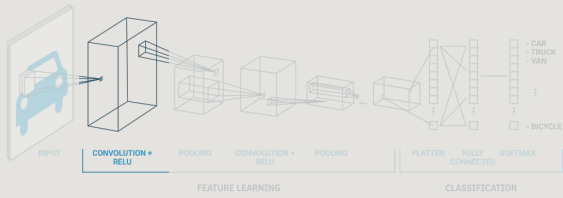
Step 2 Identify the features

Kernel

78 72 85 167 202 189 113 84 64 48 39 39 34
 122 112 121 180 198 199 151 130 107 88 69 55 37
 12 8 19 102 157 103 28 23 13 6 11 22 28
 105 132 133 172 219 172 113 95 94 84 74 39 44
 136 148 150 183 215 186 149 137 131 121 112 74 68
 22 39 53 114 178 81 38 30 21 12 13 8 13
 132 109 148 196 220 163 108 84 62 82 59 56 50
 155 138 165 195 218 180 143 129 113 128 107 102 87
 32 20 84 154 182 84 45 28 8 14 6 14 15
 117 86 149 220 213 159 105 82 79 66 53 51 45
 147 124 164 216 212 175 141 128 126 115 105 100 88
 29 14 92 185 172 95 51 33 19 14 11 12 11
 82 95 191 218 206 159 97 82 64 57 49 42 28
 122 129 193 214 206 177 134 125 107 104 96 84 63
 26 35 149 183 159 106 46 38 25 20 18 15 8
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 109 152 201 217 205 166 125 59 33 34 20 16 13
 25 77 161 184 152 96 37 31 17 21 15 18 13
 72 150 197 221 174 122 103 18 16 16 17 16 19
 104 167 196 218 185 146 136 16 15 14 15 13 16

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1



Step 2 Identify the features

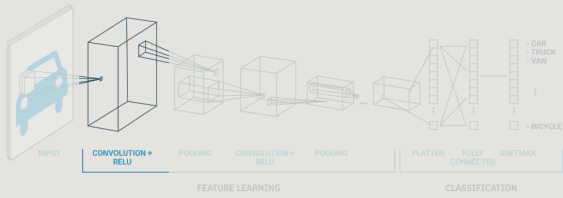
Kernel

78	72	85	167	202	189	113	84	64	48	39	39	34
122	112	121	180	198	199	151	130	107	88	69	55	37
12	8	19	102	157	103	28	23	13	6	11	22	28
105	132	133	172	219	172	113	95	94	84	74	39	44
136	148	150	183	215	186	149	137	131	121	112	74	68
22	39	53	114	178	81	38	30	21	12	13	8	13
132	109	148	196	220	163	108	84	62	82	59	56	50
155	138	165	195	218	180	143	129	113	128	107	102	87
32	20	84	154	182	84	45	28	8	14	6	14	15
117	86	149	220	213	159	105	82	79	66	53	51	45
147	124	164	216	212	175	141	128	126	115	105	100	88
29	14	92	185	172	95	51	33	19	14	11	12	11
82	95	191	218	206	159	97	82	64	57	49	42	28
122	129	193	214	206	177	134	125	107	104	96	84	63
26	35	149	183	159	106	46	38	25	20	18	15	8
71	129	200	220	203	147	87	46	23	24	16	19	14
109	152	201	217	205	166	125	59	33	34	20	16	13
25	77	161	184	152	96	37	31	17	21	15	18	13
72	150	197	221	174	122	103	18	16	16	17	16	19
104	167	196	218	185	146	136	16	15	14	15	13	16

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

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Step 2 Identify the features

Kernel

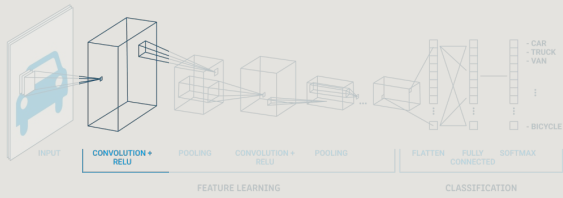
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78 72 85 167 202 189 113 84 64 48 39 39 34
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71 129 200 220 203 147 87 46 23 24 16 19 14
109 152 201 217 205 166 125 59 33 34 20 16 13
25 77 161 184 152 96 37 31 17 21 15 18 13
72 150 197 221 174 122 103 18 16 16 17 16 19
104 167 196 218 185 146 136 16 15 14 15 13 16
  
```

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

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Step 2 Identify the features

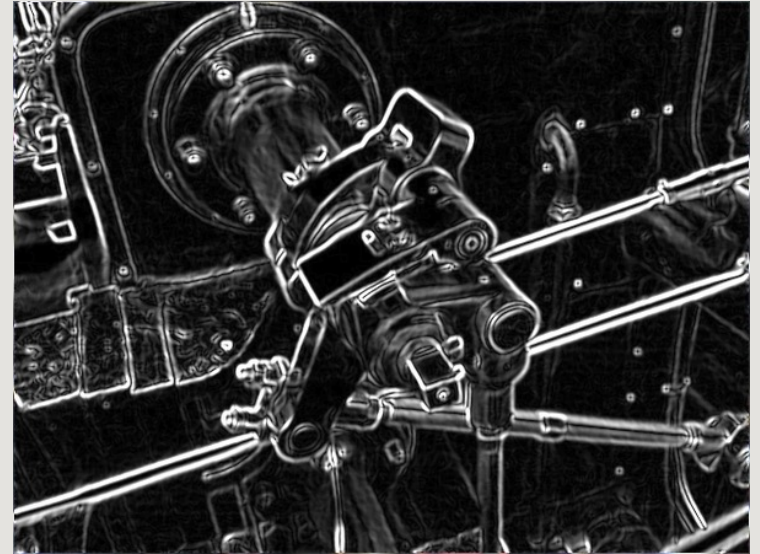
Kernel

```

78 72 85 167 202 189 113 84 64 48 39 39 34
122 112 121 180 198 199 151 130 107 88 69 55 37
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136 148 150 183 215 186 149 137 131 121 112 74 68
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72 150 197 221 174 122 103 18 16 16 17 16 19
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```

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1



What features are useful and how do we extract them?



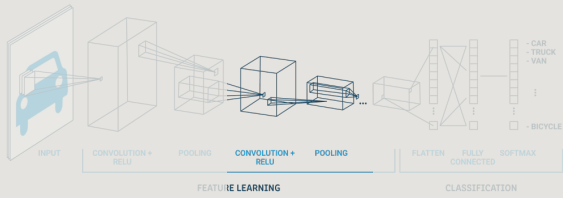
Let's just throw everything at it and let the AI decide!



Kernels everywhere!

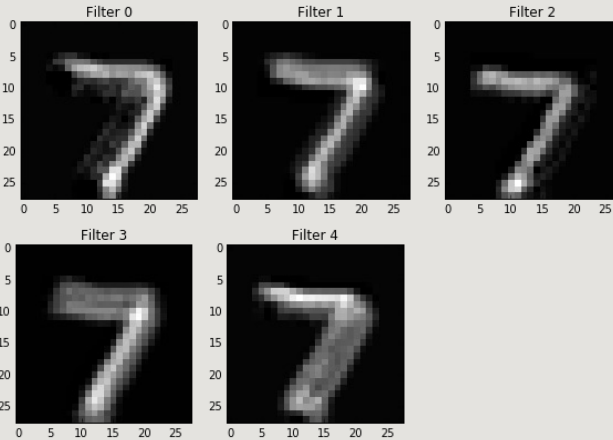
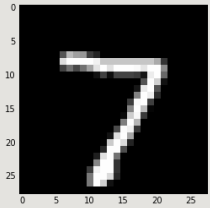


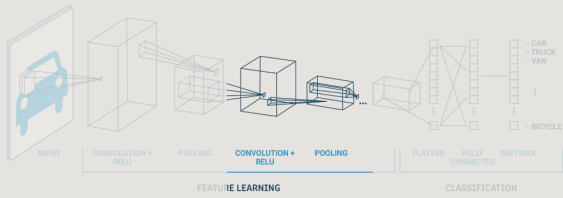
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Step 3 Convolutions

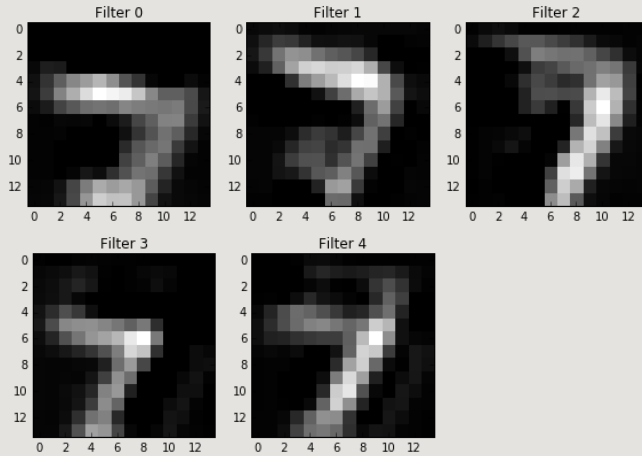
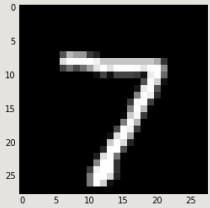
Convolution 1

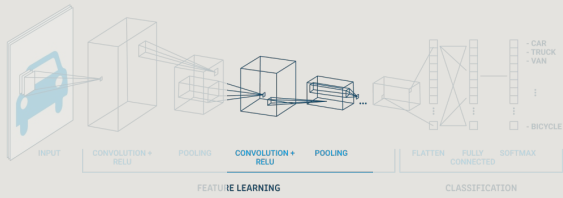




Step 3 Convolutions

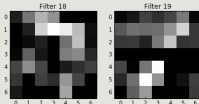
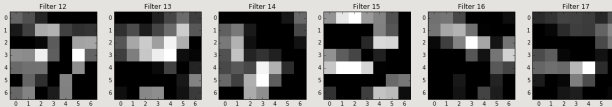
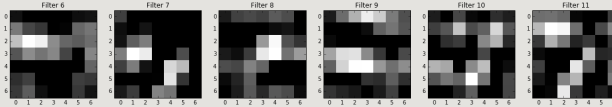
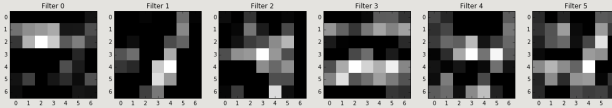
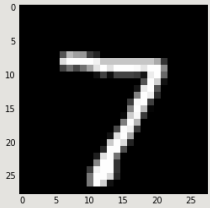
Convolution 2





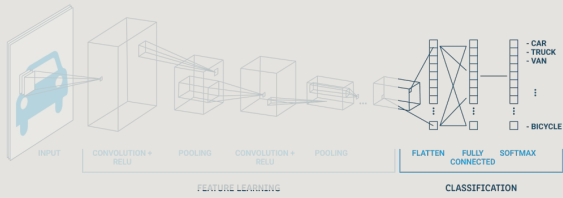
Step 3 Convolutions

Convolution 3

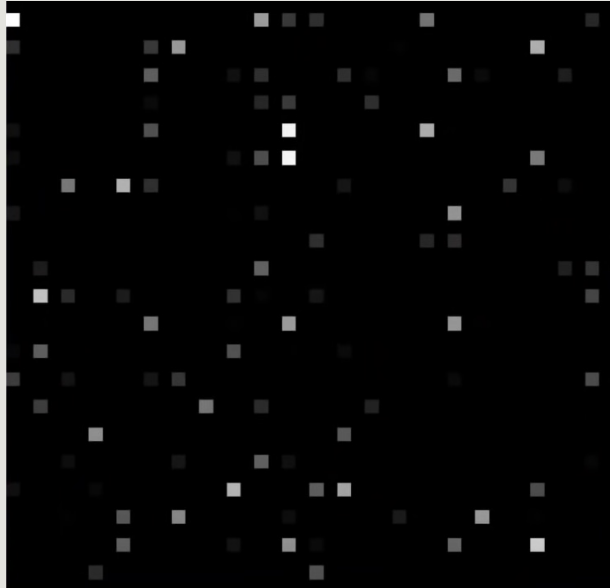
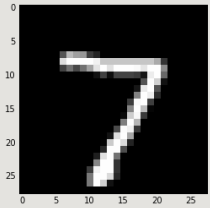


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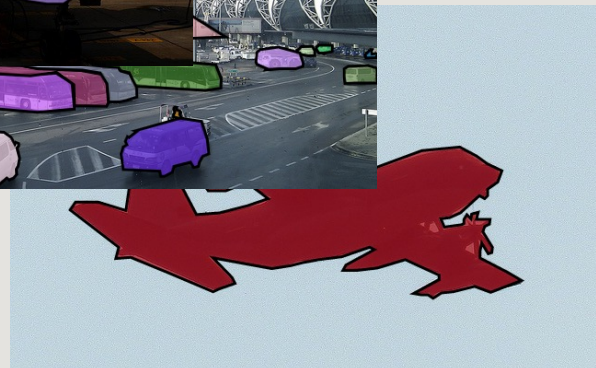
<https://awjuliani.medium.com/visualizing-neural-network-layer-activation-tensorflow-tutorial-d45f8bf7bbc4>



Step 4 Object recognition (neural network)



Training is the missing link



https://en.wikipedia.org/wiki/MNIST_database#

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Kitten



Kitten



Kitten



Kitten



Kitten



Presien

<https://www.youtube.com/watch?v=bM2Oh3ewG8c>



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Improving safety with AI vision

There is a moral
and economic
imperative to
improve heavy
industry safety



195

Deaths

65%

Caused by mobile plant


100k

Traumatic injuries

1,000x

Near misses

How can we improve heavy industry safety?



Hierarchy of controls

Policies and procedures rather than solution

Passive devices

(e.g. 360 and reversing cameras)

Users must be paying attention

Proximity

Cannot differentiate objects

Tag

Every object must be tagged

IR

Requires hi-vis

AI vision

Only recently possible



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<https://eesurveillance.com/solutions/warehouse-security-cameras/>

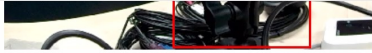


person

0.804

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TODAY



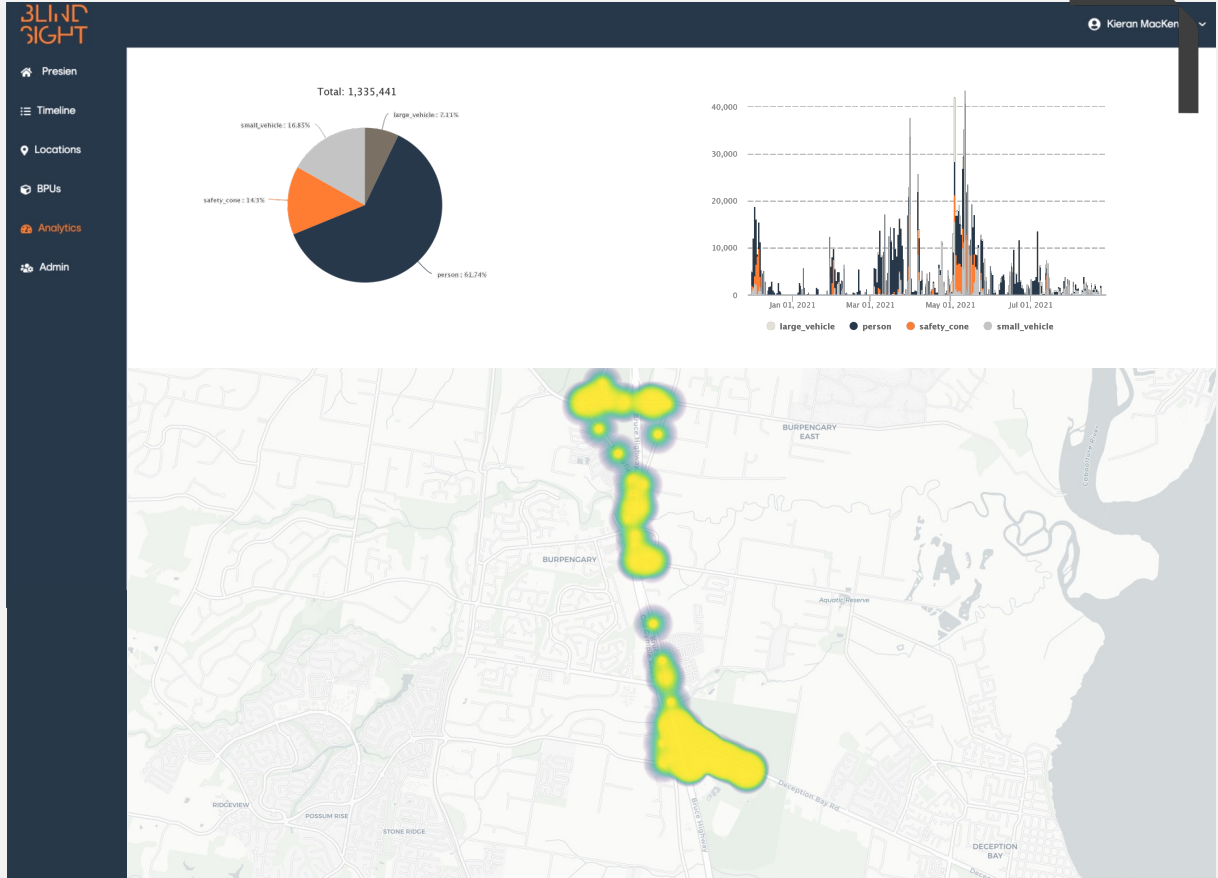
BPU settings changed
Alert zones or detections changed

Kieran's forklift
4:01 PM

BPU settings changed
Name changed to Kieran's forklift

Kieran's forklift
4:01 PM

Detection! People





BLINDSIGHT INDEX

The new lead safety metric

- Does not rely on an accident
- Does not rely on manual reporting
- Focuses on high-risk scenarios
- Can be compared across machine type, site, company, global

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Site H&S Update

Site: QLD Concrete Mixer

Date: 18th April 2023

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Implications of a new standard in safety

Safety statistics

What is the impact on remuneration/bonuses for employees with safety KPIs?

Processes

Can all near-misses be investigated and signed off by the CEO?

Insurance

What is the impact on insurance premiums?

Privacy and sharing

Who has access to the data and how can it be used?

Roles and responsibilities

Who should review the data?
Who can determine safe and unsafe?

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