FARMBOT GROWROOM

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METR4900 Semester 1, 2020

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PRESENTATION CONTENTS

- Thesis introduction, scope and relevance;
- Background information and literature review;
- Work completed so far and
- Work remaining to be done.

INTRODUCTION, SCOPE AND RELEVANCE

Why is this project important?

INTRODUCTION: RELEVANCE

- AgTech is the collection of digital technologies that provide the agricultural industry with the tools, data and knowledge to make more informed and timely on-farm decisions [1]
- Changes driving the agriculture industry:
  - increasing population;
  - changes in demographic trends;
  - depleting natural resources;
  - climate change and
  - consumer dietary demands.
- Thus begs the question:

  'How can technology be used to improve and assist the agricultural sector?'

INTRODUCTION, SCOPE

- This project will focus on the design of a robotic arm to be used in conjunction with a small scale spherical structure (the GrowRoom) that enables individuals to grow and monitor their own food.

In Scope	Out of Scope
Mechanical design	Construction and assembly of GrowRoom
Electronic design and build	End-effector design
Software development	
Component selection	
Modifications to current Farmbot Universal Tool Mount (UTM)	
Physical prototyping	

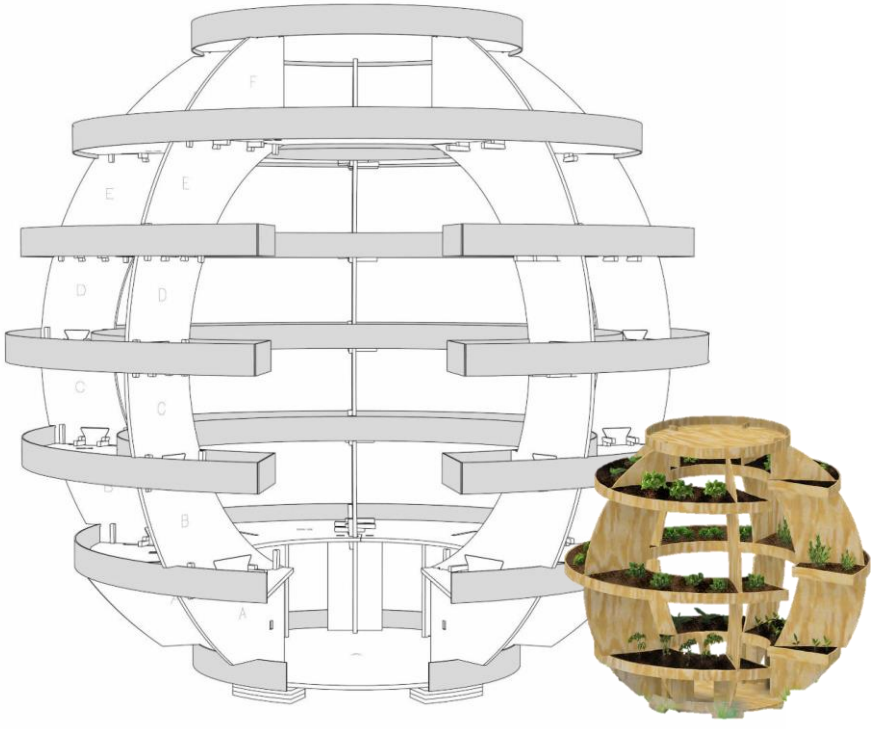
LITERATURE REVIEW

Background information and past works

LITERATURE REVIEW: GROWROOM

- Created by SPACE10, IKEA's external innovation hub, the GrowRoom is the spherical structure designed to promote local food production.

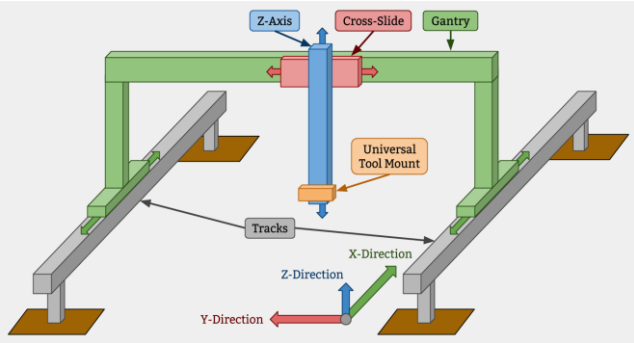
- This project will focus primarily on the design and build of a robotic arm to fit inside a small scale (approximately 0.8m x 0.5m x 0.5m GrowRoom).



LITERATURE REVIEW: FARMBOT

HARDWARE

- The CNC farming machine consists of a Cartesian co-ordinate, gantry style robotic system.
- FarmBot is capable of movement in the x,y and z planes, governed through different physical structures:
  - Tracks (x direction)
  - Gantry (y direction)
  - Lead Screw (z direction)



SOFTWARE

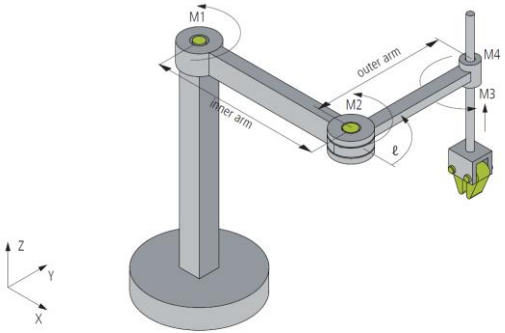
- A Raspberry Pi 3 is used as the "host computer" of FarmBot **[16].**
- This:
  - Runs the operating system
  - Communicates with the web application over ethernet or Wi-Fi.
  - Communicates to the Farmduino over a USB serial connection.

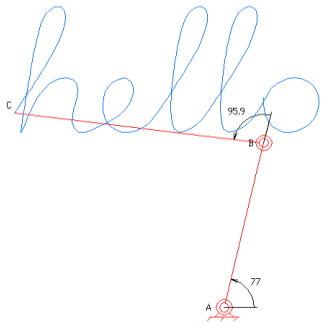
ELECTRICAL

- "The 'Farmduino' is an electronics board that combines the functionality of an Arduino MEGA 2560 microcontroller and a RAMPS shield" [16].
- It:
  - Integrates with stepper motors and monitors information.
  - Receives commands from the Raspberry Pi.

LITERATURE REVIEW: SCARA

- SCARA is an acronym for **S**elective **C**ompliance **A**rticulated **R**obot **A**rm.
  - Compliant in the X-Y axis, and rigid in the Z-axis.
- The SCARA's structure consists of two arms joined at the base and the intersection of arms one and two.
- The final X-Y location at the end of arm two is a factor of the M1 angle, M2 angle, length of arm one and length of arm two.
- SCARAs are four-axis robots.





CURRENT PROGRESS

What has been done so far?

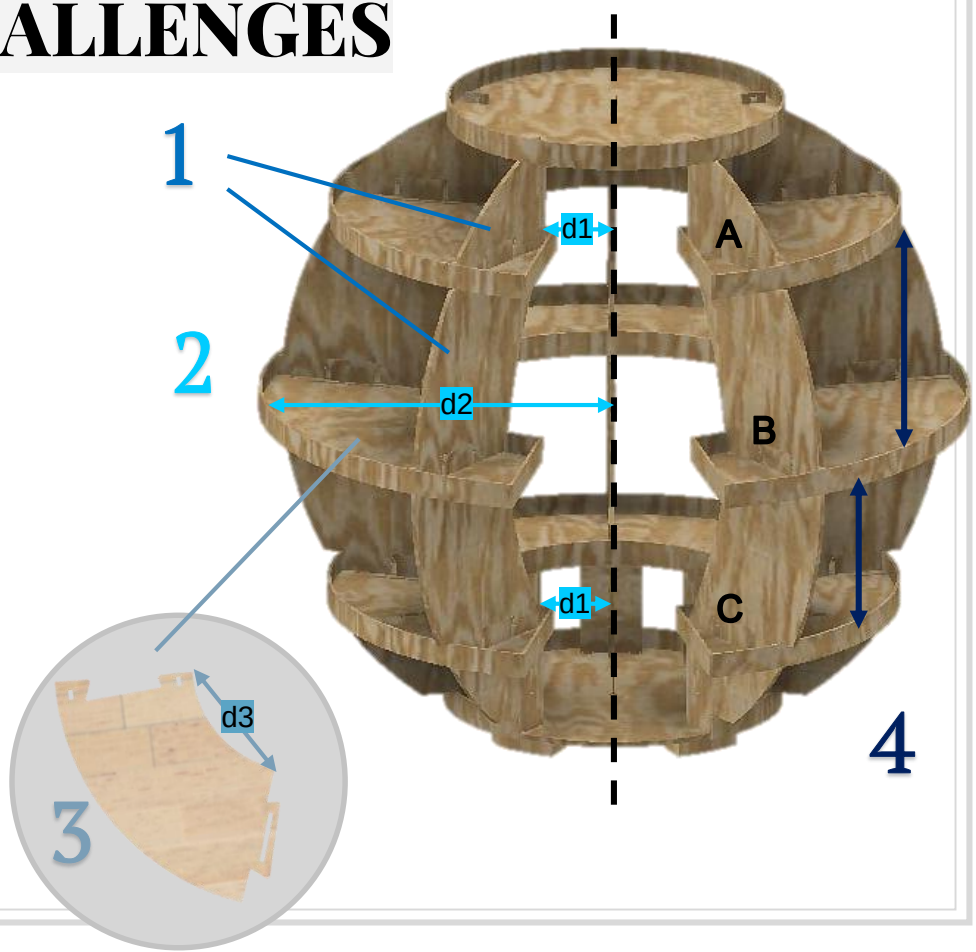
KEY CHALLENGES

1. The support structure of the GrowRoom.

2. The differing diameters between shelves A and C and shelf B.

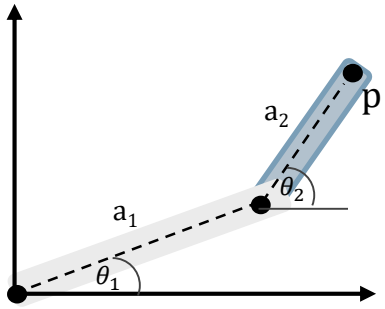
3. The size/shape of the space between support structures (the shelves).

4. The vertical distance between shelves.



ARM

Inverse Kinematics:



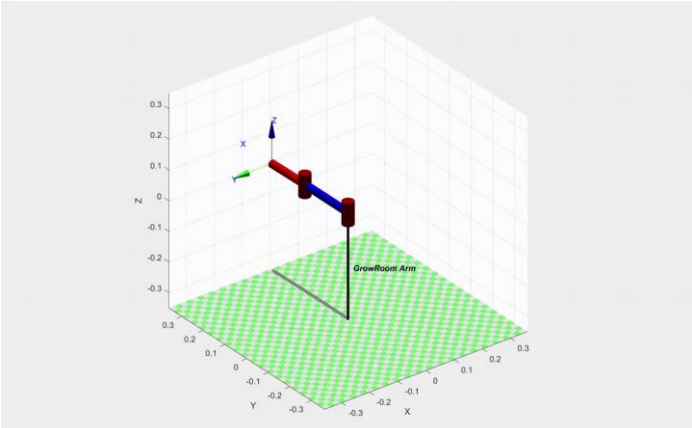
$$p = [p_{x-coord} \quad p_{y-coord}]$$

$$k = \frac{{p_x}^2 + {p_y}^2 - {a_1}^2 - {a_2}^2}{2a_1a_2}$$

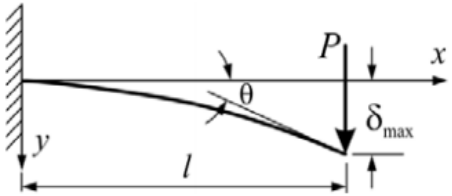
$$\theta_2 = \cos^{-1} k$$

$$m = \frac{p_x(a_1 + a_2C\theta_1) + p_y a_2 S\theta_2}{{a_1}^2 + {a_2}^2 + 2a_1a_2C\theta_2}$$

$$\theta_1 = \cos^{-1} m$$



Deflection:

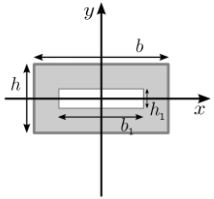


I = *Area moment of intertia of beam* (kgm^2)
P = *Force acting on beam* (N)
E = *modulas of elasticity* (Pa)
l = *length of beam* (m)
θ = *angle of deflection* (*degrees*)
δ_{max} = *deflection* (m)

$$\boldsymbol{\delta_{max} = \frac{Pl^3}{3EI}}$$

$$I_{filled\_rectangle} = \frac{bh^3}{12}$$

$$I_{hollow\_rectangle} = \frac{bh^3 - b_1{h_1}^3}{12}$$



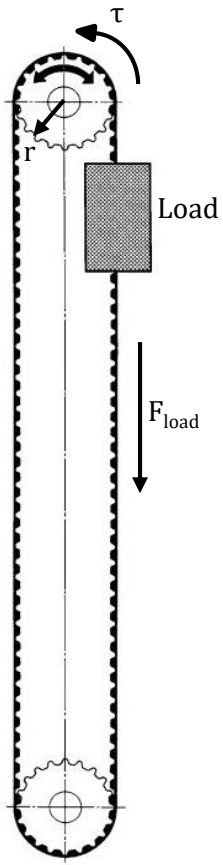
Options	Material Dimensions	Deflection (mm)
Option 1	Steel plate (25 x 3mm)	0.028028571
Option 2	Steel plate (30 x 3mm)	0.023357143
Option 3	Steel plate (40 x 3mm)	0.017517857
Option 4	Steel plate (50 x 3mm)	0.014014286
Option 5	Steel rectangle (38 x 25 x 1.2mm)	0.000121974
Option 6	Steel rectangle (50 x 25 x 1.6mm)	7.18713E-05

LINEAR TRANSMISSION ANALYSIS

		A	B	C	D	E
		Cost	Accuracy	Size	Stability	Availability
A	Cost		AB	A	AD	A
B	Accuracy			B	BD	B
C	Size				D	CE
D	Stability					D
E	Availability					

Weightings	
A	0.29
B	0.29
C	0.07
D	0.29
E	0.07

Linear Transmission System						
Type	Cost	Accuracy	Size	Stability	Availability	Weighted Total
Lead Screw	1.43	0.57	0.29	0.29	0.07	2.6
Ball Screw	1.43	0.29	0.29	0.29	0.07	2.4
Timing Belt	0.57	0.86	0.07	0.57	0.07	2.1
Rack and Pinion	1.43	0.29	0.14	0.57	0.36	2.8



CURRENT PROGRESS: ANALYSIS

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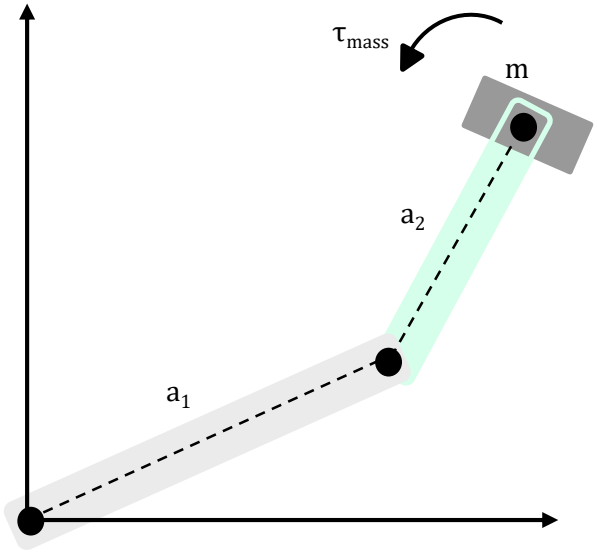
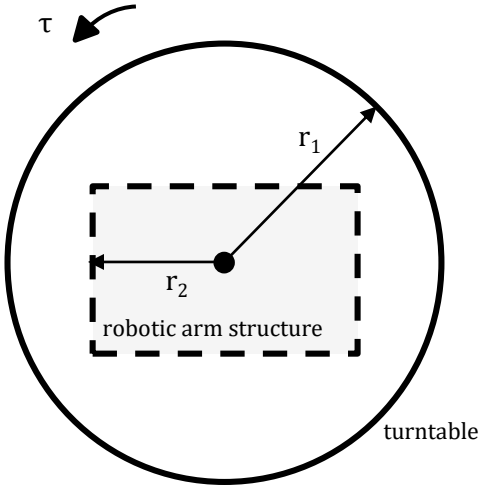


CURRENT PROGRESS: ANALYSIS



MOTOR SELECTION ANALYSIS

Linear Actuation					
Motor	**Precision/Control**	**Torque Capability**	**Size/Weight**	**Cost**	**Total**
AC	5	Yes	Implementation Dependent	4	9
DC Brushed	5	Yes		3	8
DC Brushed with Encoder	1	Yes		4	5
DC Brushless	5	Yes		2	7
DC Brushless with Encoder	1	Yes		4	5
Servo Motors	2	Maybe		1	3
Stepper Motors	1	Yes		2	3

Motor	Torque (Ncm)	Torque (Nm)	Cost (AUD)	Weight (kg)	Dimensions (mm)
Nema 17 Unipolar 1.8deg 15.8Ncm (22.4oz.in) 0.31A 12V 42x42x33mm 6 Wires	15.8	0.158	13.77	0.22	42 x 42 x 33
Nema 17 Bipolar 1.8deg 16Ncm (22.6oz.in) 1A 3.7V 42x42x20mm 4 Wires	16	0.16	12.08	0.14	42 x 42 x 20
Nema 17 Unipolar 1.8deg 16Ncm (22.7oz.in) 0.95A 4V 42x42x33mm 6 Wires	16	0.16	13.77	0.22	42 x 42 x 33
Dual Shaft Nema 14 1.8deg 18Ncm (25.56oz.in) 0.8A 5.4V 35.2x35.2x34mm 4 Wires	18	0.18	14.96	0.17	35.2 x 35.2 x 34
Nema 14 Bipolar 1.8deg 18Ncm (25.5oz.in) 0.8A 5.4V 35x35x34mm 4 Wires	18	0.18	12.56	0.19	35 x 35 x 34

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DC Brushless with Encoder	1	Yes		4	5
Servo Motors	2	Requirement Dependent		1	3
Stepper Motors	1	Yes		2	3

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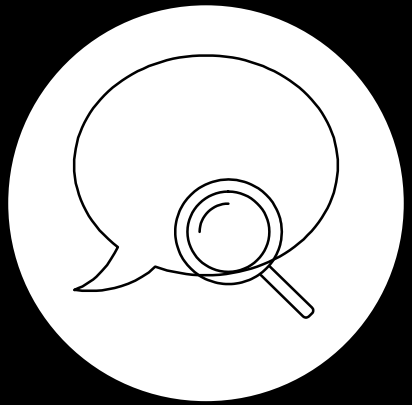
CAD

FUTURE PLAN

What is left to do?



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1.
Transition headline

Let’s start with the first set of slides

Quotations are commonly printed as a means of inspiration and to invoke philosophical thoughts from the reader.

This is a slide title

- Here you have a list of items
- And some text
- But remember not to overload your slides with content

Your audience will listen to you or read the content, but won’t do both.

You can also split your content

White

Is the color of milk and fresh snow, the color produced by the combination of all the colors of the visible spectrum.

Black

Is the color of coal, ebony, and of outer space. It is the darkest color, the result of the absence of or complete absorption of light.

In two or three columns

Yellow

Is the color of gold, butter and ripe lemons. In the spectrum of visible light, yellow is found between green and orange.

Blue

Is the colour of the clear sky and the deep sea. It is located between violet and green on the optical spectrum.

Red

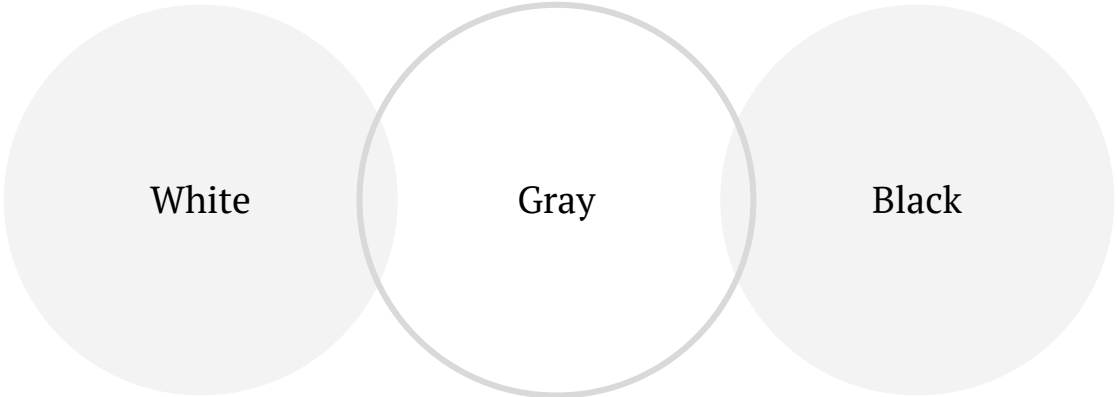
Is the color of blood, and because of this it has historically been associated with sacrifice, danger and courage.

A picture is worth a thousand words

A complex idea can be conveyed with just a single still image, namely making it possible to absorb large amounts of data quickly.


want big impact?
Use big image

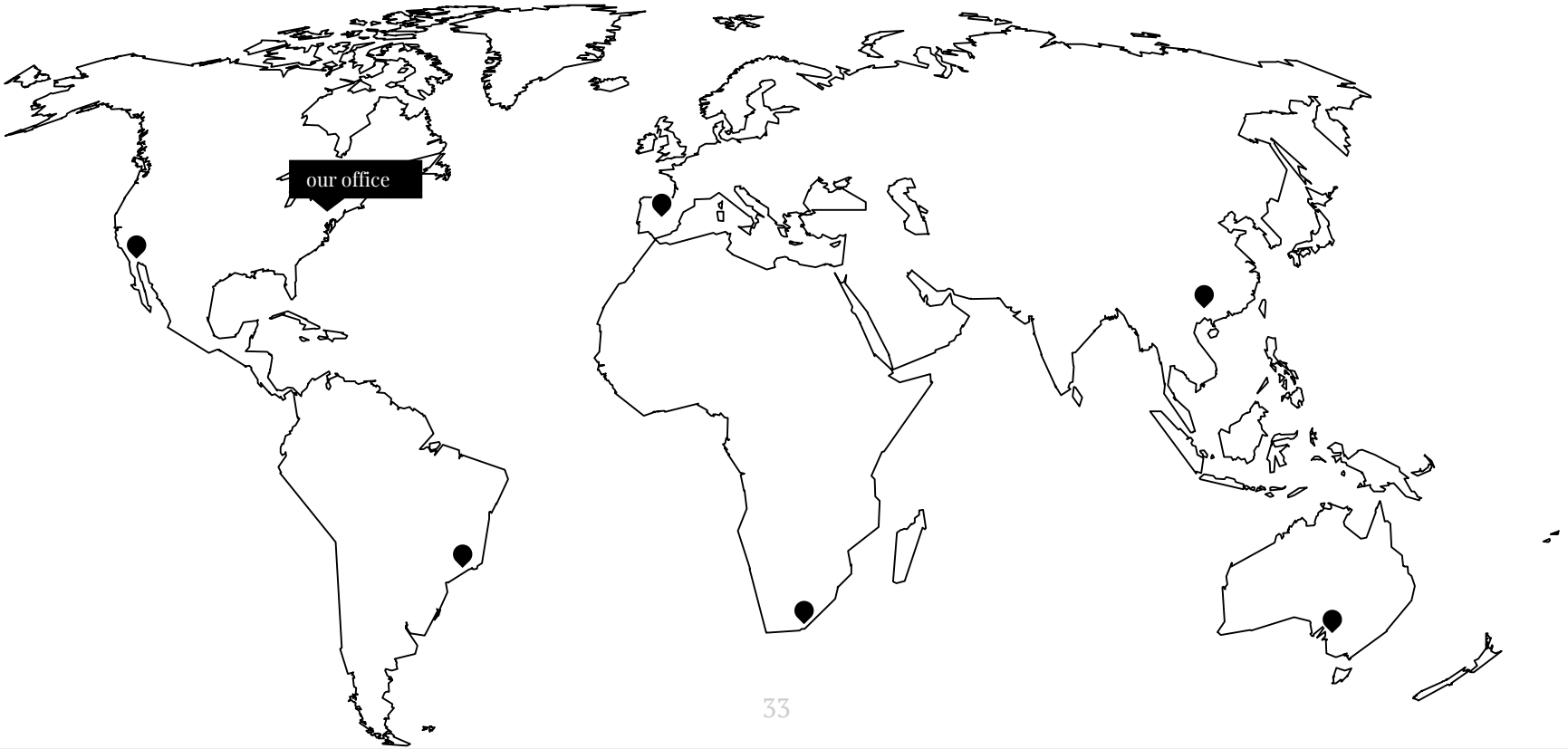
Use charts to explain your ideas



And tables to compare data

	A	B	C
Yellow	**10**	**20**	**7**
Blue	**30**	**15**	**10**
Orange	**5**	**24**	**16**

Maps



89,526,124

Whoa! That’s a big number, aren’t you proud?

89,526,124$

That’s a lot of money

185,244 users

And a lot of users

100%

Total success!

Our process is easy

Let’s review some concepts

Yellow

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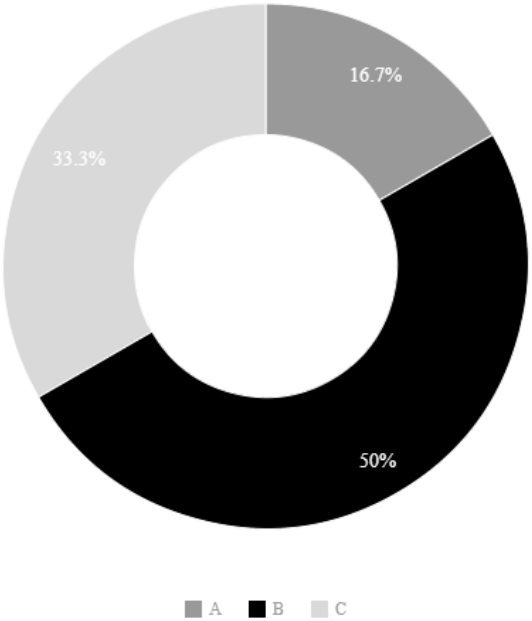

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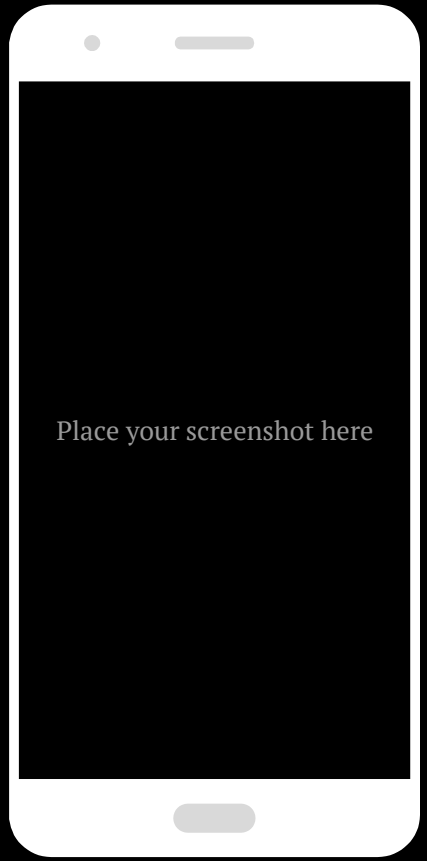

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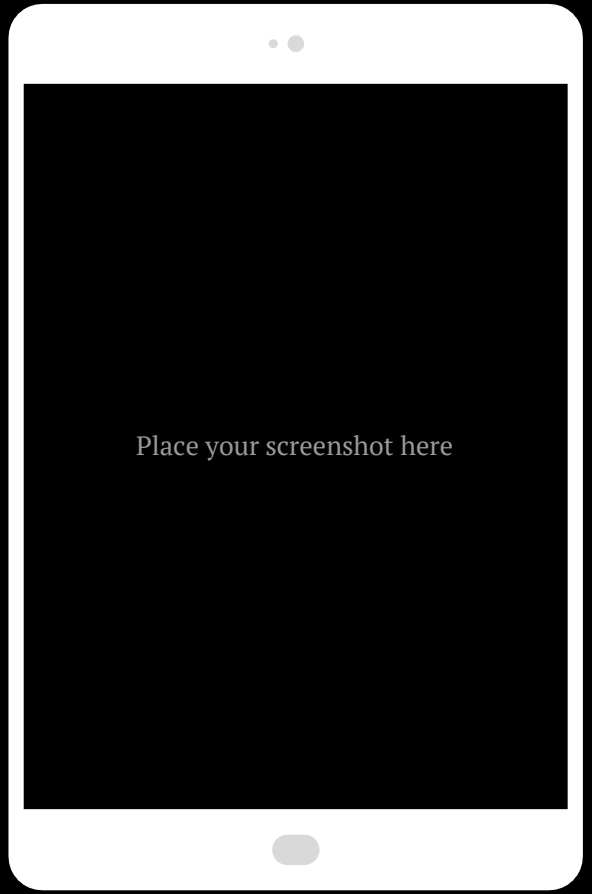

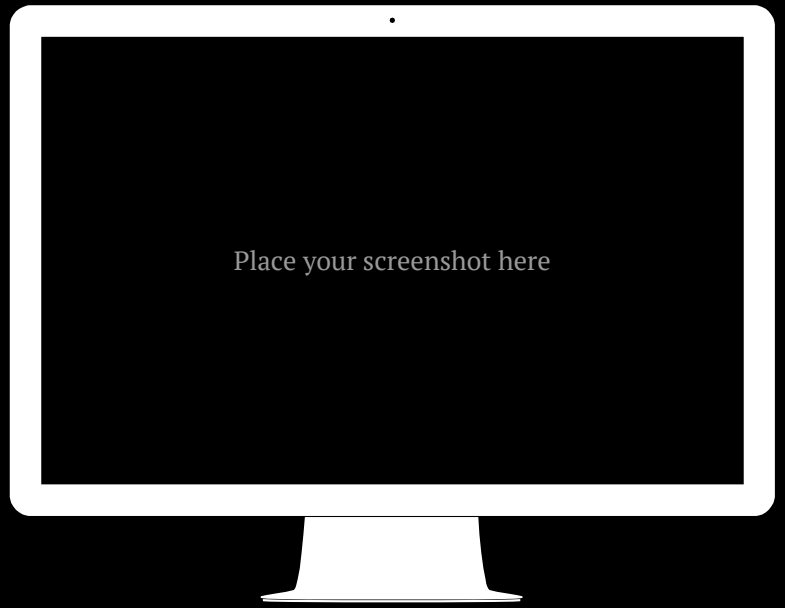

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thanks!

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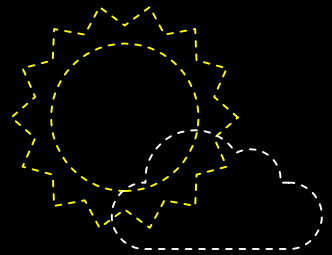

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