2-Dimensional Color Barcoding Using Iterative Error Correcting Codes

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PROPOSAL

Various forms of 2-dimensional (2D) color barcodes have become popular due to their ease of readability and their storage capacity. Notable examples of 2D barcode standards include the QR code and the Data Matrix. It is also possible to make such barcodes colored, in effect increasing capacity through wavelength-division multiplexing. This has been done in schemes such as SpectraCode, Mobile Multi-Colored Composite (MMCC) and Microsoft's High Capacity Color Barcode (HCCB).

This project aims to implement color barcoding techniques using a DROID phone as a reading platform. MMCC codes were developed to target a variety of mobile cameras, including very low quality ones. HCCB codes are capable of using eight colors, but the basic version uses four which does not fully utilize the three independent color detectors of an Android camera. Other variants, like Paper Memory (PM) Codes, are overly sensitive to noise in the color spectrum. PM Codes claim to be able to use up to 17,000 different colors to encode information, but this scheme would require overly complex error correction to account for the inevitably large reading bit error rate when using an Android to capture data. As a further difference, we are approaching the problem by viewing the color channels as three separate channels. In other words, we are not concerned with matching our eight (2^3 for three binary channels) color possibilities correctly, but rather we are concerned with properly deconstructing the individual channels to grayscale and *then* matching the values to the correct value.

Our scheme would be to simply overlay three QR codes each in a different color channel (i.e. red, green, blue). Due to many external variables including lighting conditions, it is likely that these channels will be received with different error rates. To overcome this, we plan to implement an error correcting scheme with data interleaved across each color channel. Candidate error correcting codes could include low-density parity checks (LDPC) or turbo product codes. It should be noted that use of such modern iterative coding techniques would create a significant gain in information capacity if used in current QR codes which rely on Reed-Solomon codes. Rate of the codes used could be adjusted to allow for the barcode to be decoded with only two color channels or in grayscale.

Construction of colored barcodes will be done on a personal computer using either C or MATLAB. Decoding of barcodes would involve first performing color balancing and then passing each color channel a mobile QR code reader built on the Zebra Crossing (ZXing) library which will output soft bits for each code. The soft bits will be passed to the appropriate decoder. The decoder could be ported from an open source library to Android; alternatively, both students are currently enrolled in EE388: Modern Coding Theory, and with instructor permission, students could reuse work from this course in this project.

REFERENCES

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