

Visible Light Communication

Project by -

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Introduction

Transfer of data from screen to camera using light in the visible spectrum.

Preferable over conventional schemes because the technique is

- Easy and quickest to set up
- Security against eavesdropping
- No interference possible with other methods of communication

Key Challenges -

- Viewer Experience
- Smoothing intensity from center to corner
- Detecting intensity change

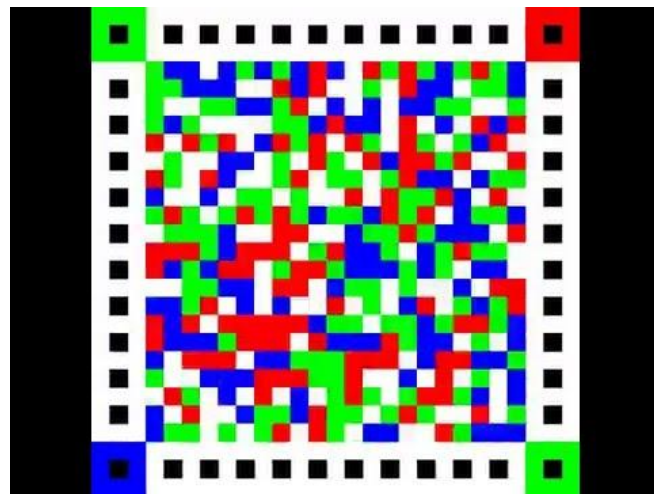
COBRA

Sender

- Uses a barcode-like pattern
- Data encoded in the Code Area.
- Corners, Tracking Bits carry metadata

Receiver

- Detects corners, orientation
- Synchronizes between frames
- Decodes the data, error correction

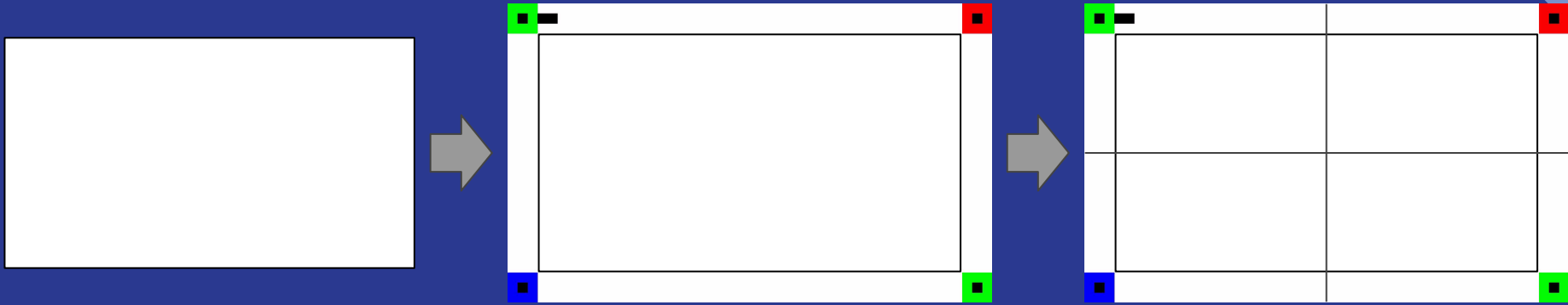


HiLight - Introduction

Key features

- Entire image used for transfer
- Encoding performed in time domain
- Modifies pixel intensities
- Viewing experience unchanged

HiLight - Encoding

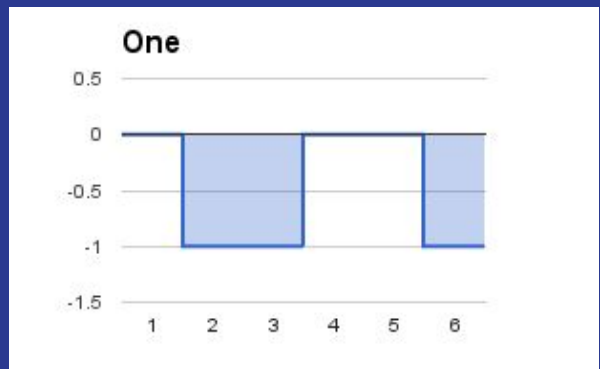
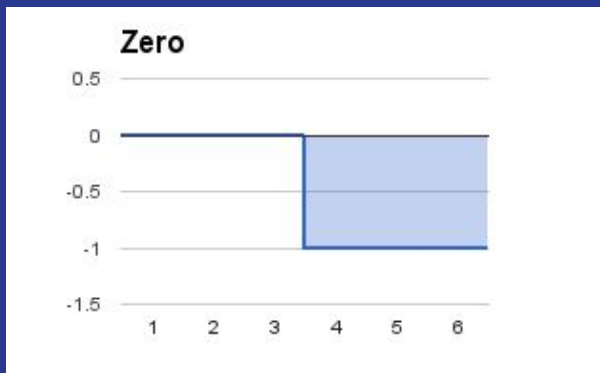


Sender frame

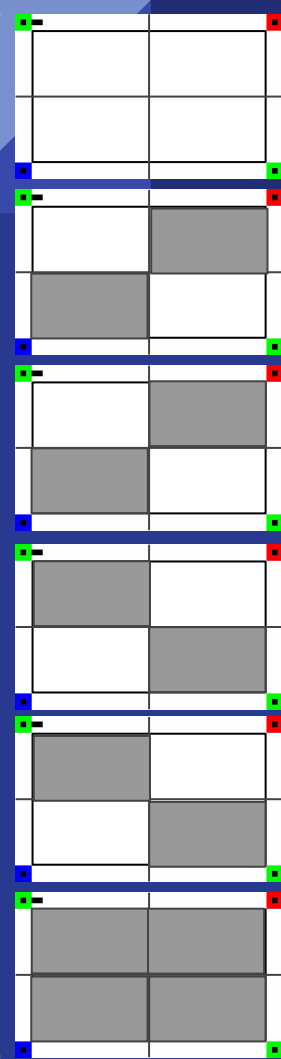
Add Corner Trackers
and Tracking bits

Divide into
blocks

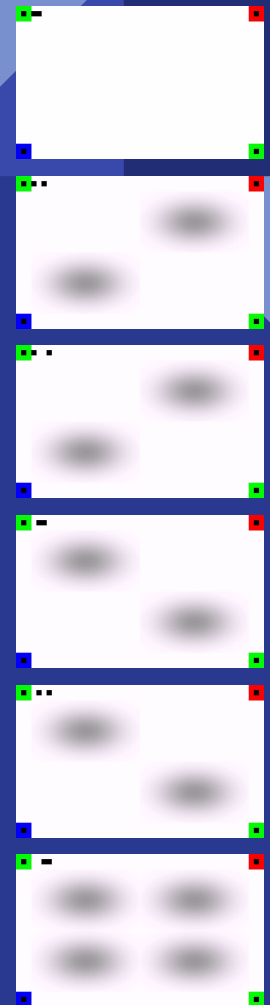
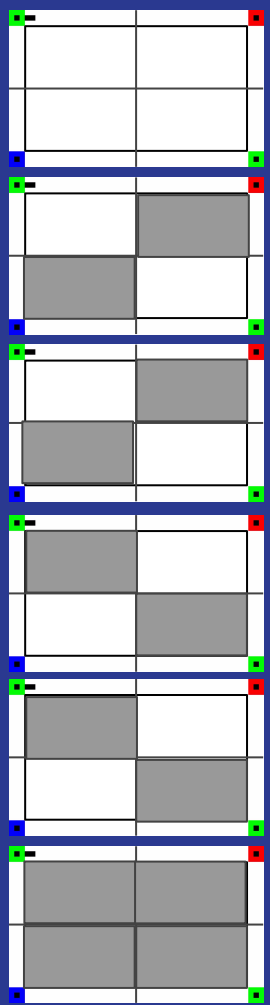
HiLight - Encoding



0	1
1	0



	0	1	
1		0	



A sample video



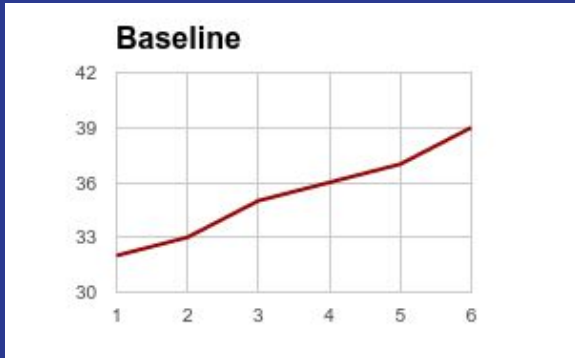
HiLight - Receiver

- Corner detection, Homography
- Synchronization
- Decoding.

Two algorithms used :

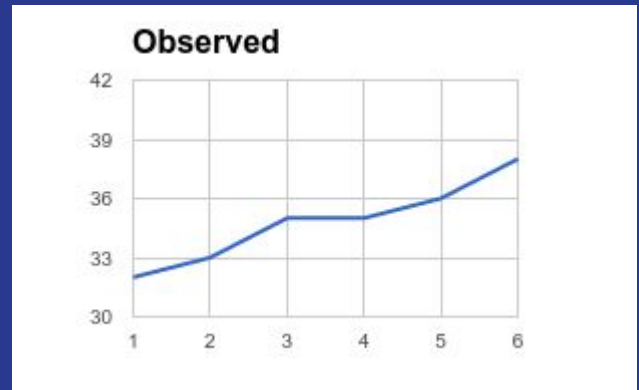
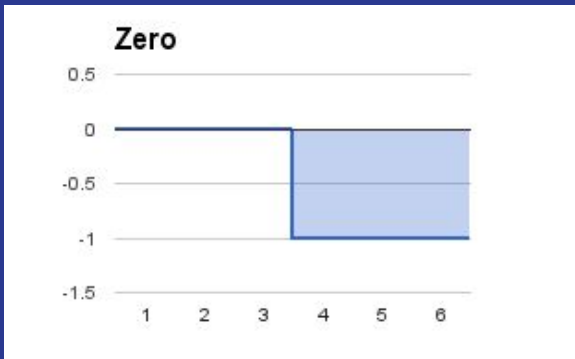
- Fit a line, compute the errors, check which bit is closer
- Reverse compute intensity assuming a bit; check which bit's best fit line has lesser total error

Algorithm 01

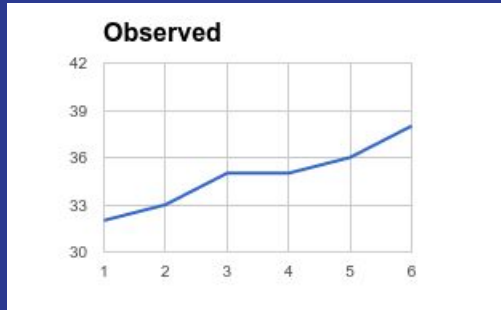


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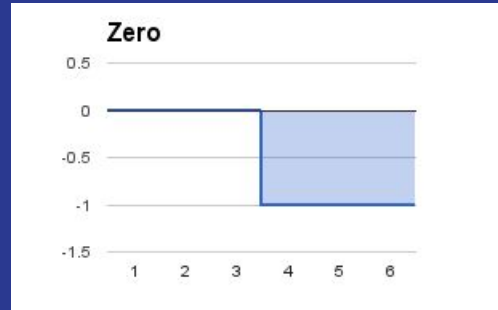
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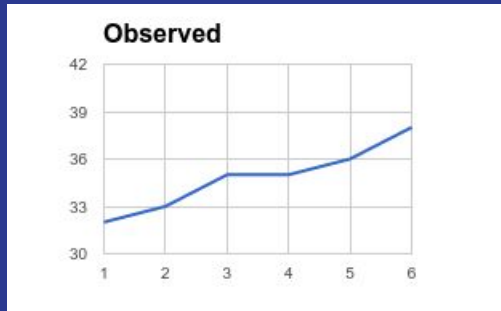
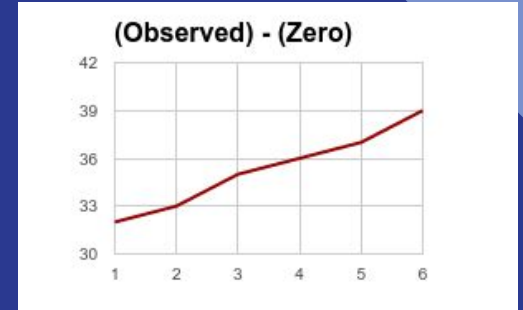
Algorithm 01



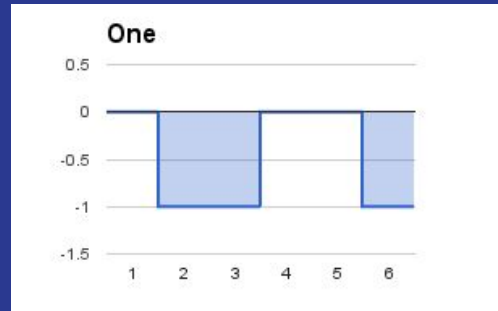
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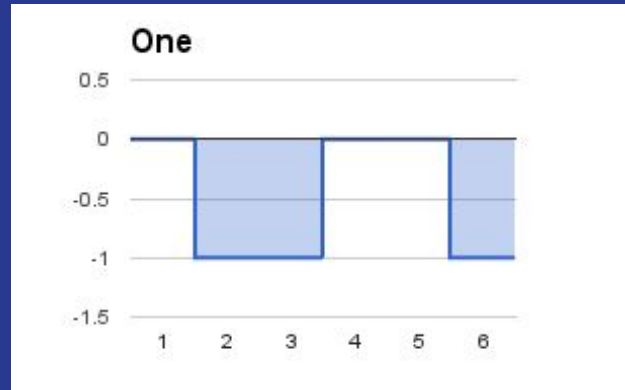
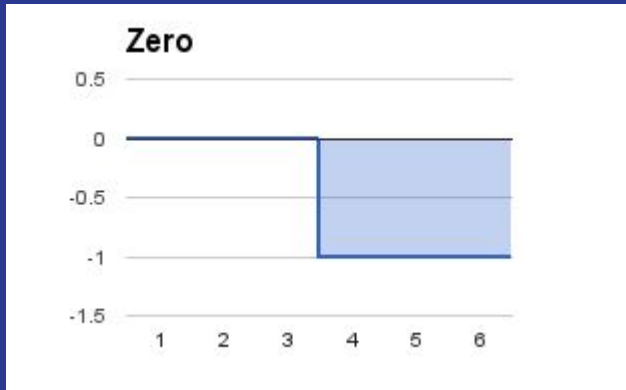
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Algorithm 02



Evaluation

- Metrics and Key Parameters
- Dependence on individual parameters

Metrics and Key Parameters

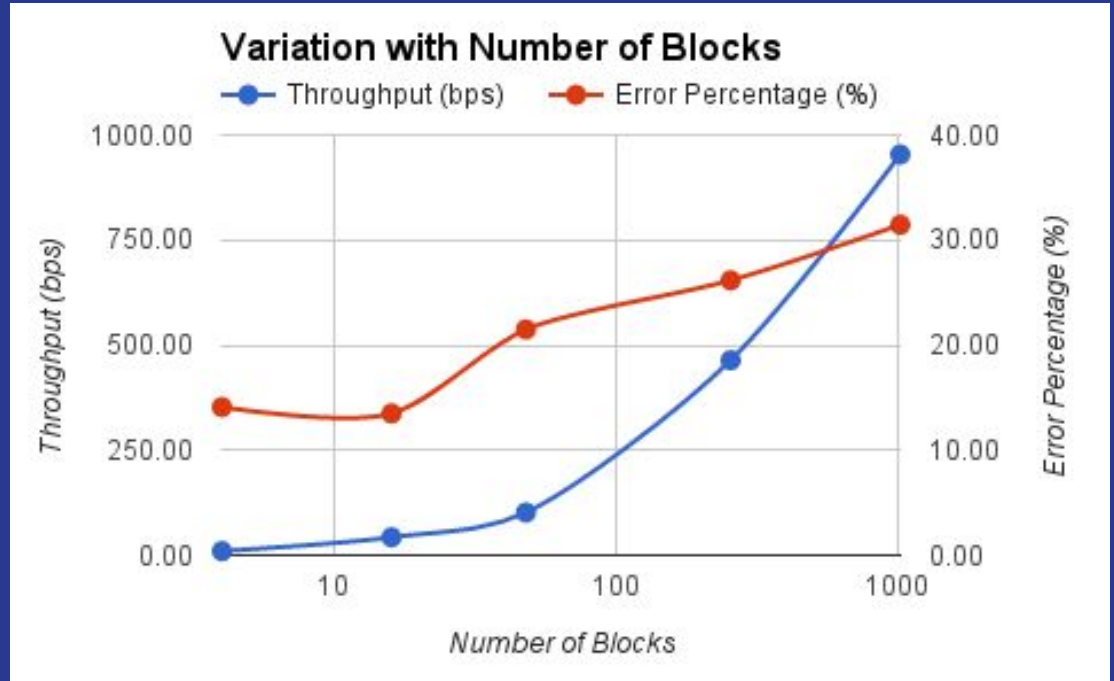
Metrics -

- Throughput
- Block-error-rate

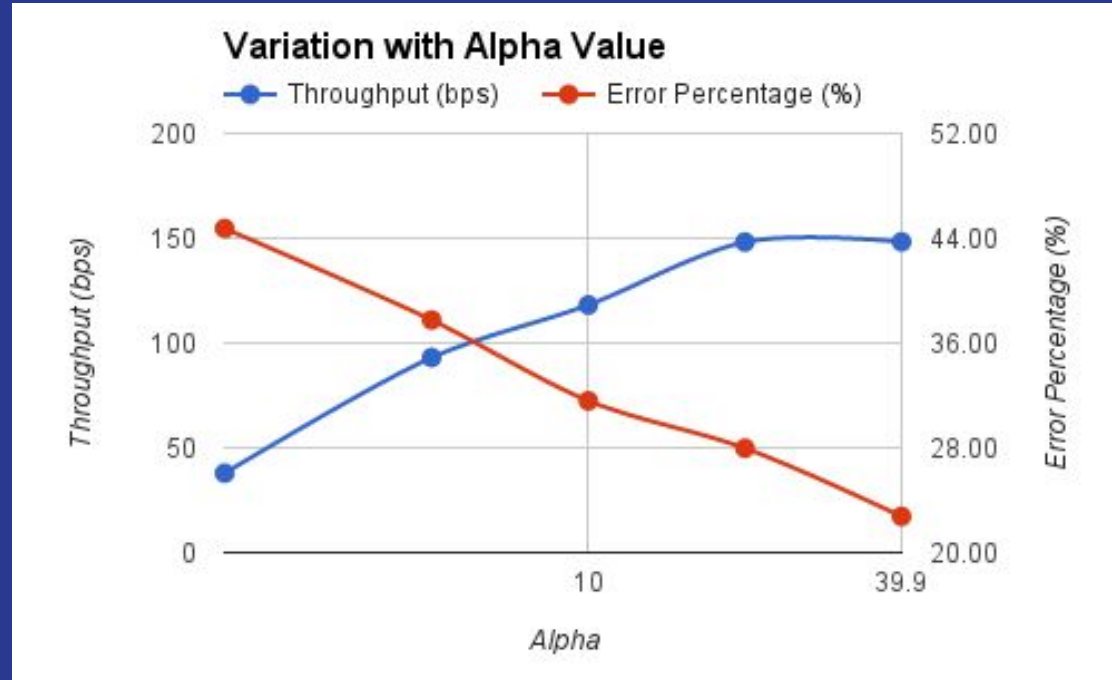
Parameters -

- Number of rows/columns
- Alpha multiplier
- Buffer size and pattern
- Pattern
- Decoder used at receiver
- Cut scene thresholds

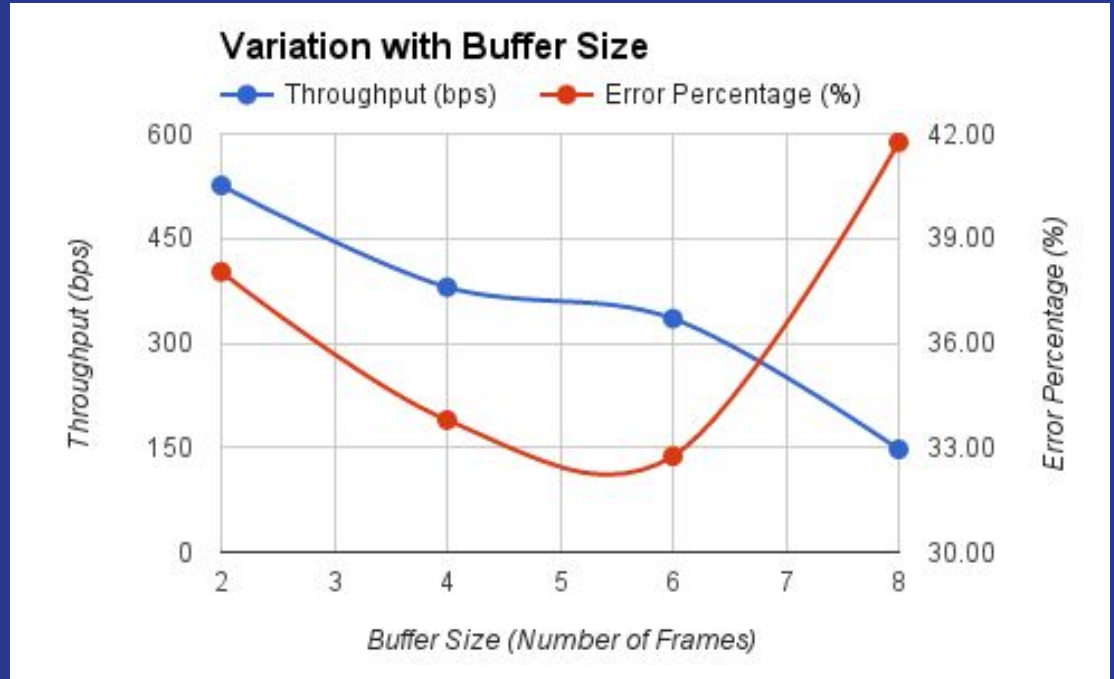
Throughput / Number of Blocks



Throughput / Alpha Value



Throughput / Buffer Size



COBRA vs HiLight (Quantitative)

COBRA

7% screen area

882 bits in every frame

Avg Throughput ~ 7Kbps

Error Rates ~ 1%

HiLight

Occupies entire screen

1024 bits in every 6 frames

Avg Throughput ~ 1Kbps

Error Rates ~ 35%

COBRA vs HiLight (Qualitative)

COBRA

- Error rates are low.
- More visually obtrusive

HiLight

- High Error rates. Due to linearity assumption and low alpha values
- With high fps and low alpha, no noticeable effect



Thank you