

A Voice-Assisted Billing Interface for the Kirana shopkeepers

M.Des. Project 3

Udayan Vidyanta

Interaction Design (2016–18)

IDC School of Design

Guided by: **Prof. Anirudha Joshi**

Spot the difference



(A)



(B)

Spot the difference



(A)

Organised Retail



(B)

Kirana Shop

Difference in methods of billing



**Organised
Retail**



**Kirana
Shop**

Difference in methods of billing



**Organised
Retail**



**Kirana
Shop**



**POS
systems**

Difference in methods of billing



Organised Retail



Kirana Shop



POS systems

Q	Ans	Y	100
(1) sugar	250 gm	x 500	88
(2) Maggi 4 pack	3 pack		40
(3) Atta	4 kg		108
(4) Biscuits	6 pi		6
(5) Atta 9	1st Mirchi	25 gm	1000
(6) Harpic	Lavender	100 ml	1 Bottle 66
(7) Harpic	— g —	20 ml	1 Bottle 120
(8) Kellogg's	Chocos	1	275
(9) atta atta	Real Cross Action brush		17
(10) Urelax	Wheat Apple	1 Bo	290
(11) Haggies	dh	1	475
(12) Colgate	sensitive tooth brush	2+1	180
(13) Lipton	Tea	1	365

Manual bills

Why Kirana shops don't do digital billing?



POS
systems



Kirana
Shop

(1) sugr	250 gm	x 500	100	100
(2) Maggi	4 pack	3 pack	140	140
(3) Atta	4 kg		108	108
(4) Bleach	6 pi		6	6
(5) Atta	1 kg	25 gm	140	140
(6) Harpic	100 ml	100 ml	180	180
(7) Harpic	200 ml	200 ml	180	180
(8) Kelllogg's	Chocor	1	275	275
(9) Wheat Wheat	Wheat	100 gm	177	177
(10) Wheat	Wheat	100 gm	290	290
(11) Huggies	di	1	475	475
(12) Dettol	sensitive	tooth brush	21	180
(13) Dettol	tooth brush	1	365	365

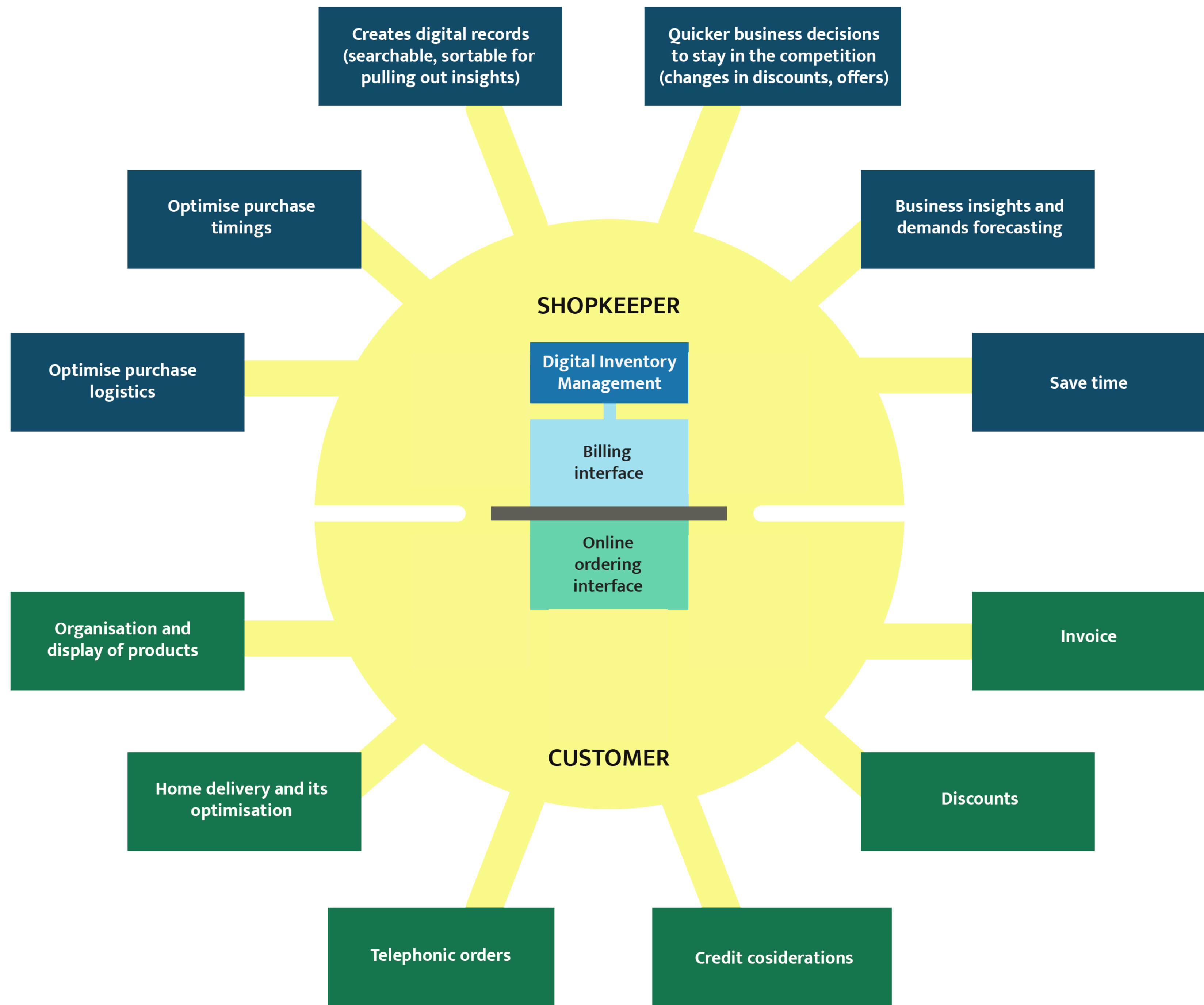
Any better POS systems in market?

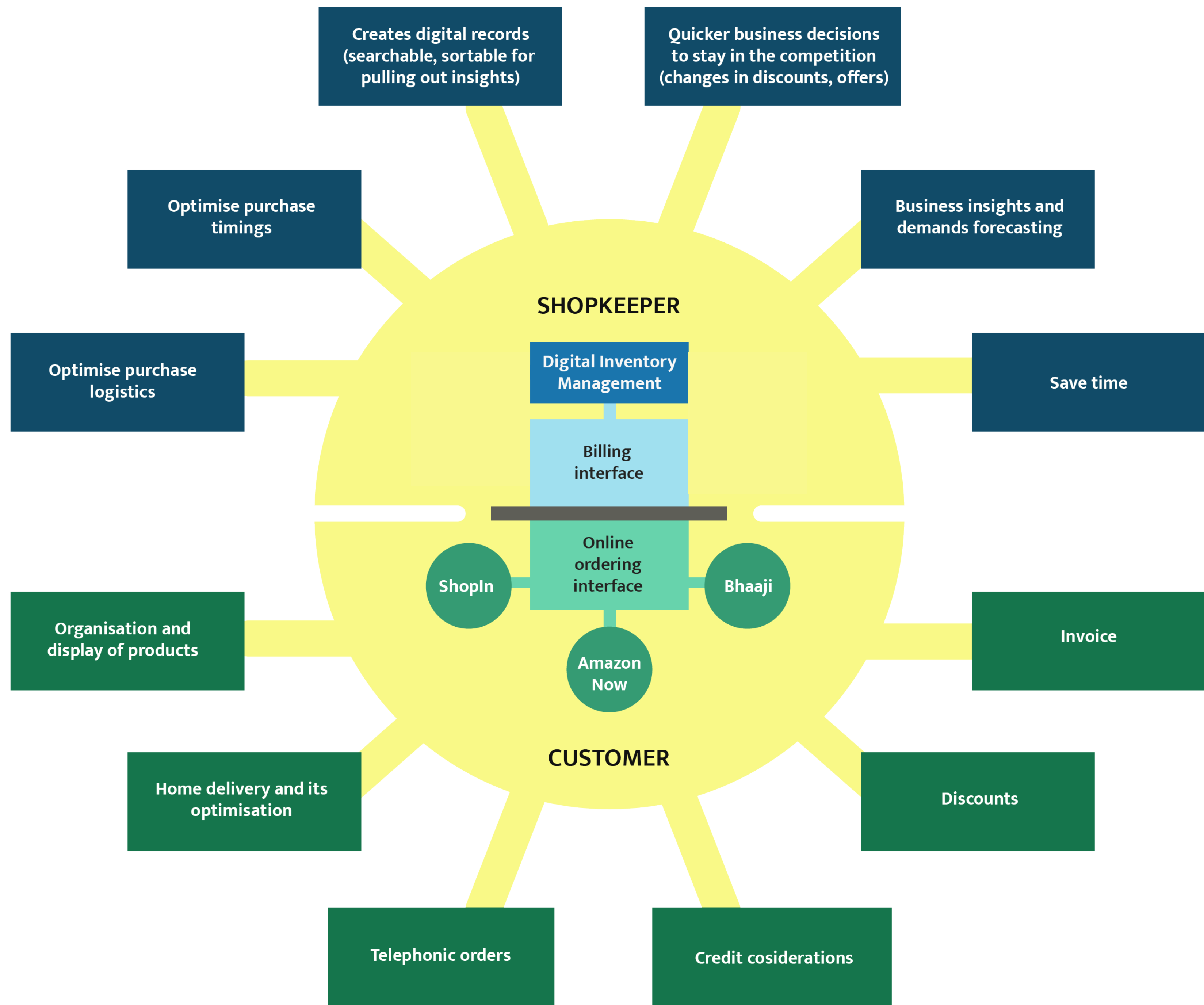


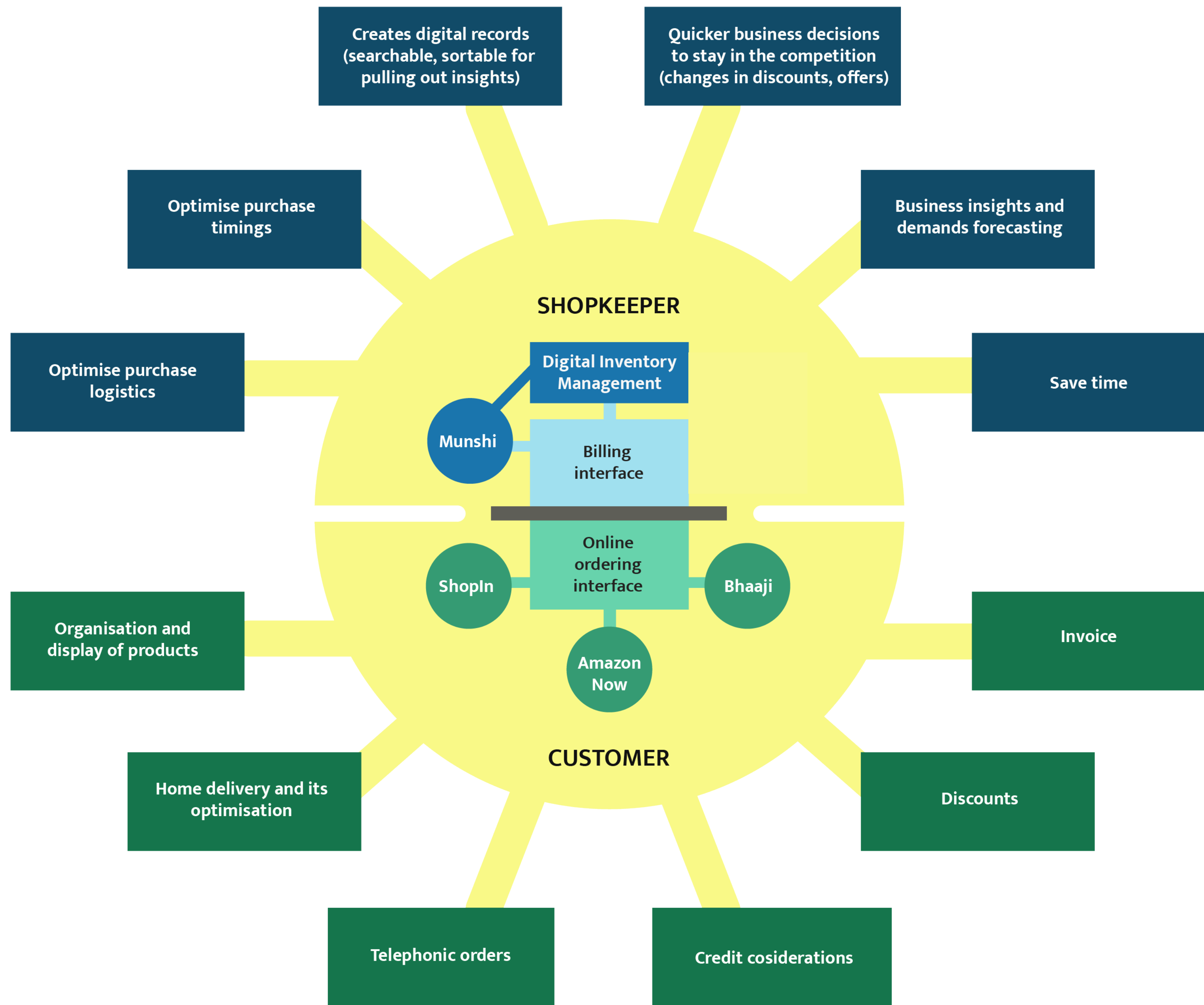
How sale of items sold loose (by weight)
are handled in Snapbizz

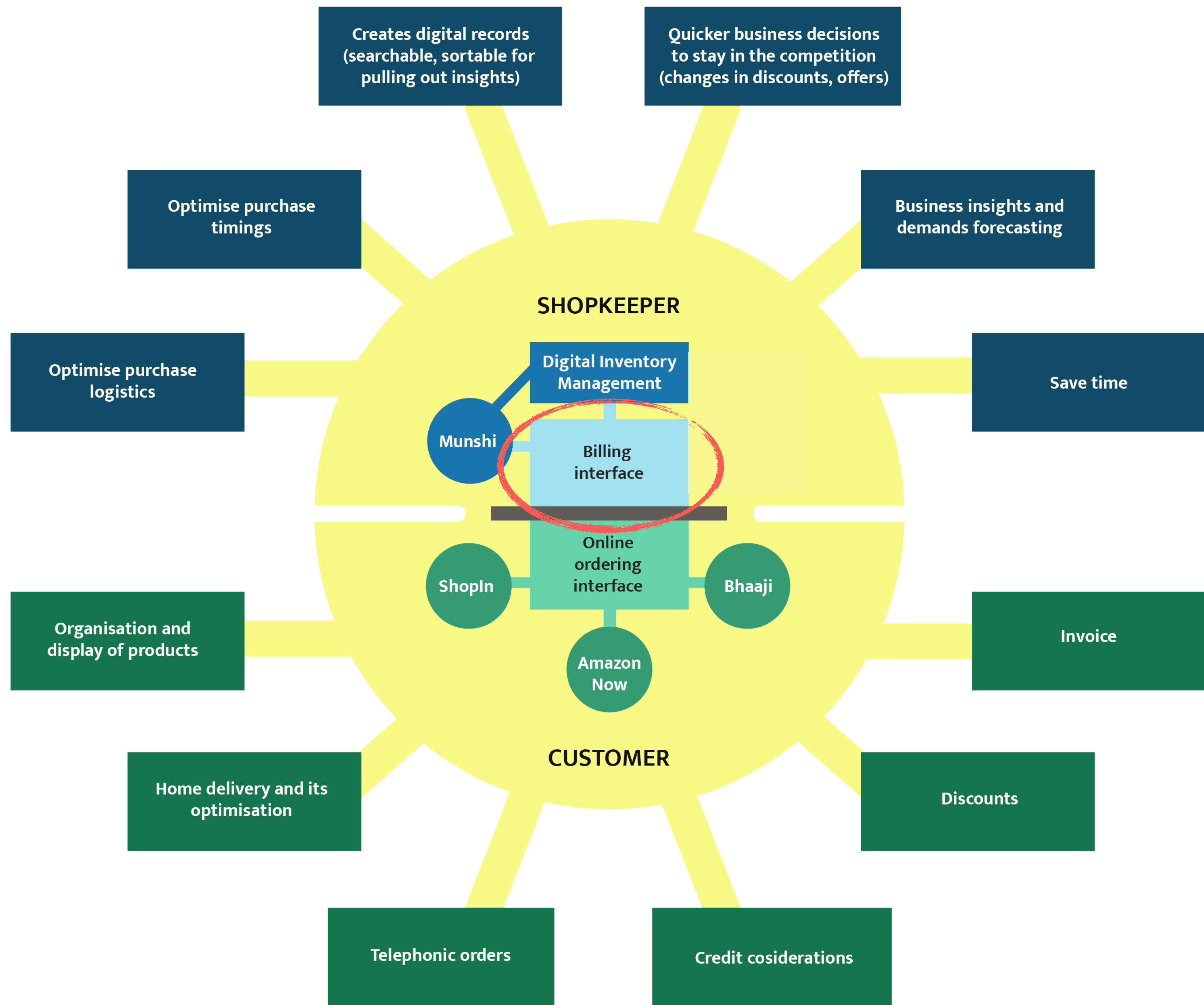
	abc ₹50	chana daal ₹70	chanoli 120 ₹119	ghhjj ₹38
1 thoor dal ₹70	arhar dal ₹75	Chana Dal ₹52	chiwda ₹45	Hara Watana 40 ₹48
2 dal chana ₹50	badam ₹800	Chana dal ₹95	Daliya ₹165	hing ₹18

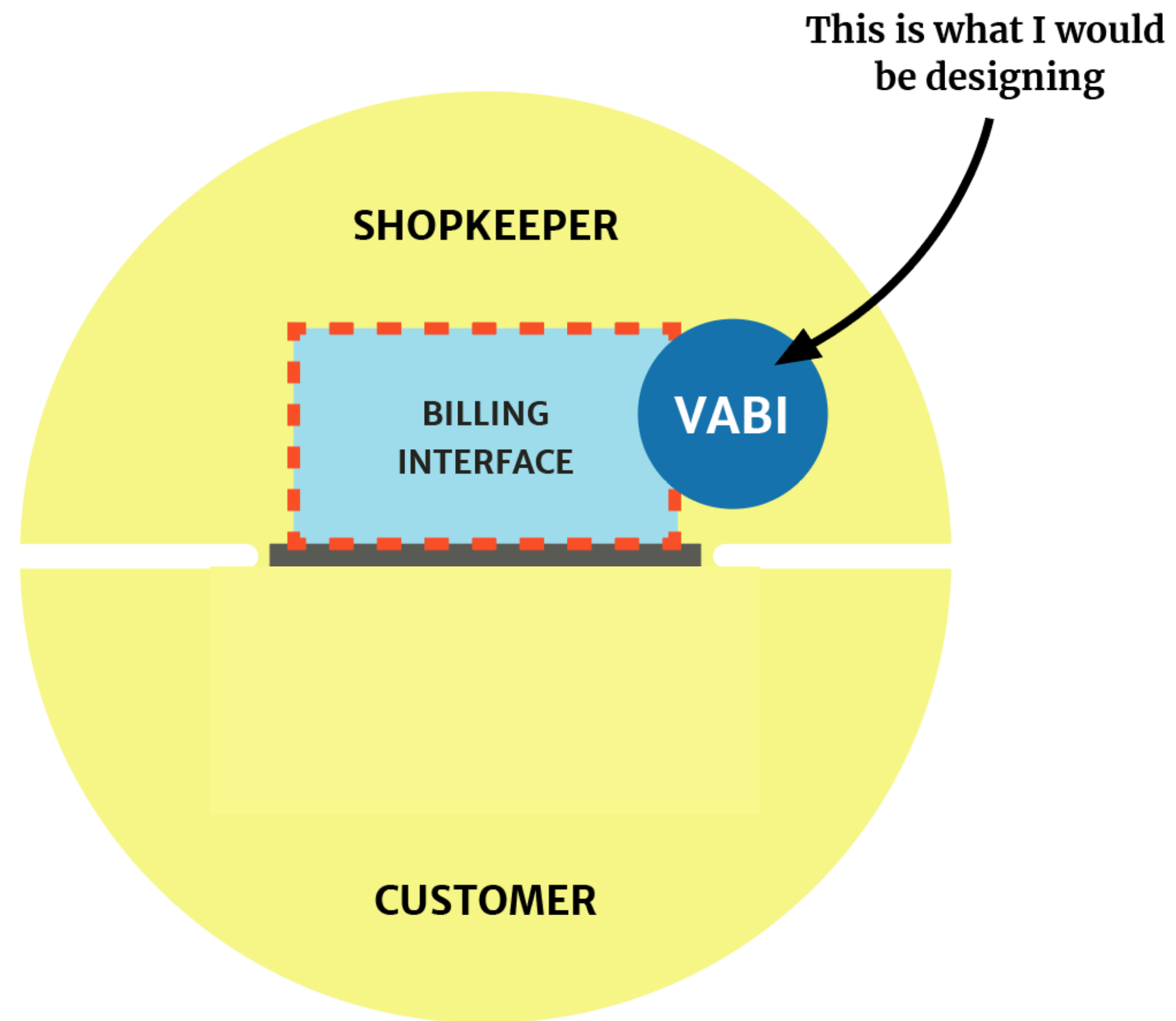
	10 gm	20 gm	25 gm	50 gm
100 gm	200 gm	250 gm	500 gm	750 gm
1 Kg	2 Kg	3 Kg	4 Kg	5 Kg
10 Kg	15 Kg	20 Kg	25 Kg	50 Kg



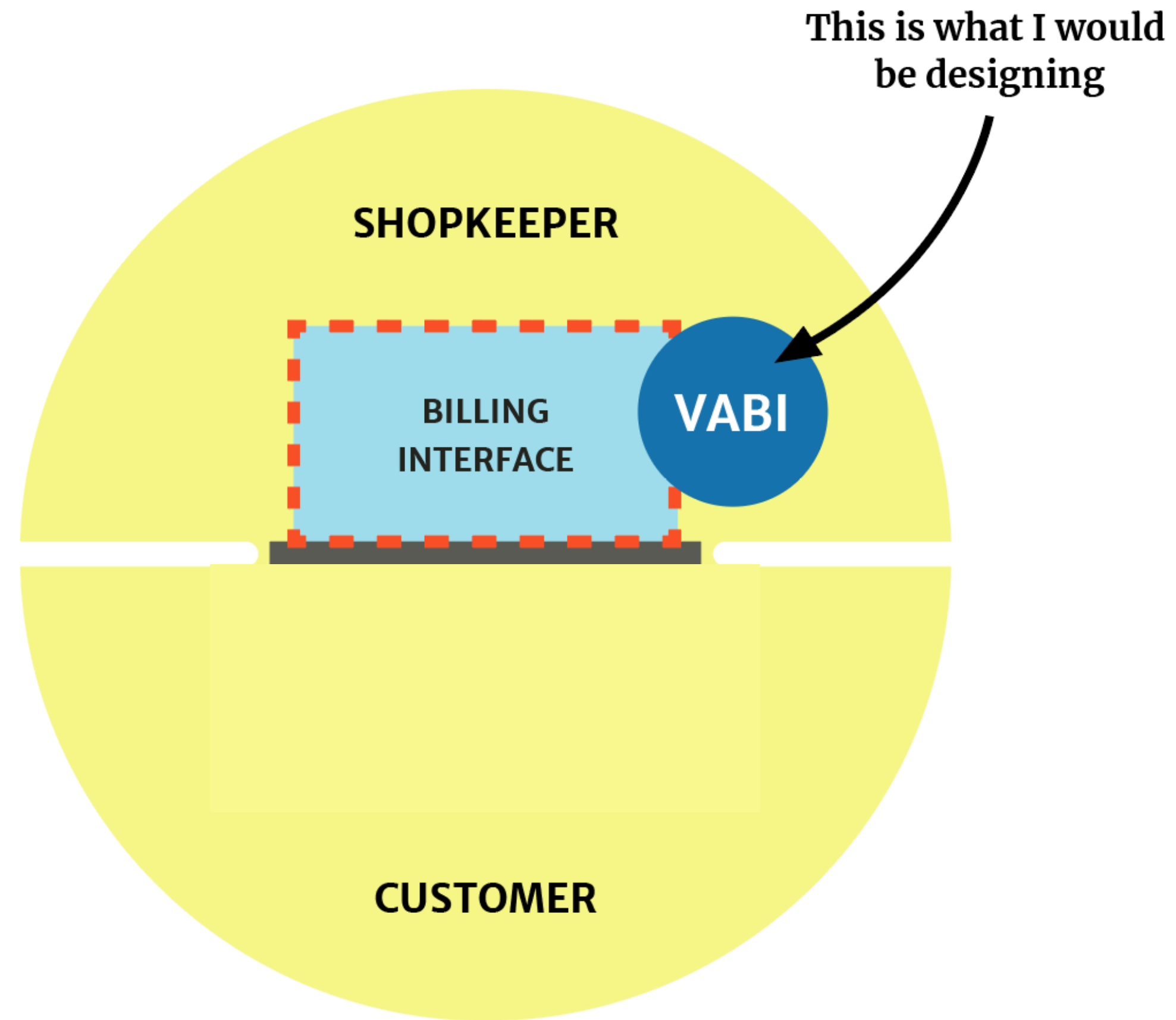








Voice Assisted Billing Interface (VABI)



Voice Assisted Billing Interface (VABI)

Voice

Touch

Why **voice**?

1. Speed
2. Handsfree
3. Does not restrict mobility
4. Better for directed tasks
5. Adoption and ease of use
6. Can be used for a public tasks to enhance transparency

Why **touch**?

1. Visual feedback is better in *some cases*
2. One tap can often save time spent in speaking out an entire voice command

(Wake word),
4 kg आटा जोड़ दो

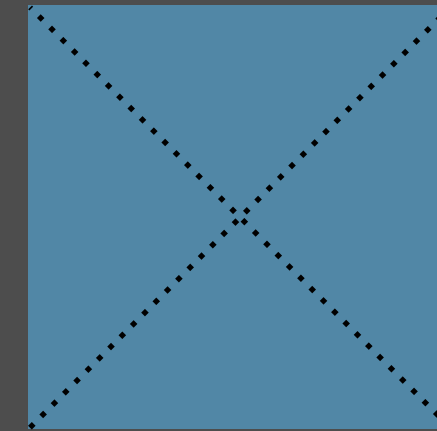
आटा 4 प्रकार में उपलब्ध है

- 26 रुपए किलो वाला आटा
- 27 रुपए किलो वाला आटा
- 30 रुपए किलो वाला आटा
- 35 रुपए किलो वाला Multigrain आटा

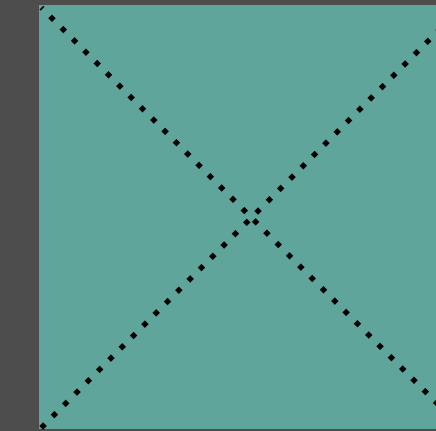
कृपया चयन करें

(Wake word),
4 kg आटा जोड़ दो

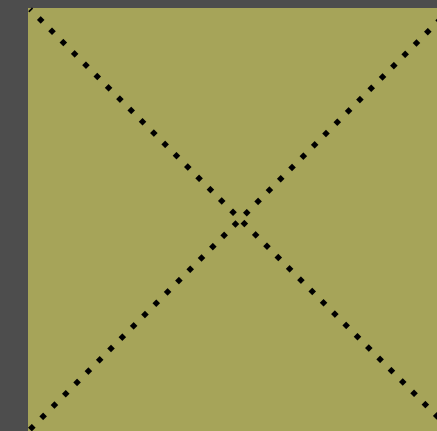
आटा के प्रकार का चयन करें



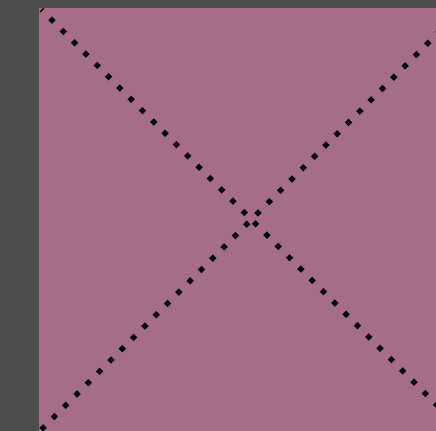
26 रुपए किलो वाला आटा



27 रुपए किलो वाला आटा



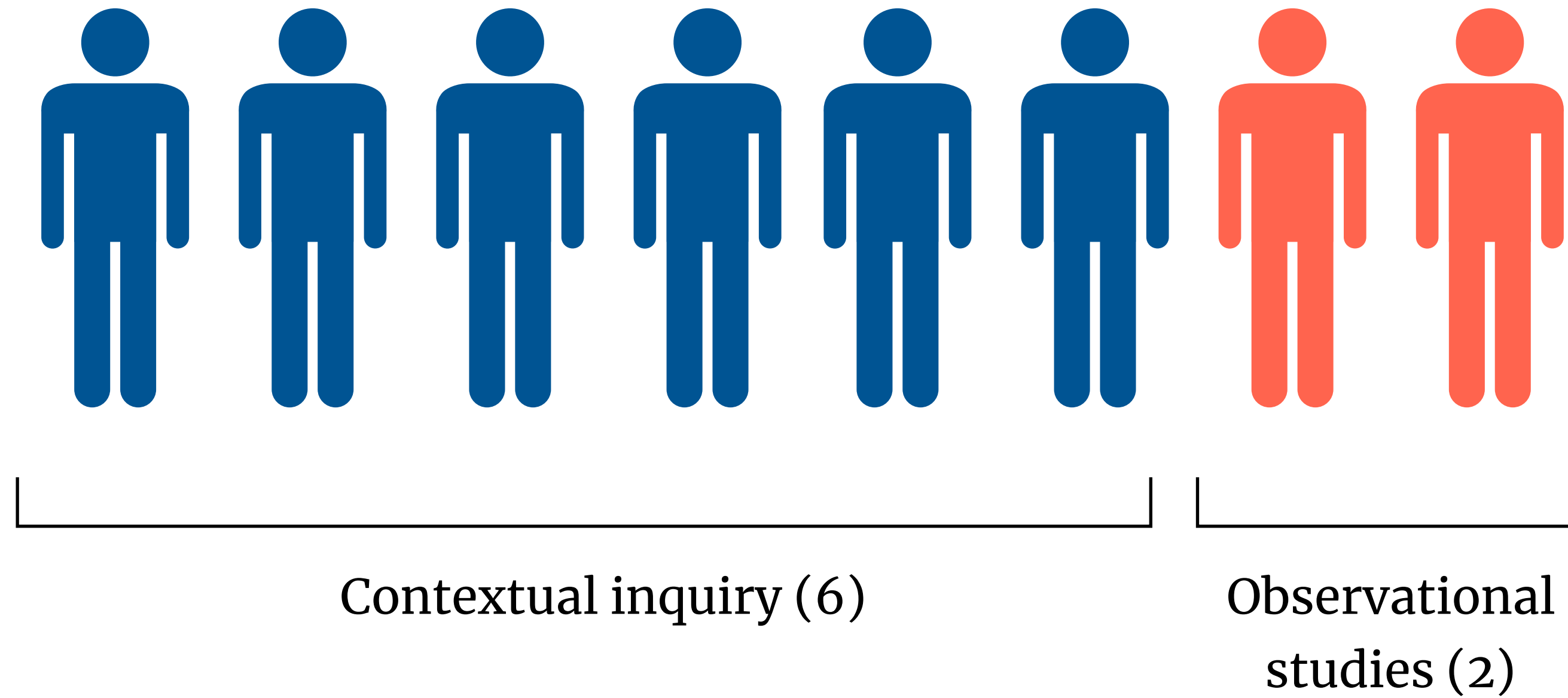
30 रुपए किलो वाला आटा



35 रुपए किलो वाला
Multigrain आटा

Primary Research

User Studies



shopkeepers in Mumbai



shopkeepers in Lucknow

Findings regarding billing issues

1. Bills are created on pieces of paper.
2. A customer complained, "*it appears as coded as a doctor's prescription.*"
3. A shopkeeper claimed to be able to recite the tables till 20 in reverse, as he had been making such bills for the past ten years.
4. Manual calculation of long bills (having more than 7-8 items) takes more time as they are verified twice to prevent any calculation errors.
5. A shopkeeper said, "*By the time I punch in the numbers (on the calculator), I would have done it in my head.*"

(1) Sugar 250 gm x 500	125 4 100	12500
(2) Maggi 4 pack 3 pack		140
(3) Atta 4 kg		108
(4) Biscuits 6 pi		6
(5) Atta but Mirchi 25 gm		1000
(6) Harpic Lavender 100 ml		1 Bottle 66
(7) Harpic — 200 ml		1 Bottle 120
(8) Kellogg's Chocos 1		275
(9) tooth brush deal Cross Action brush		177
(10) Urelan wheat Apple 1 Box		290
(11) Haggies dhi 1		475
(12) Colgate sensitive tooth brush 2+1		180
(13) Lipton Tangehng tea 1		365
(14) Garnier men face wash 1		160
(15) Sugar 3 kg		120
		<hr/>
		2288
		- 102
		<hr/>
		2390

Design Goals

Functional goals

1. Automatic calculation
2. Printable format
3. Multiple bill creation simultaneously
4. Editing of bills

UX goals

1. As fast (if not faster) than manual billing
2. Multitasking
3. Longer-range of distances (say 5 metres)
4. Feedback
5. Low learning curve
6. Maximising information, and enhancing transparency

Scope

Legacy Kirana stores



Hardware Setup for VABI

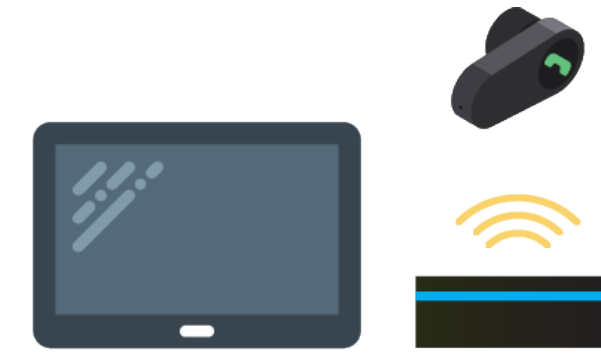
(A.) Tablet + Smart speaker housing voice assistant
+ wireless Bluetooth headset,

(B.) Tablet + Mirrored display + Smart speaker
housing voice assistant + wireless Bluetooth headset

(C.) Tablet + 24" monitor screen + Smart speaker
housing voice assistant + wireless Bluetooth headset

(D.) Tablet + 24" monitor screen + Mirrored display
+ Smart speaker housing voice assistant + wireless
Bluetooth headset

A.



B.



C.



D.



Issues in Voice UI Design

Conversational voice assistant

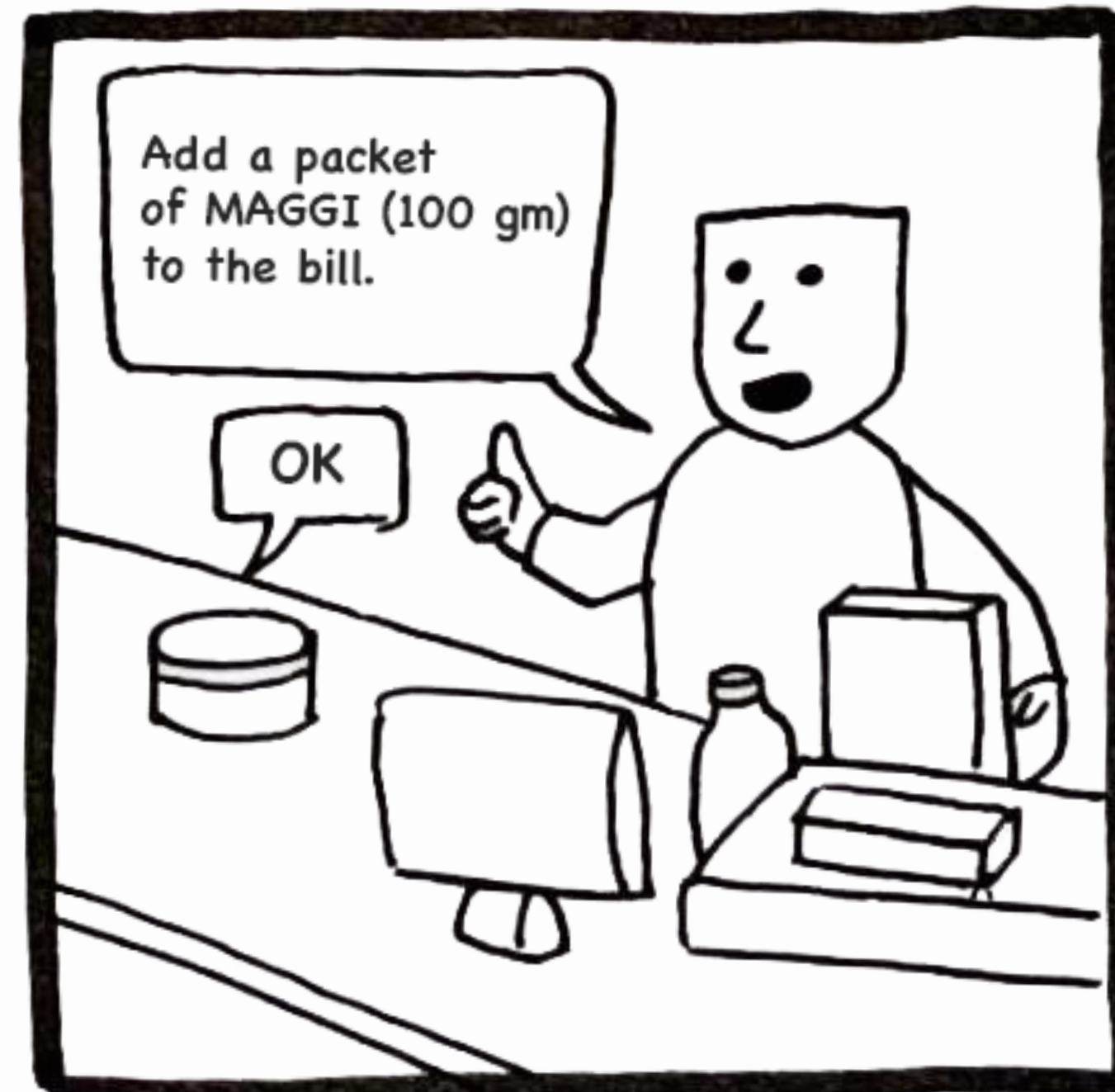
VS

Set-command based VUI

Conversational voice-assistant



(A)



(B)



(C)

Conversational Voice Assistant would be the ideal thing

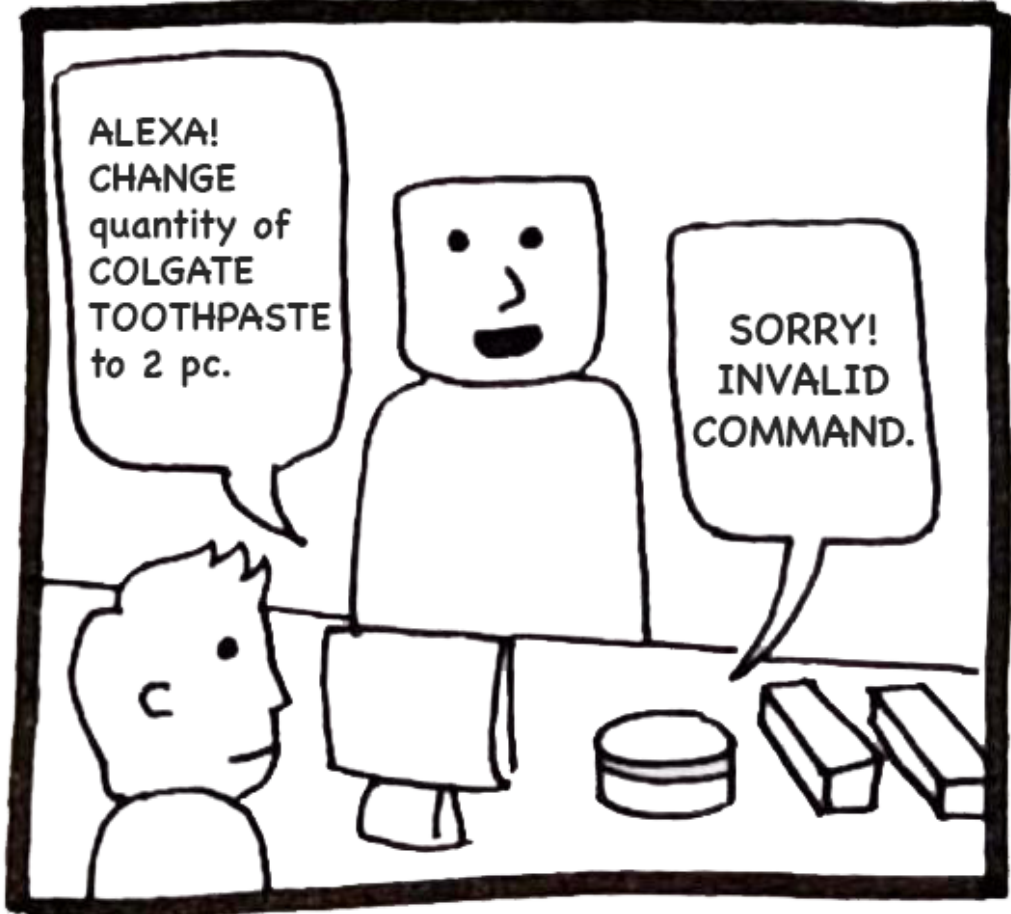
Set-command VUI



(A)



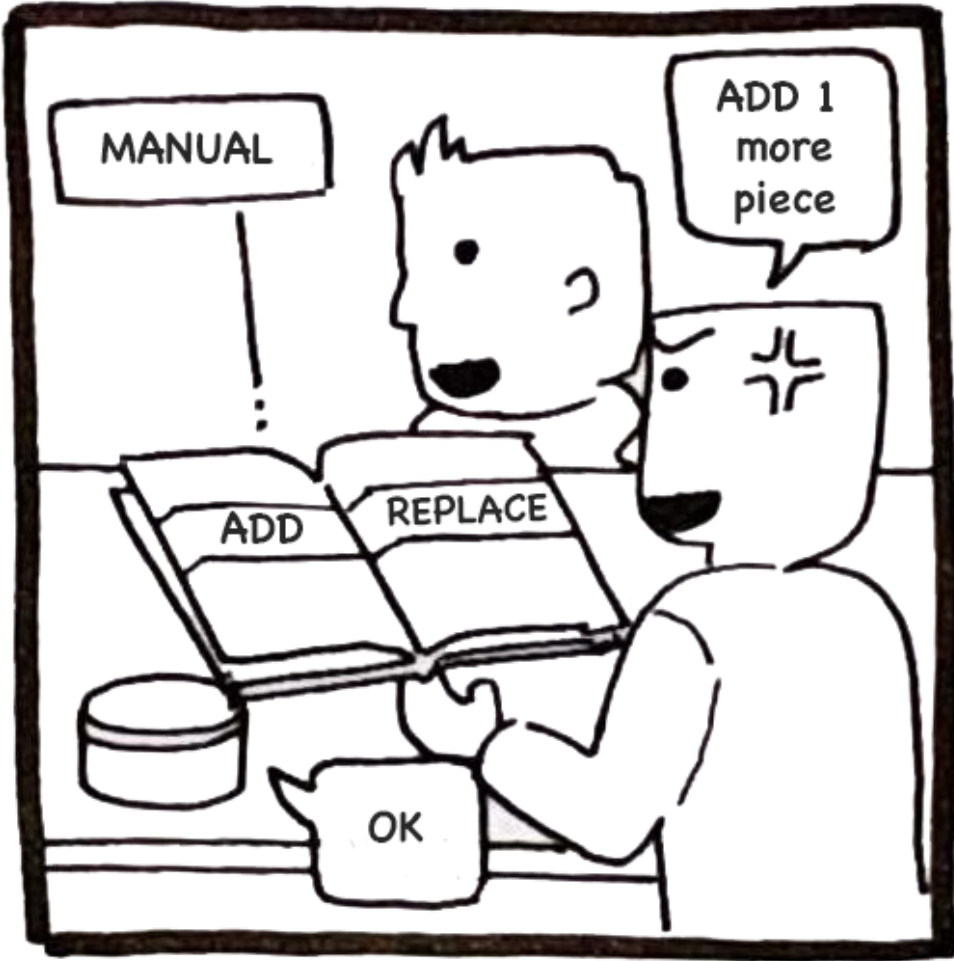
(B)



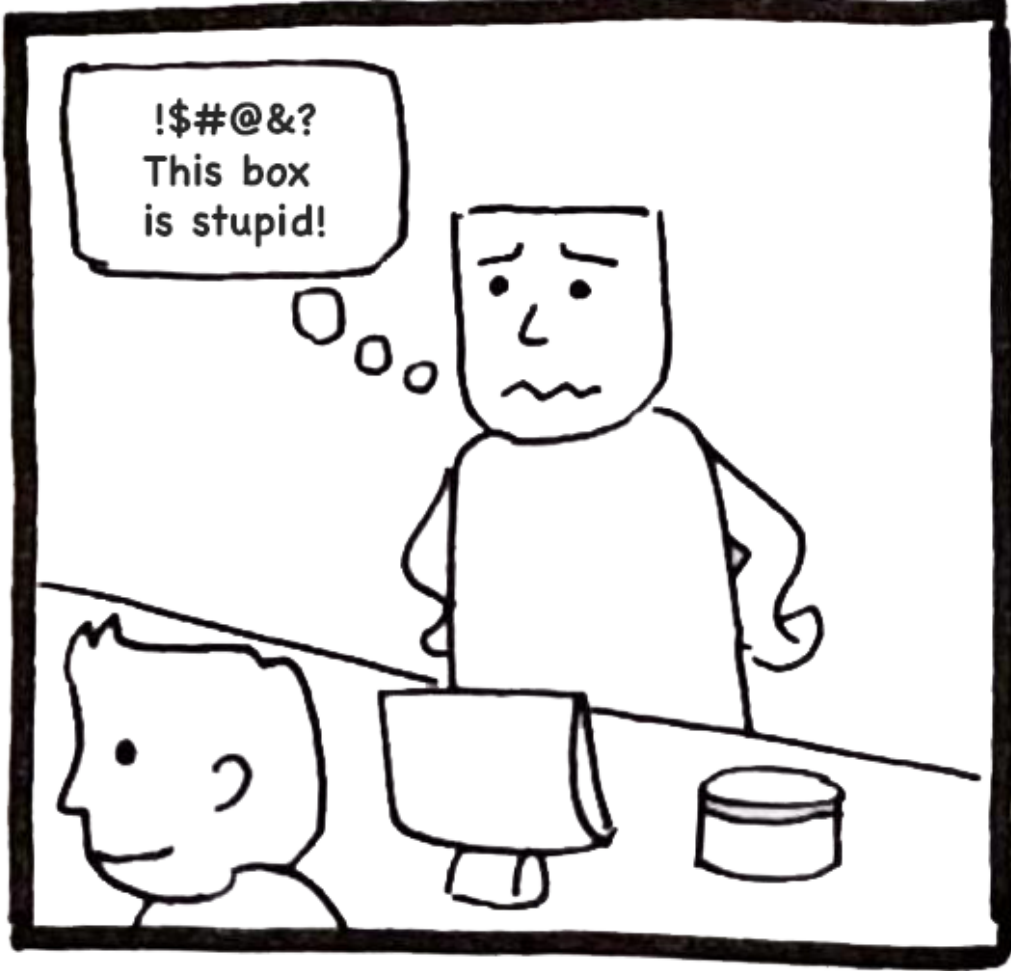
(C)



(D)



(E)



(F)

Hassles of set command-based VUI

Conversational voice-assistant

vs

Set-command VUI

1. Do not need to remember command syntax

2. Prone to more errors (47% accuracy)

3. Not feasible with present voice-recognition technology

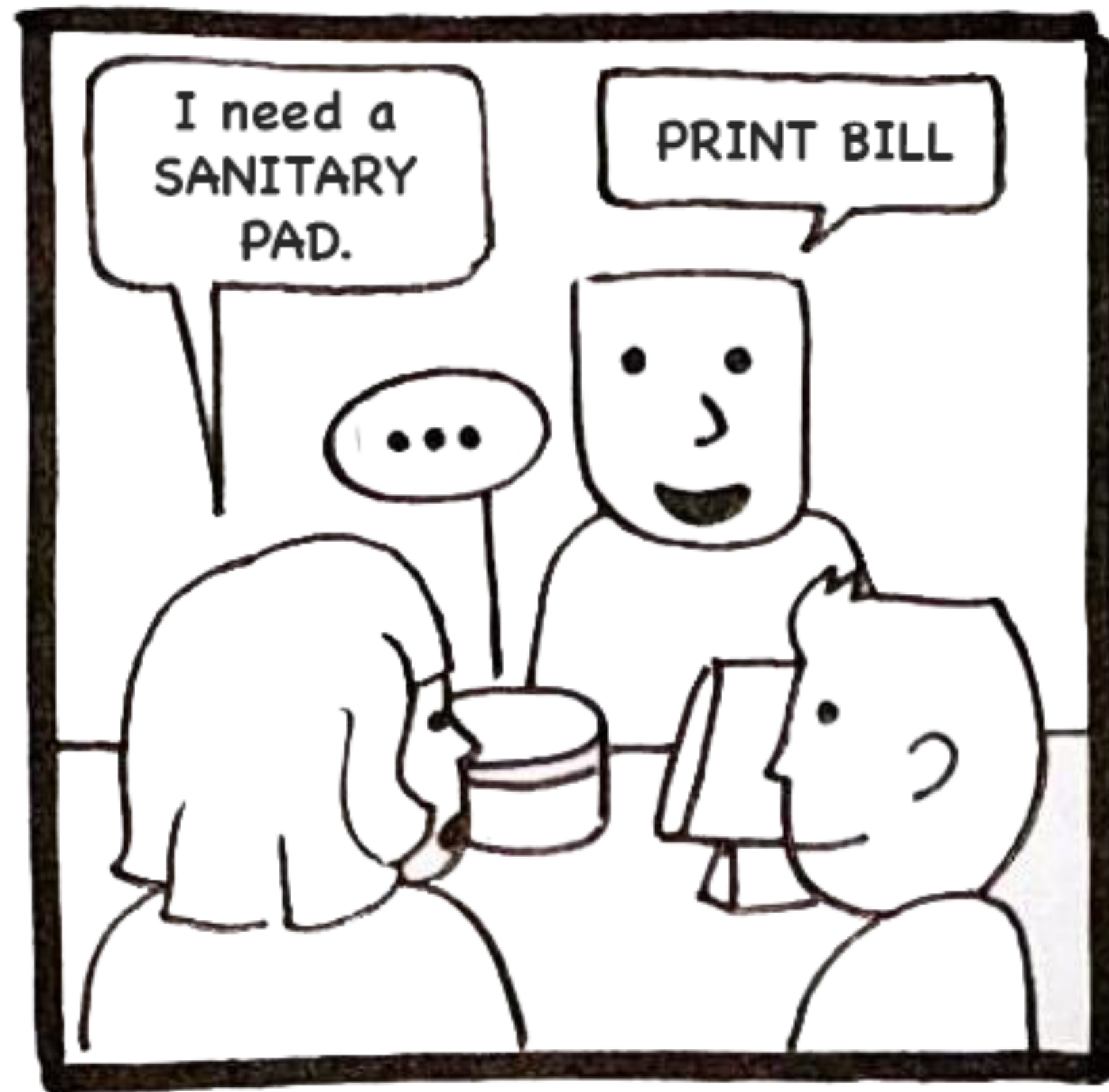
1. Need to remember command syntax

2. Prone to less errors (*speculation*) as shorter commands have greater accuracy rates (55% accuracy)

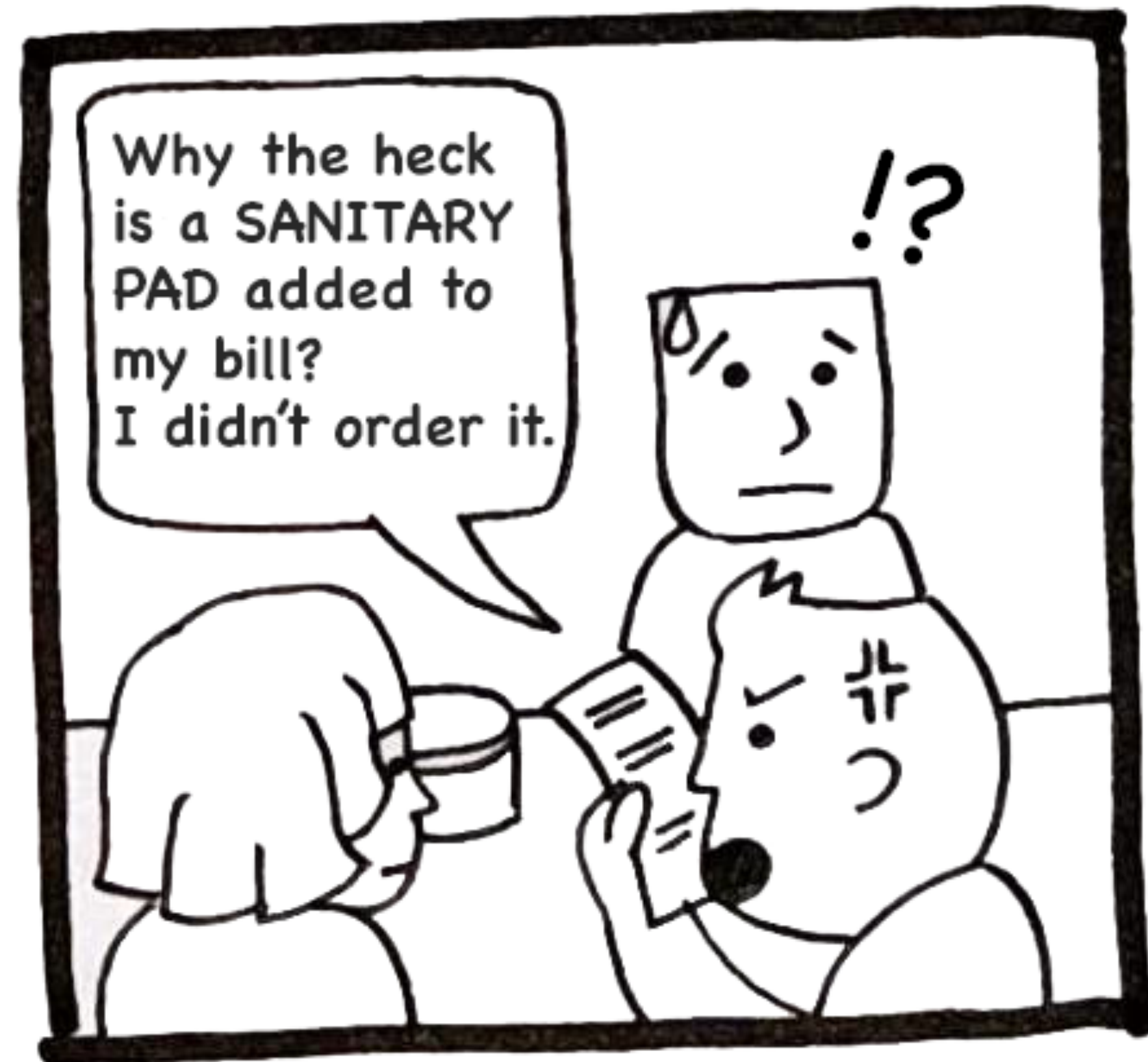
3. Feasible with present voice-recognition technology

would be discussed in the evaluation section

Control of operation



(A)

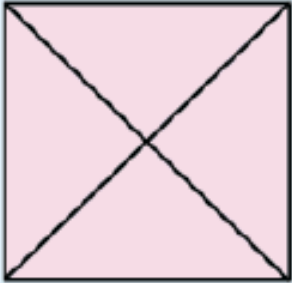
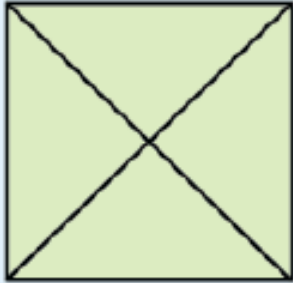


(B)

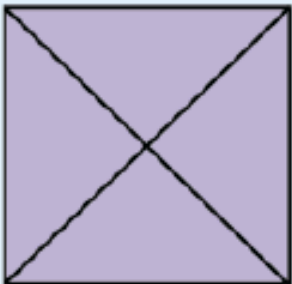
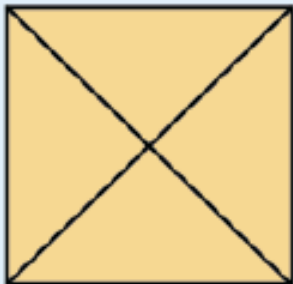
What might happen if the customers share the control

Level of Details and Speed of Feedback

आटा चार प्रकार में उपलब्ध है
कृपया चयन करें



26 रुपये किलो वाला आटा 27 रुपये किलो वाला आटा

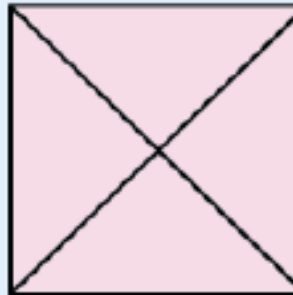
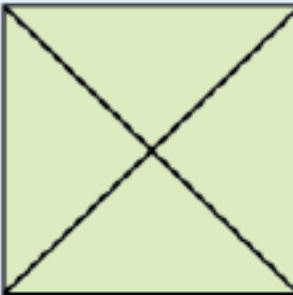


30 रुपये किलो वाला आटा 35 रुपये किलो वाला multigrain आटा

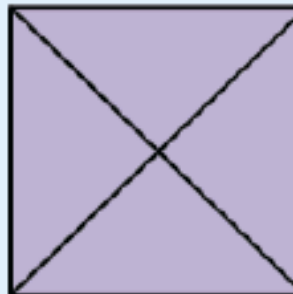
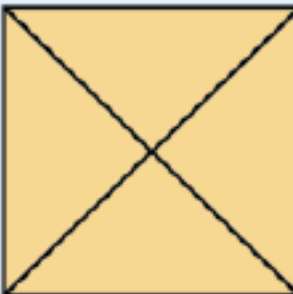
आपको कौन सा प्रकार जोड़ना है?

More
Detailed

आटा के प्रकार का चयन करें



26 रुपये किलो वाला आटा 27 रुपये किलो वाला आटा



30 रुपये किलो वाला आटा 35 रुपये किलो वाला multigrain आटा

Less
Detailed

3x

2x

1x

Speed of
speech

More Detailed

1x

PERSONA 1



PERSONA 2



Less Detailed

3x

More Detailed

1x

PERSONA 3



This system seems to be quite useful!

PERSONA 4



More Detailed

2x → 3x

Confirmation and Disambiguation: *validated*

Shopkeeper: “एक हगीज”

VUI: “हगीज डायपर्स, एक पीस”

Shopkeeper: “तीन पीस हार्पिक लेवेंडर सौ एमएल”

VUI: “हार्पिक लेवेंडर सौ एमएल, तीन पीस”

Implicit confirmation

Confirmation and Disambiguation: *validated*

Shopkeeper: “गार्नियर मेन पॉवरव्हाइट”

VUI: “गार्नियर मेन पॉवरव्हाइट का size बताइये ”

Shopkeeper: “सौ ग्राम”

VUI: “गार्नियर मेन पॉवरव्हाइट, सौ ग्राम, एक पीस”

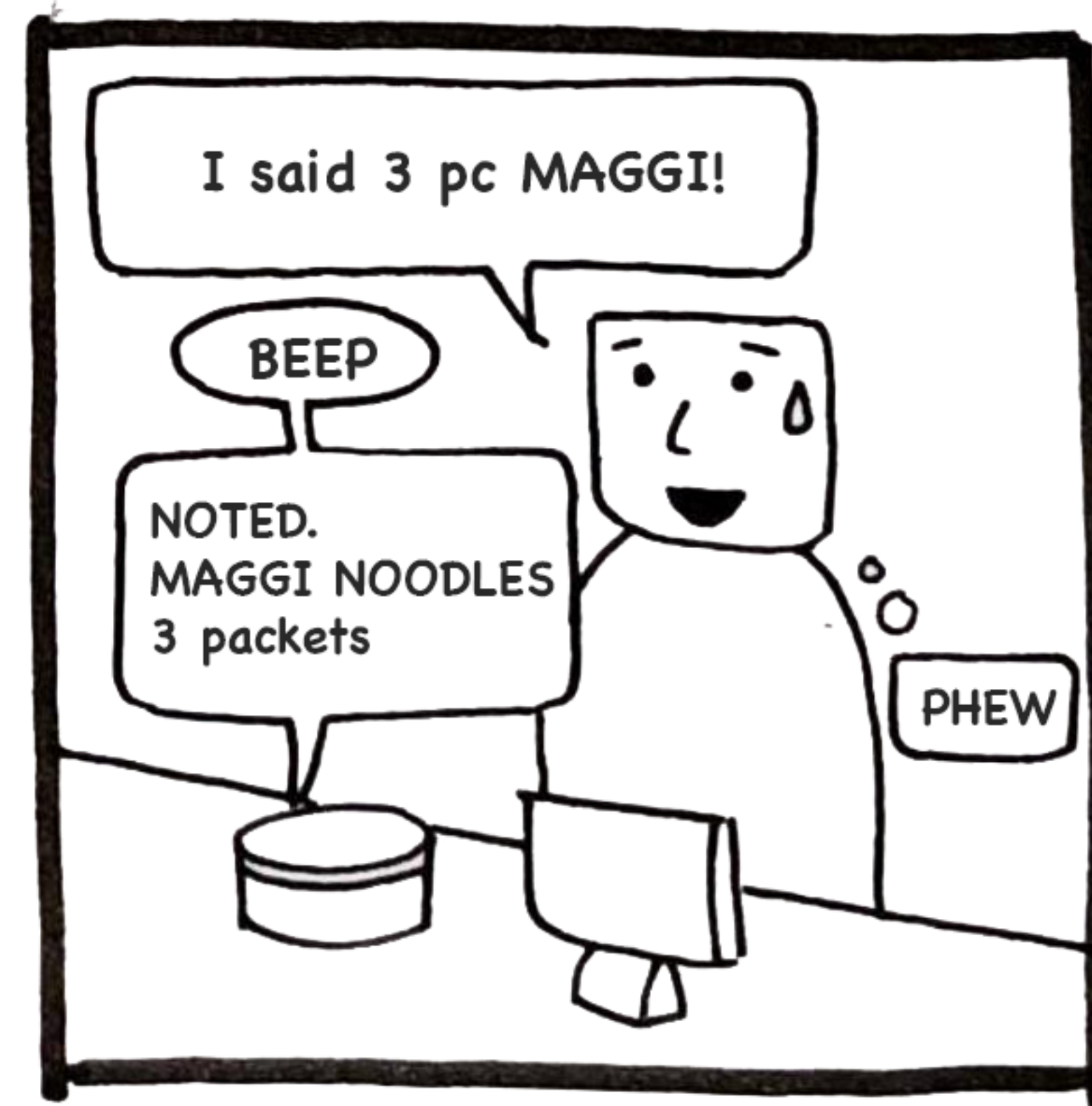
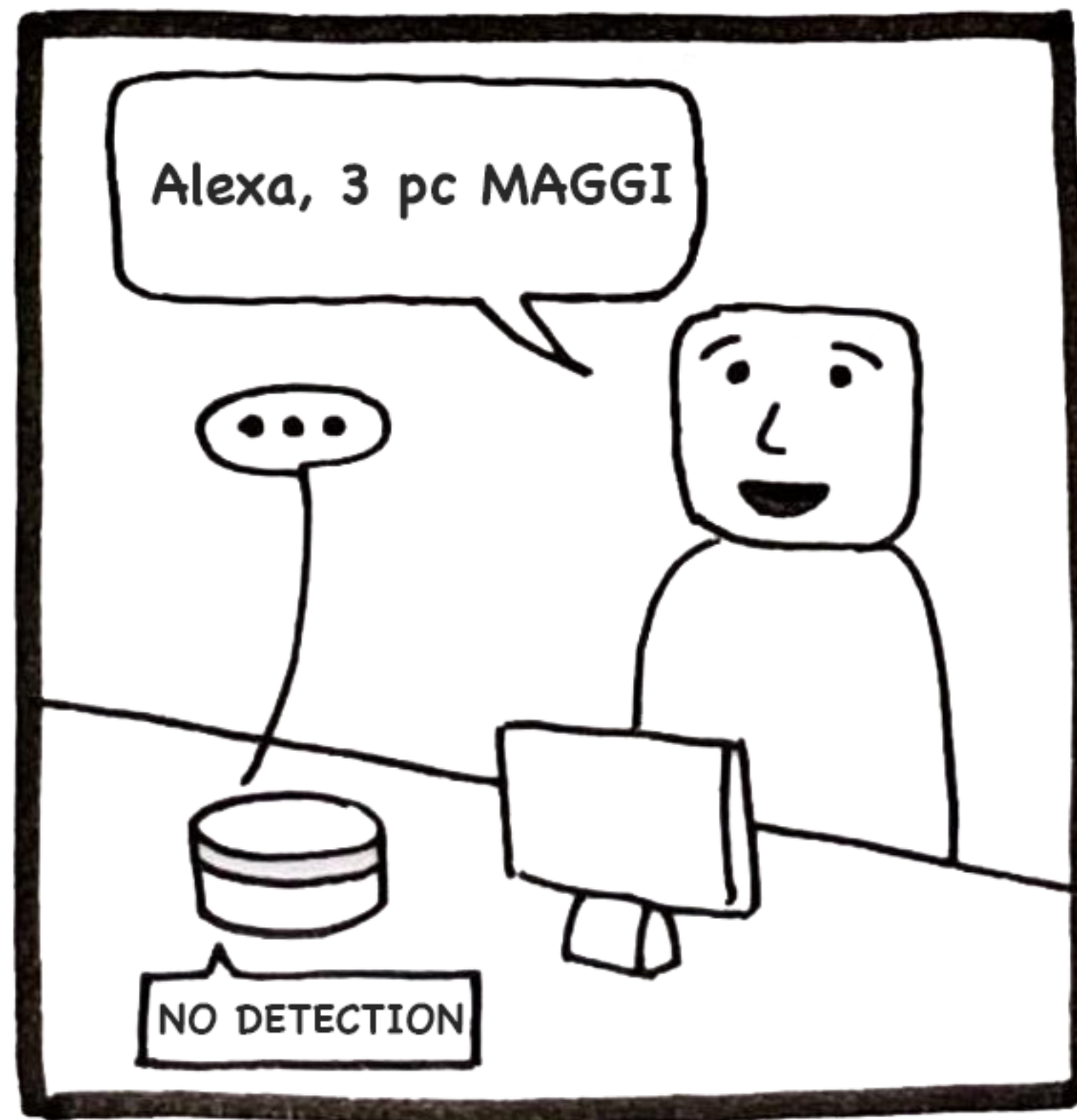
Explicit confirmation

Confirmation and Disambiguation

S.no.	Item name	Rate (₹)	Quantity	Price (₹)
1	Sooji	36.00 /kg	500 g	18.00
2	Maggi Noodles (pack of 4)	40.00 /pc	3 pc	120.00
3	Aata	27.00 /kg	4 kg	108.00
4	Eclairs	1.00 /pc	6 pc	6.00
5	Sabut Lal Mirch	400.00 /kg	25.0 g	10.00
6	Harpic Lavendar (100 ml)	66.00 /pc	1 pc	66.00
Total		6 items	₹	328.00

Non-speech confirmation

Handling of errors

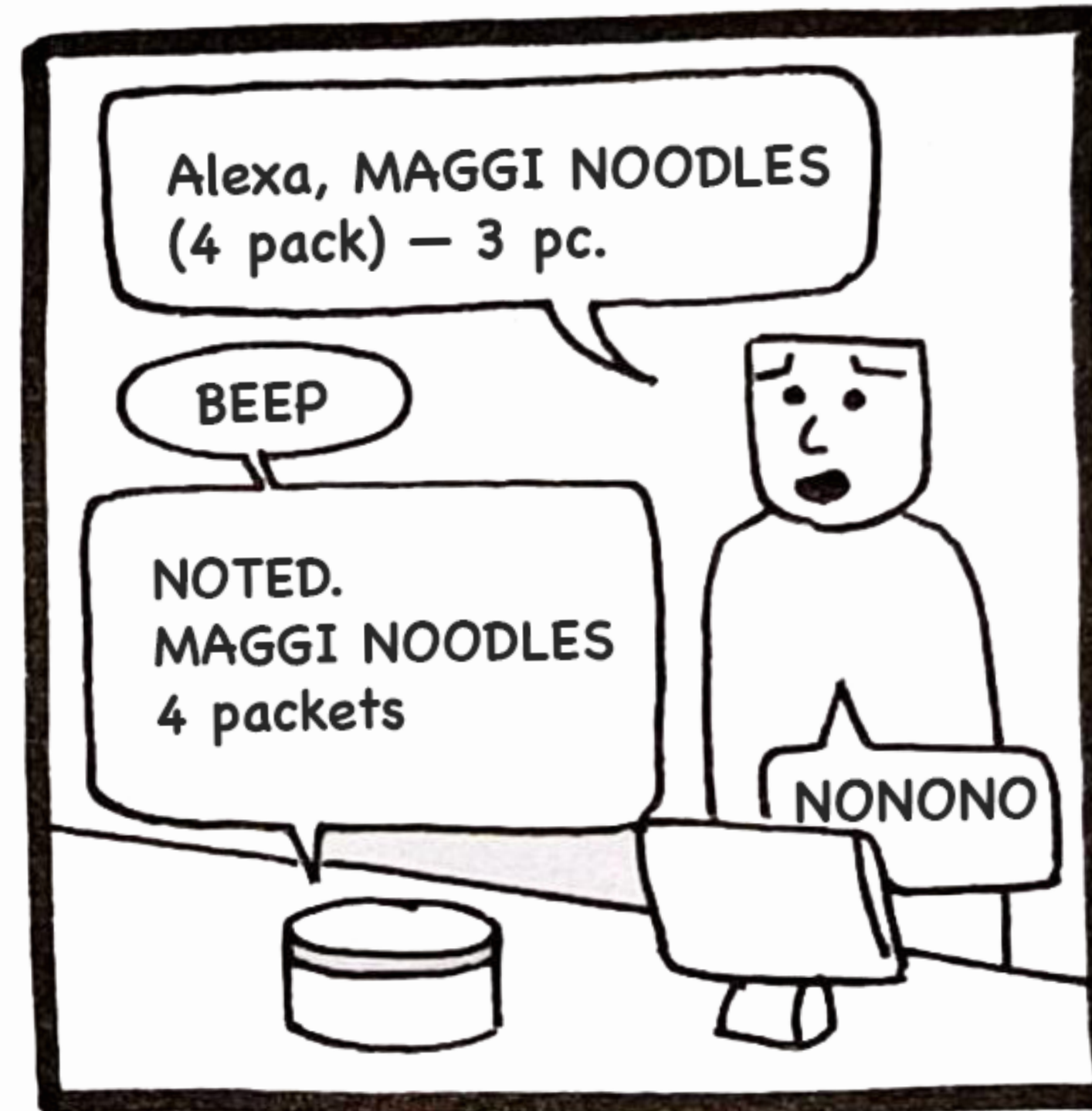


Case 1: No speech is detected

Handling of errors



Case 2: Speech detected, but nothing was recognised

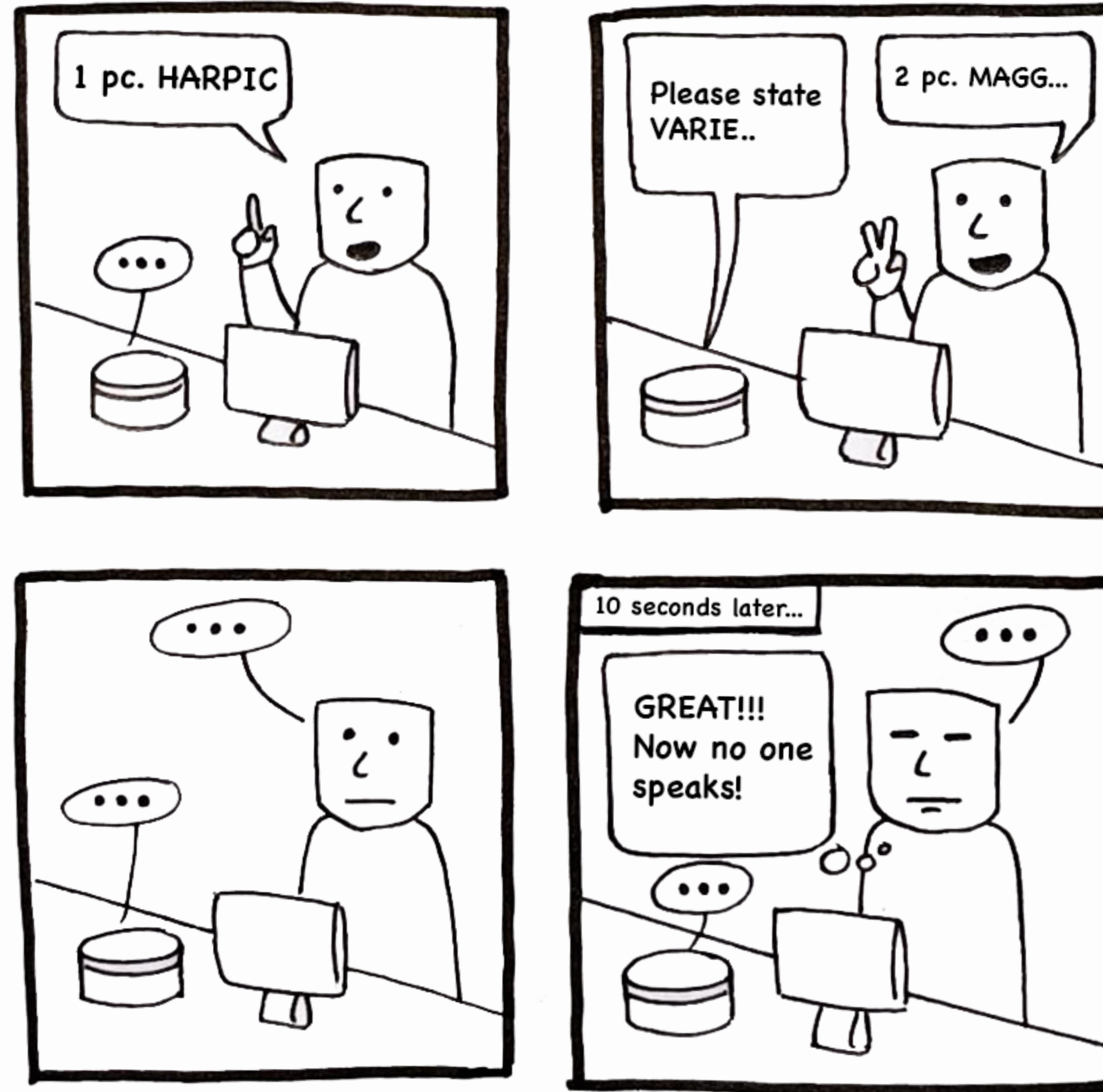


Case 3: Voice recognised correctly, but wrongly handled



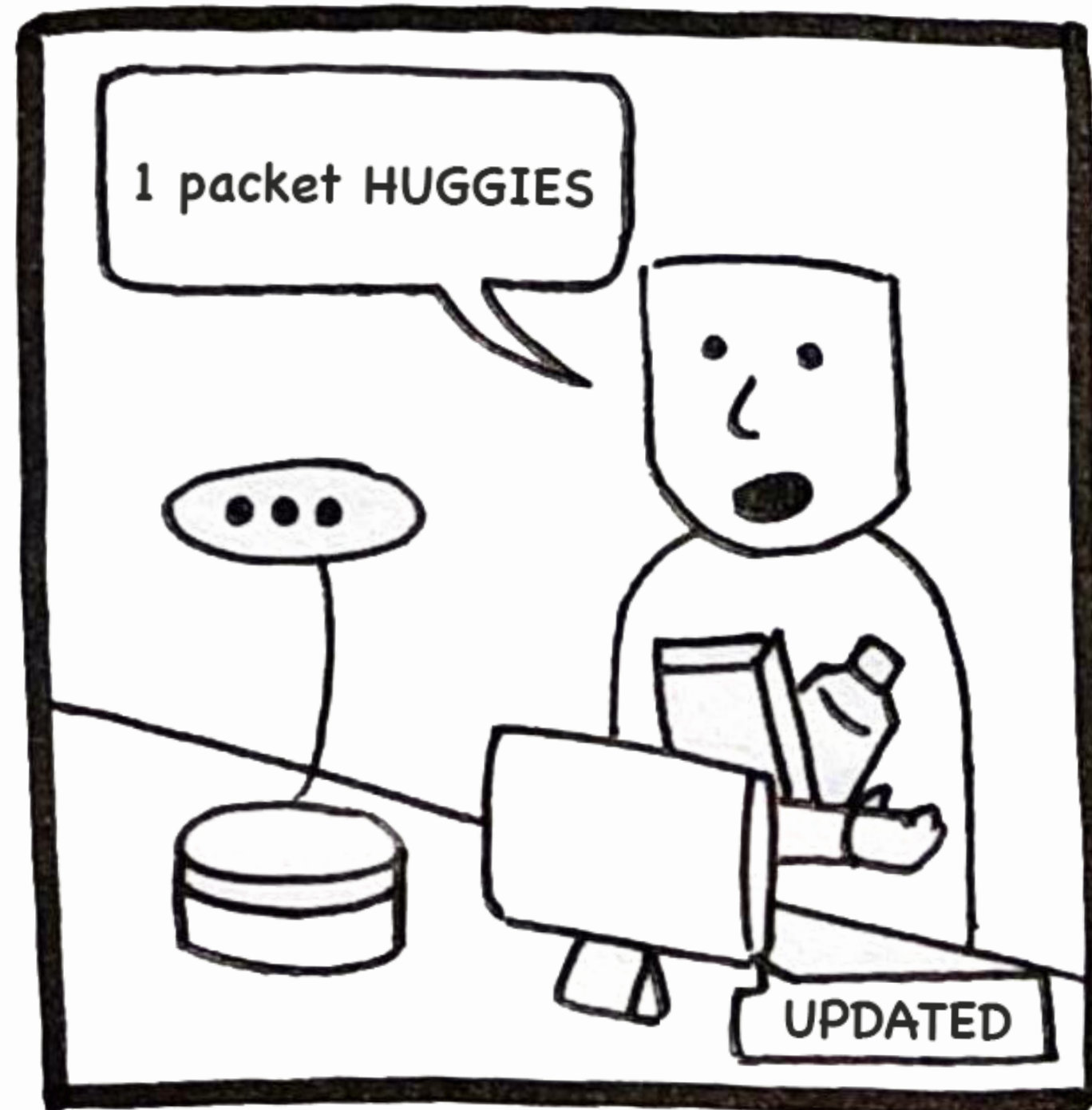
Case 4: Incorrect voice recognition

Interruptions



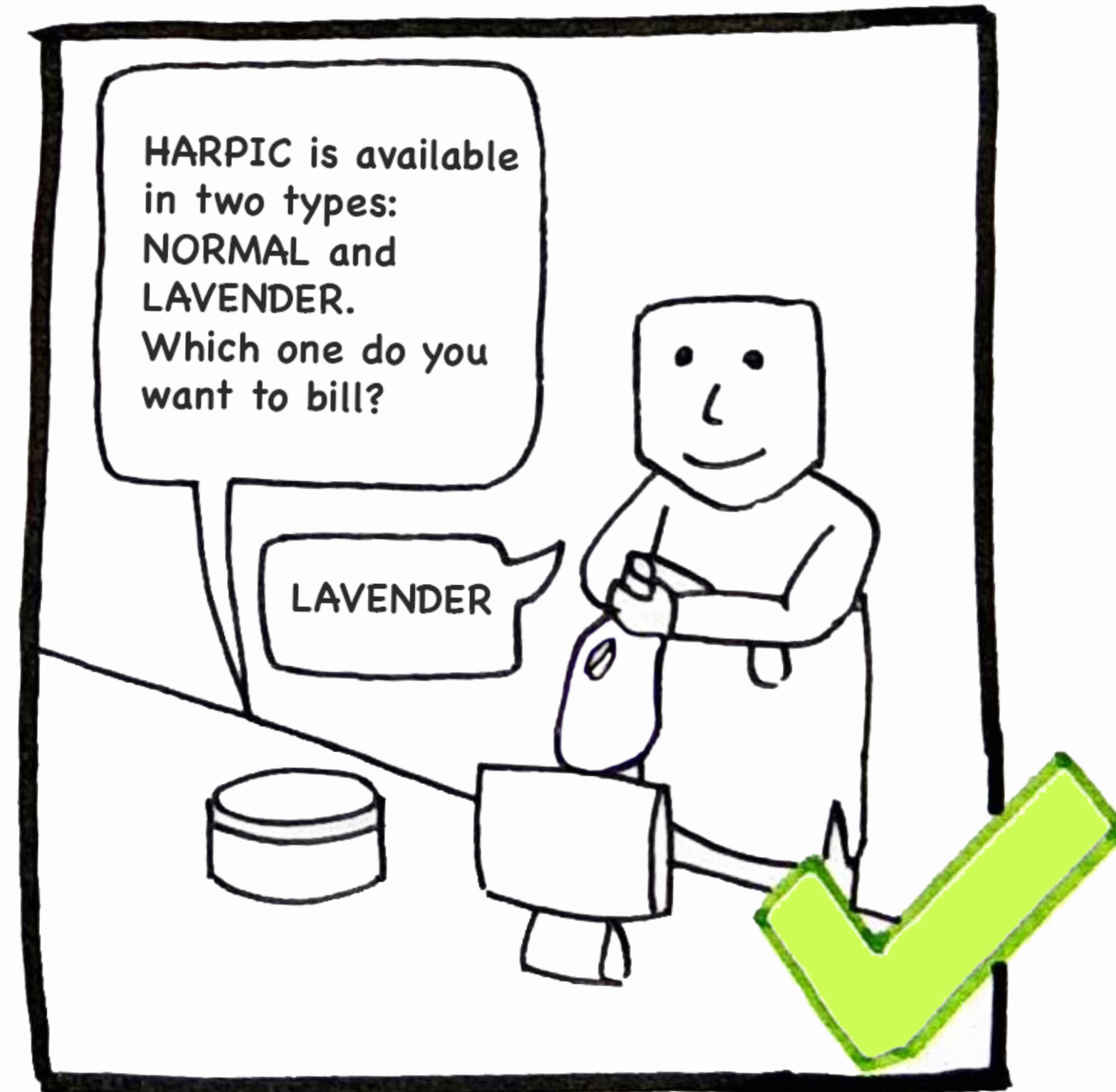
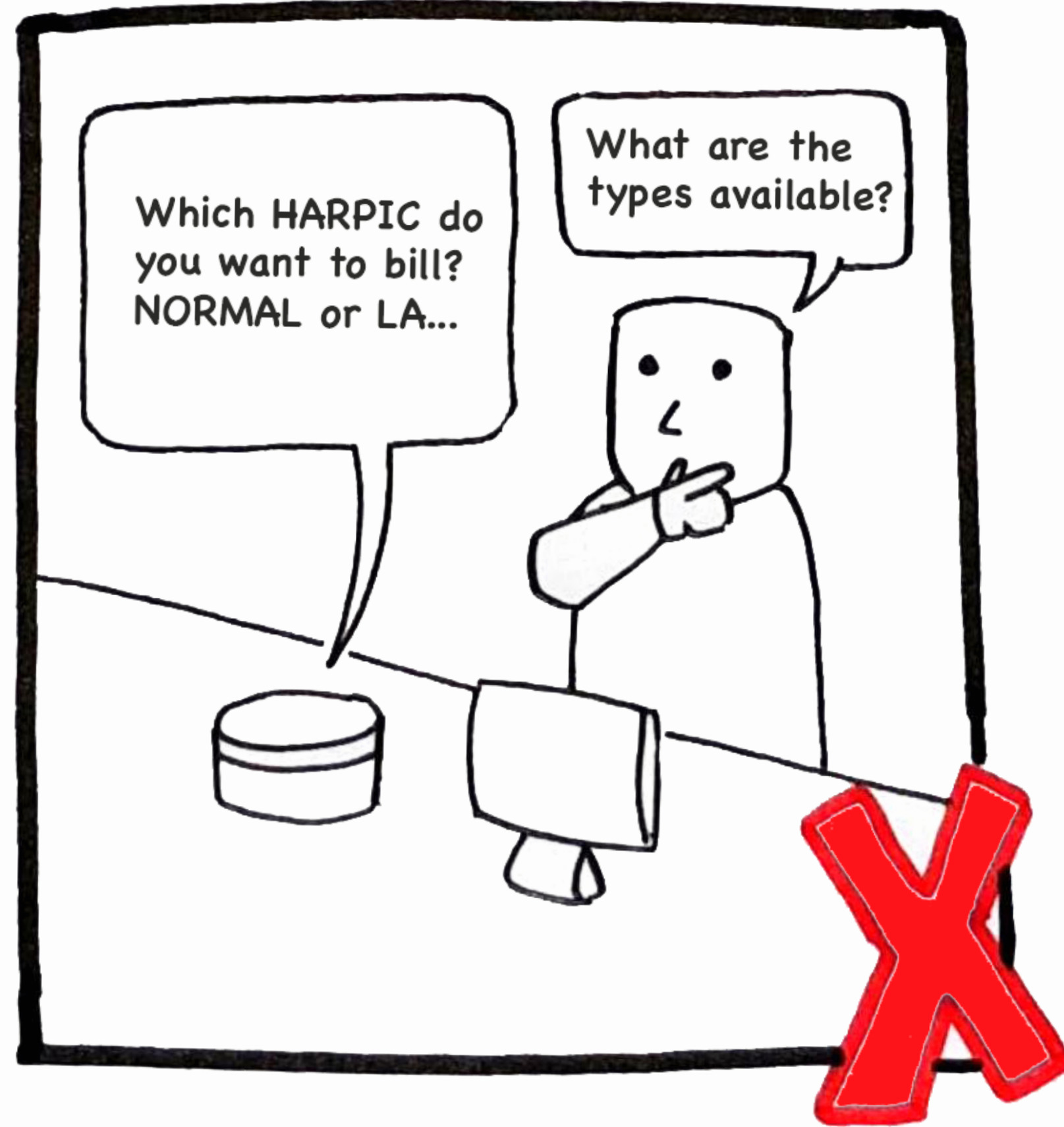
Case 1: Accidental interruptions

Interruptions



Case 2: Barge-In

Interruptions



Case 3: Wrong prompt-design

Issues in Screen UI Design

Disambiguation

version 1

THEKIRANAAPP


Mittal Provision Stores

Bill No. 502


New Bill +

S.No.	Name of Item	Quantity	Rate (Rs.)	Price (Rs.)
1.	Maggi noodles (pack of 4)	3 pc.	40 /pc.	120
2.	Multigrain Atta	4 kg.	35 /kg.	140
3.	Lal Mirch	? kg.	?	10

Choose variety




Sabut Lal Mirch
Price per kg : Rs. 400




Pisi Lal Mirch
Price per kg : Rs. 480

Related



MDH Lal Mirch Powder (50g)
Price per pc : Rs. 50



MTR Lal Mirch Powder (60g)
Price per pc : Rs. 55

Total Price (3 items):

Rs. 270.00

PRINT

SEND TO MOBILE

version 2

KIRANA STORE
billing

Mittal Provision Stores

Bill No. 502

New Bill +

Undo

Cut

Copy


Paste

Delete


Send to mobile

Print


S.no.	Item name	Rate	Quantity	Price
2.	Multigrain Atta	₹ 35.00 /kg	4 kg	₹ 140.00
3.	Lal Mirch	?	?	₹ 10.00




Sabut Lal Mirch
(₹ 40/100 g)



Pisi Lal Mirch
(₹ 48/100 g)

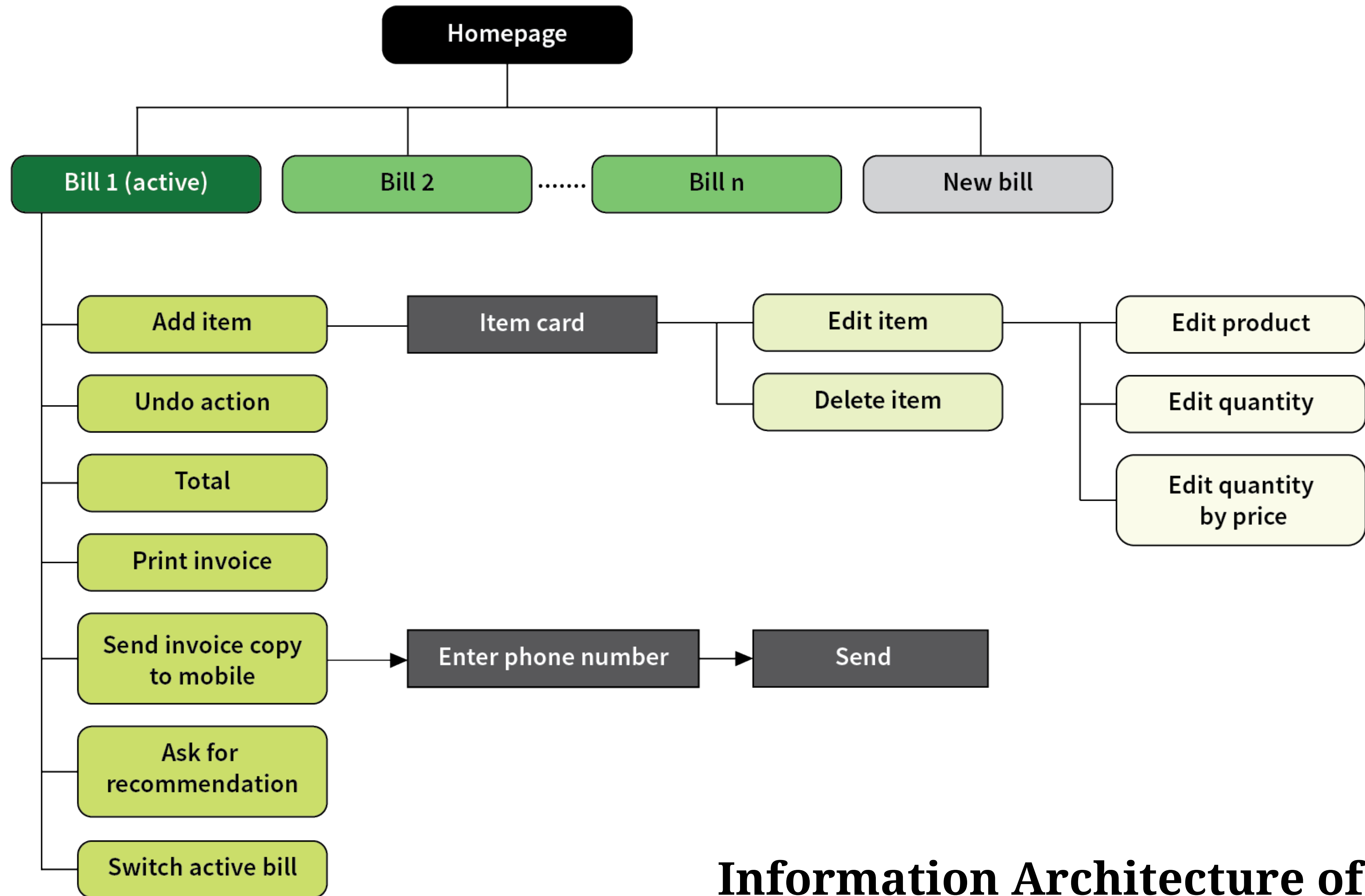


MDH Lal Mirch Powder
(50 g)



MTR Lal Mirch Powder
(60 g)

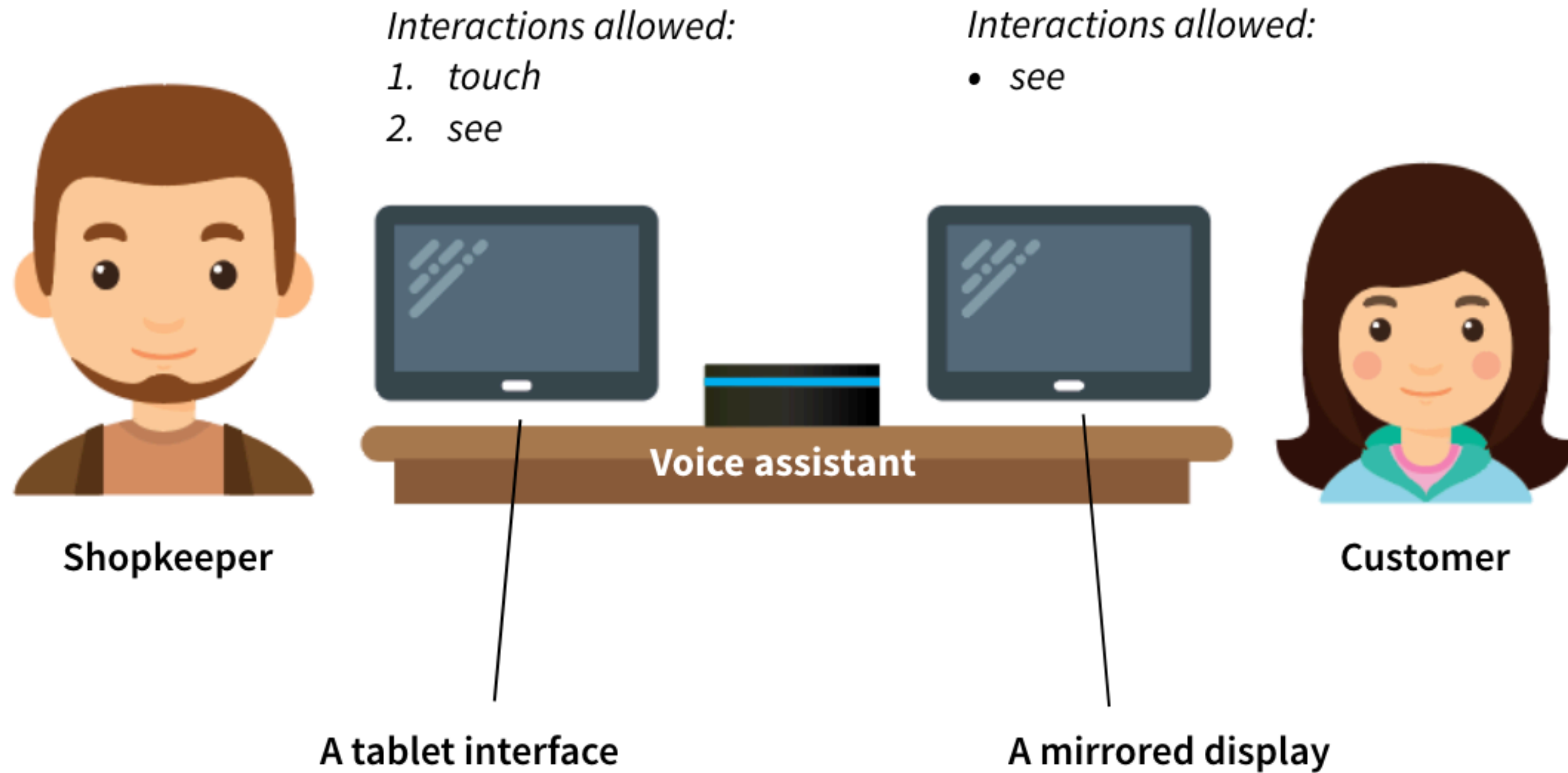
Total (3 items) = ₹ 270.00

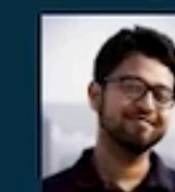


Information Architecture of VABI

Design Explorations

Iteration 1





Bill No. 502

New Bill +

S.No.	Name of Item	Quantity	Rate (Rs.)	Price (Rs.)
1.	Maggi noodles (pack of 4)	3 pc.	40 /pc.	120
Total Price (1 item):				Rs. 120.00

PRINT

SEND TO MOBILE

Selected



Maggi noodles
(pack of 4)
Price per pc : Rs. 40

Related



Maggi masala-e-
magic
Price per pc : Rs. 3



Maggi soup- small
(vegetable)
Price per pc : Rs. 10



Maggi atta noodles
Price per pc : Rs. 18

Design features of Iteration 1

The red inactive bill tab with the bill number

The green active bill tab with the bill number

The neutral grey new bill tab

Billing area

Recommendation pane

THE KRANA APP

Mittal Provision Stores

502

Bill No. 503

New Bill +

S.No.	Name of Item	Quantity	Rate (Rs.)	Price (Rs.)
1.	Maggi masala-e-magic	5 pc.	3 /pc.	15
Total Price (1 item):				Rs. 15.00

PRINT

SEND TO MOBILE

Selected

Maggi masala-e-magic

Price per pc : Rs. 3

Related

Maggi noodles (pack of 4)

Price per pc : Rs. 40

Maggi soup- small (vegetable)

Price per pc : Rs. 10

Maggi atta noodles

Price per pc : Rs. 18

Limitations of Iteration 1

THEKIRANAAPP


Mittal Provision Stores

Bill No. 502

New Bill +


S.No.	Name of Item	Quantity	Rate (Rs.)	Price (Rs.)
1.	Maggi noodles (pack of 4)	3 pc.	40 /pc.	120
2.	Multigrain Atta	4 kg.	35 /kg.	140
3.	Sabut Lal Mirch	30 g.	400 /kg.	10

Selected




Sabut Lal Mirch
Price per kg : Rs. 400


Related



MDH Lal Mirch Powder (50g)
Price per pc : Rs. 50



MTR Lal Mirch Powder (60g)
Price per pc : Rs. 55



Pisi Lal Mirch
Price per kg : Rs. 480

Total Price (3 items):

Rs. 270.00

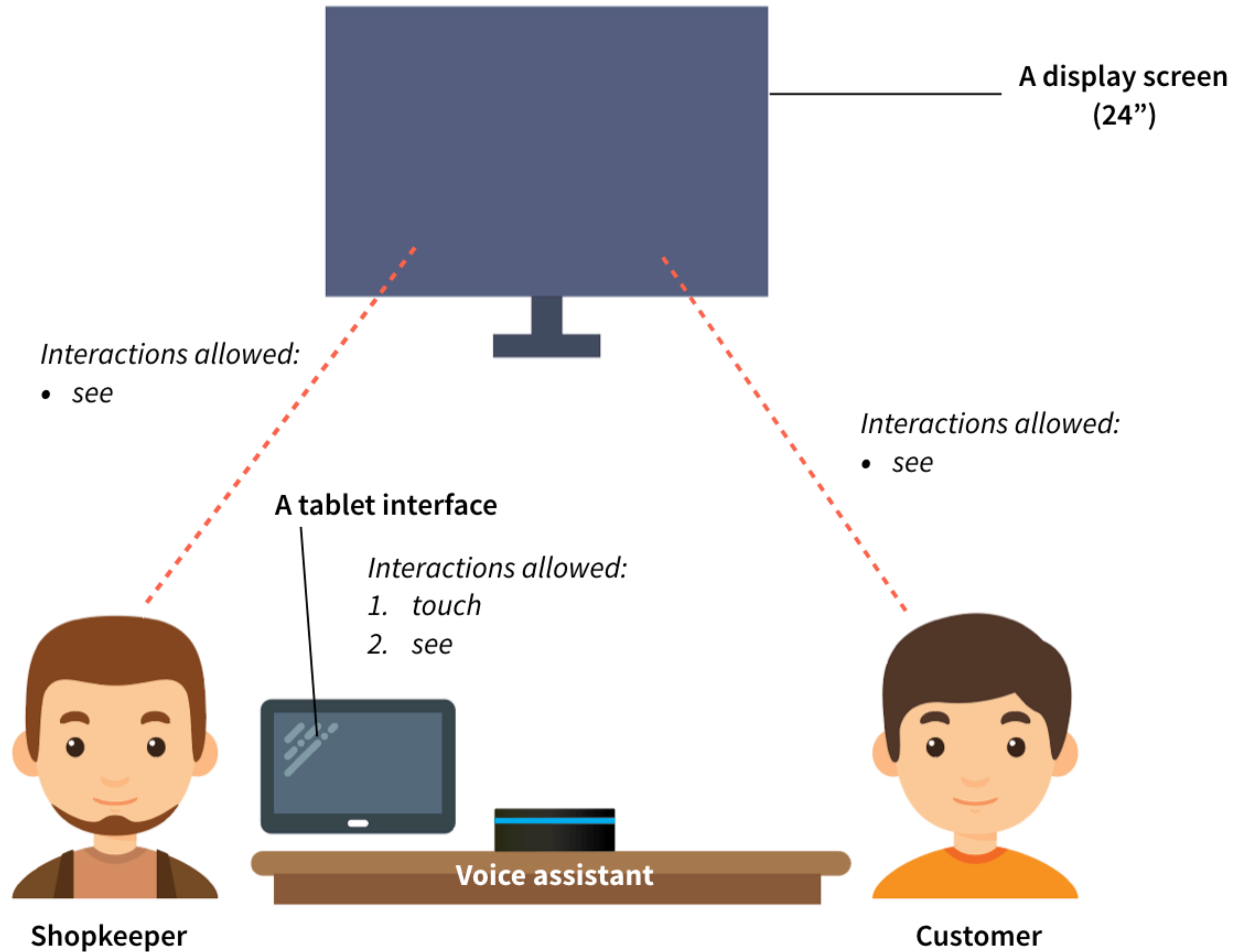
PRINT

SEND TO MOBILE

Text size too small to see for the moving shopkeeper

Total price needs to be highlighted

Iteration 2





Bill No. 502

New Bill +

Undo

Send to mobile

Print

S.no.

Item name

Rate

Quantity

Price

1. Maggi Noodles (pack of 4)

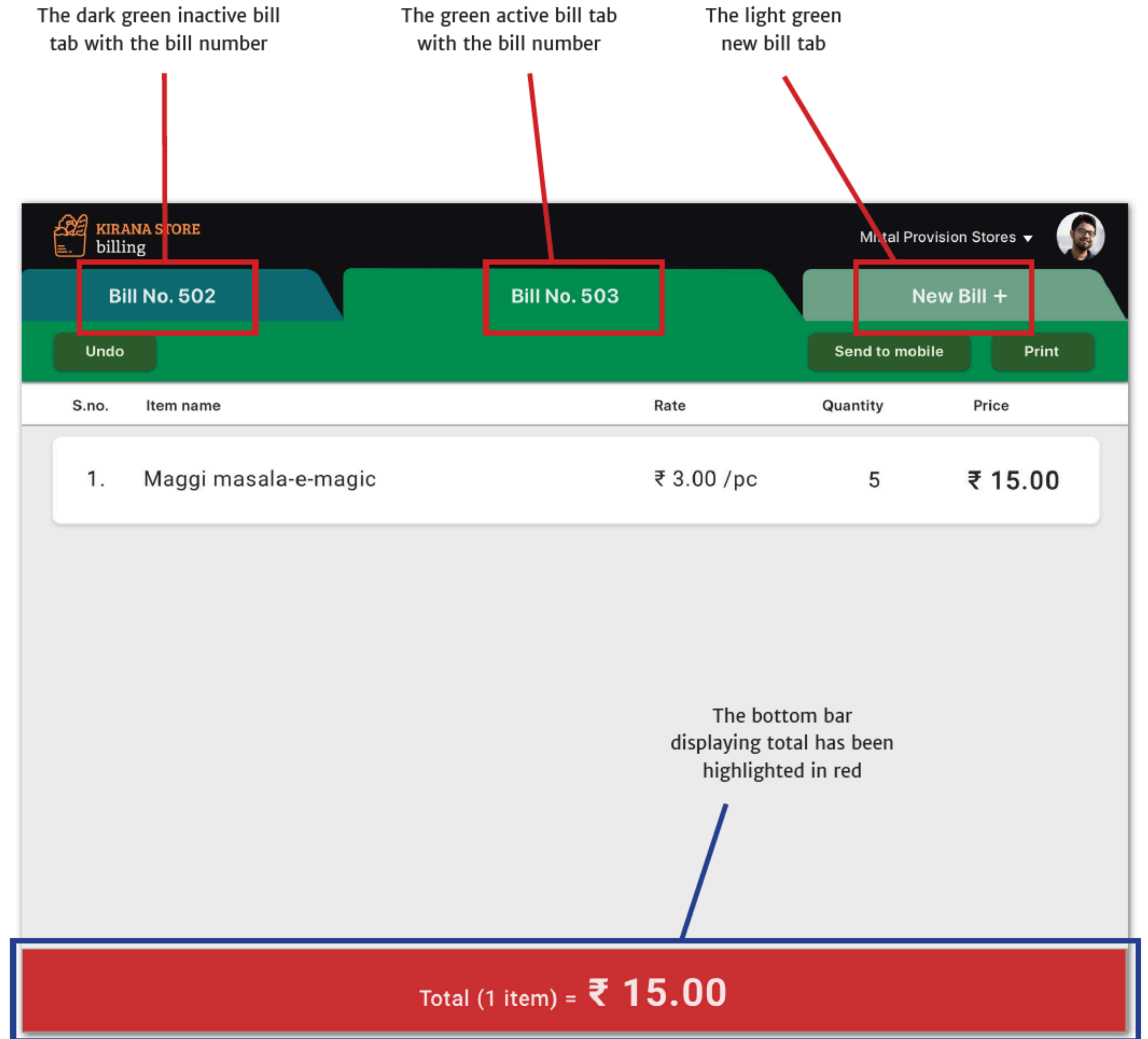
₹ 40.00 /pc

3

₹ 120.00


Total (1 item) = ₹ 120.00


Design features of Iteration 2



Design features of Iteration 2

The 3 action buttons

 **KIRANA STORE**
billing

Mittal Provision Stores ▾ 

Bill No. 502

New Bill +

Undo

Send to mobile

Print

S.no.	Item name	Rate	Quantity	Price
1.	Maggi Noodles (pack of 4)	₹ 40.00 /pc	3	₹ 120.00
2.	Multigrain Atta	₹ 35.00 /kg	4 kg	₹ 140.00
3.	Sabut Lal Mirch	₹ 40.00 /100 g	25 g	₹ 10.00
4.	Tej Patta	₹ 95.00 /100 g	15.8 g	₹ 15.00

↑
↓


Cards are larger in height for easy tapping


₹ 15.00

The net price has been made bold

Total (4 items) = ₹ 285.00

Design features of Iteration 2

 **KIRANA STORE**
billing

Mittal Provision Stores 

Bill No. 502

New Bill +

Undo

Send to mobile

Print

S.no.	Item name	Rate	Quantity	Price
1.	Maggi Noodles (pack of 4)	₹ 40.00 /pc	1	₹ 40.00

1

2

3

4

5

6


7

8

9

.


0




ENTER

Total (1 item) = ₹ 40.00

Limitations of Iteration 2

 KIRANA STORE
billing

Mittal Provision Stores 

Bill No. 502

New Bill +

Undo

Cut

Copy


Paste

Delete


Send to mobile

Print


S.no.	Item name	Rate	Quantity	Price
1.	Maggi Noodles (pack of 4)	₹ 40.00 /pc	3	₹ 120.00
2.	Atta	₹ 27.00 /kg	4 kg	₹ 108.00




Atta (₹ 27/kg)



Atta (₹ 25/kg)



Multigrain Atta
(₹ 35/kg)




Ashirvaad Multigrain
Atta (5 kg)

Total (2 items) = ₹ 228.00

Design features of Iteration 2

Bill No. 502



Tej patta

₹ 95


per 100 g

Quantity 15.8 g

Price ₹ 15

Total (4 items) = ₹ 285.00


Related



Choti ilaichi

₹ 250


per 100 g



Laung

₹ 200

per 100 g







Darchini

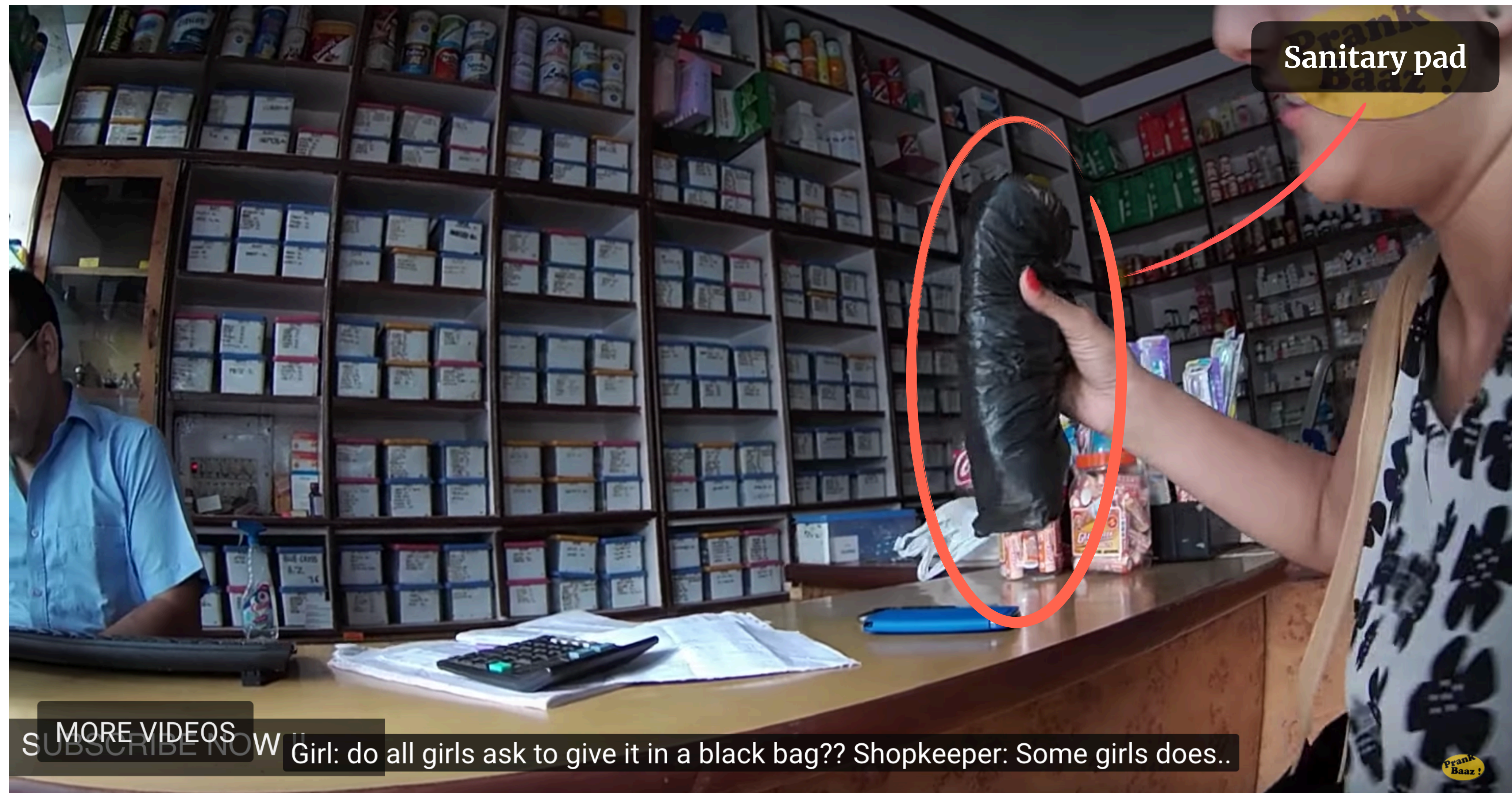
₹ 75

per 100 g

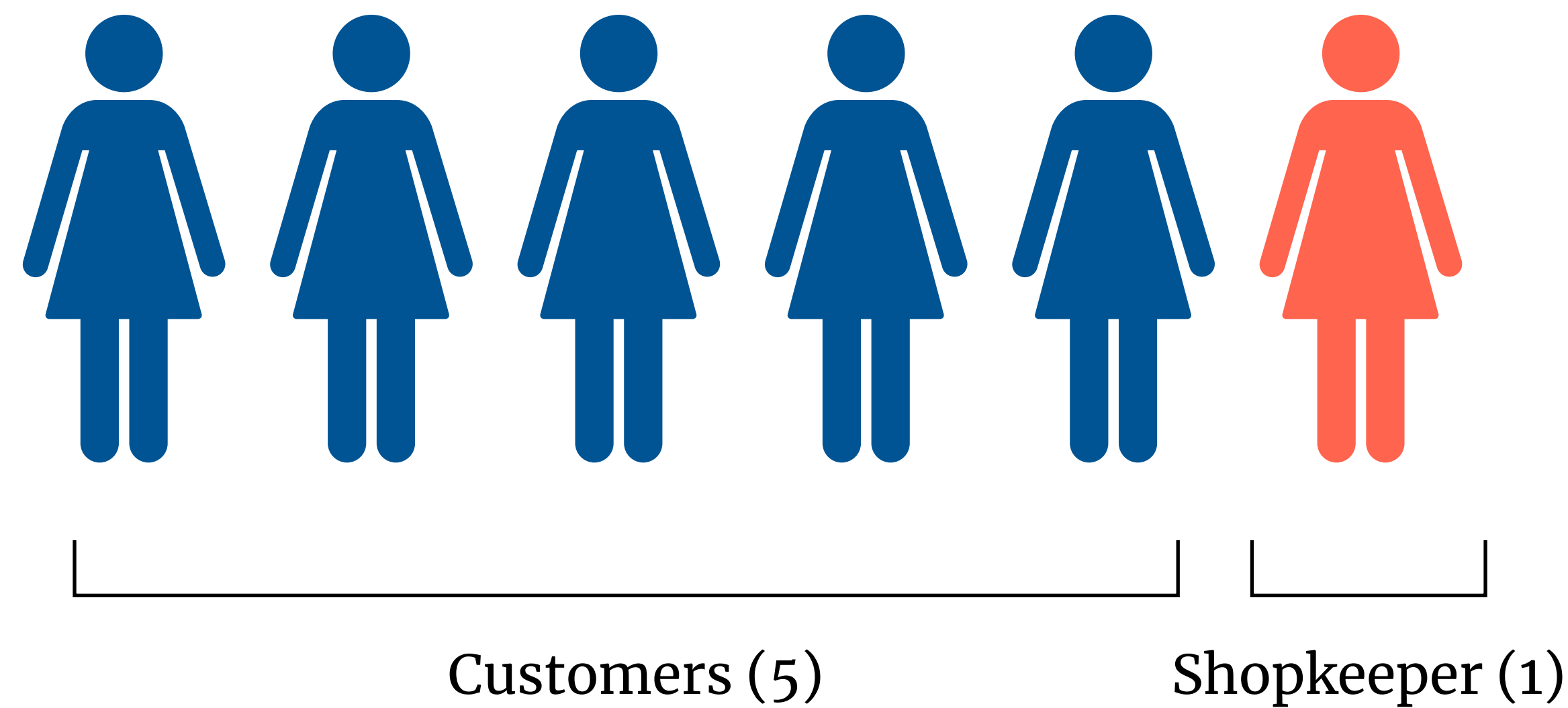
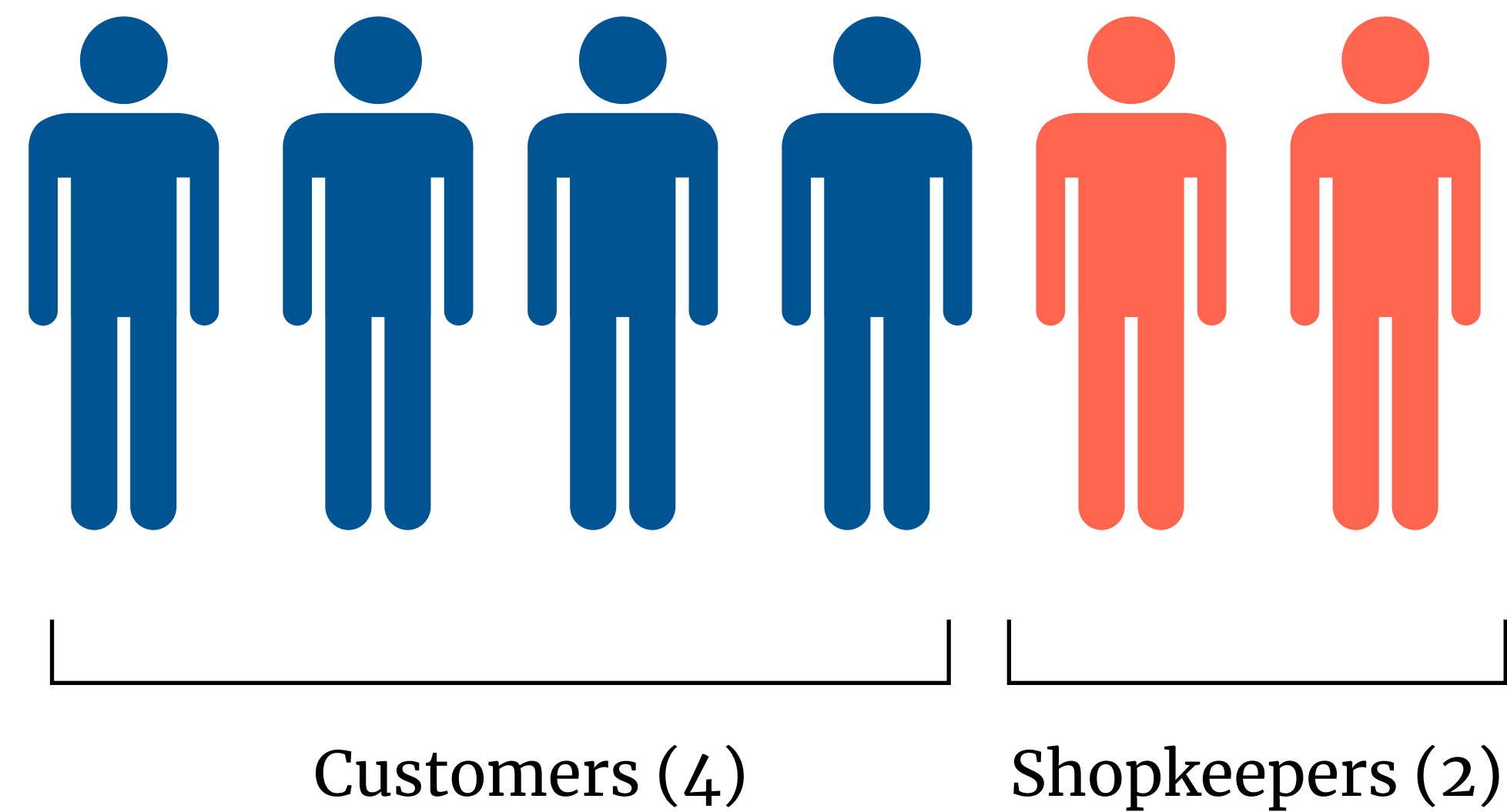
Cart (4 items)



Concerns for privacy

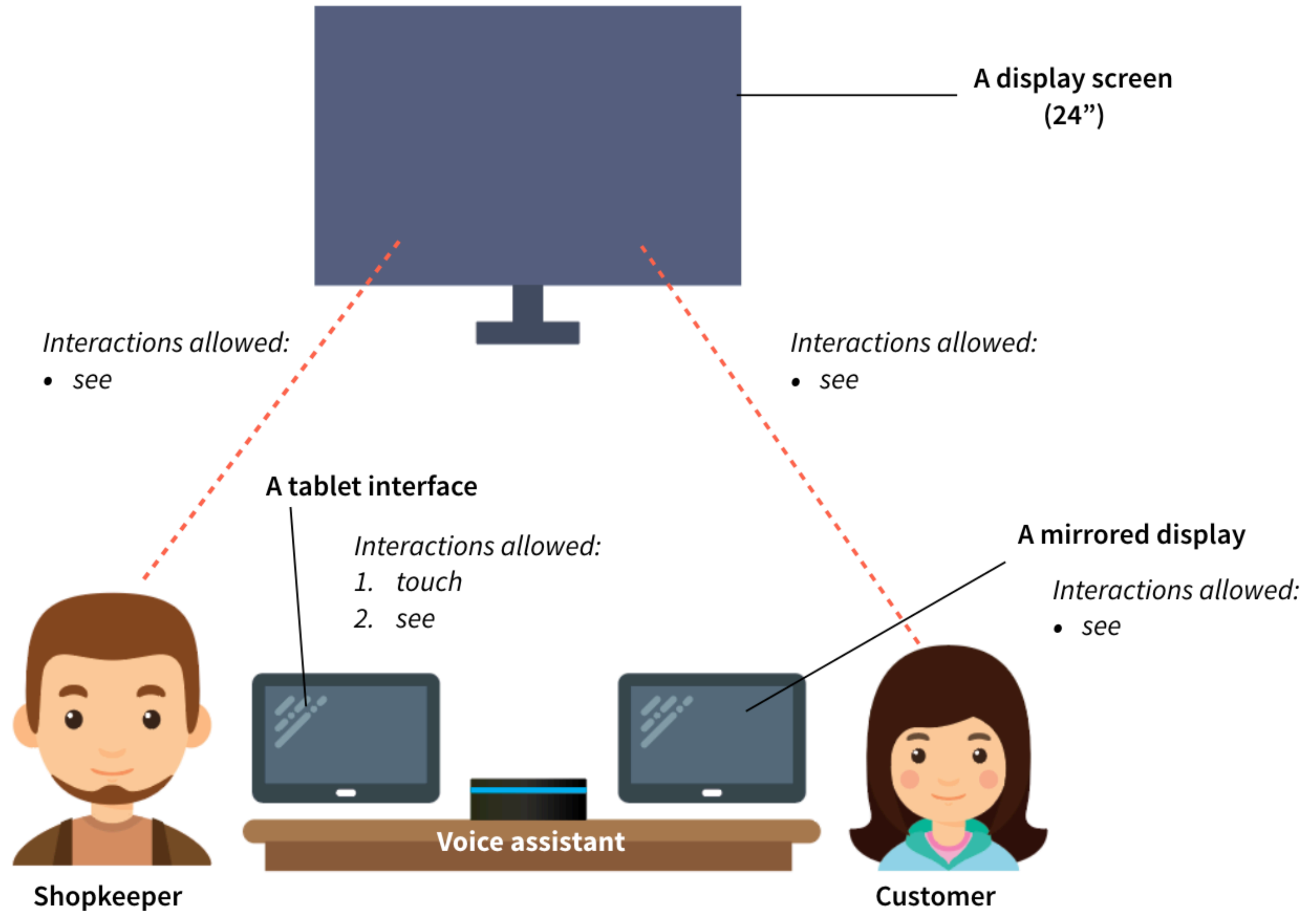


Concerns for privacy: *investigated*



except a few items like sanitary pads

Iteration 3



You selected



Yipee Noodles
(pack of 4)

Quantity 2

Price ₹ 90

+



Heinz Tomato
Ketchup (900 g)

Quantity 1

Price ₹ 140



Better deal

BESTSELLING



Maggi Noodles
(pack of 4)

Quantity 4

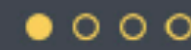
Price ₹ 160



Maggi Hot and Sweet
sauce (300 g)

Quantity 1

FREE!



People who bought



Cerelac Wheat Apple (300 g)

₹ 179
per pc

Also bought



Johnson's baby powder
(200 g)

₹ 106
per pc



Huggies Wonder Pants
(XL)

₹ 454
per pc



You selected



Oral B Crossaction
Toothbrush

Quantity 1

Price ₹ 77



Better deal

Buy 2
Get 1
FREE



Colgate Sensitive
Toothbrush (Combo)

Quantity 1

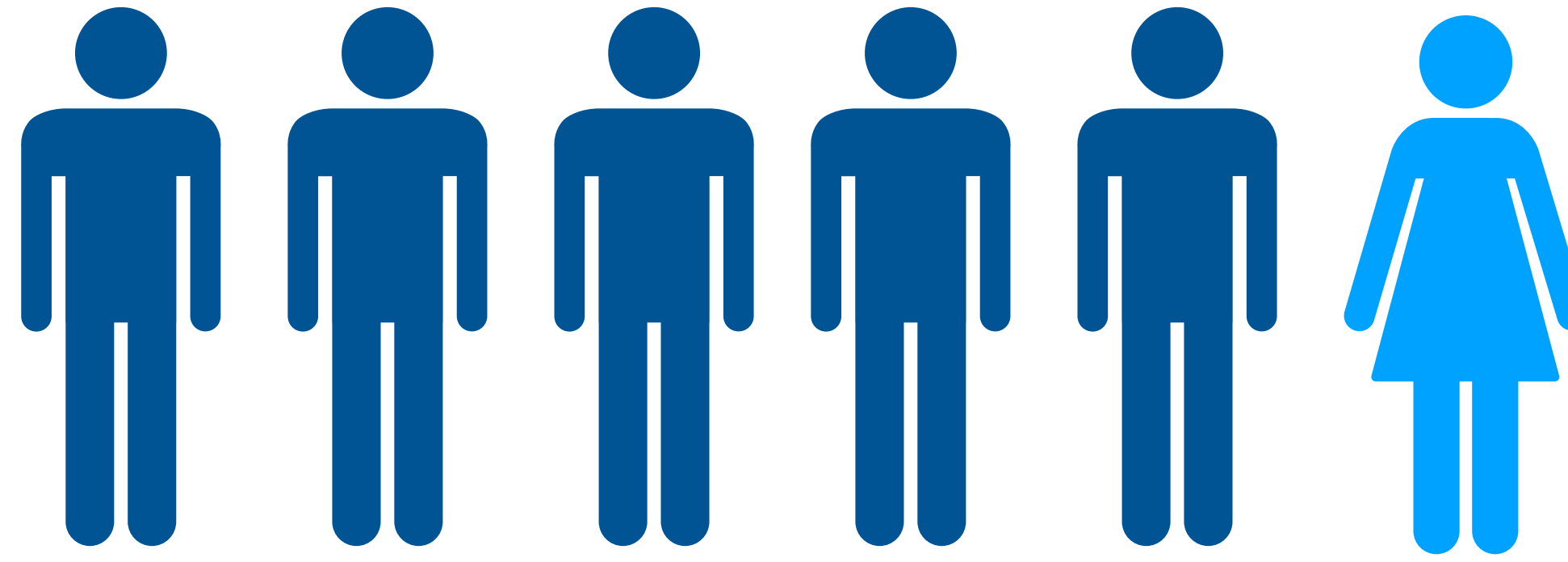
Price ₹ 90



Quantitative Longitudinal Study

Performance Evaluation

6 participants



VABI
(WoZ prototype)

vs

Manual billing

No implicit audio feedback

clarification was given only
in cases of ambiguity

Counterbalancing

USERS	Day 1		Day 2		Day 3		Day 4	
	task 1	task 2	task 3	task 4	task 5	task 6	task 7	task 8
User 1	Ma	Va	Vb	Mb	Mc	Vc	Vd	Md
User 2	Vb	Mb	Mc	Vc	Vd	Md	Ma	Va
User 3	Mc	Vc	Vd	Md	Ma	Va	Vb	Mb
User 4	Vd	Md	Ma	Va	Vb	Mb	Mc	Vc
User 5	Ma	Va	Vc	Mc	Mb	Vb	Vd	Md
User 6	Vd	Md	Mb	Vb	Vc	Mc	Ma	Va

Guide	
M	Manual Billing
V	Billing using VABI (without implicit audio feedback)
a	Shopping list A
b	Shopping list B
c	Shopping list C
d	Shopping list D

Tasks



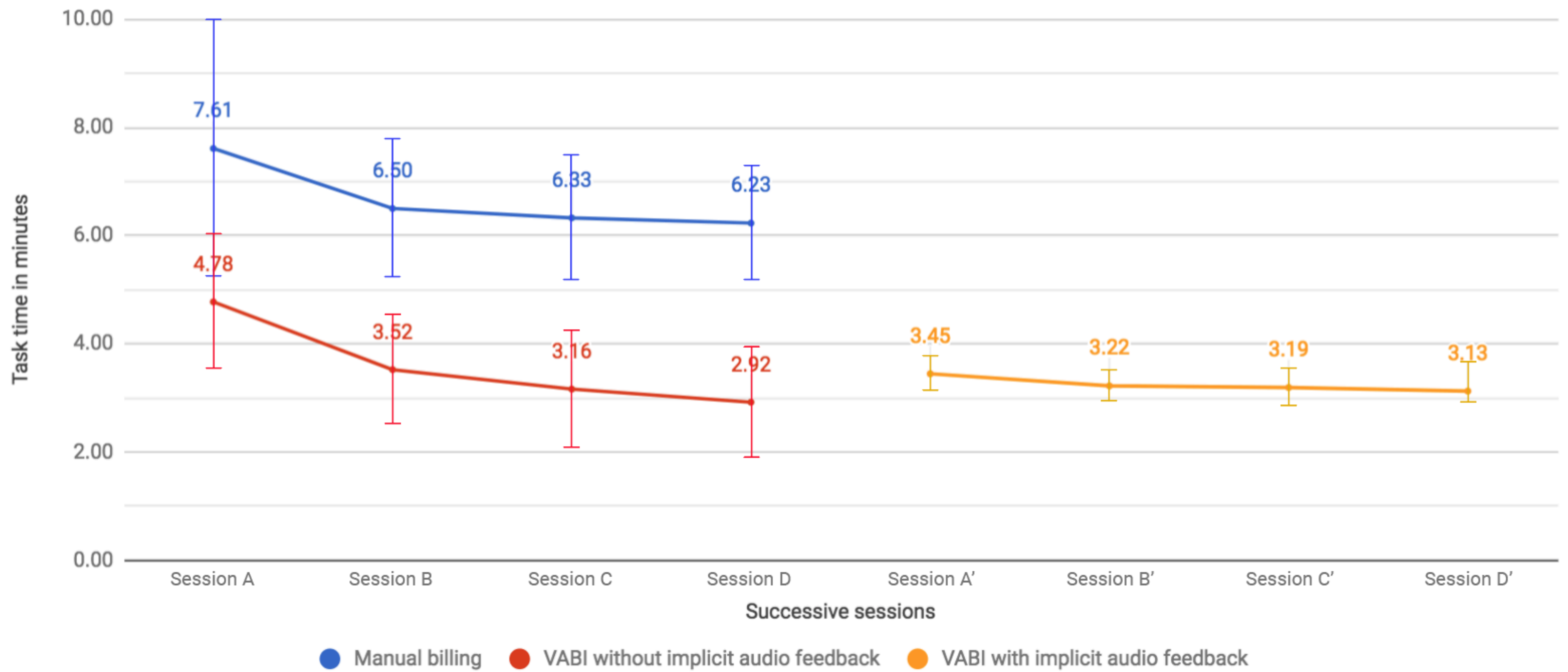
Manual billing



VABI
(WoZ prototype)

The Wizard of Oz Setup

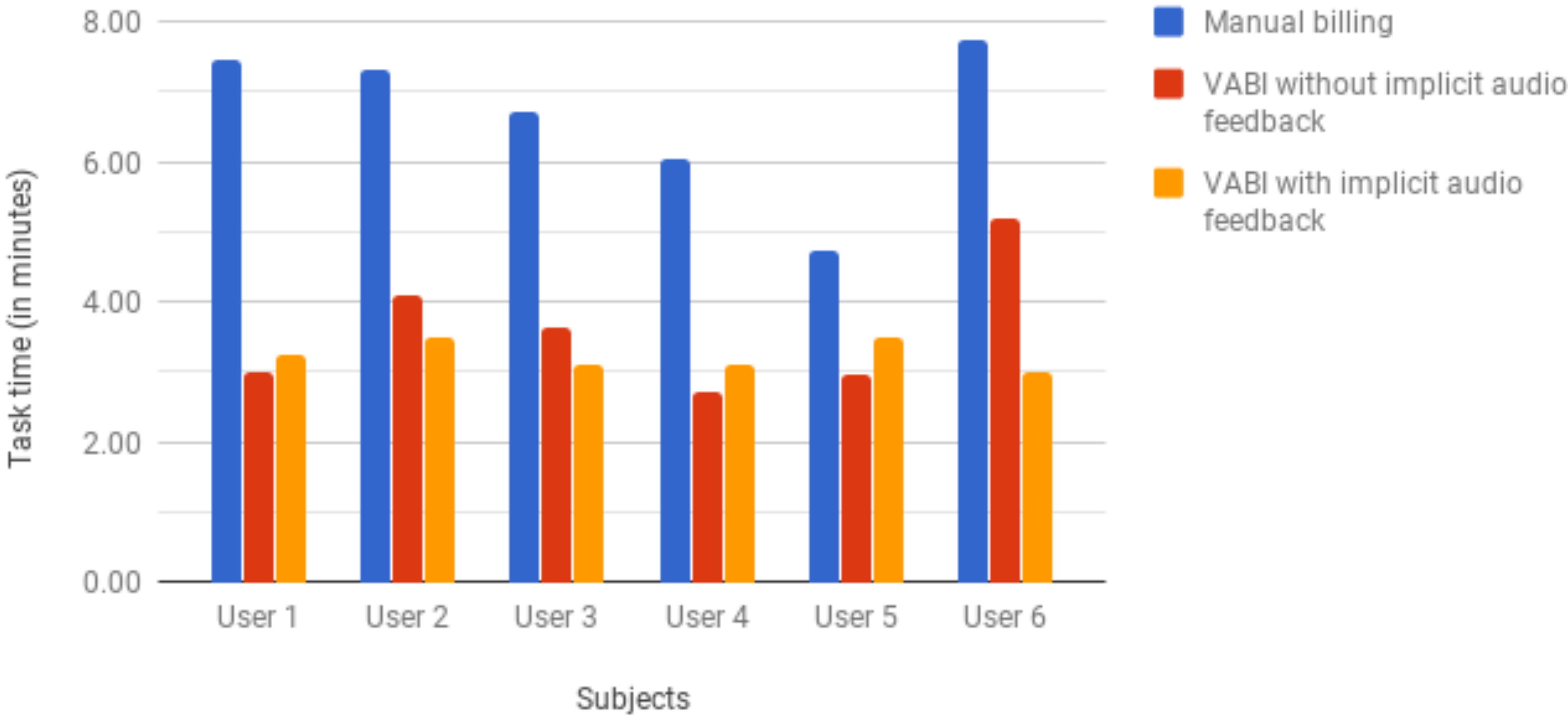
Speed and Learnability



Overall results

Subjects	Average time (in minutes) taken for different systems		
	Manual billing	VABI without implicit audio feedback	VABI with implicit audio feedback
User 1	7.46	3.00	3.25
User 2	7.32	4.08	3.50
User 3	6.71	3.63	3.11
User 4	6.06	2.71	3.12
User 5	4.72	2.97	3.51
User 6	7.74	5.19	3.00

Average time taken for different systems



Qualitative findings

Issues with the elderly, less-literate and people with vocal disabilities

Less-literate →

Elderly →

People with
vocal disabilities →

Subjects	Accuracy rates (in %) in speech to text	
	inventory items	item callouts
User 1	63.74	74.12
User 2	76.96	74.29
User 3	58.93	63.5
User 4	54.85	64
User 5	67.07	84.74
User 6	79.78	76.38
Average	66.89	72.84

Qualitative findings

Findings related to user behaviour

1. Calculation errors, and effect of comparison on users
2. User never tried to *barge-In*
3. VABI with implicit audio feedback took more time, but was considered *smoother in operation*
4. “Bill first, get items later”

Qualitative findings

Issues faced by the wizard

1. The wizard often could not distinguish between the voices of the user and the moderator over the phone.
2. The users on several occasion confused between the size (eg. 220 ml) and the price of the item (eg. Rs. 260), and the variety (eg. lavender fragrance) and type of the item (eg. toilet cleaner). The users at times gave incomplete informations even after asking several times for clarification.

Qualitative findings

Unexpected errors in voice recognition

“हगीज डायपर्स” had a mean accuracy of 31%

“एक्लेयर्स” had a mean accuracy of 69%

“दैट ऑल” in “एक पीस दैट ऑल लिक्चिड ”

“डेटोल” in “डेटोल लिक्चिड पांच पीस”

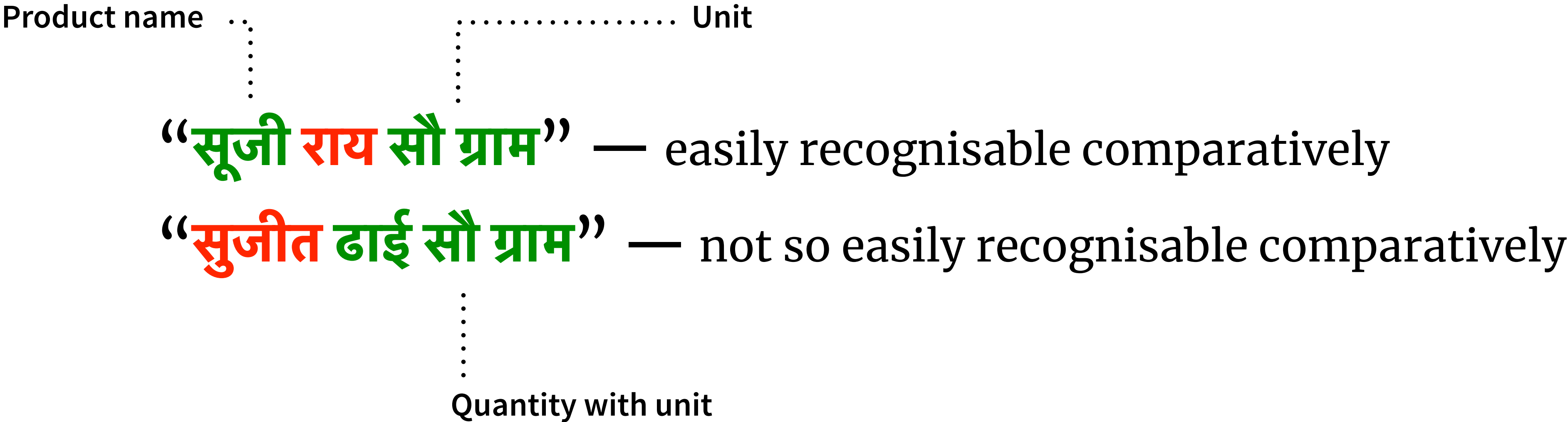
Qualitative findings

Findings related to the design of the voice-commands

“सूजी राय सौ ग्राम”
“सुजीत ढाई सौ ग्राम”

]

both have a mean accuracy of 88%



Is there a better way to determine *accuracy rate* in the *retail* context?

Item name in ENGLISH	HINDI translation (expected)	User 1	User 2	User 3	User 4	User 5	User 6
Lipton darjeeling tea (250 g)	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	विल एंड डार्लिंग की नाइग्रा	केट टर्न राइजिंग की ढाई सौ ग्राम	लिप्टन डार्जिलिंग टी टाइस होगा	लिप्टन डार्लिंग टीम प्रोग्राम	कलेक्ट एंड दार्जिलिंग टी टू फिफ्टी ग्राम्स	लेक्टरन दार्जिलिंग टी का सो ग्राम
Lizol surface cleaner (200 ml)	लाइजोल सरफेस क्लीनर दो सौ एमएल	लाइज ऑल सरफेस क्लीनर टू हंड्रेड एमएल	लाइसेंस सर सर्फ एक्सेल क्लीनर दो सोमेल	आइजोल सरफेस क्लीनर दो सौ एमएल	राइस ऑफ सर्विस के	लाइज ऑल सर्विस क्लीनर टू हंड्रेड एमएल	लाइज ऑल सरफेस क्लीनर दो सौ में
Maggi Noodles (pack of 4)	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	मैगी नूडल्स पैक ऑफ फोर	मैगी नूडल्स पैक ऑफ फोर	मैगी नूडल्स स्टेक ऑफ फोर	मैगी नूडल्स पैक ऑफ फोर	मैगी नूडल्स पैक ऑफ फोर
Oral B Cross-Action Toothbrush	ओरल बी क्रॉस एक्शन टूथब्रश	ओरल बी क्लास एक्शन टू झा	ओरल बी फ्रांस एक्शन टू क्रश	फॉर वेल वी क्रॉस सेक्शन थ्रू	फोर फॉर री प्रोजेक्शन टू क्रश	कोरल भी क्रॉस सेक्शन टूब्रश	कोरल भी क्रॉस सेक्शन टूब्रश
Park Avenue deodorant (Voyage)- 220ml	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	फॉर ए वेन्यू ड्यू रेनवाटर टू ट्वेंटी एमएल	पार्क वेन्यू डियोडोरेंट्स वोयेज दो सौ बीस एमएल	पार्क केविन ड्यूरेंट वायर्स दो सौ बीस एमएल	आर्ग्यूड एंड वायर दो सौ बीस सेवन	ऑर गिवेन यू टू यू एंड योर	पार्क एवेन्यू डियोडरेंट वेज दो सौ बीस एम एल
Pisi Lal Mirch	पीसी लाल मिर्च	पी सी लाल मिर्च	पीसी लाल मिर्च	किसी रायल मेस	किसी लाल मिस	पीसी लाल मिर्च	पी सी लाल मिर्च
Sabut Lal Mirch	साबुत लाल मिर्च	साबुत लाल में ए	साबुत लाल मिर्च	साबू क्लाइमेक्स	साबुत लाल मिस	साबुत लाल मिर्च	साबुत लाल मिर्च
Saffola Gold (2 lt)	सफोला गोल्ड दो लीटर	सपोला गोल्ड दो लीटर	सपोला गोल्ड दो लीटर	सपोला गोल्ड टू लीटर्स	बोरा गोल्ड दो लीटर	सफला गोल्ड दो लीटर	सपोला बोर्ड टू लीटर्स
Sooji	सूजी / रवा	सूजी	सूजी	सूजी	सूजी	सूजी	सूजी रवा
Sugar	शुगर / चीनी / शक्कर	शुगर	शुगर चिन्नी शक्कर	शुगर चीनी शक्कर	शक्कर	शुगर	शुगर
Surf Excel Matic (2 kg)	सर्फ एक्सेल मैटिक दो केजी	सर्फ एक्सेल मैटिक टू	सर फैक्स मेटिंग दो केजी	सर सेसिल मेडिक टू के जी	सेल में मैंने पिक कर दोगे जी	सर्फ एक्सेल मैटिक क्यों क्लोज	सर्फ एक्सेल मैटिक दोगे जी
Tetley darjeeling tea (25 bags)	टेटली दार्जीलिंग टी (पच्चीस बैग)	बेट्टी जीन द ट्वेंटी फाइव	डेडली डार्जिलिंग टी पच्चीस में	टेटली राइजिंग की बच्ची है	एट्टी डार्लिंग टीम व्हिच इज बैक	टेटली डार्जिलिंग टी ट्वेंटी फाइव टी बैग्स	टेटली दार्जिलिंग भी पच्चीस पे

Qualitative findings

Findings related to the design of the voice-commands

Subjects	Accuracy rates (in %) in speech to text		% commands identifiable	
	inventory items	item callouts	inventory items	item callouts
User 1	63.74	74.12	66.67	47.06
User 2	76.96	74.29	55.56	47.06
User 3	58.93	63.5	40.74	26.47
User 4	54.85	64	22.22	38.24
User 5	67.07	84.74	74.07	79.41
User 6	79.78	76.38	74.07	44.11
Average	66.89	72.84	55.56	47.06

Conversational voice-assistant

1. Do not need to remember command syntax
2. Prone to more errors (47% accuracy)
3. Not feasible with present voice-recognition technology

vs

Set-command VUI

1. Need to remember command syntax
2. Prone to less errors (speculation) as shorter commands have greater accuracy rates (55%)
3. Feasible with present voice-recognition technology

Better chances of recognition

“हार्पिक वंडर्स सो एम एल”

“हार्पिक लेवेंडर स्वयं में”

If “Harpic” is recognised correctly, prompts could be given for *disambiguation*

Please choose your Harpic



Harpic Powerplus 10/10 (100 ml)
Rs. 77



Harpic Lavender (100 ml)
Rs. 66



Harpic bathroom cleaner (100 ml)
Rs. 61

Training the recognition system

“क्लेयर्स”

“डिक्लेर्स”

“एक्लेयर्स”

all could be mapped to “Eclairs”

“दैट ऑल”

“डेटोल”

both could be mapped to “Dettol”

“रेड हार्पिक”

“हार्पिक बाथरूम क्लीनर ”

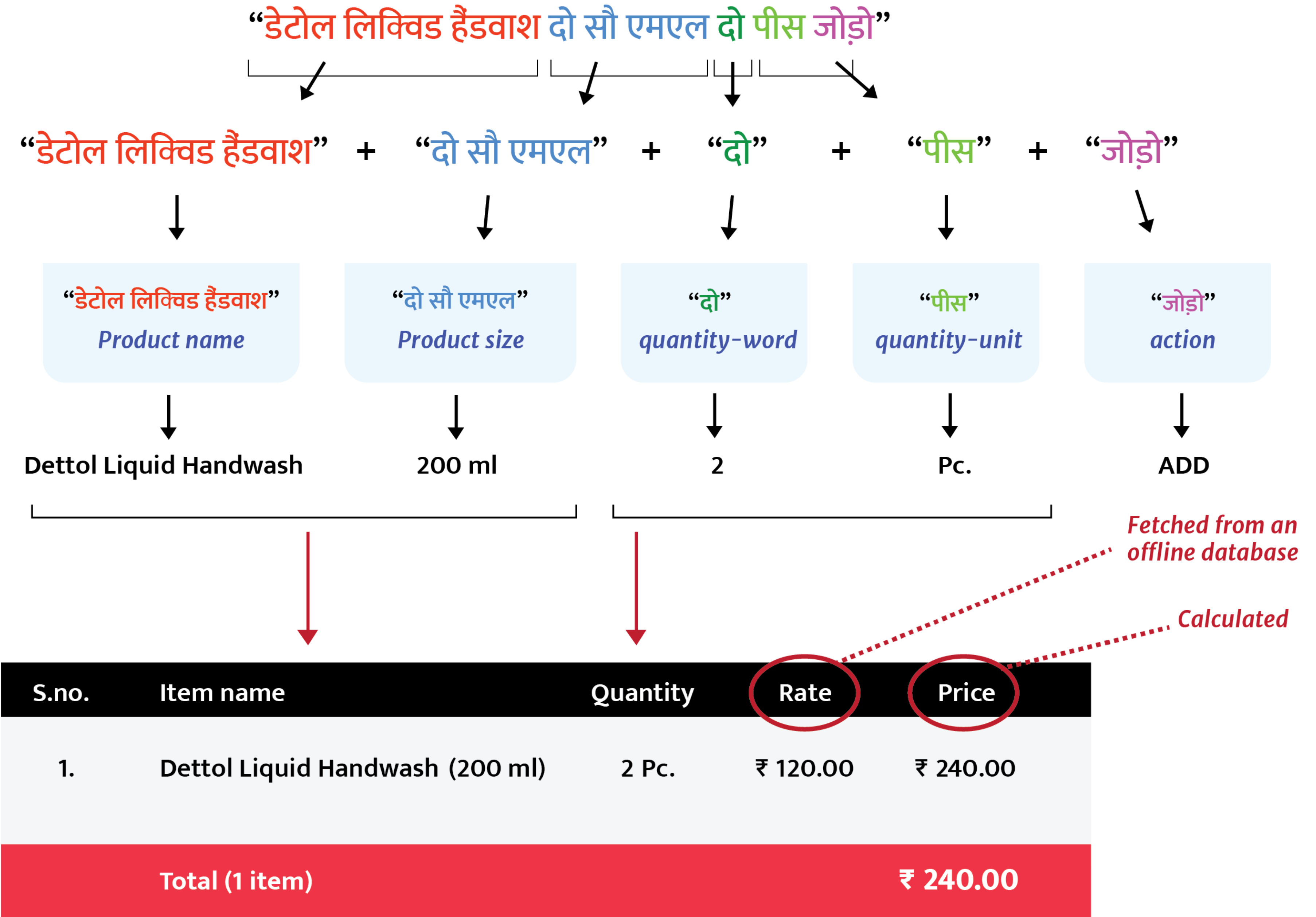
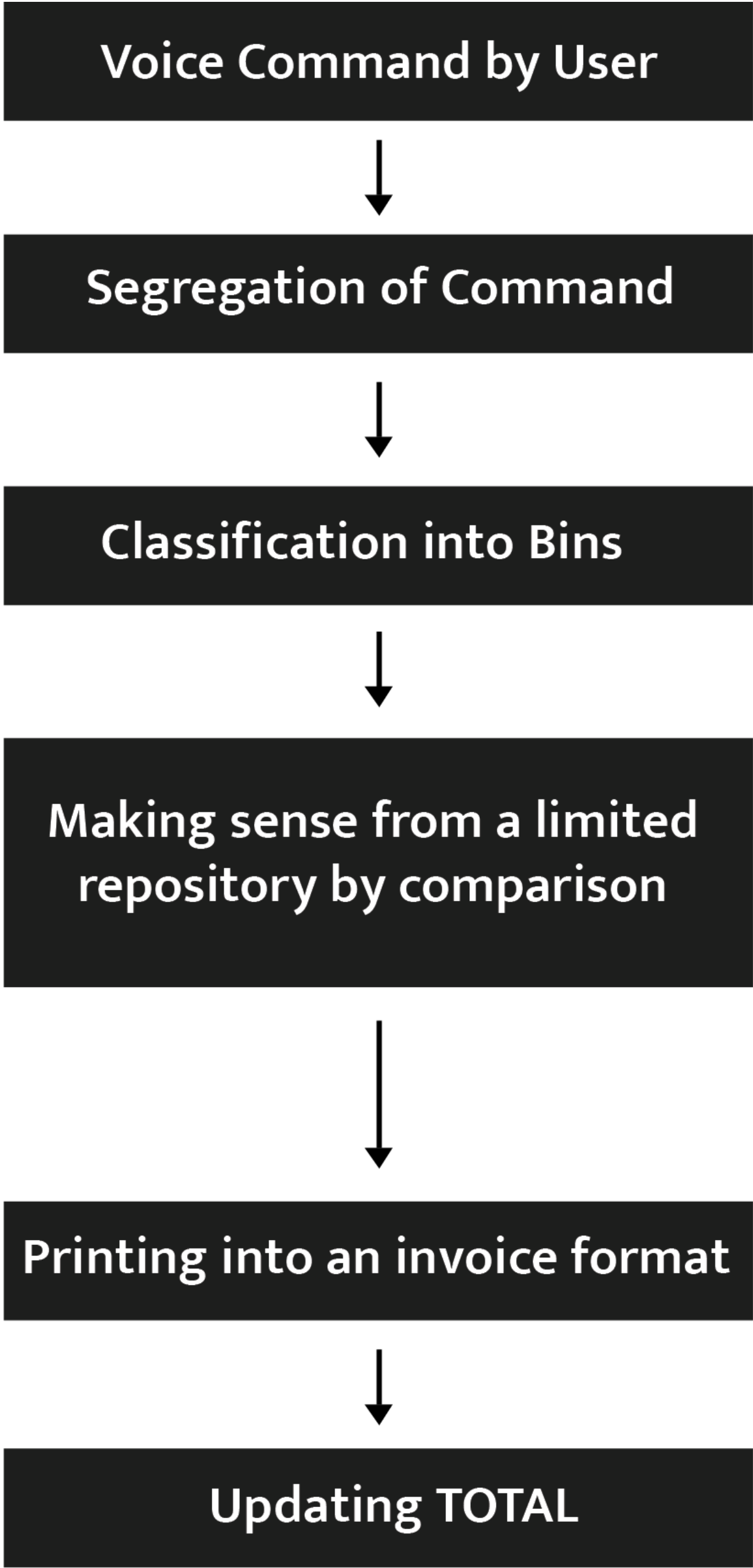
both could be mapped to



Harpic bathroom cleaner (100 ml)

Rs. 61

Proof-of-concept prototype




```
MacBook-Pro:voice_assistant nikhilwan1$ python3 voice_assistant.py 8
```

```
I
```


Conclusion and Future Research

1. Multi-modal Interface; *feasible for deployment*
2. VABI emerged *faster* in performance evaluation
3. A set-command based VUI is *more practical* in present: *have to be evaluated for effectiveness*
4. Confirmations and Disambiguation: *validated*
5. Detail and Speed of Feedback: *needs future work*
6. Handling of Internal Errors: *needs future work*
7. Number of sessions need to be increased to investigate Barge-In: *needs future work*
8. Concerns for privacy: *investigated*
9. Touch-based interface and Error correction: *needs future work*
10. Need of a *different evaluation measure for measuring accuracy* of voice commands in contextual settings like **Retail**

Thank You.

I thank my guide **Prof. Anirudha Joshi** for his valuable guidance and support throughout the project. Working under AJ sir was a great experience and he taught me many things, the prime being the art of presenting arguments.

I thank the IDC Interaction Design faculty **Prof. Venkatesh Rajamanickam**, **Prof. Girish Dalvi**, **Prof. Ravi Poovaiah**, **Prof. Jayesh Pillai**, and **Prof. Pramod Khambete**, for all their inputs and feedback.

I would like to give a shout-out to my friends for helping me out. **Rohit** and **Shilpa** gave me their valuable time for discussions. Design truly is fun and productive when discussed and contradicted. **Nikhil** and **Manjiri** helped me test the technological constraints of this project. **Vartika** and **Manasi** gave their voice to the voice-assistant during experiments and demo respectively. **Ruchi** and **Rohit** suggested some interesting reading material.

Most importantly, I would like to thank *my family and friends* for their help, support and encouragement. Thank you **Maa** for constantly nagging me; my lazy self needed it.