

Technological support for novice bamboo artisans: Potentials and challenges

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12TH WORLD BAMBOO CONGRESS

TAIWAN



Outline

INTRODUCTION
RELEVANT LITERATURE
METHODOLOGY
RESULTS
DISCUSSION
KEY TAKEAWAYS



Introduction

Support for novice designers

Versatility of bamboo strips for constructing curved surfaces and inherently flexible.

Accumulation of expert weavers through making over years of practice.



Aim of research



Aim

This paper aims to understand the extent of the positive impact on the utilisation of **mobile AR** through feedback provided by **bamboo enthusiasts** during the empirical data collection.

Research target

Non-experts who are keen to acquire handicraft knowledge through the assembly process.

Scope of work

A small prototype

"What are the potentials and challenges of using mobile AR in the bamboo woven design process?"

Relevant literature

Huang et al (2016)

Lightweight weaving spatial structural systems

**Harnomo and
Indraprastha (2016)**

Computational weaving grammar of traditional Indonesian patterns, particularly patterns originating from West Java

**Shinohara and Chan
(2024)**

Bamboo basketry's digital form-finding and manual fabrication experiment in woven architectural design using Kagome style.

Utilisation of **contemporary digital technology** allows explorations which were not possible without, for instance, producing quick design iterations using parametric design tools or structural simulations.



Methodology



Two mobile AR interface

Participants: 21 non-expert bamboo enthusiasts

Design background: architecture, industrial design and interior design

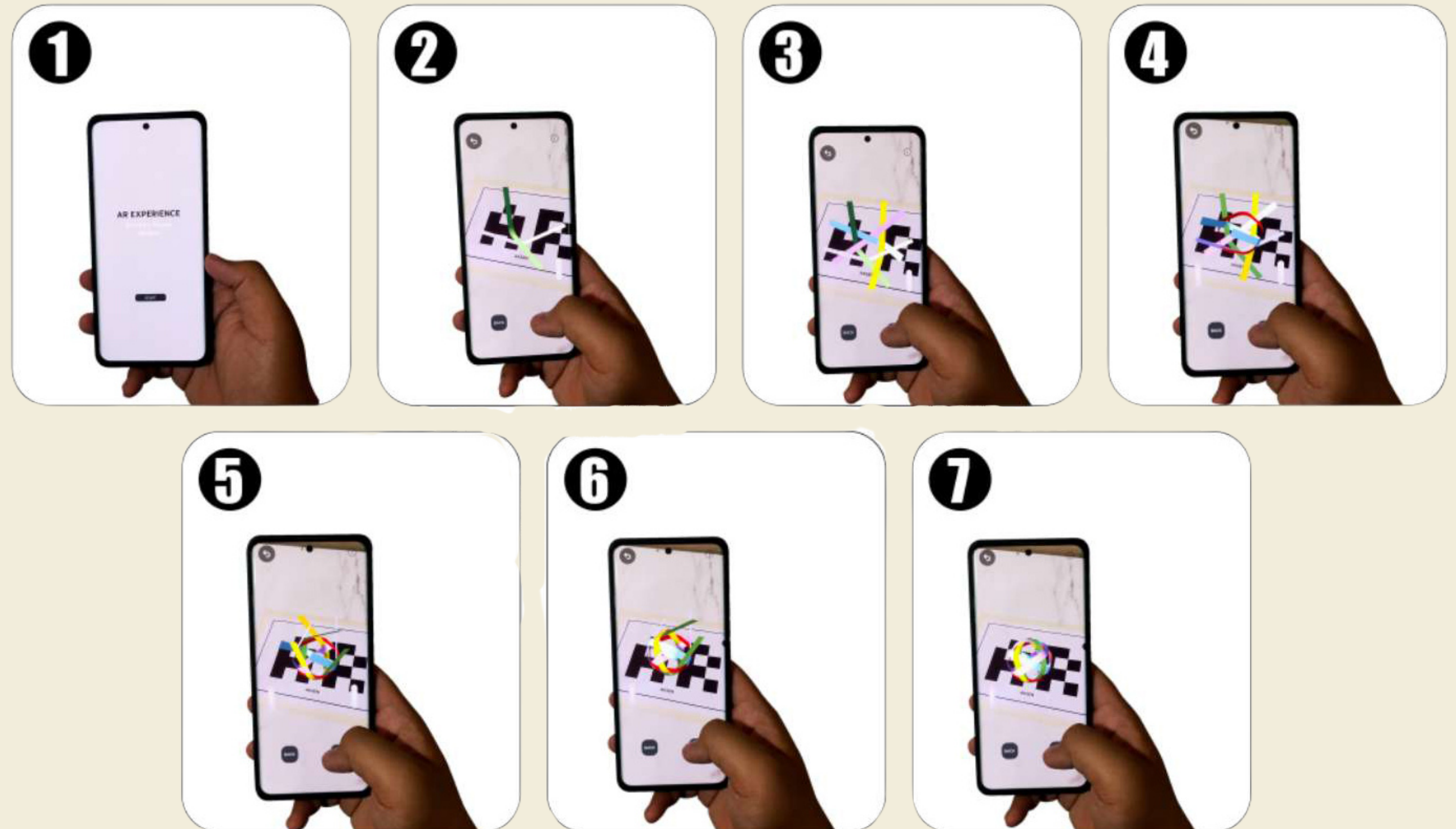
Each participant did two experiments, totalling 42 sessions

Filling questionnaire (rating and open-ended questionnaire) on visual display

Four categories of rating: environment tracking, user movement tracking, user interface and user-friendliness

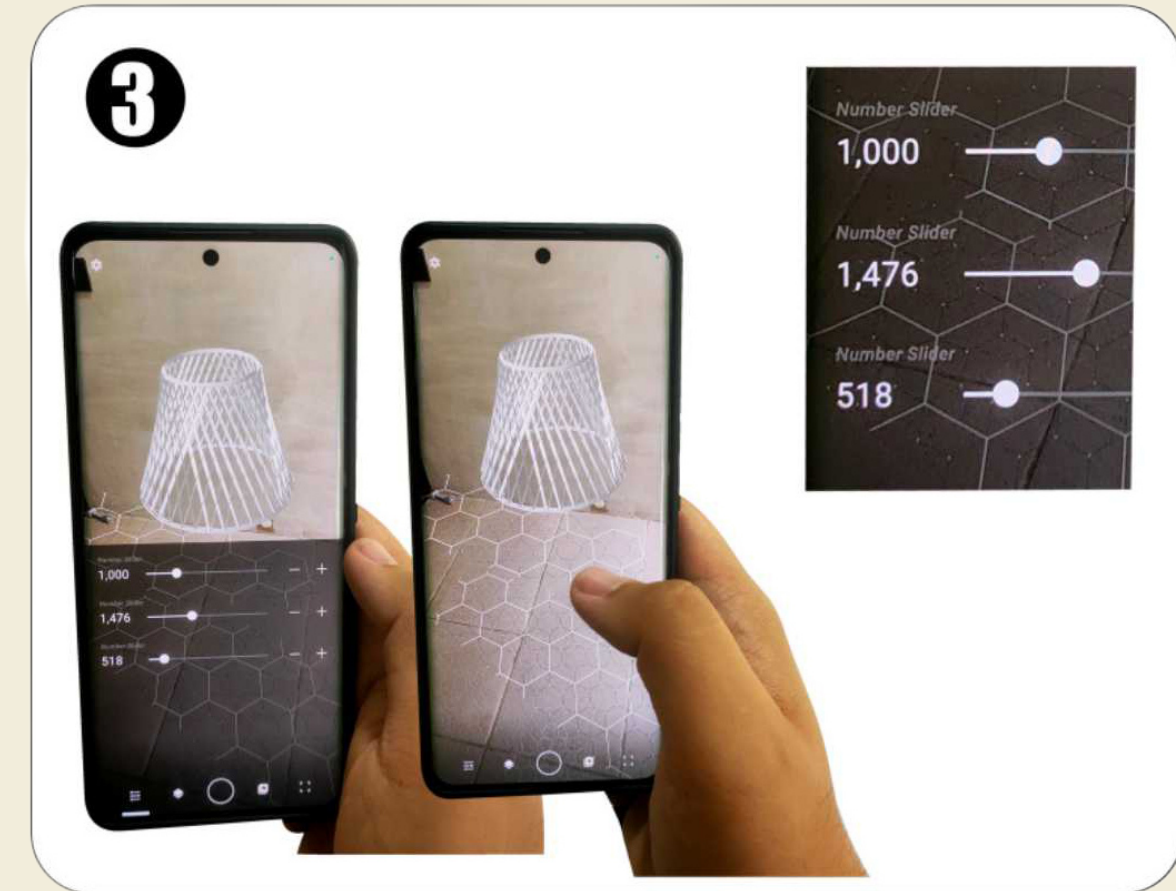
Experiment 1

Ball making



Experiment 2

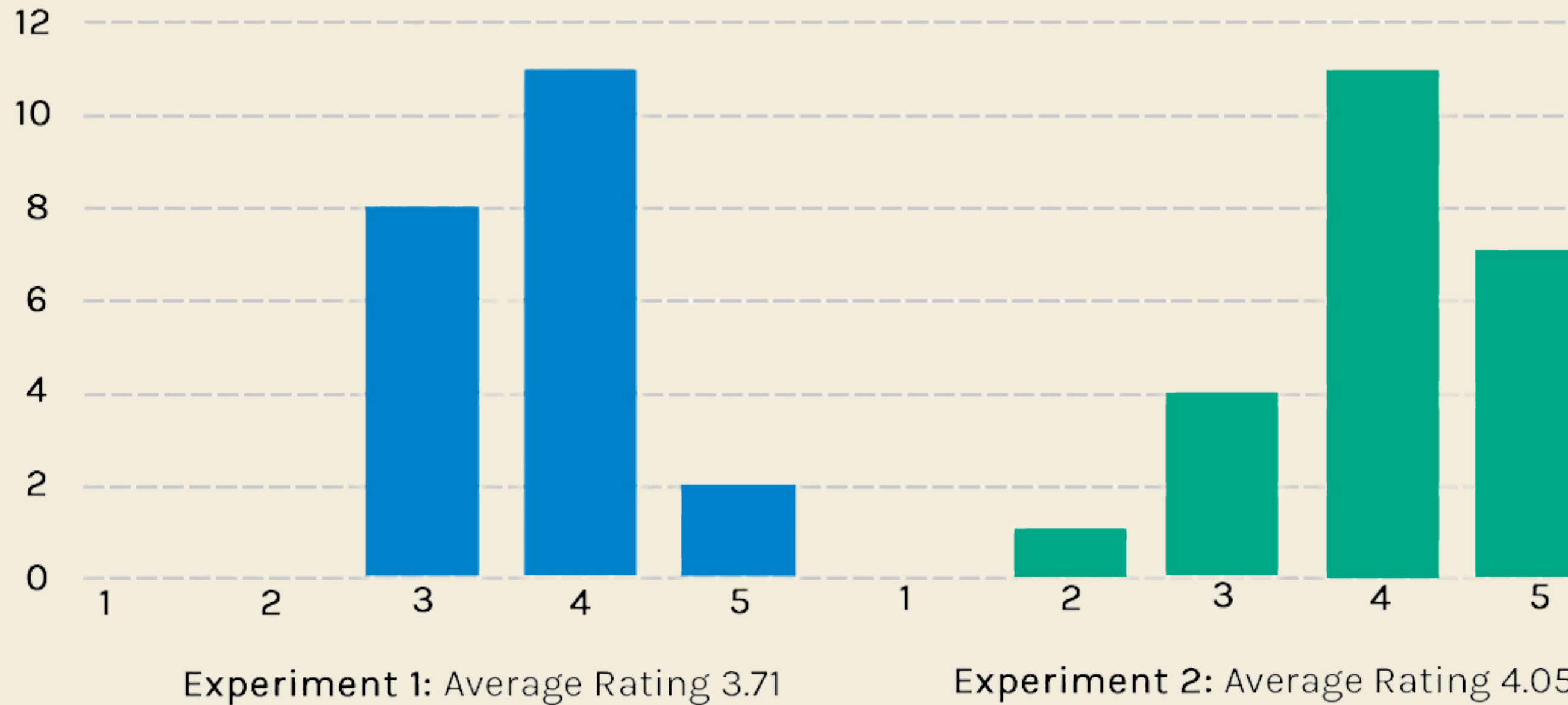
Lampshade making



Most participants favoured
Experiment 2 with more diverse
choices

Results

Overall rating



Two lowest ratings are 'colour' and 'eye strain' for both experiment.

Experiment 2 lacks of interaction

Results

AR visual display rating

1 2 3 4 5

Potential of outdoor use

Interaction

Multi-user potential

Brightness and contrast

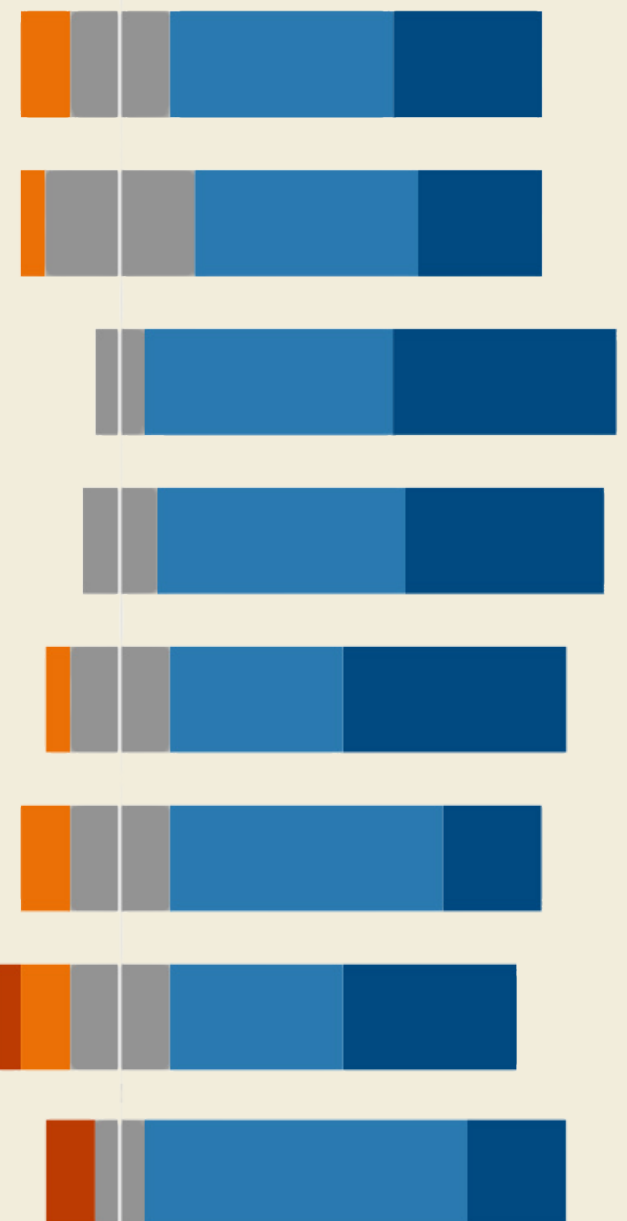
Resolution

Field of view

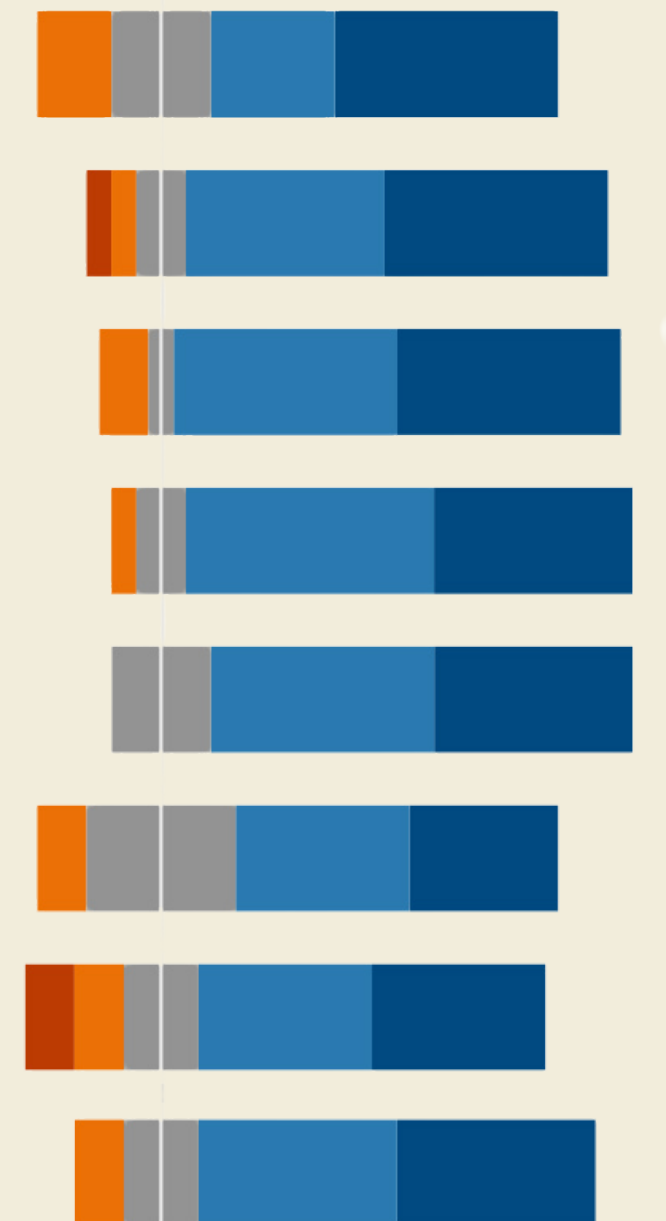
Colour

Eye strain

EXPERIMENT 1:



EXPERIMENT 2:



100%

0%

100% 100%

0%

100%



95% will recommend
Highest correlation is between 'user friendliness' and 'user interface'
Second highest correlation is between 'resolution' and 'brightness&contrast'

Discussion

Experiment 1 descriptive analysis

	Mean	Std. Deviation	1	2	3	4	5	6	7	8	9	10	11	12	13
1- Gender	1.2381	0.43644	1												
2- Experience	1.7619	0.43644	0.05	1											
3- Area_design	2	0.70711	0.324	0.162	1										
4- Complete_task	1.7143	0.64365	-0.102	0.102	0	1									
5- Potential_of_outdoor_use	3.9048	0.94365	-0.064	-0.422	0.075	0.282	1								
6- Interaction	3.8571	0.85356	-0.038	-0.499	0	0.013	0.603	1							
7- Multi_user_potential	4.3333	0.65828	-0.116	-0.058	0.107	0.236	0.376	0.356	1						
8- Brightness_and_contrast	4.2381	0.70034	0.296	-0.132	0.202	-0.063	0.036	0.311	0.145	1					
9- Resolution	4.1429	0.91026	0.162	-0.162	0.155	-0.012	0.249	0.542	0.25	0.807	1				
10- Field_of_view	3.8095	0.87287	-0.269	0.006	-0.243	0.343	0.159	0.364	0.116	0.405	0.539	1			
11- Eye_strain	3.8095	1.07792	-0.111	0.005	0.197	0.062	0.325	0.458	0.305	0.46	0.641	0.597	1		
12- Environment_tracking	3.1905	0.87287	-0.256	-0.531	0.162	0.013	0.387	0.508	0.58	0.004	0.027	0.05	0.2	1	
13- User_movement_tracing	3.4762	0.87287	-0.313	-0.344	0	0.343	0.301	0.364	0.232	0.051	0.099	0.519	0.526	0.531	1
14- User_interface	4	0.83666	-0.137	-0.548	-0.254	0.186	0.443	0.63	0.454	0.341	0.394	0.411	0.388	0.411	0.548
15- User_friendliness	4.1429	0.57321	-0.143	-0.657	-0.123	-0.019	0.396	0.657	0.398	0.409	0.438	0.357	0.451	0.642	0.657

Positive relationships between AR display elements and others

Better resolution with a viable balance of brightness and contrast can help artisans reduce eye strain's impact.

Discussion

Experiment 1's observed advantages:

Being able to see all sides
(360deg) of the object

Step-by-step assembly guide

Learning basic process of
bamboo woven



Experiment 1's observed disadvantages:

Less suitable for complex
structure.

Colour coding was not
suitable for bright
environment



95% will recommend
 Highest correlation is between
 'environment tracking' and 'user
 movement tracking'
 'Brightness & contrast' against five
 elements

Discussion

Experiment 2 descriptive analysis

	Mean	Std. Deviation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1- Gender	1.2381	0.43644	1															
2- Experience	1.7619	0.43644	0.05	1														
3- Area_design	2	0.70711	0.324	0.162	1													
4- Complete_task	1.8095	0.67964	0.161	-0.161	0	1												
5- Potential_of_outdoor_use	3.9524	1.11697	0.127	-0.127	0.127	0.449	1											
6- Interaction	4.0952	1.09109	0.16	-0.055	0.13	0.363	0.578	1										
7- Multi_user_potential	4.1905	0.92839	0.129	-0.129	0.076	0.14	0.684	0.82	1									
8- Brightness_and_contrast	4.1905	0.81358	0.007	-0.007	0	-0.022	0.451	0.542	0.678	1								
9- Resolution	4.1905	0.7496	0.007	-0.16	-0.283	-0.023	0.37	0.649	0.592	0.429	1							
10- Field_of_view	3.8095	0.98077	-0.122	-0.228	-0.144	0.018	0.493	0.392	0.426	0.674	0.596	1						
11- Colour	3.7143	1.30931	0.125	-0.125	-0.162	-0.008	0.537	0.65	0.623	0.664	0.721	0.578	1					
12- Eye_strain	4.0476	0.97346	-0.146	0.028	0	0.0140	0.692	0.56	0.598	0.619	0.604	0.796	0.639	1				
13- Environment_tracking	3.5238	1.12335	0.243	-0.345	0.252	-0.0590	0.419	0.488	0.571	0.651	0.351	0.73	0.447	0.525	1			
14- User_movement_tracing	3.5714	1.07571	0.228	-0.335	0.263	-0.049	0.44	0.505	0.586	0.669	0.354	0.724	0.477	0.546	0.981	1		
15- User_interface	3.8571	1.10841	0.177	-0.281	0	0.427	0.721	0.839	0.854	0.586	0.636	0.526	0.625	0.609	0.545	0.533	1	
16- User_friendliness	4.0952	0.83095	0.21	-0.348	0	0.2990	0.598	0.817	0.883	0.637	0.612	0.453	0.67	0.489	0.587	0.607	0.884	1

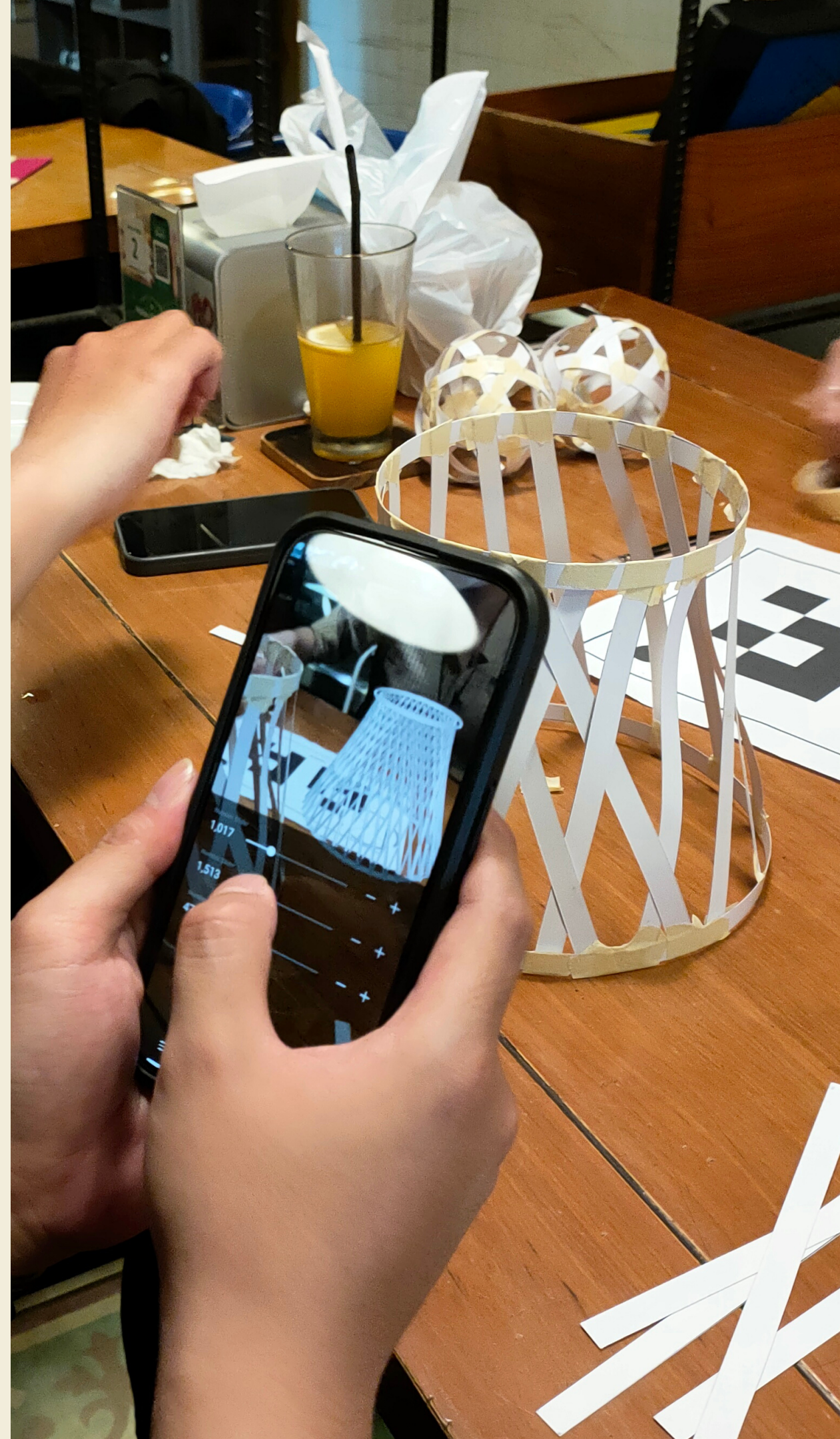
Brightness and contrast of the digital model provides fundamental footings for useable AR

Discussion

Experiment 2's observed advantages:

Real-time parameters (shape, position and size) changing

Rapid design iteration



Experiment 2's observed disadvantages:

No step-by-step assembly

3D display only

Lack of accuracy of
dimension



Discussion

A positive support

Promoting traditional bamboo woven patterns

Mobile AR with its low investment

A better support

Based on a follow-up interview with P2 who did not recommend both interface:

Additional benefits compare to a video tutorial should be more evident



Re-iterating RQ

"What are the potentials and challenges of using mobile AR in the bamboo woven design process?"

POTENTIALS

- Being able to see 360-degree views of the object assembly guide
- Being able to learn the basic process of weaving bamboo strips
- The ability to simulate ideas rapidly

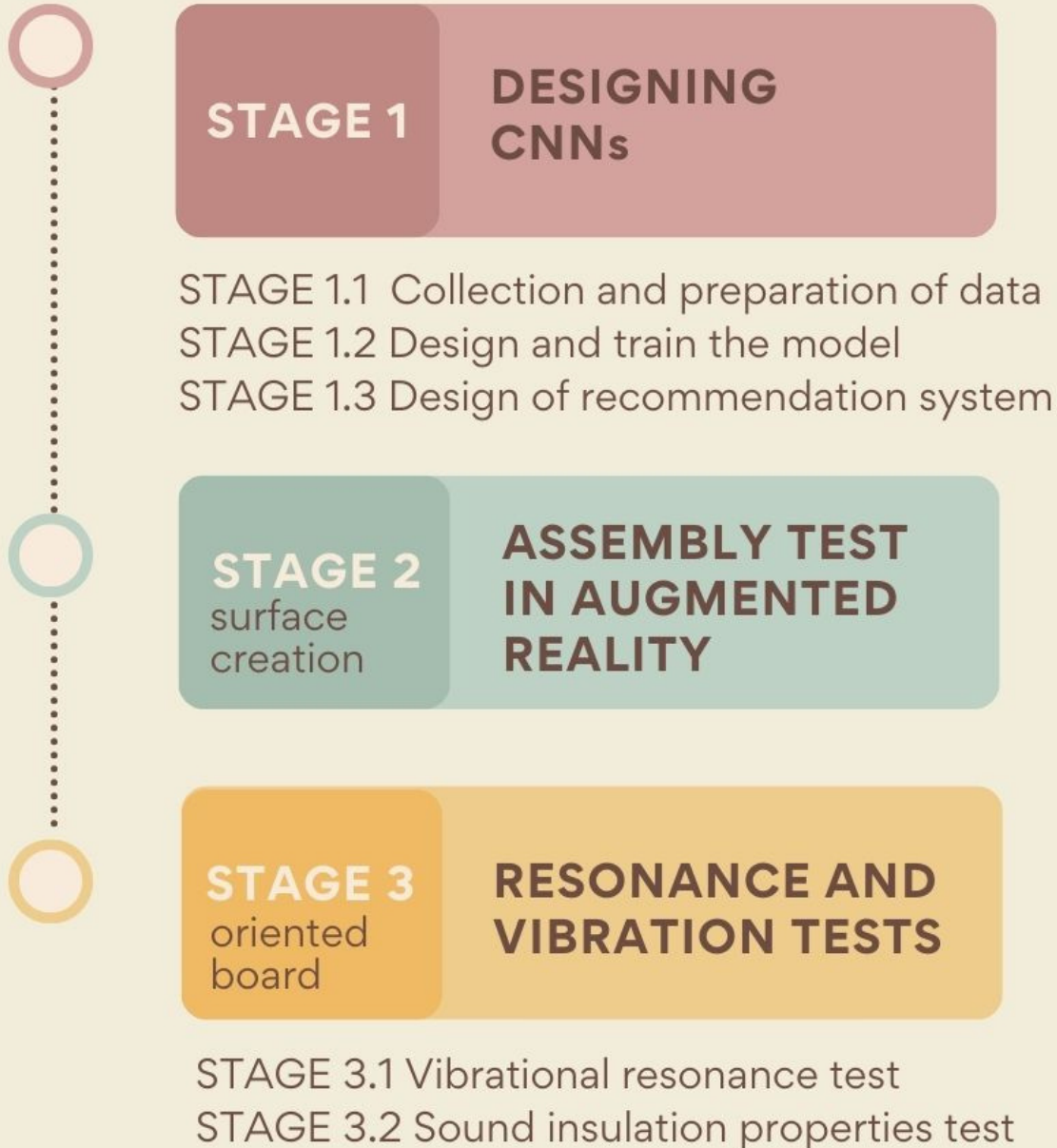
CHALLENGES

- Accuracy (dimension),
- Hologram colour being suitable for indoor and outdoor use
- Benefits in comparison with pre-recorded video tutorials



Further recommendations

And further study



A more developed assembly system

Written guides and animated instructions more accurate dimensions

Further study includes cataloguing bamboo woven pattern for machine learning with two immediate applications: AR assisted pavilion and dry walls made of stacked bamboo woven.

Combining the two experiments' set-up (assembly guide and parametric design features)

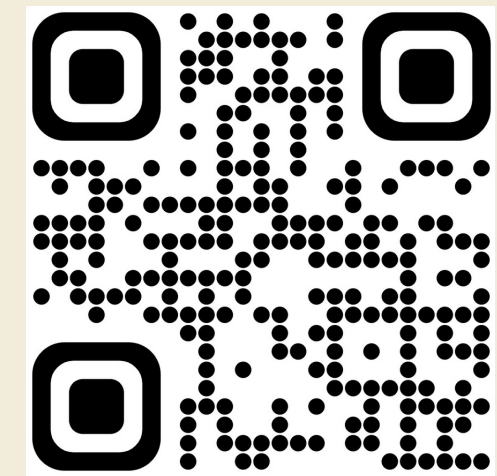
Improving the surface detector with markers (for Experiment 2).



TBE



Tectonic Bamboo Education (TBE)



A collective endeavour (Siti, Maurin and Mia), advocating to embed tectonic bamboo into mainstream architecture pedagogy. QR code is for the pubpub page where we document the journey.

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