DeepPicar: A Low-cost Deep Neural Network-based Autonomous Car

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DeepPicar

- Low-cost autonomous RC car platform using a deep convolutional neural network (CNN) [1].
- Small scale replication of NVIDIA’s Dave-2 [2].
- Use the same CNN: ~250K weights, ~27M connections.
- Uses Raspberry Pi 3 for real-time CNN inferencing (CPU only).
- Uses python, TensorFlow, and Linux
- Uses affordable components (<$100).

End-to-End Deep Learning-based Control

(a) Standard robotics control approach

(b) End-to-end deep learning approach

• Replace traditional control pipeline with a DNN.

Real-Time Control Loop

```
while True:
    # 1. read from the forward camera
    frame = camera.read()
    # 2. convert to 200x66 rgb pixels
    frame = preprocess(frame)
    # 3. perform inferencing operation
    angle = CNN_inferencing(frame)
    # 4. motor control
    steering_motor_control(angle)
    # 5. wait till next period begins
    wait_till_next_period()
```

- Simple control loop implementation

Real-Time Performance

- >20 Hz using just one Cortex-A53 core
- >30 Hz using two cores.

Use Cases

- Research
  - DeepPicar’s CNN workload can be used as a representative real-world benchmark workload.
- Education
  - DeepPicar can be used for student projects (both University and K-12) to have hands on experiences at a much lower cost.

Availability

- Source code, building, videos, and operating instructions: https://github.com/mbechtel2/DeepPicar-v2

Demonstration

- First and third person perspectives of DeepPicar driving autonomously.
