

# Clank - an evolution

## How it works

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# Me

## CTO at pi.pe gmbh

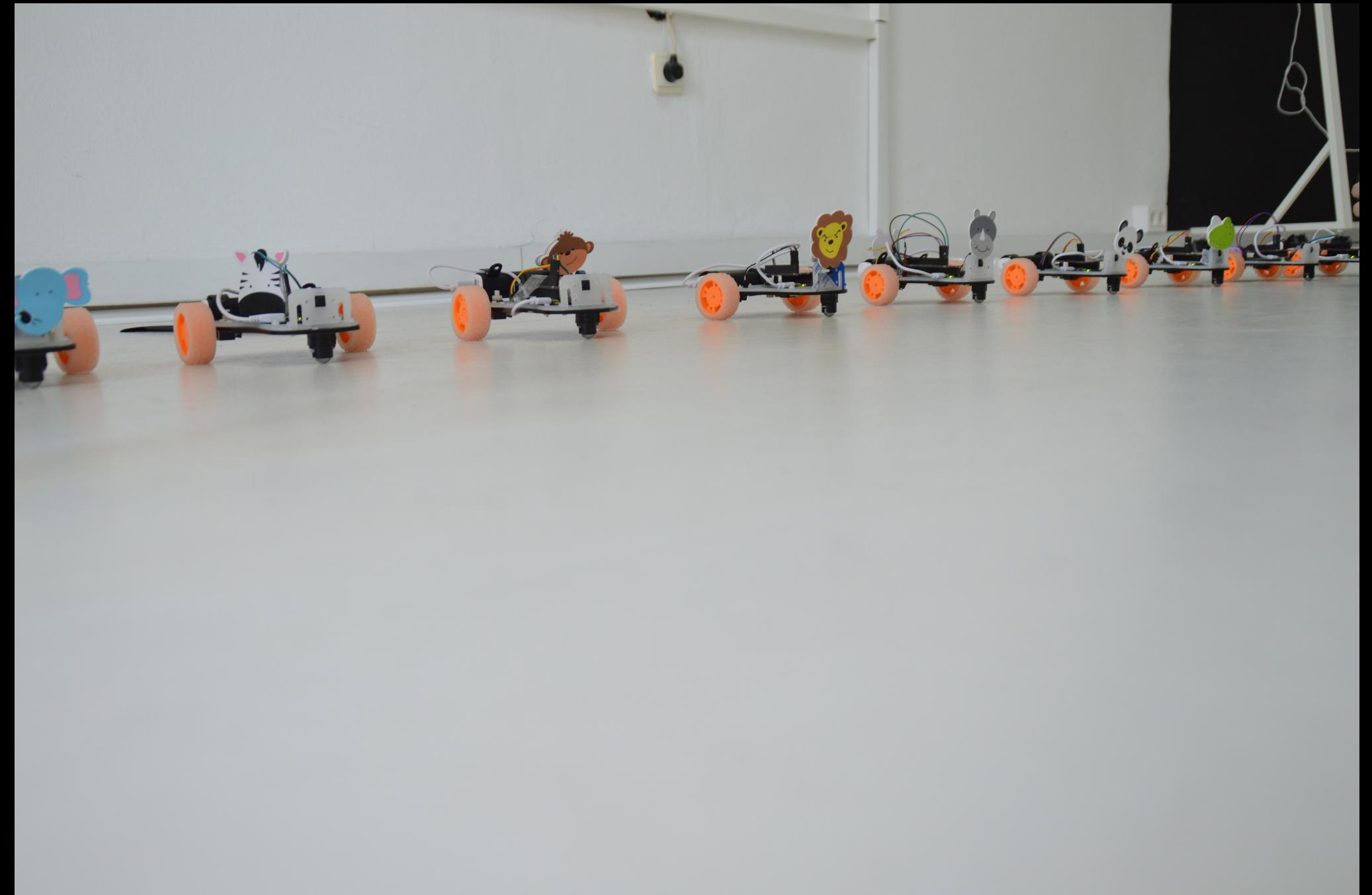
- |pipe| licenses a webRTC toolkit
- For Baby monitors and other IoT cameras
- Includes a secure distributed auth layer
- Usable directly in all major browsers - no app needed



# Robotics ?

**STSpi**

- We used them for workshops
- And remote robot football
- Etc



# AI

## 2019 robocars

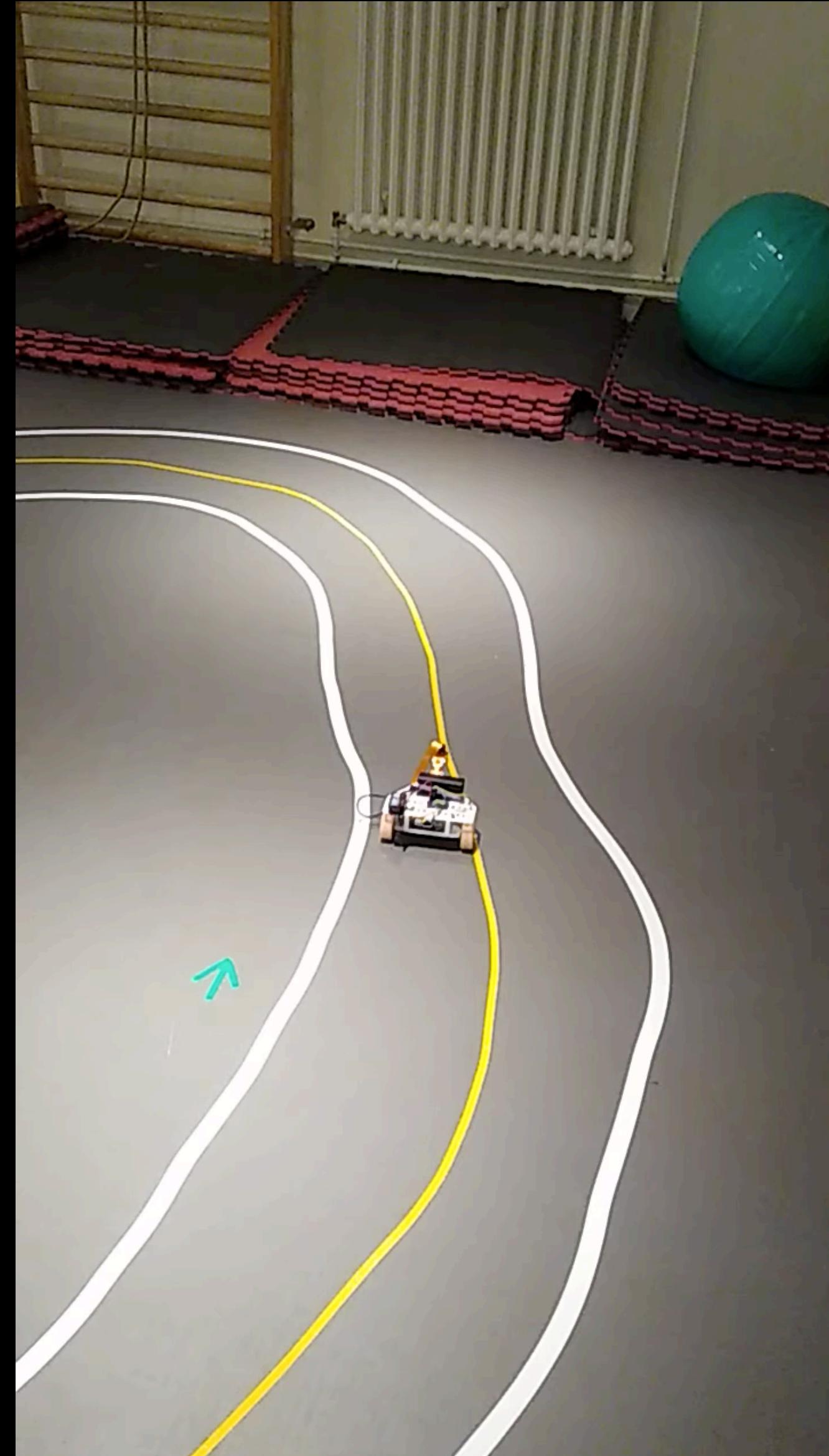
- STSpi chassis
- Google Coral
- AI model
- Built by me driving  
‘through the glass’
- Tensor flow light
- Came 3rd



# 2022/23 Robocars

v1

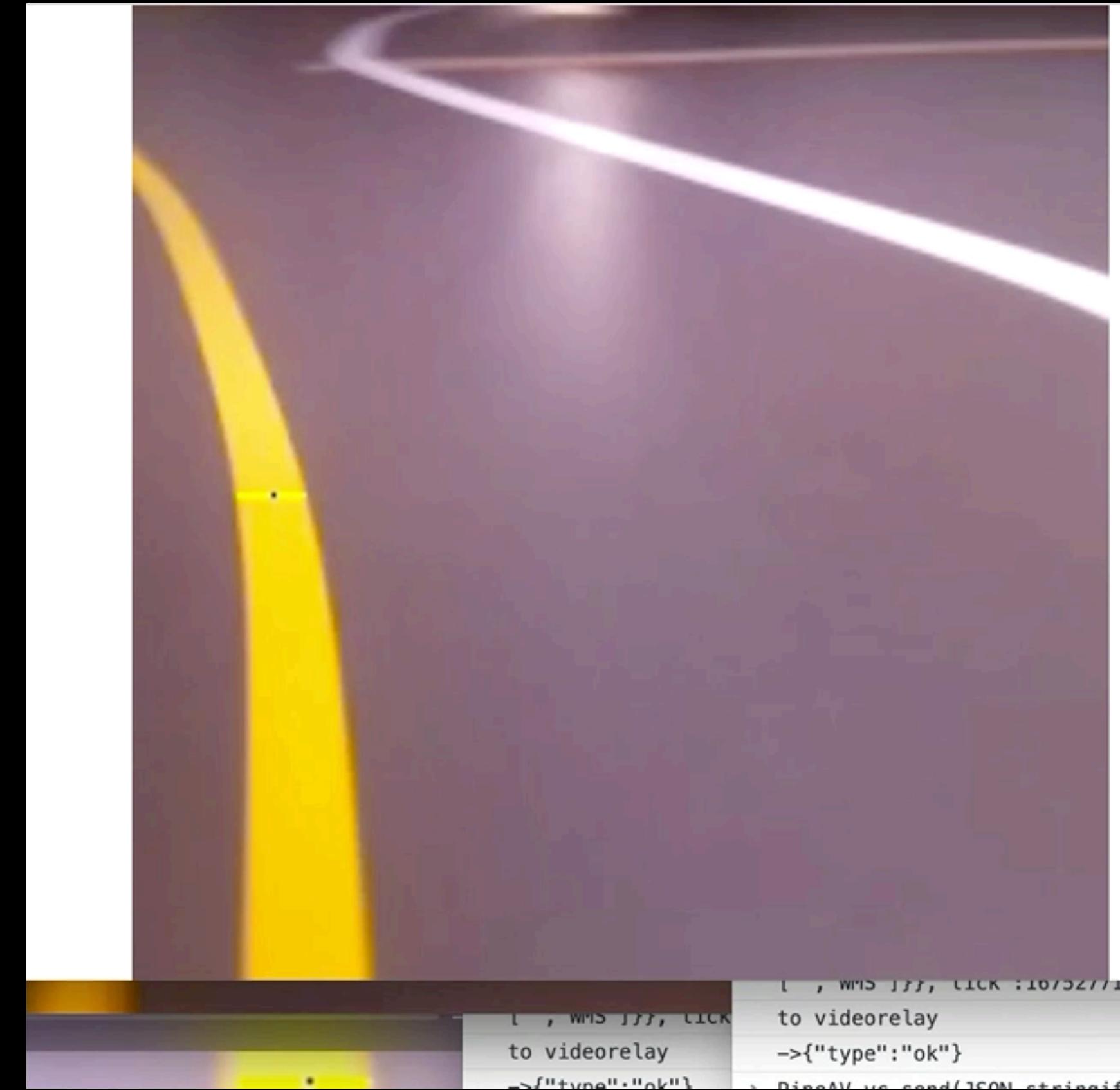
- Improve 2019 hardware
- New AI model
- Not through the glass
- Worse than '19
- Google dropped support for board
- Google started charging for model building



# Total Rethink

## Back to basics

- Light weight
- Raspi Zero
- Quick
- Line follower
- Diagnosable



# Line follower

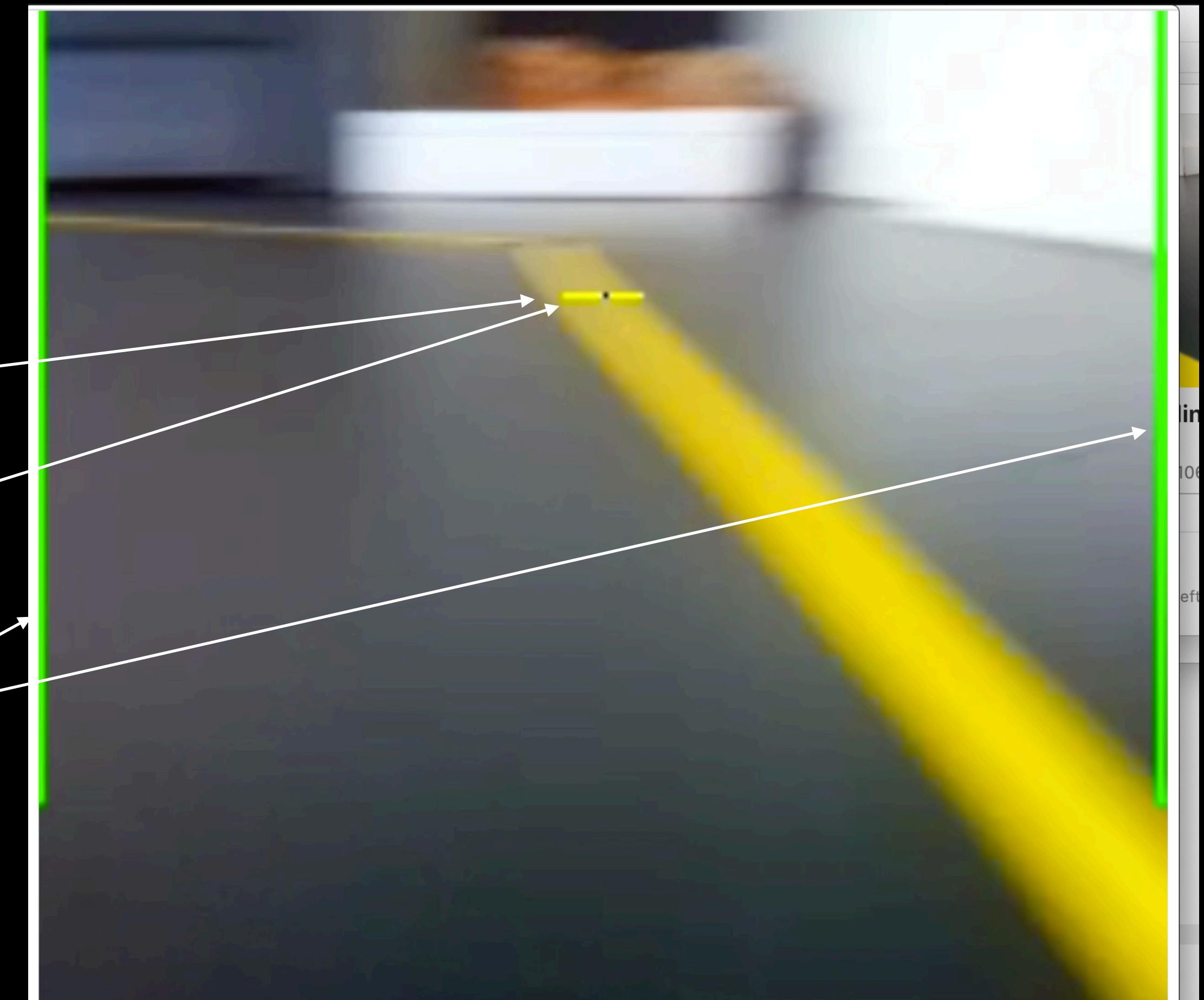
## In java with help from ChatGPT

- Reads RGB from /dev/video0
- Converts a line to HSV
- Looks for largest group of yellow pixels
- Steers towards centre of yellow
- Write to /sys/class/pwmchip0/pwm[01]/duty\_cycle
- 30 fps

```
private int toHSV(byte[] frame, int midlineStart) {  
    int last = midlineStart + lineLen;  
    int yellowStart = 0;  
    int yellowLength = 0;  
    int maxLen = 0;  
    int center = -1;  
    boolean inBlob = false;  
    int pixel = 0;  
    for (int i = midlineStart; i < last; i += bpp) {  
        int r = Byte.toUnsignedInt(frame[i]);  
        int g = Byte.toUnsignedInt(frame[i + 1]);  
        int b = Byte.toUnsignedInt(frame[i + 2]);  
        float[] hsv = rgb_to_hsv(r, g, b);  
        boolean y = isYellow(hsv);  
        if (y) {  
            if (inBlob) {  
                yellowLength++;  
            } else {  
                inBlob = true;  
                yellowStart = pixel;  
                yellowLength = 1;  
            }  
        } else {  
            if (inBlob) {  
                if (yellowLength > maxLen) {  
                    center = yellowStart + (yellowLength / 2);  
                    maxLen = yellowLength;  
                }  
                inBlob = false;  
                yellowLength = 0;  
            }  
        }  
        if (y) {  
            if (high != null) {  
                int rgb = high.getRGB();  
                frame[i] = (byte) ((rgb & 0xff0000) >> 16);  
                frame[i + 1] = (byte) ((rgb & 0x00ff00) >> 8);  
                frame[i + 2] = (byte) (rgb & 0x0000ff);  
            }  
            pixel++;  
        }  
    }  
    // cover the case that it is yellow to the right hand edge  
    if (inBlob && (yellowLength > maxLen)) {  
        center = yellowStart + (yellowLength / 2);  
    }  
}
```

# Subtleties (Aka hacks)

- Only check a few lines
- Go faster if yellow is at top of screen (further away)
- Paint target bright yellow
- Paint sides with speed indicator
- Reverse if no yellow to be seen
- Video sent through [pipe] 's webRTC to browser



# Thanks !

## Lots of help

- Peter - motor driver board
- Ian - encouragement
- Rolf - 3d print
- Ralf - Python/tensor flow
- Younger Son for the plush Clank

