

# EcoEssentials

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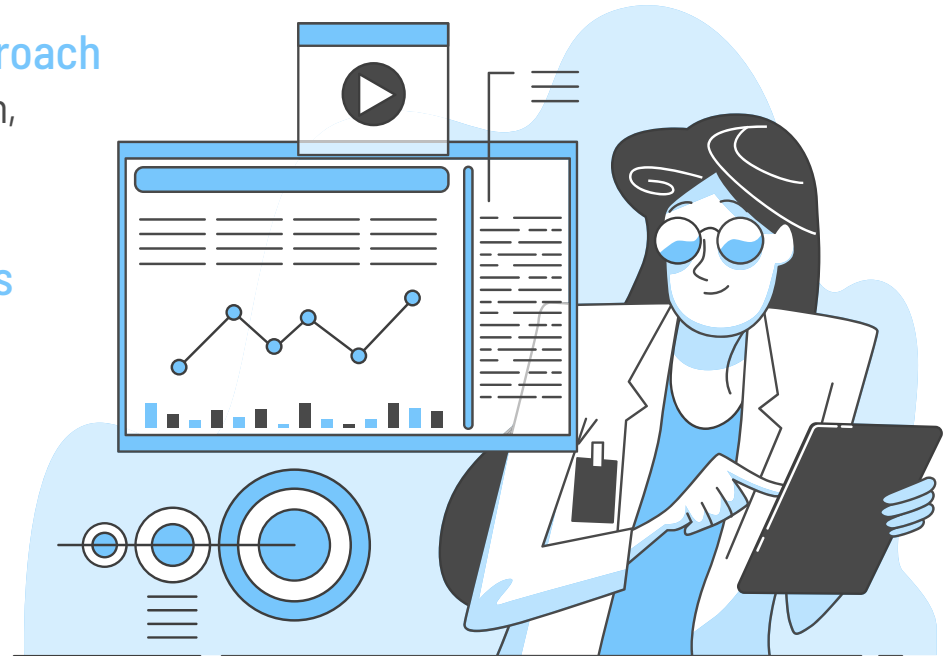
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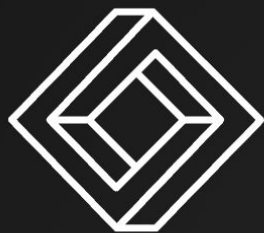


# 01

# Introduction

Problem Statement, Background,  
Needs Statement, Objective





EcoEssentials

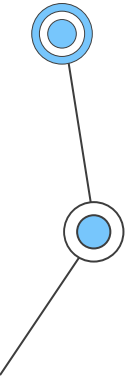
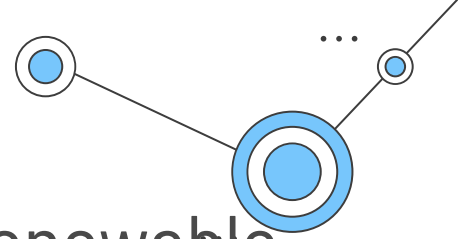
## EcoEssentials

EcoEssentials uses smart technology and customer expertise to deliver technology that makes consumers lives easier while being energy efficient.

...

# The Problem Statement

The overconsumption of power from nonrenewable energy sources has increased greenhouse gas emissions, caused extreme weather changes, and negatively impacted the ecosystem. Inefficient heating and cooling systems in buildings are one of the main contributors to this problem, leading to the need for an energy-efficient solution such as a smart thermostat.



# Background

**01**

The Bronx has the highest number of Black and brown neighborhoods affected by the instability of climate change in New York City (Sequeira 2022).

**02**

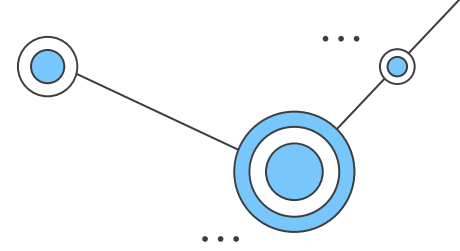
Climate change is caused by the overconsumption of electricity, which leads to the use of more fossil fuels and the production of greenhouse gases.



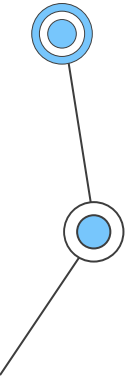
# Needs Statement

There is an urgent need for an energy-efficient thermostat that can accurately monitor temperature changes, regulate heating and cooling systems, and optimize energy consumption.

# Objective



The main objective is to create an environmentally sustainable product that satisfies consumer needs.



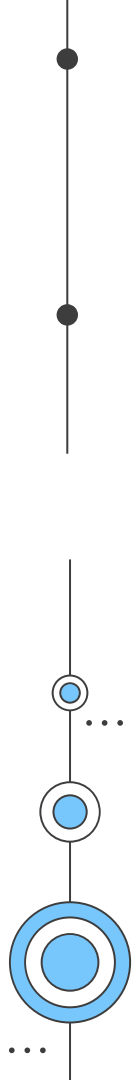




# 02

# Proposed Technical Approach

Requirements, Costs, Design,  
Implementation, Quality





# Requirements



01

## Mechanical Engineer

Someone with knowledge of thermodynamics, heat transfer and HVAC systems

02

## Computer Scientist

Someone that can program and has knowledge of machine learning algorithms

03

## Electrical Engineer

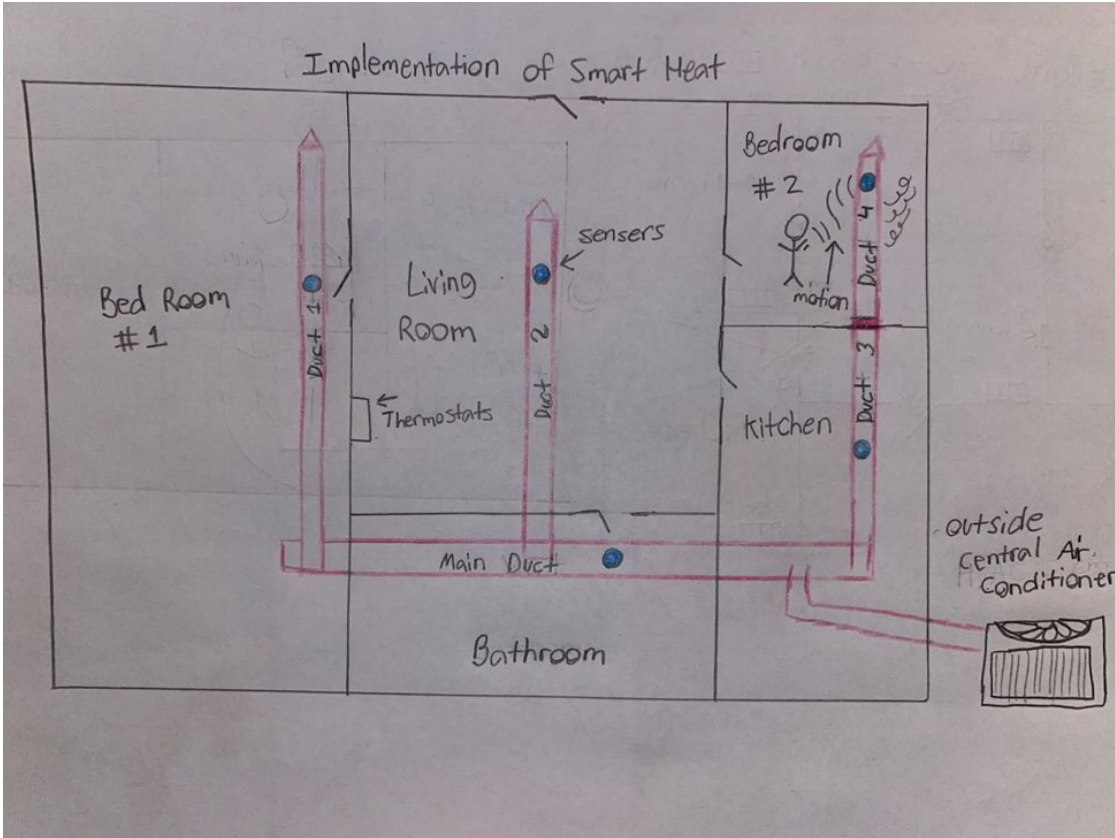
Someone that is familiar with the circuits and sensors needed for a thermostat

04

## The Actual Materials

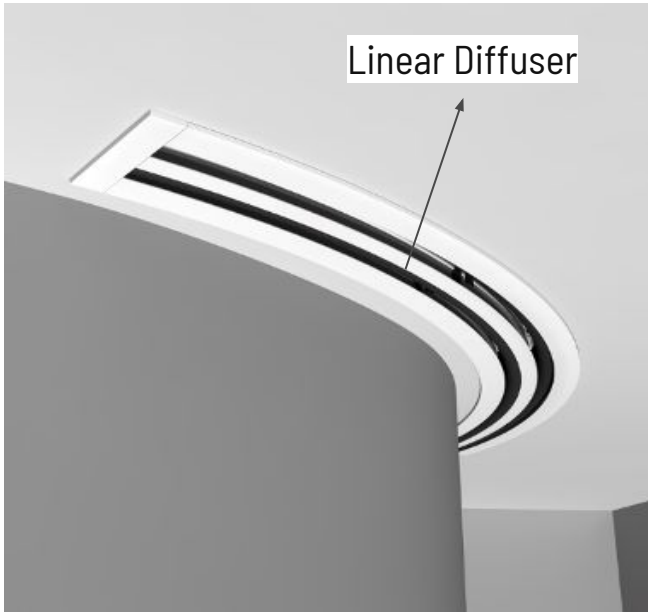
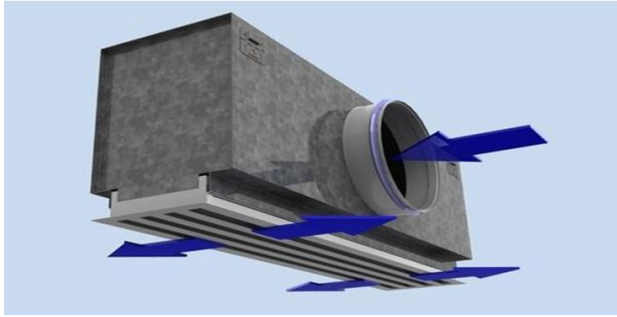
The hardware, software, and the necessary buildings

# Architecture Design



- The air will travel above the ceiling ducts and instead of using vents we will use linear diffusers
- This is to get better circulation and better view of motion by sensors, through higher elevation.
- Motion sensors pick up this movement, admitting heat that will cause it to trigger the thermostat to send air flow through the specific duct for specific room.

## Linear Diffusers



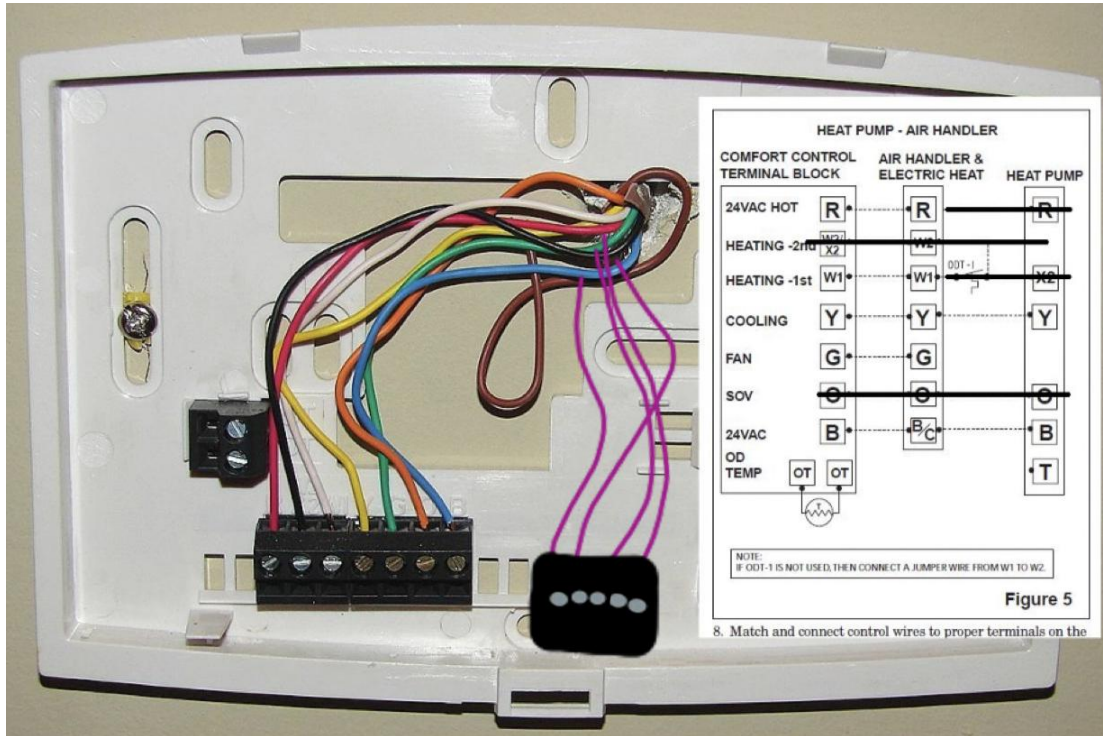
Linear Diffuser

A linear diffuser is a type of air vent that helps to distribute air evenly into a room. It has long, narrow slots that allow air to flow out in a straight line, instead of being dispersed in different directions. The diffuser helps to regulate the temperature and airflow in the room by controlling the direction and velocity of the air coming from the HVAC system. This makes the room more comfortable and helps to improve indoor air quality.

Figure 3 shows how linear diffusers look in houses, which doesn't take up space like an air conditioner or not worrying accidentally covering vents, that are usually on the floor.

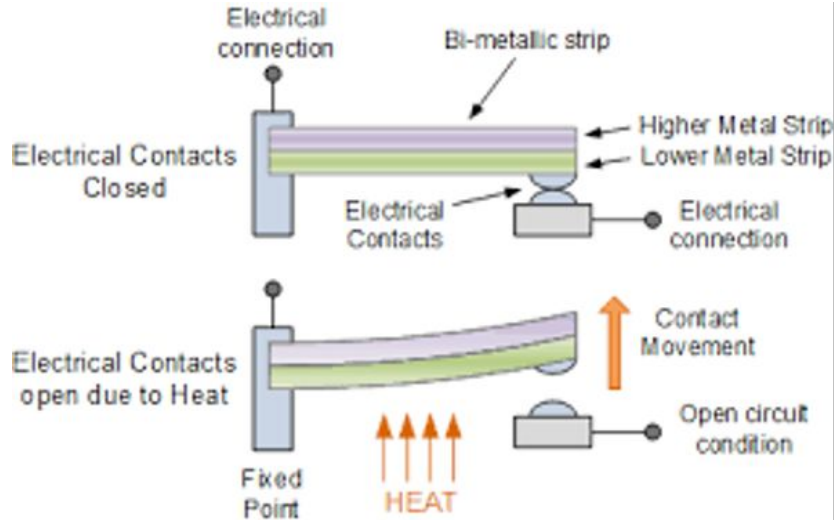
# Mechanisms and Processes: A Comprehensive Explanation

Figure 4- "Wiring Diagram of thermostat" by Magnusrosen, edited by EcoEssentials



- A thermostat's purpose is to be a switch to the different wires for either ventilation, heating, or cooling.
- It is implemented to connect the thermostat and the multiple motion sensors placed in each room of the house
- the purple wire is connected to the thermostat and as it senses a person enter a room, it will send a signal to thermostat and make the air flow go to the specific duct.

# Thermostat Operation using Bimetallic/PIR Sensor



The bimetallic strip is a small piece of metal that expands or contracts as the temperature changes. The PIR sensor detects motion and changes in heat, and it can determine if someone is in the room or not.

When you set your desired temperature on a smart thermostat, it will use the bimetallic strip to monitor the temperature of the room. If the temperature is too low, the strip will expand and trigger the thermostat to turn on the heating system. If the temperature is too high, the strip will contract and trigger the thermostat to turn on the cooling system.

The PIR sensor is used to detect when someone is in the room. If the sensor detects motion, it will assume that someone is present and adjust the temperature accordingly. If no motion is detected for a period of time, the thermostat will assume that the room is empty and adjust the temperature to conserve energy.

# PIR Motion Sensor

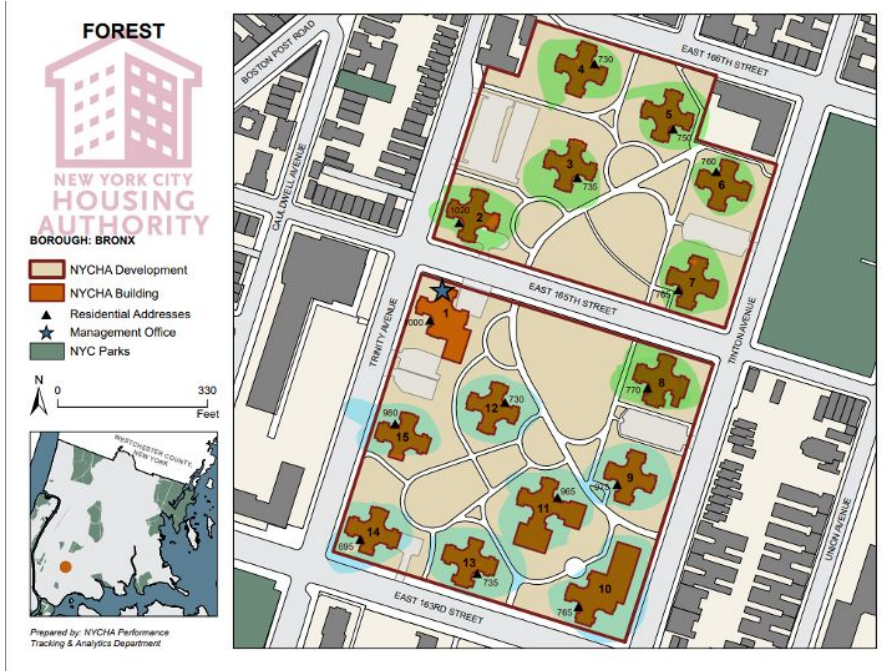


Figure 6 – “PIR Motion Detector Sensor Module HC-SR501” by electronicscomp

- The Passive Infrared Sensor (PIR) motion detector sensor will be in the diffusers since it is small to fit but also be able to follow the motion of the person
- Detects the physical movement of people by looking at changes in infrared energy that are caused by moments of humans and pets (eletroniscomp, 2023, n.p.).
- The combination of a bimetallic strip and PIR motion detector can allow the Heat Smart thermostat to adjust temperature settings based on whether someone is in the room or not



# Testing



The Forest housing Project in the Bronx has a total of fifteen buildings. With the permission of the New York City Housing Authority, we will use 14 of the 15 buildings to test out the smart thermostat. Buildings 2- 8 (Highlighted in Green) will be used as the experimental group for the smart thermostat. While buildings 9-15 (Highlighted in blue) will be the control group, to see results on how much energy these smart thermostats save in energy.

Figure 1- A 15 building housing project owned by the New York City Housing Authority, located in Bronx (NYCHA, 2021)



# Costs Research

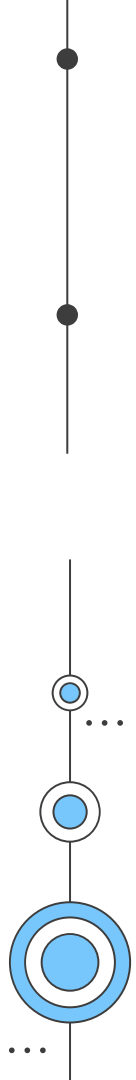
Front-End Developer	\$80,000 per year
Back-End Developer	\$103,000 per year
Embedded Systems Engineer	\$90,000 per year
Quality Assurance Engineer	\$50,000 per year
Product Manager	\$110,000 per year
Industrial Designer	\$70,000 per year
Office Space	\$24,000 per year
Prototype Development	\$50,000
Material Costs	\$20,000
Certifications and Compliance Costs	\$10,000



# 03

# Expected Project Results

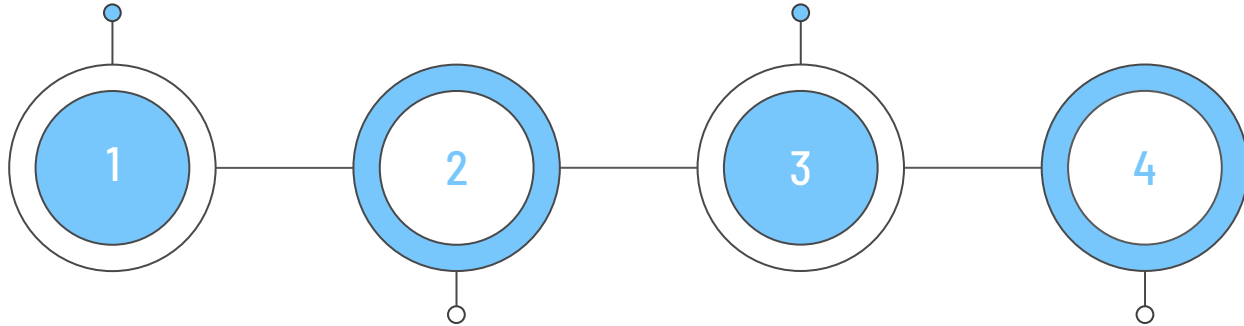
Measure of Success



# Measure of Success

Energy Savings: the amount of energy consumers save after installing the device

User Satisfaction: easy usage, dependability, and experience with device



Carbon Footprint Reduction: decrease in carbon emissions after installing device

Adoption Rate: the number of users who adopt the device after testing



# 04

# Schedule

Our timeline



# Our Schedule:

Tasks	Start Date	End Date	Duration	Phases					
				Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Research and planning	5/5/23	5/30/23	25	■					
Hardware and Software Design	5/31/23	9/23/23	115		■				
Prototyping	9/23/23	12/2/23	70			■			
Testing and Refining	12/2/23	2/5/24	65				■		
Manufacturing	2/5/24	3/11/24	35					■	
Launch	3/12/24	4/10/24	29						■

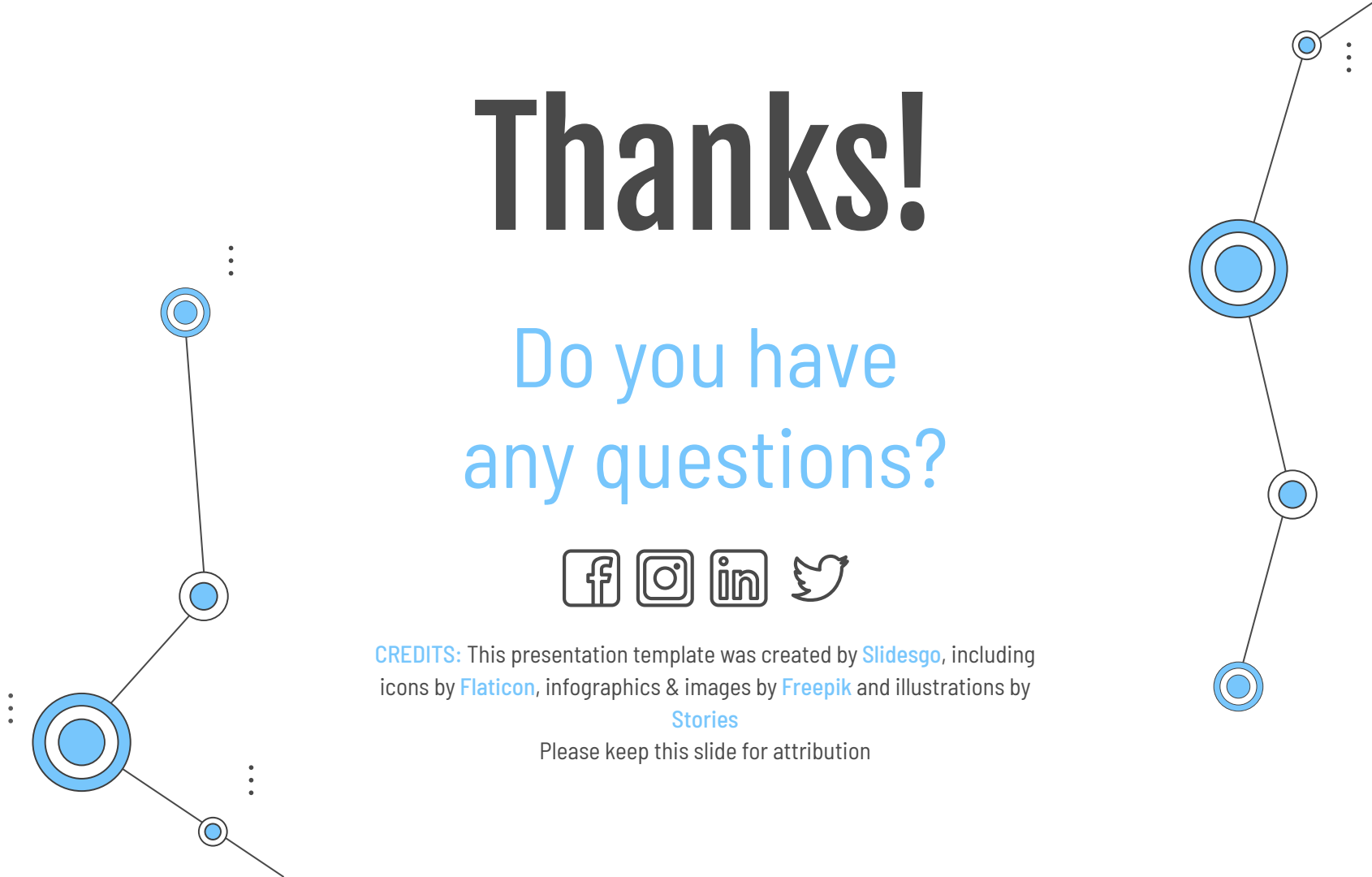
# Thanks!

Do you have  
any questions?

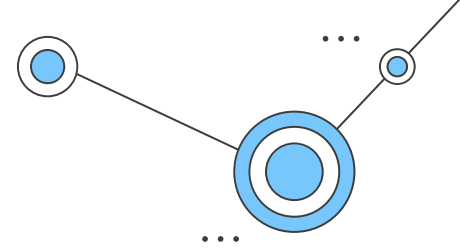


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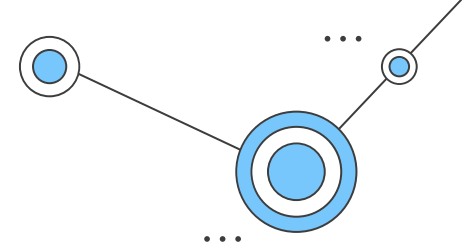
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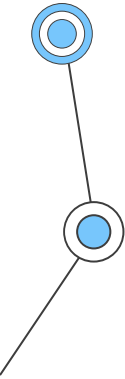
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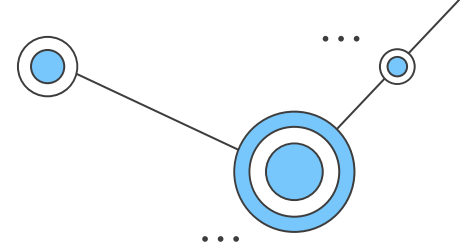
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