



# S3NTIGRAPH WHITEPAPER

Decentralized Presentation of  
Cumulative Emotion Coordinates

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## 1. Introduction

### 1.1 This document

This document describes a platform that utilizes the blockchain technology to generate meaningful graphical emotion trends based on the users' textual inputs.

### 1.2 The problem

The world we live in is characterized by numerous events that not just affect our countries, but directly affect our lives. These events could be relatively negative, positive or neutral. While classical economists hold on to the Gross Domestic Product, GDP, as a method for grading a country's economic performance, it completely fails to address the underlying issue of individual happiness and overall well-being of say, a country.

The Gross National Happiness, GNH, coined in the 70's, is actually agreed upon by many socio-economists as a better "tool" for measuring the overall well-being of humans and that the GDP is an outdated measure (Waele and Waele, 2017). An interesting and really important quote from Gerd Leonhard, *"Happiness tells us how well a society satisfies the major concerns of people's everyday life. GDP is a measure limited to one aspect of economic life, the production of material goods. The aphorism that money isn't everything in life, applies here. If happiness were to supplant GDP as a leading measure of societal wellbeing, public policy might perhaps be moved in a direction more meaningful to people's lives."* (Leonhard, 2016).

The problem, however, with the GNH is its tardiness and inability to reflect an individual's state of mind. GNH does not offer enough information regarding a user's well-being in relationship with certain external impulses.

Happiness is the “nucleus” of our lives. In as much as we try to stay happy by conditioning our minds, it still is gravely affected by external inputs and impulses. Thus, we need a way to dynamically track the overall happiness or sentiments of any arbitrary participant. This data will help any authority, parent, teacher, governing body etc., understand how their daily decisions directly affect the lives of their constituents, students, citizens etc.

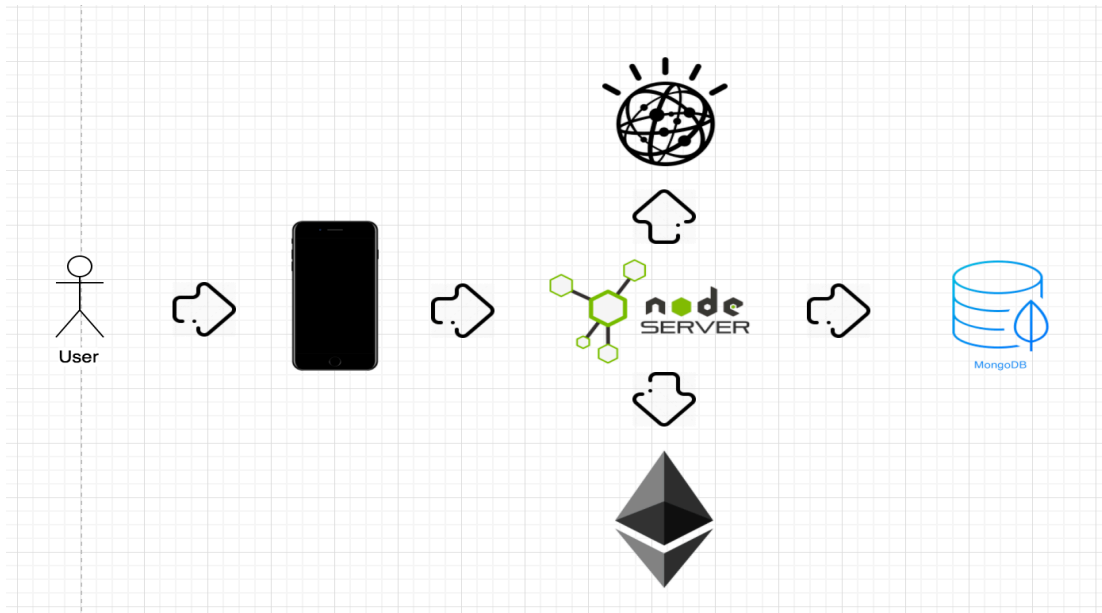
### 1.3 The solution

We at s3ntigrapH believe that devising an algorithm to categorize our various tones from a given utterance (in this case, textual input), persisting the computed data in a decentralized manner via blockchain technology (in this case, the Ethereum blockchain), and rendering the overall trend to the user, presents a good starting point for tracking/monitoring our happiness in real-time, and also to map those periods to what actual events triggered those corresponding results.

### 1.4 The platform

There is currently an Ethereum Smart Contract in place that we have carefully written to interface between user client inputs (web or mobile browsers) and the blockchain. A Node JS application serves the User Interface to the browser for the user’s interaction. Each user entry triggers an asynchronous XHR to IBM Watson’s Tone Analyzer API, which returns a 5-vector sentiment coordinate. We use Mongo to store Watson’s JSON feedback, perform some off-chain calculations and finally persist our sentigraph index( $si$ ) to the blockchain.  $si$  is a value representation of an arbitrary user’s coordinates, computed based on an algorithm. Finally, the user can see the overall trend as a chart plots  $si$  against time,  $t$ .

As at today, our code (partial) is publicly accessible and hosted on GitHub (<https://github.com/s3graph/sentigraph>). The following diagram is a brief précis of the platform’s ecosystem:



### Description:

- Using the web/mobile app, the authenticated user enters a string of his/her thought or feeling.
- On submission to the Node server, an asynchronous request is sent to Tone Analyzer API to fetch JSON 5-vector coordinate.
- Via an off-chain algorithm, *si* is computed.
- *si*, coordinates, initial utterance/string, timestamp and other geo-related data is persisted to Mongo DB.
- Every 1 hour, we bulk-write data to the blockchain to save on “gas” should we have immediately written to the blockchain after every user entry.
- When user gets authenticated, the app fetches pre-persisted sentigraph index, coordinate, string, and timestamp data from the blockchain.
- This data is then represented to the user via a trend chart
- The user can query to view the overall trend chart of everyone in the s3ntigraph network.

## 1.5 The algorithm

So Watson Tone Analyzer returns a coordinate in a 5-dimensional space representing the following arbitrary axes (*anger* [0.60], *disgust* [0.57], *fear* [0.33], *joy* [0.89], *sadness* [0.01]). Each tone value,  $V$ , ranges from 0 to 1. We can illustrate this 5-dimensional space as a sphere,  $H$ .

Now for every arbitrary user's utterance we get a point (coordinate),  $P$ , such that  $P$  is statically embedded and positioned in  $H$ .

Let's assume the center of equilibrium,  $e$ , the point (coordinate) at which the individual enjoys utmost satisfaction and well-being. This point,  $e$ , is a perfect situation of pure "joy" depicted as follows:

*anger* [0.00], *disgust* [0.00], *fear* [0.00], *joy* [1.00], *sadness* [0.00]

Furthermore, we consider a "bias",  $b$ , for all values of the coordinate that takes into consideration the negativity (or positivity – *this can be flipped*) of the sentiments. For instance, Points  $P_1$  and  $P_2$  could have a distance of  $s$  from  $e$ , being equidistant, but have a distance of  $k$  between themselves.  $P_1$  perhaps could be an "anger" sentiment while  $P_2$  is a "joy". An example of  $b_1, b_2, \dots, b_n$  that favors "joy" is:  
*anger* -> 3, *disgust* -> 2.5, *fear* -> 1.5, *joy* -> 1, *sadness* -> 2

We adjust all  $V$  in  $P$ , to accommodate for the bias and thus reposition  $P$  in  $H$ . This will shift  $P_1$  in  $H$  as follows:

*anger* ->  $3*0.60$ , *disgust* ->  $2.5*0.57$ , *fear* ->  $1.5*0.33$ , *joy* ->  $1*0.89$ , *sadness* ->  $2*0.01$

So for one utterance, we can calculate the  $si$ , which is the Euclidian distance between points  $P_1$  and  $e$  as follows:

$$si_1 = |P_1 - e| \text{ OR}$$

$$si^2 = \sum_{p=1}^n (V_{ki} - V_{kj})^2$$

where:

$P_1$  is an arbitrary weighted point in  $H$

$e$  is the equilibrium coordinate in  $H$

$si_1$  is the sentigraph index, the Euclidean distance between  $P_1$  and  $e$

$V$  is the value of each emotion in coordinate  $P_1$

$V_{ki}$  is emotional value of  $k^{\text{th}}$  variable in coordinate  $P_i$

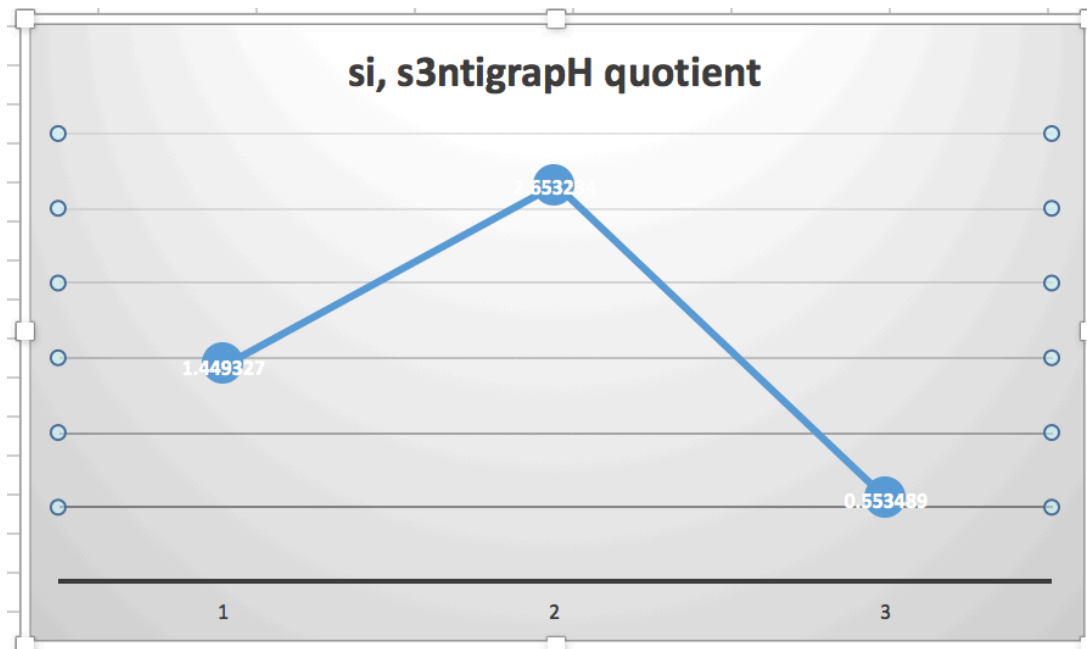
$V_{kj}$  is emotional value of  $k^{\text{th}}$  variable in coordinate  $P_j$

Finally, a trend graph of  $si$  against  $t$ , is plotted and presented to the user. Also a cumulative  $si$  is plotted against  $t$ , and presented to everyone in the s3ntigraphH network.

Here is a sample run for 3 utterances by an arbitrary user:

Utterance #1							s3ntigraphH quotient
Emotion	Watson Score	Bias	Adjusted (Score * Bias)	e	t, pm		
Anger	0.06	3.00	0.18	0.00	2:57:00 PM		
Disgust	0.57	2.50	1.43	0.00			
Fear	0.33	1.50	0.50	0.00		$si$	1.449327
Joy	0.89	1.00	0.89	1.00			
Sadness	0.01	2.00	0.02	0.00			
Utterance #2							
Emotion	Watson Score	Bias	Adjusted (B*C)	e	t, pm		
Anger	0.8	3.00	2.40	0.00	3:00:35 PM		
Disgust	0.57	2.50	1.43	0.00			
Fear	0.33	1.50	0.50	0.00		$si$	2.653234
Joy	0.06	1.00	0.06	1.00			
Sadness	0.01	2.00	0.02	0.00			
Utterance #3							
Emotion	Watson Score	Bias	Adjusted (B*C)	e	t, pm		
Anger	0.02	3.00	0.06	0.00	3:17:55 PM		
Disgust	0.05	2.50	0.13	0.00			
Fear	0.25	1.50	0.38	0.00		$si$	0.553489
Joy	0.61	1.00	0.61	1.00			
Sadness	0.44	2.00	0.88	0.00			

It is important to note that the smaller  $si$  is, the closer it is to  $e$ . This also implies that a smaller  $si$  is relatively happier than a larger one. Now we plot a graph of  $si$  against  $t$  for all the iterations:



The last (third)  $si$  depicts that the user is actually “happier” than his/her initial two engagements. We can go as far as computing the percentage improvement or decline of this “state” of well-being.

It is important to note that this is just for one user. While the overall trend will be plotted ad-infinitum ( $si$  and  $t$ , are persisted in the blockchain), the overall trend for all participants of the s3ntigraph network will be computed and presented as well.



## 2. Roadmap

### 2.1 Roadmap synopsis

Phase	Period	Initiatives	Status
Now			
		s3ntigraph Smart Contract	Completed (Testnet)
		Platform setup (Mongo DB, Amazon Linux Node Server)	Completed
		Proof of Concept	Completed
		Algorithm	In Progress
$\alpha$			
	Sep-17	Algorithm	
		Android	
		iOS	
$\beta$			
	Jan-18		
		Integration with Twitter	
		Integration with Facebook	
		Integration with various Review-based systems	
		Expand team	
$\gamma$			
	May-18		
		Integration with Polling systems	
		Extensive outreach to research universities and institutes	
		Extensive outreach to News streams, publications, banks, hospitals, governments	
		Partnership with IBM Watson	
		Partnership with Google , Amazon	

## 3. Future Opportunities

It is quite apparent that the opportunities this solution would expose are bountiful. In politics, debates, promises and legislative actions can be gauged by the resultant cumulative sentigraph index of the citizens. In medicine and psychiatry, for instance, medical diagnosis and patient care can be tested for their expediency by the resultant cumulative sentigraph index of the patients.

We have also considered a situation where a twitter can tweet [@s3graph](#) to immediately watch his sentiment trend, and categorize that trend by other twitters' responses to a given topic or news.

We have considered merging sentiments from different platforms like Facebook, Twitter and LinkedIn. So a user can continue analyzing his cumulative sentigraph index regardless of what platform he/she did engage with.

What about wearables? Yes, we anticipate other modes of capturing user “utterances” including signals and waves.

Sports, criminology, psychology, TSA/border security and so on, are areas we can extend to. Again, the opportunities abound and may not be completely exhausted.

#### 4. Fundraiser

Fundraising is the process of raising funds for the development of the platform by selling Graph, the s3ntigraph token. Graph is a Waves-based token. We have made this choice to not only foster the utilization of cross-platform utilities but to have a lean decentralized application void of Smart Contracts for the sole purpose of generating ERC-20 tokens. Another benefit of using a Waves-based token is the speed to trade them. Graph will be listed on Waves DEX, and we are currently trying to get it verified by the Waves developers. The ID for Graph is:

**3PGVT9YhBjyoY5kki61x8woZPtuCyuLzxks**

*Be careful not to trade or deal any Graph with a different ID.*

We will continue to have one Smart Contract that does the job, while we “outsource” our tokenization functionality to Waves, which is what it was made to do; generating tokens for any platforms whilst being agnostic to it. This approach will also abet the “jamming” effects on the Ethereum blockchain due to multiple ICOs as observed during the Status crowdsale. We have also noticed cases with multiple reissuance of ERC20 tokens as a result of bugs in the Smart Contract. It is possible to realize missing tokens due to these errors. This has begun to present negative impressions to willing crypto investors, especially those that favor the Ethereum platform. With Graph the above mentioned flaws will be totally non-

existent. One can imagine how the Ethereum blockchain will smoothly run if it had 50% less Smart Contract tokens for ERC20 coins.

Thus, by leveraging the Waves Platform, we are ensuring a smoothly-run fundraiser with no hiccups to the blockchain from our part.

Contributions will be made via paper wallets (not exchanges) with **Waves, BTC or ETH**. Post the funds raising event, Graph tokens will be issued to the corresponding investors at their Waves wallet (those without a Waves paper wallet will be required to create one, preferably at *waveswallet.io* **prior to contributing**). *Further instructions regarding actual contributions will be released on the fundraiser page of the website.*

<b>1 Graph</b>	<b>1 Waves</b>
Total Graph Generated	5000000
Percentage of Graph to s3ntigraphH team	20%
Percentage of Graph tokens to participants	75%
Bounty	5%

We expect to distribute Graph between 2 – 4 weeks of the fundraiser completion.

If our goal is met, we guarantee the precise implementation of all our scheduled tasks for the  $\gamma$  phase.

Details of the fundraiser can be found at [sentigraph.io/fundraiser](https://sentigraph.io/fundraiser)

## 5. Graph

Graph, a Waves-based token, is the official token of s3ntigraphH. Section 4 highlights the benefits of leveraging Waves for tokens. Graph, being a non-ERC20 token cannot “play” in the Ethereum blockchain. However, s3ntigraphH’s “in-dapp” functionalities

are completely independent of any tokens. Graph will thus be conceptualized as a *store of value* and *ownership* of s3ntigraphH.

This implies that quarterly dividends *may* be issued to current Graph holders via a *proof-of-participation*, which is basically a process to verify the investor and indicate his/her interest in receiving such dividends. Dividends Per Token (DPT) for the quarter will be determined by s3ntigraphH based on its retained earnings (actually equity - *Revenues less all Expenses*), and will be between 0 and the Earnings per Token (EPT). The EPT is the ratio of the total earnings to total issued tokens. Because the Graph token is a store of value and ownership (*though no voting rights*), the dividends issued will be in Waves. Also, earnings will be reported in Waves.

Prior to dividend distribution, in the case there's one for that quarter, the proof-of-participation would require the investor to send a Graph from his wallet(s), to another destination owned by s3ntigraphH. The Graph will be returned post verification.

Quarterly financial reports will be released on the site and would detail the business's ventures, plans, revenues, costs, retained earnings, and other financial information including token price, EPT, DPT etc.

We have also considered giving more preference to loyal, long-term Graph holders, which we will refer to as "long Graphers". Long Graphers *may* receive (depending on the discretion of the s3ntigraphH team, say based on investors "Graph transaction volume" being low due to long holding), a slightly higher DPT than other holders at the time of the dividend payout. This is an effort to foster collaboration between token holders, who have become dedicated, and the s3ntigraphH project.

Regarding the re-issuance of Graph. We are locked to 5,000,000. However, economic and market situations in the future may require us to do a "stock split" or some form of dilution of tokens, and as such may need to re-issue more tokens, though unlikely. So it is fair to assume Graph is "capped" at 5 million tokens, with 3.75 of those available for purchase via the fundraiser I and fundraiser II events.

## 6. Budget

The table below shows the estimations of what the funds will be used for:

Aspect	Portion of Budget %
Development/R & D	30
Marketing/Seminars/Demos	40
Moderation & Technical Support	1
Staff Compensation and prior costs	29

## 7. References

Waele, R. and Waele, V. (2017). *Gross Domestic Product vs Gross National Happiness (GDP vs GNH)*. [online] Techvshuman.com. Available at: <http://www.techvshuman.com/2016/08/15/gross-domestic-product-vs-gross-national-happiness-gdp-vs-gnh/> [Accessed 27 Jun. 2017].

Leonhard, Gerd. *Technology Vs. Humanity*. United Kingdom: Fast Future Publishing, FutureScapes, 2016. Print.