Politics of Expertise: Who does what work of computer vision?

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Research: who does what computer vision work, how and why?

Participants: 30+ computer vision professionals at 6 companies in North America

🔍 What do they look at?
👀 What are they trained to see?
🎁 What do they share with others?
Vision + System Experts

CV research scientist

Algorithm

Vision system engineer

Image features
- Landmarks, map
- Location algorithm

Algorithm code
- Working HW/SW
- Optimized system

\[ L(x, y, k) = G(x, y, k)e^r \]

\[ D(x) = D + \frac{\partial^2}{\partial x^2} + \frac{1}{2} \frac{\partial^2}{\partial y^2} \]

\[ H = \begin{bmatrix} P_{xx} & P_{xy} \\ P_{yx} & P_{yy} \end{bmatrix} \]

\[ m(x, y) = \sqrt{(L(x+1, y) - L(x-1, y))^2 + (L(x, y+1) - L(x, y-1))^2} \]

\[ \theta(x, y) = \arctan2(L(x+1, y) - L(x-1, y), L(x, y+1) - L(x, y-1)) \]
Vision + System Experts

Images
- Image features
- Labeled datasets

CV research scientist
- Image features
  - Landmarks, map
  - Location algorithm

Algorithm
- Algorithmic functions
- Coded logic
- Algorithm code

Vision system engineer
- Algorithm code
- Working HW/SW
- Optimized system

$ L(x, y, k) = G(x, y, k) + f(x, y) $  
$ D(x) = D + \frac{\partial^2 L}{\partial x^2} + \frac{1}{2} \frac{\partial^2 L}{\partial y^2} $  
$ H = \begin{bmatrix} D_{xx} & D_{xy} \\ D_{yx} & D_{yy} \end{bmatrix} $  
$ m(x, y) = \sqrt{(L(x + 1, y) - L(x - 1, y))^2 + (L(x, y + 1) - L(x, y - 1))^2} $  
$ \theta(x, y) = \arctan\left(\frac{L(x + 1, y) - L(x - 1, y)}{L(x, y + 1) - L(x, y - 1)}\right) $
Ground truth: Curated dataset of possible uses

Algorithm

Use generated data

CV research scientist

Vision system engineer

Labeled datasets

Algorithm code

Algorithm

$m(x, y) = \sqrt{(L(x, y) - L(x, y - 1))^2 + (L(x, y + 1) - L(x, y))^2 + (L(x + 1, y) - L(x, y))^2}$

$\theta(x, y) = \max(0, L(x, y) - L(x, y - 1), L(x, y + 1) - L(x, y), L(x + 1, y) - L(x, y))$
Vision Product Development Team

- **CV research scientist**
  - Image features
  - Landmarks, map
  - Location algorithm

- **Software developer**
  - Algorithmic functions
  - Coded logic

- **Vision system engineer**
  - Algorithm code
  - Working HW/SW
  - Optimized system

```plaintext
{default: avoid
  start (force heading)
  update (command)
  instance-rear (reemulforce)
}

status

{call (event-dispatch (and force heading) plan)}
{plan (exec reemulforce (intent-force heading))}
{go}
{conditional-dispatch (significant-force-p reemulforce 1.0)
  start
  nil}
{start (output reemul (follow-force reemulforce))
  nil33}
```
Vision Product Development Team

- **CV developer**
  - Image features: Landmarks, map
  - Location algorithm

- **Software developer**
  - Algorithmic functions: Coded logic, Algorithm code

- **System engineer**
  - Algorithm code
  - Working HW/SW
  - Optimized system

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```plaintext
#define avoid
    image (force heading)
    update (command)!
    instance (navigation)
    status
      (call (event-detect (and force heading) (pre)))
      (plan (self-reckon) (latch-direction force heading))
      go
    (go (conditional-detect (significant-force p-reckon force 1.0)
                              start
                              nil))
    (start (output remand (follow-force p-reckon))
              nil))
```
Vision Product Development Team

- CV developer
- Common code base
- Algorithm to system testing
- Software developer
- System engineer
- Test data logs

- Logical functions
- "Good enough" code
- Optimized system

- [Code snippet]
  ```
  // Function definitions
  void performTask()
  {
    // Task logic
  }
  ```

- [Image of a robotic cleaner]
Vision Product Development Team

CV developer

Common code base

Software developer

System engineer

Test data logs

Algorithm to system testing

Ground truth: test use data

Use generated data

Use generated data
Who does what work of computer vision?

"What they do is not computer vision, it is system engineering"

“We don’t hire prima donnas"
Start the conversation with their concerns about data…

“Everyone dreams of the perfect ground truth data set, but it’s not possible”

“We can’t possibly test our robot in 2 million homes, so we use common sense”
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