Investigating the Impact of Video Quality, Hardware, and Software Stabilization on Facial Detection and Recognition in Mobile Robots Systems

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Introduction:

- Computer Vision (CV) is a rapidly growing field that offers a lot of potential for service robots.
- Without a stable image to process, these advanced systems will not be practical.
- Determine the most cost efficient solution for stabilizing images for mobile robots.

Objective:

- Quantify the benefit of four hardware and software stabilization solutions:

1. No Solution (baseline)
2. Hardware
3. Software
4. Both Hardware and Software

Figure 1. Turtlebot that will be used for testing

Figure 2. Hardware Solution

Methods:

- Used SLAM navigation to create a consistent path for the robot
- 3-D printed a mold to mount the hardware solution
- Conduct 15 trials for each solution (total of 60)
- Ran the 60 trials for two cameras, Samsung S7 (13 megapixels) and Logitch USB Camera (3 Megapixels)
- Extract data from facial detection/ recognition system to R
- Evaluate the detection and recognition rate for each frame of the video
- Use the evaluation to create overall measure of success for the average of each solution/ cameras trials.

Data & Conclusions:

	Dependent variable:			
	detection		recognition	
	Samsung S7 (1)	USB (2)	Samsung S7 (3)	USB (4)
hardware+software	-0.001	-0.151***	0.027***	0.279***
	(0.001)	(0.019)	(0.008)	(0.026)
hardware	-0.001	-0.139***	-0.021***	0.147***
	(0.001)	(0.019)	(0.007)	(0.026)
software	-0.000	-0.006	0.011	0.113***
	(0.001)	(0.020)	(0.007)	(0.027)
constant	1.000***	0.941***	0.044***	0.170***
	(0.0004)	(0.014)	(0.004)	(0.019)
Observations	6,134	2,487	6,134	2,487
R2	0.001	0.042	0.005	0.047
Adjusted R2	0.00004	0.041	0.005	0.046
Residual Std. Error	0.018 (df = 6130)	0.339 (df = 2483)	0.211 (df = 6130)	0.452 (df = 2483)
F Statistic	1.072 (df = 3; 6130)	36.445*** (df = 3; 2483)	10.898*** (df = 3; 6130)	40.604*** (df = 3; 2483)
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure 3. Overall Regression Results by Camera and Solution

- Stabilization Solutions negatively impacted detection rate but increased correct recognition rate
- Software had a minimal detection impact of -1.6% while benefiting recognition rate by 6.0%
- 3 Megapixels cameras are not practical when objects at greater than nine feet away
- -20% overall detection rate drop for 3 megapixel camera

References:

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- Viola, Paul, and Michael J. Jones. "Robust real-time face detection." International journal of computer vision 57.2 (2004): 137-154.