

Trabajo Final IoT

Sistema de control de CO₂ en frigoríficos

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PROBLEMÁTICA A ABORDAR



El almacenamiento de papas en cámaras frigoríficas presenta dificultades para su control. Aún en frío las papas se siguen descomponiendo y es muy difícil detectar cuando se pudren. Asimismo, es necesario mantener bajo el nivel de CO₂ en el ambiente para ralentizar el deterioro.



OBJETIVOS DEL PROYECTO

CONTROL CO₂

Poder llevar un control en tiempo real de los valores de CO₂ presentes en la cámara frigorífica con papas.

UMBRALES REALES

Siendo 800 ppm una cantidad adecuada de CO₂ pero 1000 ya algo riesgoso, la ventilación se enciende superados los 800.

VENTILACIÓN

Cuando el CO₂ es muy alto, una señal automática manda a prender la ventilación, y luego a apagarla cuando desciende.

DATOS

Toda la información de CO₂ recibida por Node-RED es llevada a una base de datos InfluxDB.

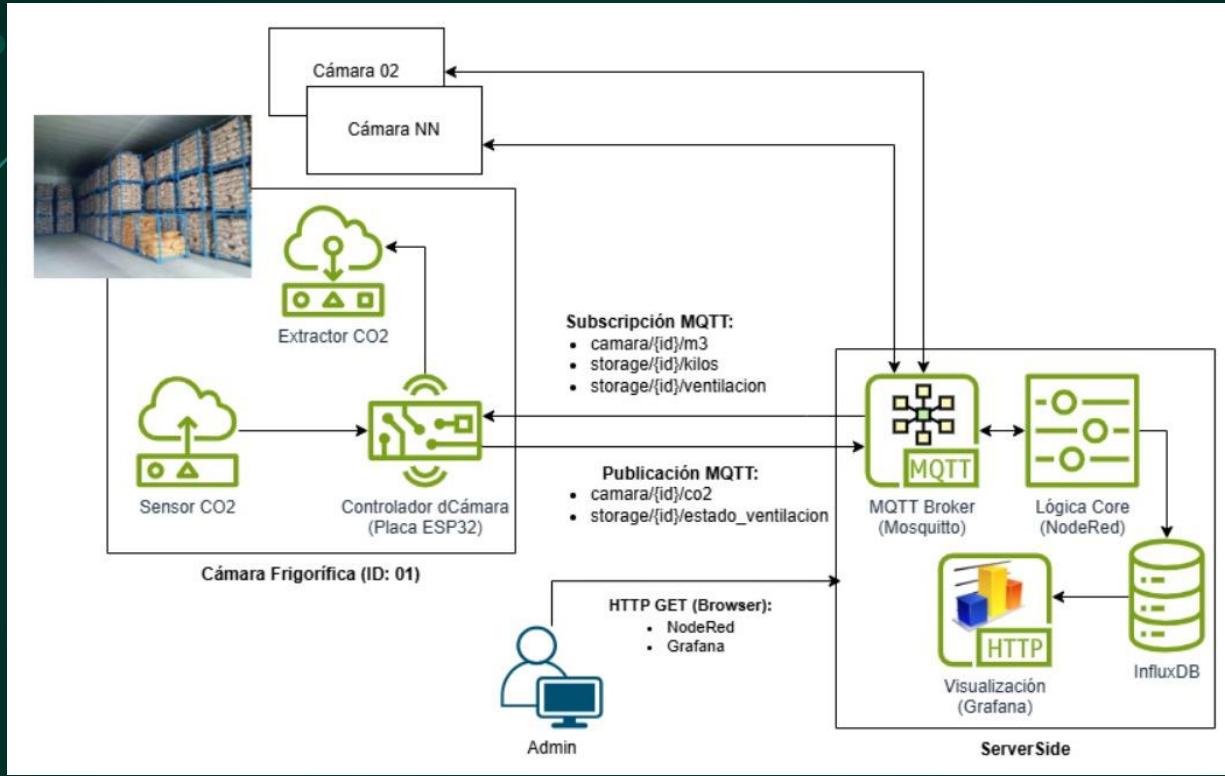
SIMULACIÓN

Los valores de CO₂ simulado se basan en el standard de **11 ppm/h** por kilo de papas sanas y **65 ppm/h** para las podridas.



GRÁFICOS

Los valores de CO₂ registrados en InfluxDB es tomada por Grafana para ofrecer una gran gama de gráficos estadísticos.



Arquitectura de solución

MEDIDAS Y UMBRALES

Algunas de las medidas y umbrales utilizados en el proyecto y su razón de ser.

Volumen cámara	Se tomó por defecto una cámara chica de 8m³ . Esta medida puede ser reemplazada desde el nodo "Setear M3" en Node-RED.
Papas	Las papas almacenadas se miden en kilogramos. Este valor puede ser modificado desde el nodo "Setear KG" de Node-RED. Por defecto, se utilizan 5000kg . Se estima que caben 1000 kg por m ³ .
Medida CO₂	Las papas generan CO ₂ al respirar, valor que no puede superar los 1000 ppm (<i>partes por millón, medida standard</i>) sin acelerar su proceso de descomposición.
Rango CO₂	El rango ideal de CO ₂ presente en el aire es de 400-800 ppm , y no se deben superar los 1000 . Es por ello que Node-RED solicita la ventilación de la cámara cuando se superan los 800 ppm .
Índice de putrefacción	La simulación de papas podridas para esta demostración implica la pudrición de 0-2% de las papas totales por segundo. Y cada vez que se setea una nueva cantidad de kilos, esto se reinicia a 0.
Calculo de CO₂	En base a los bucles de 1 segundo establecidos, el CO ₂ simulado se acumula en base a 11/3600 ppm para la cantidad de papas sanas y 65/3600 para aquella cantidad de papas podridas.

Para más información:

ASHRAE (American Society of Heating,
Refrigerating and Air-Conditioning Engineers)

Para más valores utilizados en el proyecto:

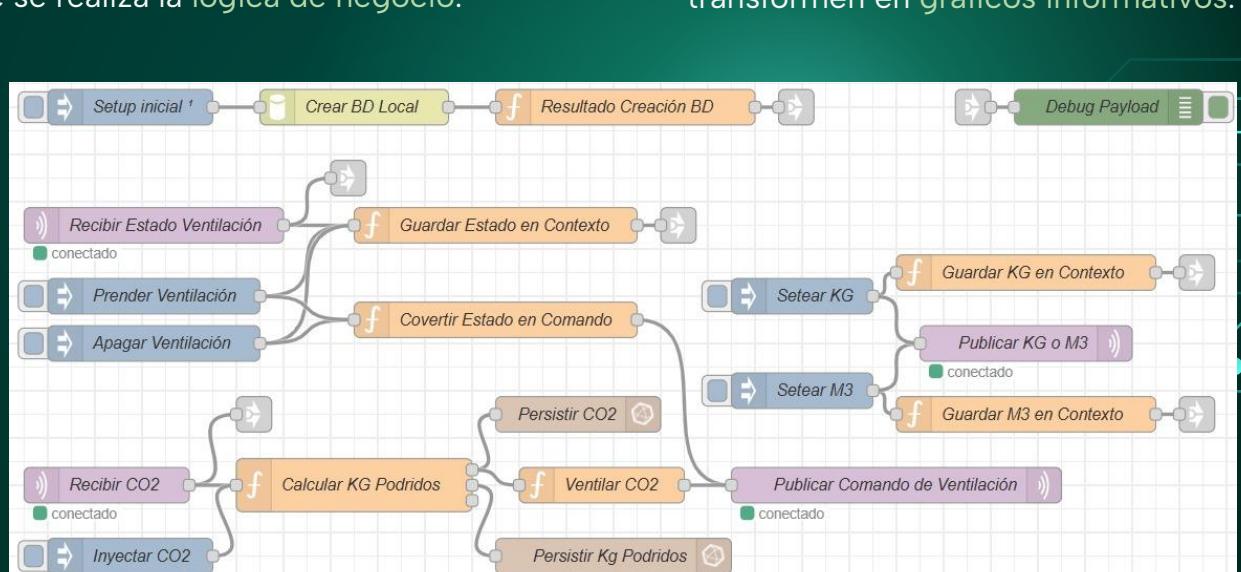
Módulo de configuración

Centro de Control Node-RED

Siendo el **ESP32** solo la parte que registra (*o simula*) e informa la generación de CO₂ en la cámara frigorífica, es en realidad **Node-RED** donde se realiza la lógica de negocio:

- Manejo de mensajes MQTT.
- Persistencia en InfluxDB.
- Comandos de encendido y apagado de ventilación.
- Setup de BD.
- Sincronización con ESP32.

Acá se centra gran parte de la lógica que permitirá que las mediciones se transformen en gráficos informativos.



INTEGRACIÓN Y PERSISTENCIA

INFLUXDB

- Los datos son almacenados en una base de datos InfluxDB con registro temporal
- La DB se crea automáticamente si no existe y comienza sin valores de ejemplo
- Las lecturas de CO₂ son actualmente el único dato que se guarda y son utilizados para Grafana
- La arquitectura modular del proyecto permite su extensión a otros valores (temperatura, humedad, etc).

```
name: co2
time          co2
-----
1751408923108110106 0
1751408924115699155 3.82
1751408925124186712 7.64
1751408926131697882 11.46
1751408927135869033 15.28
1751408928139037606 19.1
1751408929144542240 22.92
```

PRUEBAS Y RESULTADOS

Se realizaron muchas pruebas para lograr simular un funcionamiento semi-realista de una gran cantidad de kilos de papas produciendo CO₂ y pudriéndose en un corto tiempo. En los gráficos se ve el aumento de gas progresivo hasta el encendido del extractor que lo reduce rápidamente.



En la interfaz de Grafana se ofrece al usuario técnico o admin mediciones generadas a partir de los datos históricos de CO₂ y Kg de papas podridas, registrados en InfluxDB.



DESAFÍOS Y APRENDIZAJES



DISEÑO DE
ARQUITECTURA
ESCALAR



ORGANIZACIÓN DE
TÓPICOS MQTT



SINCRONIZACIÓN
NODE-RED - ESP32



TESTING CON DEBUG,
INJECT NODES Y
NODE.WARN



MANEJO DE GRÁFICOS
CON GRAFANA Y
AJUSTE DE SIMULACIÓN



PARAMETRIZACIÓN DE
VALORES PARA MEJOR
ADAPTACIÓN

FUTURO Y EXTENSIONES



Mayor sensado de información

Agregado de sensores de temperatura, humedad, y otros gases.

Alertas e integraciones

Envío de mensajes por telegram y publicación de endpoints en NodeRed.



Dashboard de control y configuración

Para que el admin pueda configurar cada cámara.

MUCHAS GRACIAS!

CUALQUIER DUDA O CONSULTA:

ignacio.traberg@gmail.com
taumartin@gmail.com



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<u>Used and alternative resources</u>	An assortment of graphic resources that are suitable for use in this presentation
<u>Thanks slide</u>	You must keep it so that proper credits for our design are given
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COMMUNITY
CORNER

01

HEADLINE NEWS

HEADLINE NEWS

Exciting news! Our company has just released a cutting-edge product that is poised to revolutionize the industry. With this new technology, businesses can:

- Optimize their workflow and increase productivity
- Automate routine tasks and free up any valuable resources
- Improve their bottom line by reducing costs and boosting profits

Stay tuned for more updates on this exciting development as we continue to innovate and push the boundaries of what's possible!



IN DEPTH ANALYSIS

EMERGING TECHNOLOGIES

Analyze a new and emerging technology that is disrupting or transforming your industry. Discuss its potential impact on businesses and consumers, and provide insights into how companies can adapt to these new changes.

MARKET TRENDS

Provide an in-depth analysis of recent market trends that are affecting your industry. This could include examining changes in consumer behavior, shifts in supply and demand, or emerging market opportunities. Offer insights into how businesses can capitalize on these trends to stay competitive.

BEHIND THE SCENES

PRODUCTION PROCESS

We pride ourselves on our high-quality products that are made with care from start to finish. Our team sources the best materials and uses skilled craftsmanship to transform raw materials into beautiful finished products.

COMPANY CULTURE

Our company culture is built on collaboration, innovation, and open communication.

We prioritize work-life balance by offering flexible schedules and remote work options when possible.

CUSTOMER SERVICE

Our customer service team is dedicated to providing exceptional support. We believe in building long-term relationships with our customers based on trust, transparency, and excellent service.



TIPS & TRICKS

TIME MANAGEMENT

Break your day into smaller chunks and focus on one task at a time. Take short breaks in between to stay fresh.

SELF-CARE

Make time for exercise, healthy eating, and hobbies outside of work to reduce stress and promote relaxation.

NETWORKING

Attend events, join professional organizations, and connect with others in your field on social media to expand your network.

LEARNING

Attend workshops or conferences, read industry publications, and take online courses to expand your knowledge base.

COMMUNICATION



Be concise when communicating ideas, actively listen to feedback, and be open to constructive criticism.

GOAL-SETTING

Set clear goals by breaking them down into smaller achievable steps and by celebrating progress.



MORE NEWS!

NEW PRODUCT LAUNCH

Our company is excited to announce the launch of a new product line that has been in development for months. This innovative product is expected to revolutionize our industry.

AWARD RECOGNITION

Our company has been recognized for excellence in our industry by receiving an award. This recognition reflects the hard work and dedication of all of our amazing employees.

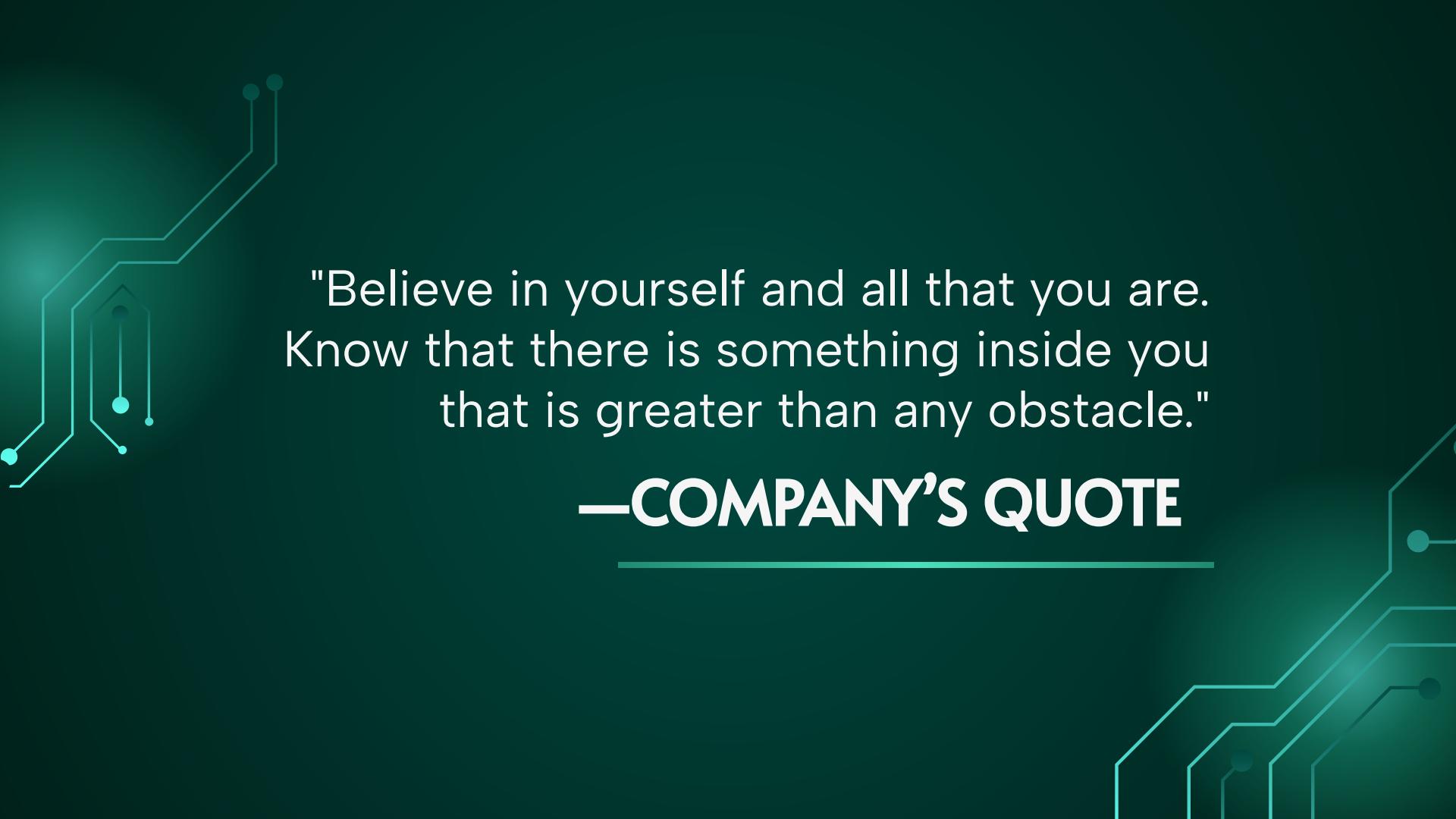


COMPANY EXPANSION

We have recently expanded our operations by opening a new office in a different place. This expansion will allow us to better serve our customers and grow our business.

CSR

We have recently partnered with a nonprofit organization to provide support and resources to those in need. We believe it is important to be very socially responsible.



"Believe in yourself and all that you are.
Know that there is something inside you
that is greater than any obstacle."

—COMPANY'S QUOTE

APRIL 14

Virtual conference on the future of technology



JUNE 6

Product demo day for new features and updates



JULY 12

Networking event with industry leaders

WHAT ARE WE GOING TO DO NEXT QUARTER?



25% LAUNCH

20% SOCIAL MEDIA

15% WEBSITE

35% TRAINING

Follow the link in the graph to modify its data and then paste the new one here. For more info, click [here](#)

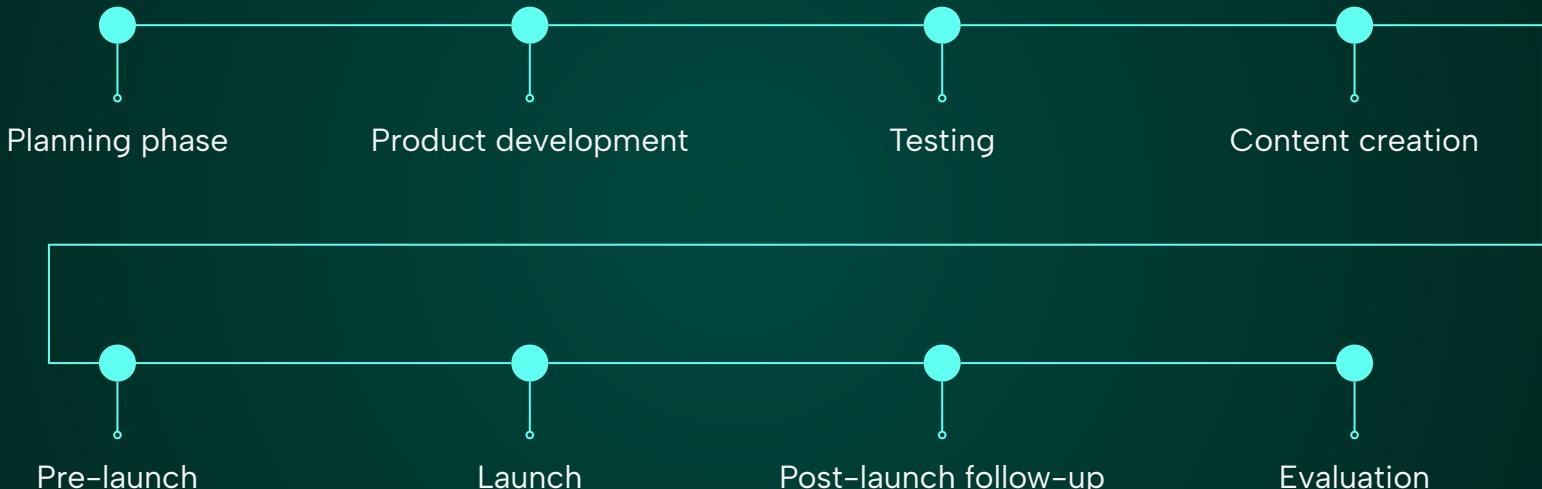
ARE OUR PRODUCTS WORKING?

PRODUCT	PRICE	DISCOUNT	AVAILABILITY	COMMENTS	RATING
PRODUCT 1	\$20	10% off	In stock	"Very good"	4/5
PRODUCT 2	\$25	No discount	Out of stock	"Could be better"	1/5
PRODUCT 3	\$50	15% off	In stock	"Quite satisfied"	3/5
PRODUCT 4	\$30	No discount	In stock	"Useful"	2/5
PRODUCT 5	\$40	20% off	In stock	"Amazing!"	5/5
PRODUCT 6	\$15	5% off	In stock	"Practical"	4/5

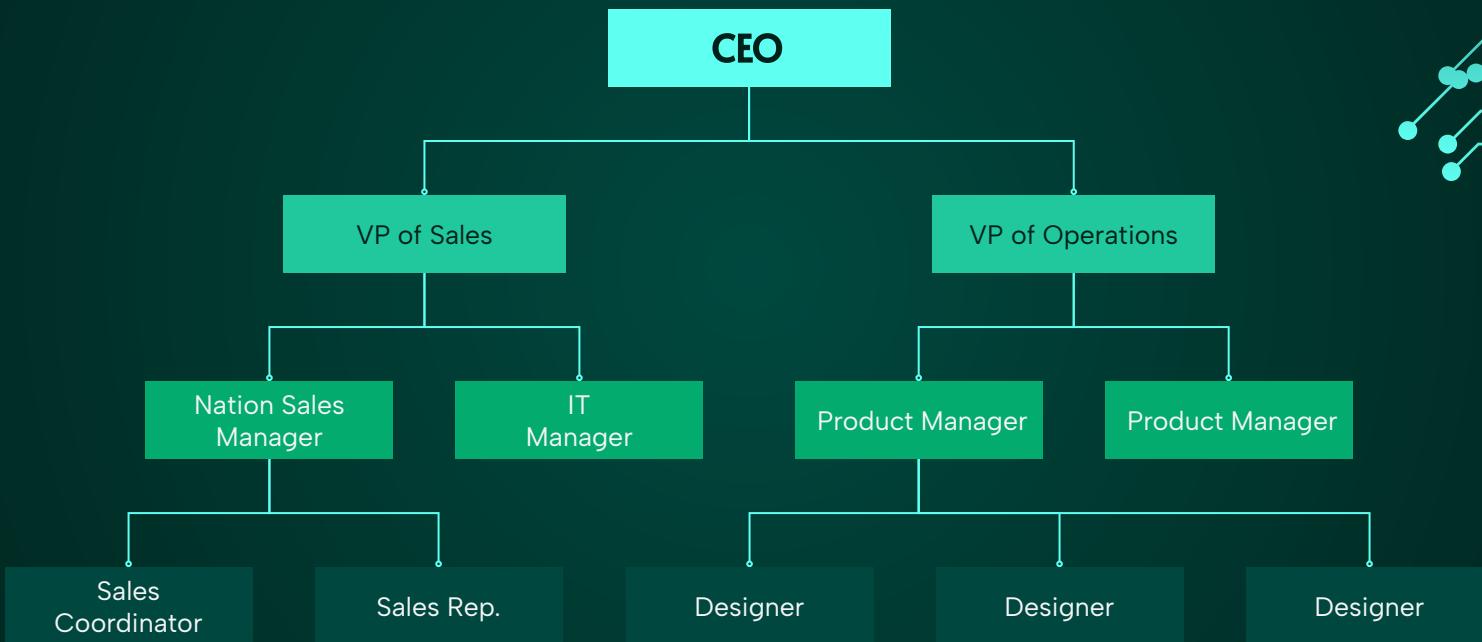


“EXCLUSIVE AND
INSPIRING.”

PROCESS FOR THE NEXT LAUNCH



ORGANIZATIONAL CHART





LIFE'S MOMENTS

Don't let life's special moments slip away – capture and preserve them through photographs. In this newsletter we want to show you these special moments!



TESTIMONIALS



"I was blown away by the exceptional customer service I received from this company."

—LAURA PATTERSON

"The quality of the products I received from this company exceeded my expectations."

—JOHN NELSON



"I love how easy it is to navigate this company's website and place an order."

—PETER JAMES



CASE STUDIES



CAMPAIGN OBJECTIVE

Increase brand awareness and drive sales for a new line of eco-friendly products.

APPROACH

- A social media campaign that focused on showcasing the sustainability and quality of our products
- Collaboration with influencers
- Encourage their followers to make more environmentally conscious choices

RESULTS

23%

Increase in website traffic

80%

Increase in sales

+10%

Increase in clicks

KEY TAKEAWAY 1

Partnering with influencers who align with the same brand values.

KEY TAKEAWAY 2

Highlighting the unique qualities of your product, such as sustainability.

THANKS

DOES ANYONE HAVE ANY QUESTIONS?

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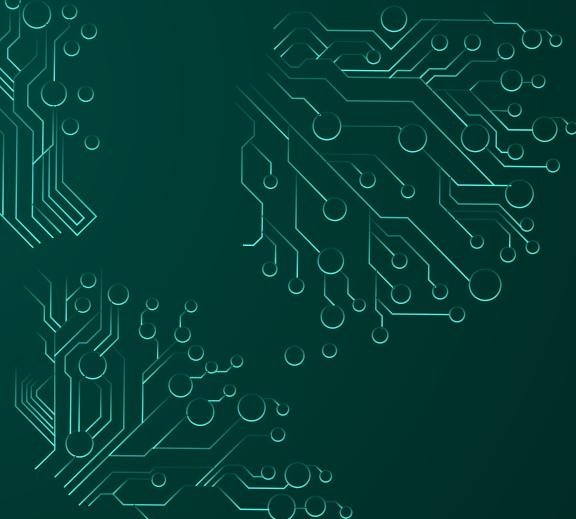
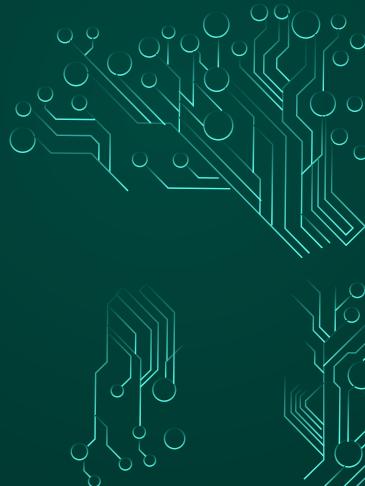
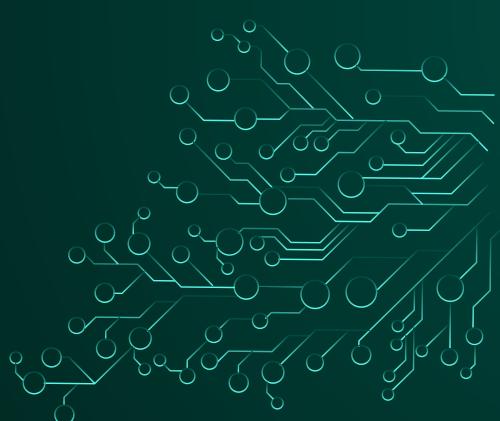
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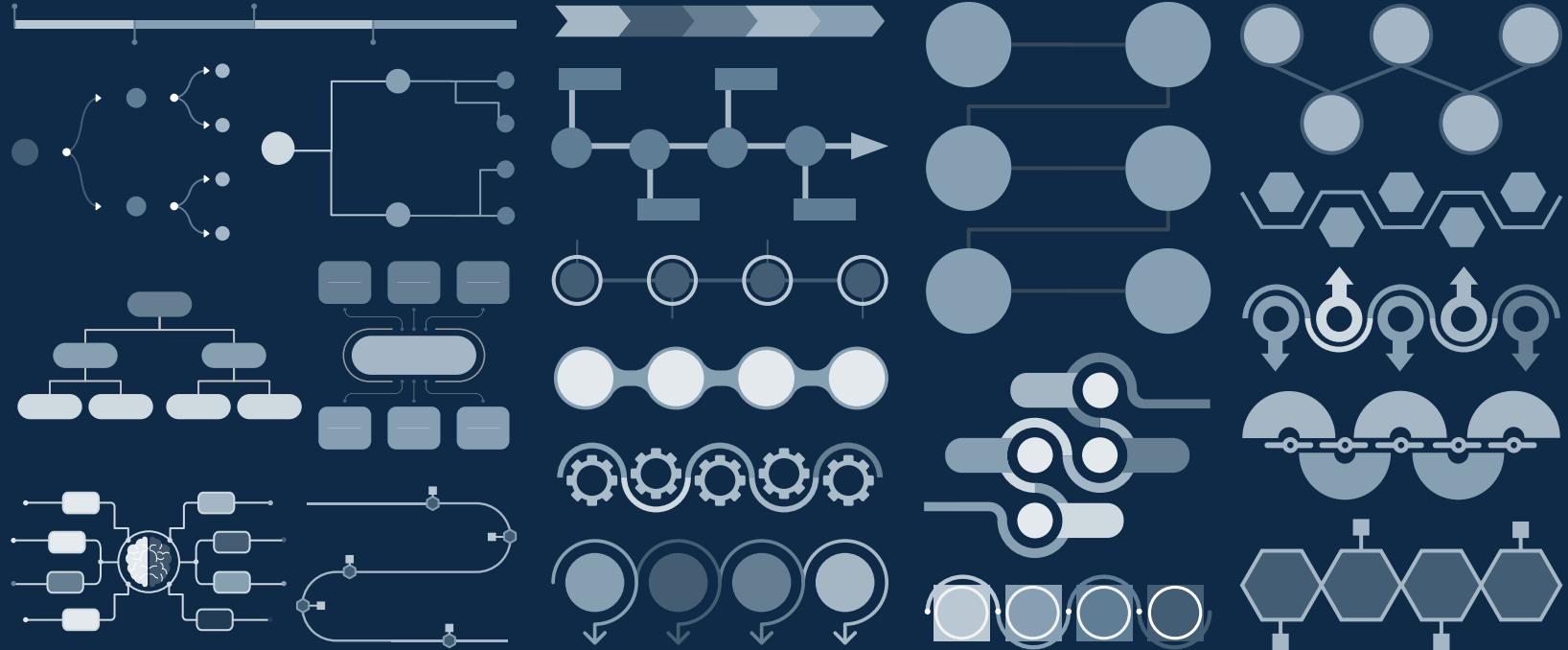
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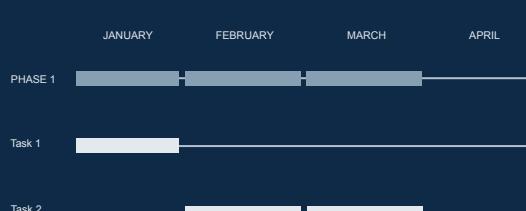
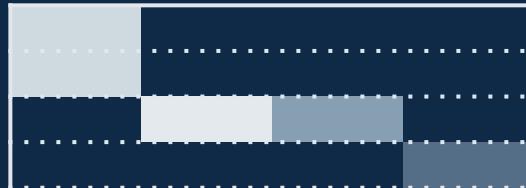
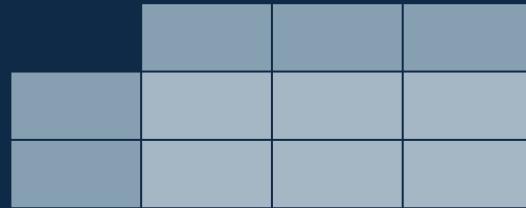
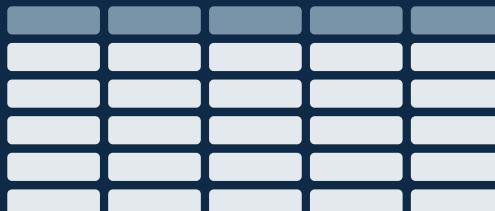
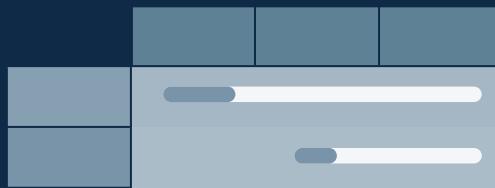
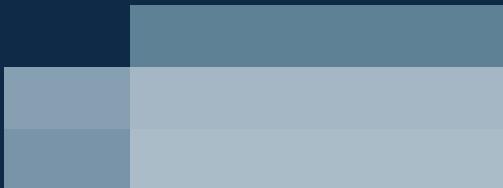
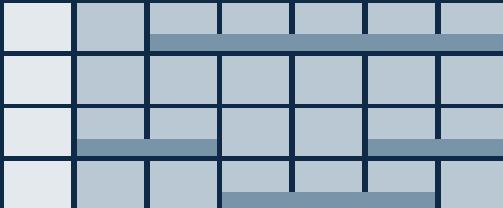
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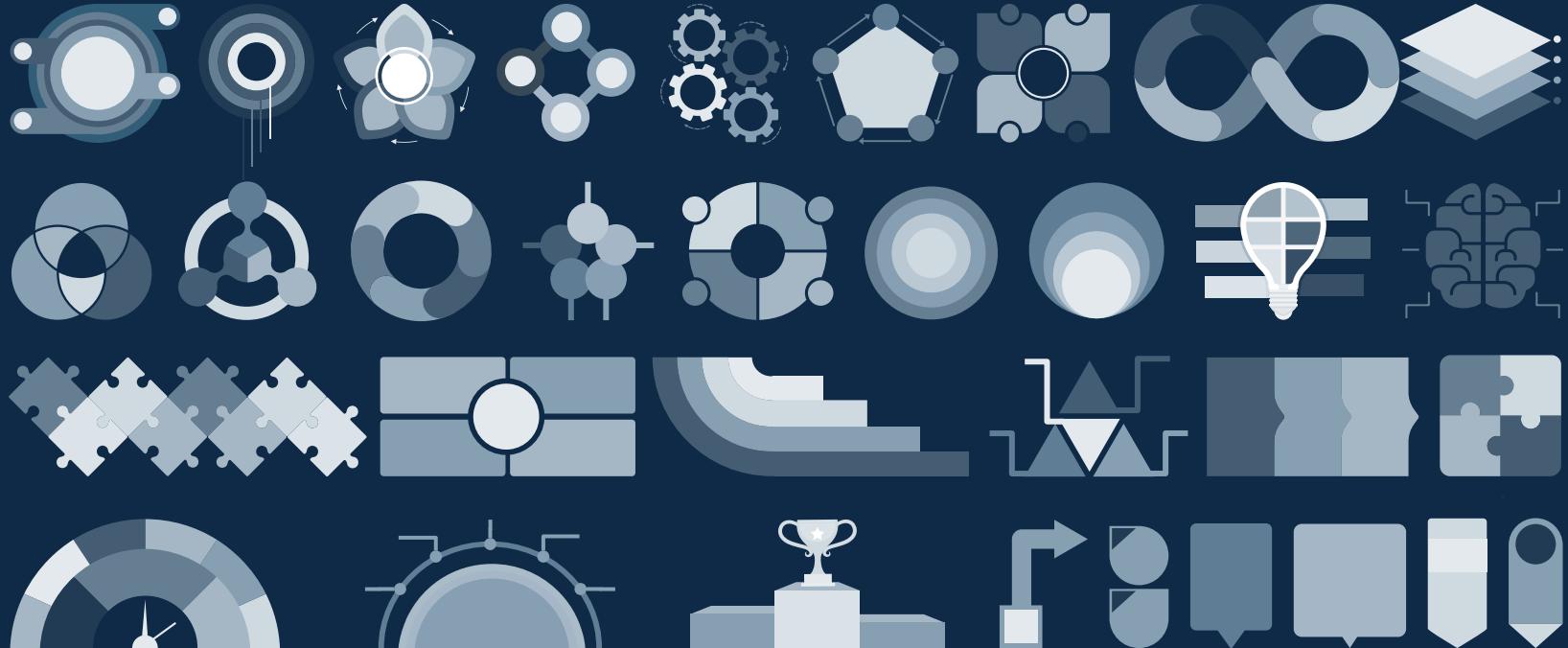
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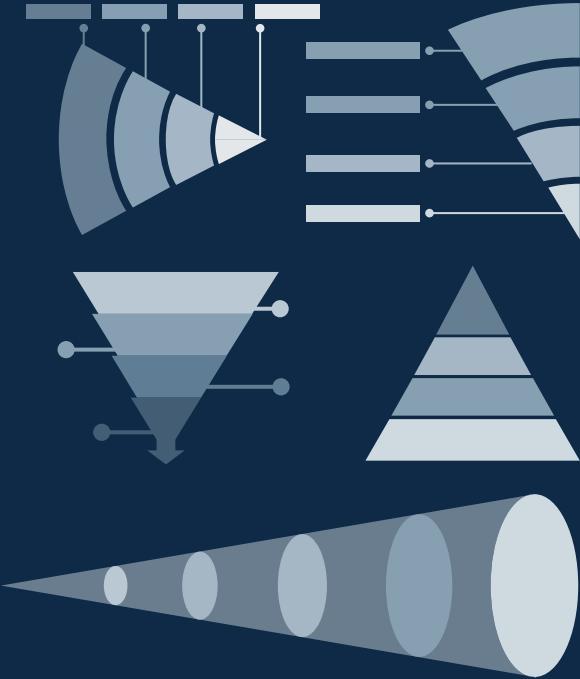
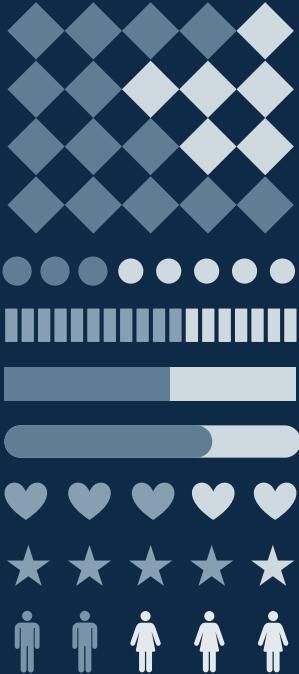
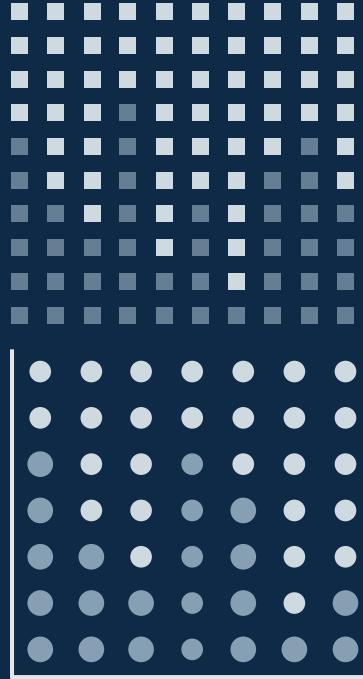












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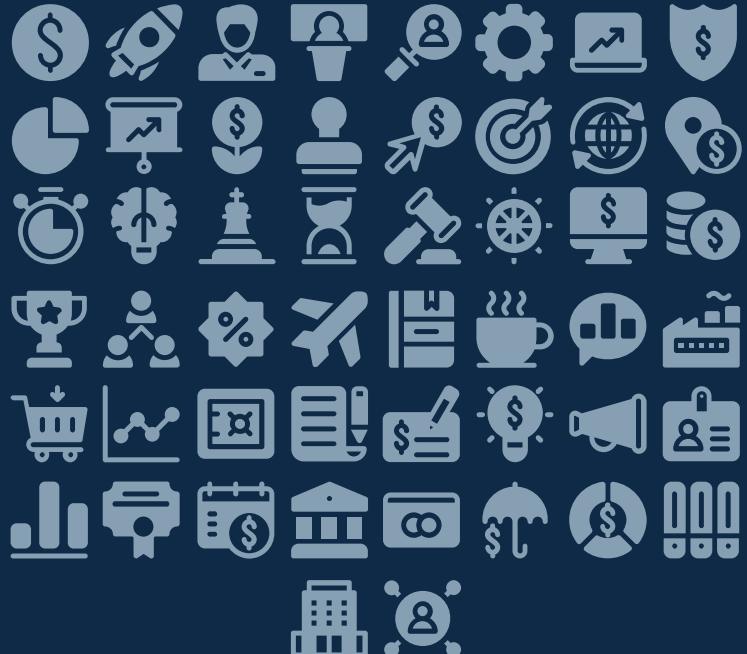
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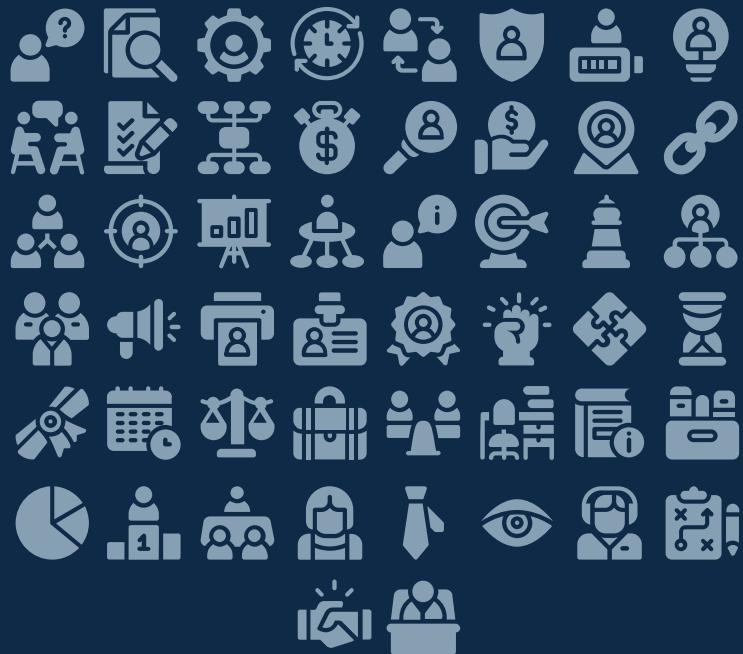
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Avatar Icons



Creative Process Icons



Performing Arts Icons



Nature Icons



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