They could live - encoding invisible information in displays and ways to extract it

Vojtech Crha
v.crha@student.tudelft.nl

Professor: Marco Zuñiga Zamalloa
Supervisor: Miguel Chavez Tapia

TUDelft — Delft University of Technology

1.Introduction

QR are useful but have serious limitations …

- Ugly
- Static
- Limited amount of data transferred

We can do better!

Screen-to-camera communication can solve these issues!

- Invisible unless you want to see it
- Dynamic
- Potentially infinite amount of data

1.Unsightly QR code
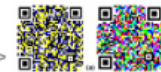
2.Research question

Existing algorithms create **2** colour (single luminence) grid and encode it in an image

2.Single luminence value grid

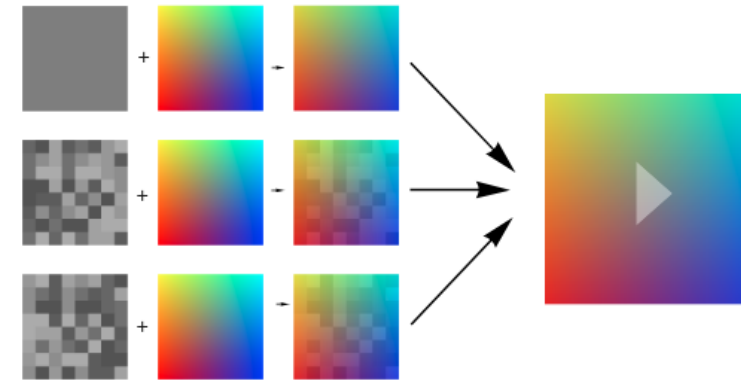### Why not more?

Kinda like this! ->

3.Proposed QR code standard hcc2d

Research questions: How many luminence levels can be used to reliably transmit data ?

4.Pipeline used by the implemented algorithm

3.Implementation

1.Generated a grid of shades of gray based on parameters

2.Create a complement of the grid

3.Alpha-compose with a picture

4.Put pictures in a video loop and play really fast (120Hz +)

4.Experiment details

Graphical aptitude test to put make results more objective

10 Randomized sets of different configurations to prevent bias
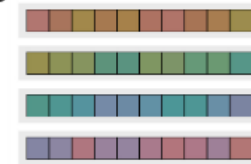
5.Farnsworth Munsell 100 Hue Test

Careful configuration generation to test as many options as possible

5.Results/conclusion

Table containing observability as well as level of transmission achieved

At any level of transmission, the effect is observable to some degree

2x or 4x data throughput is increase foreseeable but at cost of some visual artifacts

High refresh rate is way more important than color accuracy