



The Litepaper

A collaborative crypto-art project for the creative revolution

TEAM MEMBERS

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INTRODUCTION

The invention of the blockchain has brought with it things that previously had not been possible. One of these qualities is the ability to create truly unique digital objects and another is the lack of central controlling authority. We wanted to embrace the culture that has sprung up around the blockchain since we equate its fluid, ungoverned nature with freedom and this, in turn, is synonymous with art and expression.

We thus conceived the idea of a digital collaborative canvas/mural, accessible to everyone, where art and freedom of expression can be exercised without restriction. We like to think of ourselves as an art project which harnesses the power and freedom that the blockchain provides.





A LIVING, BREATHING, CONSTANTLY CHANGING CANVAS

The canvas “lives” on the blockchain, meaning its state can be altered through transactions made on the blockchain, and its entire history is recorded, meaning you can browse through the state over time, or replay its history to see how it has changed over time. It is available to be viewed by anyone with a way to explore the blockchain (for example through a web browser). The fact that it is hosted on the blockchain ensures that it is well distributed which in turn guarantees that it remains accessible to everyone without being shut down or censored.

The censorship-resistant nature of the blockchain provides users who want to make a statement (no matter how controversial) a platform to do so, and the pseudo-anonymous nature of the blockchain will mean people are able to make art or statements on the canvas without fear of being identified unless they wish to claim ownership by making a transaction.

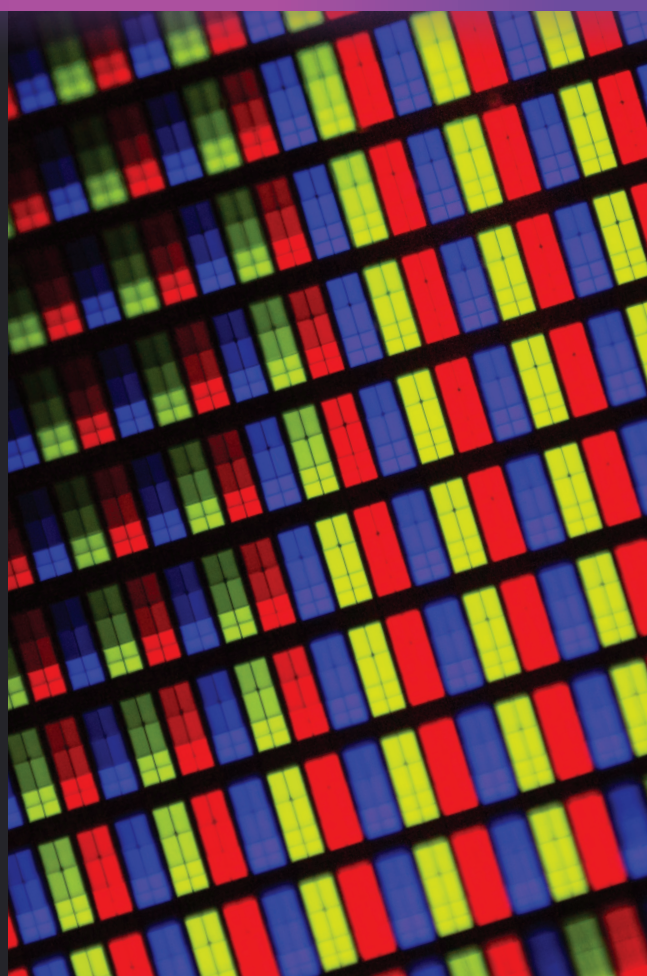
WHAT IS MURALL?

MurAll is a digital collaborative mural/canvas/wall measuring 2048 pixels by 1024 pixels (2097152 pixels in total) that anyone anywhere can draw on. There are no restrictions on what can be drawn. The entire ethos of the MurAll project is that it fits with the blockchain narrative of a neutral place that doesn't filter or stop any transaction. A place for true freedom of speech. The only thing required to draw on MurAll is the PAINT token. Any contribution to MurAll will be on the blockchain in its history for as long as the blockchain lives (i.e. you will always be able to see your contribution there in the history, even if someone draws over your pixels). When you draw, you also get a MURALL Non-Fungible Token (NFT) of your contribution, a token containing your drawing, which you own and are free to do with as you please - hold, display, trade, collect; the choice is yours.

Unlike some other collaborative drawing projects, you do not own the pixels you draw over on MurAll so someone else's drawing can be drawn over. However, no one can draw on your MURALL NFT which contains your original drawing on MurAll. The fact that MurAll can only be covered in its entirety a maximum of 21 thousand times means that people will think twice about redrawing other people's work; wouldn't you rather draw something unique considering you may not get the opportunity to draw on MurAll again?

COLOURS

MurAll uses RGB565, a 16-bit colour space which gives the best look while allowing for more pixels per transaction, as well as taking up less room on the blockchain. Each drawn image can have up to 256 distinct colours from the RGB565 spectrum. There is no set 256 colour palette, each artist can choose any 256 colours to use for each drawing.




TRANSACTION DATA

What's going on in the background?

Under the hood, the EVM deals with 32-byte objects. Even objects smaller than 32-bytes are converted to 32-bytes objects, hence 32-byte objects are the cheapest, most gas efficient objects to use for our transaction data, and we have taken this into account when building the smart contracts for MurAll.





The transaction data sent as part of the drawing onto MurAll consists of: the colour index (up to 256 colours), metadata (consisting of name, number, series id, and whether the image contains alpha), and the pixel data of the image.

- The colour index consists of ordered RGB565 colours (2 bytes each) grouped into 32-byte objects (hence 16 colours) up to 256 colours (hence 8 32-byte objects). If alpha is enabled, the colour at index 0 is used as the alpha channel.
- The pixel data consists of 3 arrays of 32-byte objects - pixel groups, pixel group indexes and individual pixels. The pixels in the data are references to the colour index, i.e. numbers 0 - 255 and thus only take 1 byte, which enables us to fit up to 32 pixels in a 32-byte object. The pixel groups are exactly this: 32-byte objects consisting of up to 32 pixels. The pixel group index array consists of the group position on the canvas where the 32 pixel group is located. This group position takes 2 bytes due to the resolution of the canvas being 2048 x 1024, which gives us 2097152 individual pixels, divided into groups of 32 = 65536 groups numbered 0 to 65535. Since 65535 is the highest number you can fit into 2 bytes it allows us to remove all validation of these group positions on the smart contract as there is no possibility for any number to fall outside the range of 0-65535 with respect to the group indexes. Each 32-byte object in the pixel group index array can fit in 16 group positions. The individual pixel array consists of individual pixels (1 byte) twinned with their group position on the canvas (2 bytes), and the position of the pixel within the 32 pixel group i.e. 0 - 31 (1 byte). Any number larger than 31 put into the byte referencing the position within the group is rounded to 31 on the client. Up to 8 pixels can be included in the 32-byte objects inside the individual pixel array. The MurAll client intelligently decides the most cost-effective way to populate the arrays with the pixel data of the artists' drawings.
- The metadata consists of an array of two 32-byte objects. The first 32-byte object is a name assigned to the NFT (up to 32 characters). The second 32-byte object contains a number optionally assigned by the artist (3 bytes - up to 16777216) a series id optionally assigned by the artist (also 3 bytes) plus the final bit is put to a value above 1 if alpha is enabled in the drawing.

Although this approach to the transaction data is complex, it has allowed us to fit the most pixel data we can into every drawing that is done on MurAll, and keep the gas price as low as possible considering the smart contract has no need to validate the data. We have also reduced the cost by pushing the data into the event logs rather than writing to contract storage.

TOKENOMICS

PAINT

PAINT is an ERC-20 token, required to draw on MurAll. Just like real-life paint, you can only use as much as you have to draw on the canvas, and just like real-life paint, when it's used it can't be used again. PAINT has a fixed supply of 22,020,096,000. At 0.5 PAINT per pixel, it costs 1,048,576 PAINT to draw over all 2,097,152 pixels once. Thus the whole canvas can be drawn over in its entirety 21 thousand times ($1,048,576 \text{ PAINT} \times 21,000 \text{ draws} = 22,020,096,000 \text{ PAINT}$). This means, the larger the area you wish to draw on the canvas, the more PAINT tokens are required to do so. PAINT tokens are not minable as all tokens have been created at project inception. Users can acquire PAINT by participating in the airdrop, or by buying on the open market after the airdrop.

In each transaction made on the canvas, tokens are "burnt", meaning all tokens that are spent drawing to the canvas are taken out of circulation. This reduces the total supply, which increases the rarity (and in turn, the value) of the remaining tokens. This means at the beginning of the life of MurAll when PAINT is plentiful in supply, drawing to the canvas will be incredibly cheap, which no doubt will result in lower quality artwork, where anyone and everyone will draw anything and everything on the canvas because it is so cheap. However, over time as the tokens' supply reduces (and thus the rarity increases), the remaining tokens will increase in value, causing token holders to be more reluctant to use their tokens to draw meaningless things, leaving only those who truly want to make a statement or who truly want to make good quality art with the desire to use the tokens to draw on the canvas.



MURALL Non-Fungible Token (NFT)

Users are able to “mint” a MURALL; a “write-once” ERC721 Non-Fungible Token (NFT) that is produced when they complete a drawing on the canvas. This gives them a piece of MurAll that they own, which they can hold onto or trade, and given the finite nature of the PAINT token, there will only be a finite amount of NFTs produced by MurAll, making them scarce and collectable. A user could, for example, collect pieces like a puzzle or buy other users’ work to own for themselves.

Users are able to track their contribution to the canvas (i.e. the transactions on the blockchain) to see their “part in history” in the life of the canvas, and given the finite life of the canvas, they have an incentive to draw on it so as to be included in its life. Also, the NFT facet of the project will give MurAll something that can continue to live well past the life of the MurAll canvas.

In order to maximise the number of pixels you can draw to MurAll, the NFT initially contains a hash of the user’s contribution onto the MurAll canvas. This avoids sharing the transaction’s gas cost between the drawing and the NFT and thus increases the number of pixels that can be drawn for that transaction. Additionally, users can choose to fill the NFT with the original pixel data meaning that the pixel data will be permanently stored inside the NFT on the Ethereum blockchain. However, users may opt to leave it unfilled, because they simply want to draw on MurAll in order to collaborate with the existing artwork on the canvas.

It does not cost PAINT to create an NFT, since the user has already spent PAINT to draw on the canvas but they will pay the network gas fees for the transaction to create and fill the NFT data. The NFTs are coded in a “write once” setup, meaning it will fill the NFT as much as possible using the gas provided. If it runs out of gas it will stop where it is and make note of where it got to, meaning subsequent transactions will fill the remaining data continuing from where it last finished.





GALLERY

The MurAll client provides a gallery where you can view the MURALLs you own. You can use it to display them as they are or combine them together to create whole new pieces of art for your personal viewing. You can also trade your

MURALL, or buy other peoples MURALL to add to your collection. MURALL NFTs can also be imported into other platforms that support our open source mappers.

DATA STORAGE

All canvas pixel data is stored on the Ethereum blockchain. Most current solutions use things like IPFS however they are not anywhere as decentralised as the blockchain itself, and also separate the ownership of the data and the data itself. We really wanted to provide a solution that was without the compromise of this separation, so we have done our best to create a solution that has all data on-chain.

From a technical perspective, the color index, metadata on-chain and data hash of the pixel data are stored on-chain by the NFT

minting event which pushes the data into the Ethereum log storage. These logs can then be used at a later date to fill the NFT using the “write once” mechanism and place the drawing data directly onto the blockchain, should the user opt to do so.

In addition, we have an off-chain solution that listens for all MurAll state changes and stores them for later retrieval. This provides faster, more efficient access than would be achievable by directly accessing the Ethereum logs.



FROM A USER'S PERSPECTIVE

Users will be excited to participate in the canvas seeing as there will be only 1 canvas, with the limited token supply (and thus limited "life" of the canvas), which will drive interest and participation, plus the fact that they will produce the NFT which can be held and traded on the open market will give even more drive for participation. As interest grows, and the PAINT token price increases, perhaps even high profile artists will be willing to contribute their art to the canvas. Even without participation, as a viewer, you could display the canvas and see it change over

time as more people contribute. I envision people constructing live desktop wallpapers that listen to changes to the blockchain and display the new artwork as it happens, or projectors displayed publicly connected to the canvas blockchain to display the artwork and its changes as it happens, perhaps even smart picture frames people can have in their homes that display the art live, with the ability to navigate to points in the blockchain with art that you like, or perhaps replay changes at your request.

CONCLUSION

This is a truly unique project, utilising the unique aspects of blockchain technology to achieve something previously not possible. The canvas has a wide reach in terms of audience (i.e. anyone with an internet connection) and is available for everyone, with or without artistic ability.

KEY TAKE-AWAYS

- Collaborative digital mural
 - On-chain data storage
- Off-chain fast access state storage
 - Fixed Supply PAINT token
 - NFT (ERC-720) Creation facility
- Optional on-chain NFT data storage

