A Voice-Assisted Billing Interface for the Kirana shopkeepers

Project 3

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1. Introduction and Background

Today, with several big, organised, resource-rich retail chains popping up in the country, the friendly neighbourhood provision stores (commonly known as the Kirana stores) are finding it hard to keep up with the competition. Further competition comes from online grocery shopping and home delivery systems that have revolutionised the market, making shopping for household items effortless and less time-consuming. Taken together, we refer to these as the "organised retail". The organised retail gives customers everything they want: (i) ease of scrutiny before making the purchase, (ii) ease of ordering from home via an app/website, (iii) visible choices of a lot of variety, and (iv) less waiting time. The small-scale Kirana stores do not come as close as these big business chains in terms of efficiency but are still somehow in the competition owing to (i) customer loyalty built over generations of business, (ii) their proximity to homes, (iii) their understanding of the local market, and (iv) home-delivery of telephonic orders for no extra charge. They also used to provide products to customers on credit, but in our studies we noticed that this is a reducing trend. These offerings may have sufficed to keep these Kirana stores in the competition for so long, but without the opportunities for optimisation, efficiency, and business forecasting that the retail chains enjoy, these provision stores may not last long in the business.

A pre-requisite for realising the opportunities for optimisation and efficiency is digitalisation. Shahar Markovitch, the Chief Digital & Information Officer at EL AL Israel Airlines, and Paul Willmott, Senior Partner at Digital McKinsey, London, claim that if digitalisation of a business is done right, it can also facilitate the offering of more competitive prices because of lower costs, better operational controls, and less risk.[21] However, Kirana store shopkeepers, being generally less educated and digitally illiterate, seem to have stayed ashore of this digital on-boarding. Devanuj et al. call such users "emergent" and identify them as the new and expanding section of ICT users in India.[20] Being resistant to change, they prefer using the legacy methods of manual management of billing and inventory management. Creating bills on pieces of paper, counting items left in stock, and documenting every stock detail in their minds thereby increasing their cognitive load, are just some things that have become routine to them. Unfortunately, this non-digitised workflow cuts them off from several benefits that big retail stores using POS software enjoy, namely, inventory optimisation, order management, online orders, purchase optimisation, trend analysis, business forecasting, and customer loyalty management. To account for their smaller business turnover and taxes, efforts need to be made to onboard these "emergent" users onto a digital platform.

However, there are several initiatives to encourage more transparency. For example, the demonetisation in December 2016 led to an increase in digital payments; implementation of GST saw payment of a lot of taxes in cases of small and big businesses. With digitalisation of backend procurement in effect, it is only sensible if a digitalisation of front-end is accepted. A variety of digital Point of Sale (POS) systems are available

in the market and a lot of them find their use in the checkout queues of hypermarkets and departmental stores. The question is, then *why do the Kirana store shopkeepers don't use them?* While it is true that these POS systems are very efficient in billing packed goods in controlled environments, they are not the most efficient systems in a Kirana store setting. A departmental store checkout counter is a controlled space, which encounters one customer at a time and has a trained worker to focus on just one task, i.e. billing the goods. On the contrary, the Kirana store environment is an uncontrolled setting where multiple customers are served at once by a single shopkeeper. Even when there are assistants present to help out in the shop, the payment counter is often centralised with the shopkeeper (owner). In such a setting, the ability to multitask is crucial, and in my opinion, the present POS systems do not seem to allow that as they require the user to input data while standing near the system.

I propose a Voice-Assisted Billing Interface (VABI), which although may find its use universally, but is specifically designed to suit the needs of a typical Kirana store shopkeeper. This interface allows the shopkeeper to create multiple bills at a time, just by conversing with a voice-assistant naturally. Using voice as a medium offers advantages like intuitiveness (less familiar users can operate the system naturally, and learn faster), a hands-free use (allowing users to multitask), and better speed over the manual billing. I conducted a Wizard of Oz prototype testing with 6 users, in their shop, over a period of 4 days. During the study, I did a performance evaluation of the VABI against manual billing methods and analysed usage logs. This report discusses my working procedure and the insights that informed the voice-design of the VABI. I claim that this interface will save time and increase the productivity of the shopkeepers in the high-frequency tasks like billing.

Figure 1(a). Tanay's 'Bhaaji'

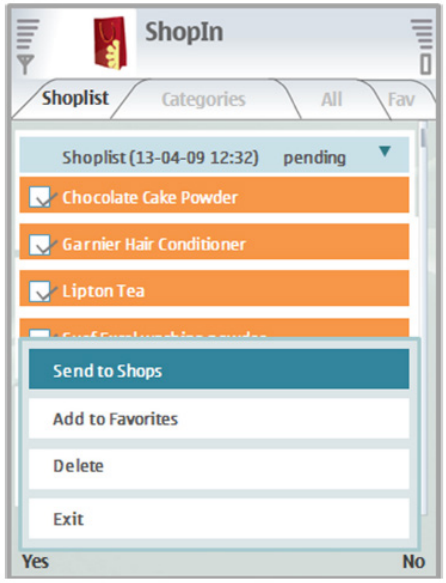


Figure 1(b). Shreyasi's 'ShopIn'

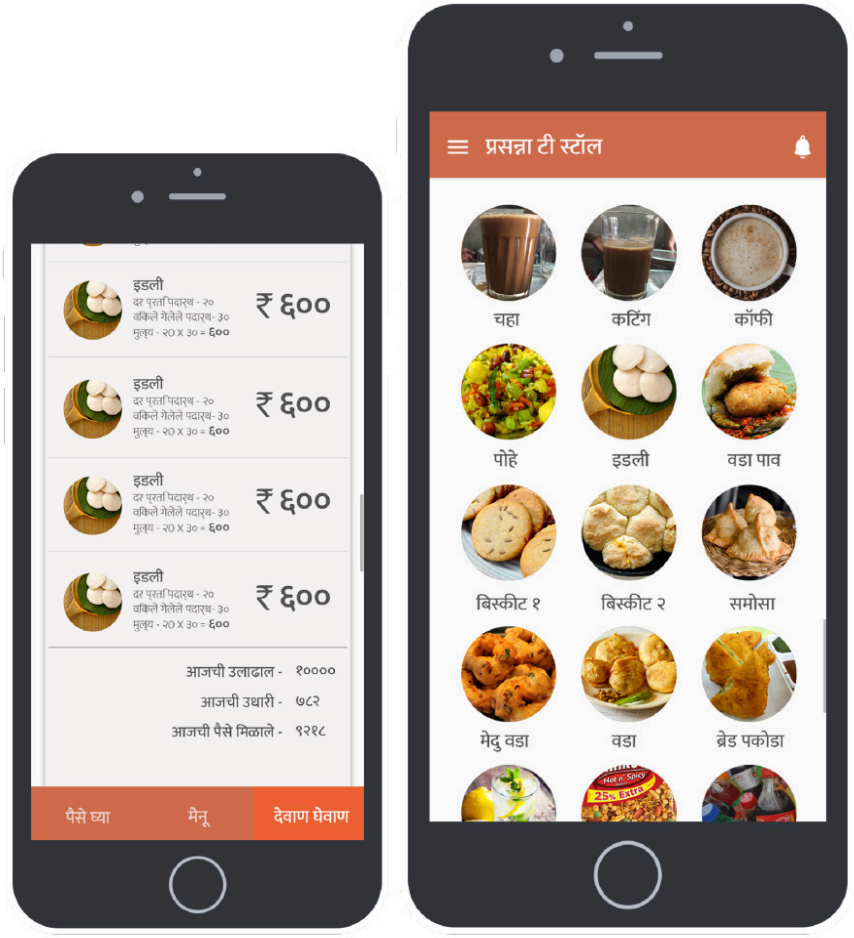


Figure 1(c). Indrajeet's 'Munshi'

2. Related Work and Opportunities

Quite a lot of work has been done in the past few years to enhance the productivity in a seller-consumer ecosystem. Aggregation services like Amazon's Pantry, Fresh and Now, Big Basket, Grofers, Godrej's Nature Basket, etc. allow customers to order household products and groceries from home, to be delivered within a day. IDC itself has produced several interface design projects in the related domain. Tanay's project 'Bhaaji', in 2002, provided a visual interface for the urban customers to order vegetables from the farmer's market, removing the middleman from the chain and increasing the farmers' profits.[22] It was quite interesting to see the way he had used the visual elements on the screen to present a medium-sized inventory of dozens of items. Though the interface looked a bit cluttered, it is commendable that he managed to segregate the inventory into categories like essential vegetable, green vegetables, leafy vegetables and masala vegetables. If I would have been creating an inventory management system for the shops, his project would have been the most relevant. Shreyasi's project 'ShopIn', in 2008, was a mobile application that enabled the customers to shop daily household items from provision stores, similar to what Amazon and the other competitors offer now.[23] She designed this interface on feature phones, in a very small screen space, which is commendable. However, touchscreen phones providing large screen spaces have made our lives very easy in the present. I would mention that for both their projects, I really liked the idea of saving the shopping list for future use; saving popular user actions reduces the user's operation time. Indrajeet's project 'Munshi', in 2016, was a mobile application for small and medium-scale food stalls to assist the shopkeepers in billing, credit and inventory management. [24] His application was found useful but not usable; his target users had less experience with operating mobile apps on the go, and found the tasks of performing calculations and recording sales too complex. However, recent digitalisation initiatives like Demonetisation and Digital India has encouraged users to use digital applications; his project may succeed if implemented in the present.

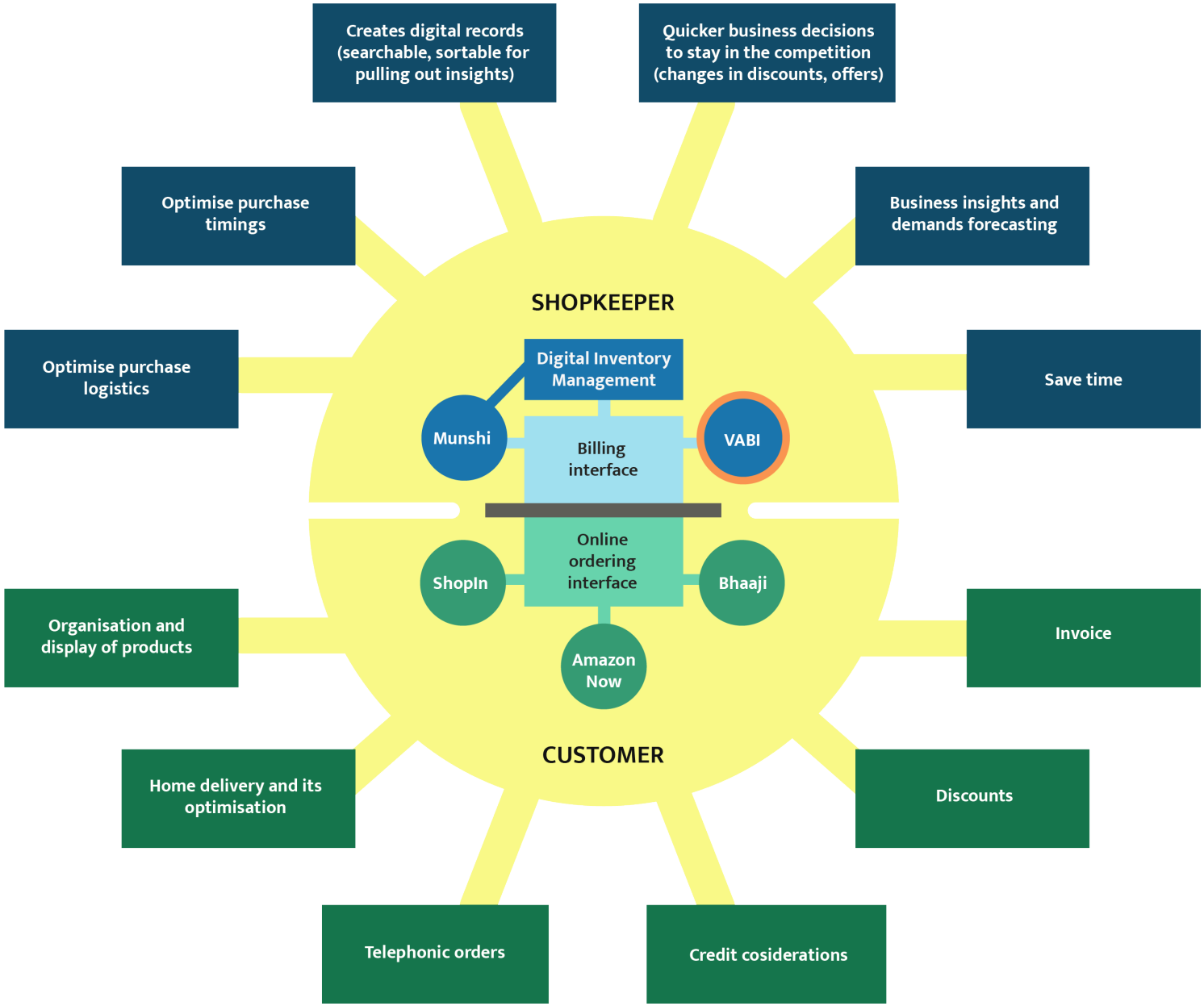


Figure 1(d). The opportunity space in the retail business and where does my project VABI fit in

Looking carefully at figure 1(d), we would realize that all these digital products, except Indrajeet's 'Munshi', cater to the customers' side of the activity, saving them the time and hassle of visiting multiple provision stores and vegetable stalls. These interfaces aggregate the inventory of a large number of nearby shops/sellers, allowing customers to browse through the options, compare prices, and place orders. From the analysis of all these products, I found that while designing interfaces for the customers' side requires more attention needs to be paid to the transparency of information. The task time is not very critical in such cases, as the number of operations made on the customer-side per day is very small. A similar assumption cannot be made for the shopkeeper, who is constantly moving in his shop while handling multiple customers, managing inventory and cash transactions, almost hundreds of time per day. An ideal interface for shopkeepers would be one that increases their efficiency without slowing them down. Such an interface would require physical data input to be minimum, and effortless navigation through the menu.

In my opinion, Indrajeet's project 'Munshi' is the most similar to my project as it tries to save the shopkeepers' time and boost the efficiency. His interface was contextualised for small food-stalls which generally have no more than 20-25 menu items. For such a use-case, the scrollable grid-view display of inventory items made sense for his design. However, in a Kirana shop, which stocks hundreds of items, a scrollable interface for viewing the inventory may not work. Segregating all inventory items by category and variety in a grid view, or a list view is not feasible for an interface the size of a tab, or even a computer screen. For this reason, most touch-based POS systems go for dynamic interfaces wherein the items to be billed or searched have to be either scanned by a bar-code reader or manually inputted through a keyboard (both of which require the user to stay near the interface).

There are many existing retail products out there in the market for billing and inventory management. They generally fall in one of the two following categories:

1.) POS systems

A point of sale (POS) system is a combination of software and hardware that allows merchants to calculate the bill amount, and prepare an invoice for the customer.[1] A retail point of sale system typically includes a cash register (which in recent times comprises a computer, monitor, cash drawer, receipt printer, customer display and a barcode scanner) and sometimes a debit/credit card reader too. Though a POS system is only meant to be concerned with the sales report and work offline, modern POS systems like Fusion Retail, Snapbizz, etc. are trying to include features to manage the inventory.[3,4,5]

2.) ERP software

ERP is an acronym for Enterprise Resource Planning. There are various processes that are essential to running a business, including inventory and order management, sales, accounting, human resources, customer relationship management (CRM), etc. At its most basic level, ERP software integrates these various functions into one complete system to streamline processes and information across the entire organization.[2] It does so with the help of a shared database that supports multiple functions used by different business units.

A POS system generally does not have a backend and shared database. This allows a POS system to be comparatively cost-effective and work without an internet connection. Owing to its limited scope and functionality, POS systems are comparatively easier to operate and have a smaller learning curve. Both POS and ERP systems need a computer or a digital device to operate.

Presently, these retail solutions are not being used in Kirana shops. For the people who might attribute the non-adoption of these retail solutions to the tech-illiteracy of the shopkeeper and their unwillingness to purchase digital devices for their shops, I would politely like to bring into notice the fact that these shopkeepers oftentimes are found using smartphones, and CCTV cameras for the security of their shop. What is the reason then for these shopkeepers to not use the current retail software? One reason for this could be the price; ERP systems cost between INR 2-5 crores, which is not affordable for small businesses like the Kirana shops. My answer to that question would be that most retail software manufacturers do not contextualise their software to the specific needs of a Kirana store. A Kirana store is a fast-paced environment, where a shopkeeper is responsible for handling multiple customers, a huge inventory of hundreds of items, and cash transactions, simultaneously. He has to frequently move between the shelves, remember the orders received from different customers, and keep track of the sale of different items.

The figure 2 shows a typical POS system which requires multiple taps and scanning of barcodes to enter the item being billed. Supporters of such systems may argue that bar-coding has made life easier for retail shops, but I would like to contend saying that bar-coding cannot efficiently solve the problem of billing non-branded items that are

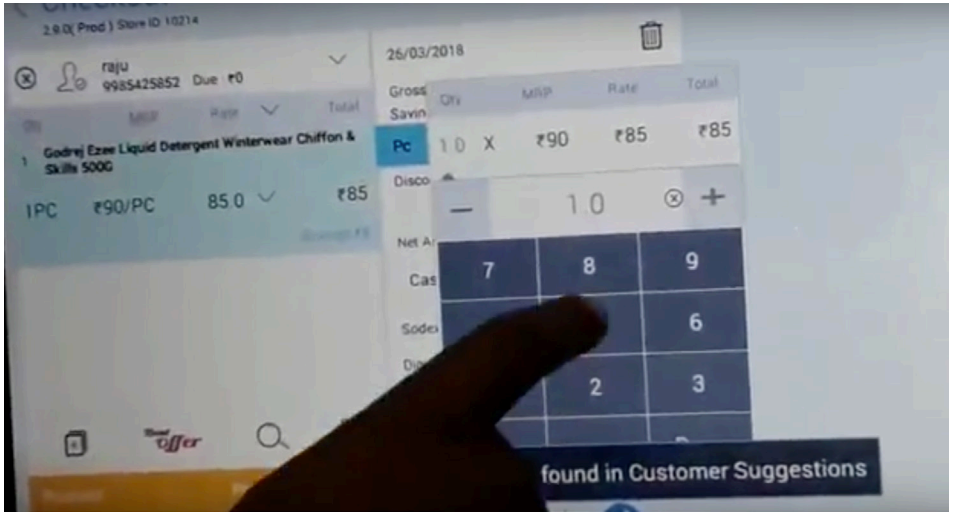


Figure 2. Billing interface of Snapbizz [34]

typically sold loose (such as flour, pulses, alum, etc.). These POS systems can effectively work in the big retail chains, which exclusively sell branded items in bar-coded packets. However, in a Kirana store, it is not feasible to pre-pack loose items in standardised packets by weight, and bar-code them separately; therefore such a POS system is not the ideal choice for these shops. Lastly, present POS systems require touch-based interactions to operate and are immobile, which constrains the user to stand near the device while billing. This is not a problem for the workers at the billing counter of the departmental store, as the items are being brought to them by the customers themselves. However, the shopkeepers in a typical Kirana shop have to constantly move between the shelves and the counter to get the items the customers demand on their shopping list. The ideal billing interface suited to their needs should be either mobile or operable over long range of distances, where the current POS systems fail.

To summarise, the conventional retail billing software interface struggles to solve two essential problems:

(i) An excessive physical input of data: As we discussed earlier, the interface displays the stored inventory dynamically while billing or searching, for want of screen-space. To bill an item in the system, one needs to scan the product using a bar-code scanner or type in the first few characters of its name in a search bar using a digital on-screen keyboard. Most products working only with bar-code inputs are rendered unusable in cases where loose items (like flour, pulses, spices, alum, etc.) have to be billed. Products like Snapbizz[6] do a great job of handling such loose items locally, by providing an exclusive menu for such items and a pop-up keyboard for choosing pre-defined quantities (see figure 3 and 4). All these touch-based 'tap' interactions considerably consume time and do not allow the shopkeeper to multitask.

(ii) Immobility of the interface: The conventional interfaces are restricted by the fixture of the devices they operate on (like a tablet, computer, etc.). These devices are generally placed on the counter and hinder the mobility of the shopkeeper while being used.

In an ideal billing software for a Kirana store, it should be possible to bill the loose items with similar ease as that of the packaged items, and it should be operable on the move. The physical input method of 'tap and type' seems inadequate for such a system and therefore there is a need to explore alternate input methods. A conversational 'voice' interface seems like a good option for this case.

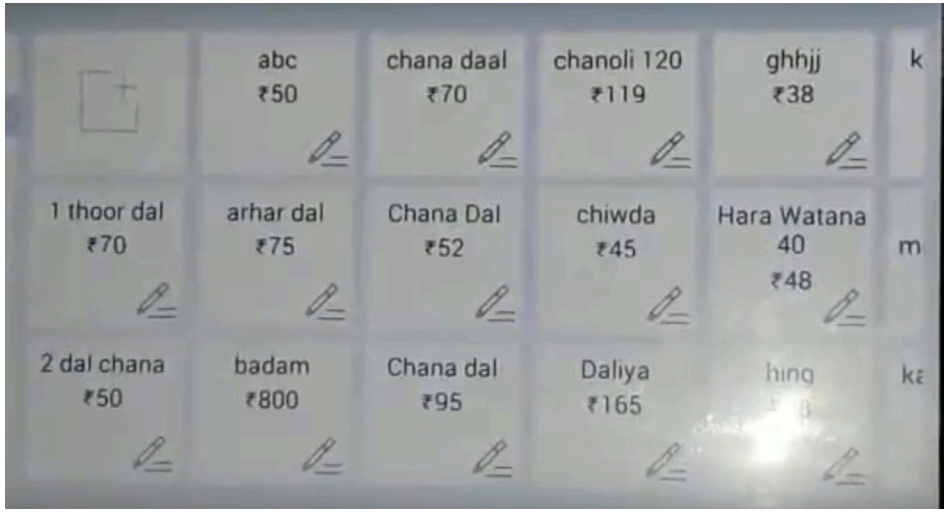


Figure 3. Snapbizz manages the sale of loose items locally by having a separate interface for loose items.[34]

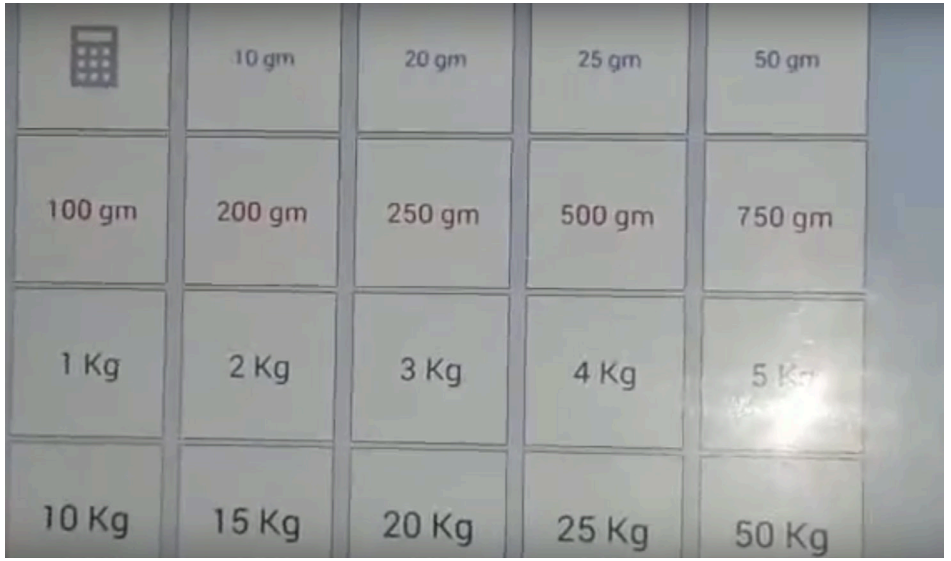


Figure 4. Snapbizz manages the quantity input of loose items by providing a pop-up keyboard with buttons for pre-set quantities from 10 g to 50 kg.[34]

Voice recognition technology has advanced significantly in recent years. The greatest advantage that a voice interface would offer is a hands-free operation.[25] This would enable the shopkeeper to multitask, allowing him to get the products from the shelves while simultaneously interacting with the interface through voice. Moreover, a recent Stanford study proves that dictating text messages was faster than typing, even for expert texters.[26] A similar study was reproduced for Hindi by an IDC research team (work yet to be published). The overall task-completion time can be further reduced if tasks are streamlined by removing several unimportant confirmatory steps.[13] An invoice made by voice might actually be faster (which we prove in this thesis), thus making speaking rather than typing or tapping much more practical.

Voice user interfaces like IVRs are considered best for targeted actions. A conversational voice UI (like that of Alexa, Google-assistant, Cortana, Siri, etc.) would make the task flow pretty linear and eliminate navigation issues. Voice is the natural medium of communication for humans. Adoption of a conversational voice interface would be easier for new users (even those who are less familiar with technology) owing to the already existing conceptual model of communication.[25]
Due to its intuitiveness, voice UI has the potential to increase the performance of illiterate and less-literate users, as well as the literate users.[19, 28] Unlike in a touch-based interface, a voice interface can facilitate long-range operations with a wireless Bluetooth microphone and speaker, allowing the shopkeeper to move freely in the shop even while operating the interface. Furthermore, a Bluetooth headset would minimise the errors in speech recognition caused due to external disturbances. Lastly, a voice-assisted system when used for a public task like billing, can aid in enhancing the transparency of the billing process, and win customer's trust.

Though conversational voice UI seems to have genuine potential, it is important to note that it has several limitations too, most of which are technological limitations. Voice authentication is still not that secure and such systems can pose potential privacy risks.[27] Cases have been recorded where voice-assistants have leaked personal data of owners after misinterpreting background noises as actual commands. In an open-microphone situation, the microphone is listening at all times for voice commands. To ensure that the microphone does not attempt to interpret the user and the second-person's conversation as commands, a wake word (like "Ok Google", or "Alexa") is important.[12] Voice technology is still developing; presently such systems are prone to errors due to external noise, misinterpretation of user's intent[17, 18] and lack of contextual understanding.[14, 15, 16]

Research shows that a voice interface puts a lesser load on the user's cognition than purely visual or manual interfaces, while the user is engaged in some other primary activity.[10,11] However, a simple voice interface does not make much sense as users are somewhat unsure of the capabilities of speech recognition systems; therefore, feedback is required to provide assurance that commands are being heard and understood correctly.[12] Feedback received through voice, is not always enough. Prior work shows that when drivers used a voice interface while driving, they still desired visual confirmation that the commands were accurately recognised.[13] Moreover, adding a combination of GUI and text elements to voice interfaces can considerably increase the efficiency and the success of the interactions.[25] Abhishek's PhD thesis compares the performance of audio-visual interfaces (IVR assisted with audio prompts and visuals) against simple audio-only IVR interface and GUI, to demonstrate that audio-visual interfaces provide higher efficiency and memory retention.[28] The main focus, as claimed,

while designing such interfaces should be creating a balance between achieving higher efficiency and reducing ambiguity.[12]

I have designed a Voice-Assisted Billing Interface (VABI) for the shopkeepers. Though all the interactions in this interface can be achieved by conversing with a voice assistant alone, affordances have been kept for screen-based interactions too. Preachers of simplicity are right to object that the interface could be made simpler and economic by eliminating the touchscreen. But on the other hand, I agree with Cathy Pearl that good design should be multimodal. Cathy says, "Multimodality should ensure that all modalities are available at all times, and the designers should not make assumptions about how all users will prefer to access these systems."[25] Some information we prefer to hear; other information we prefer to see. Short commands are remarkably efficient through voice, but communicating a list of items is much more efficient on screen. Humans have a limited capacity to remember a string of information; typically, a user can't remember more than about seven auditory items at a time.[29] Hence, multimodality is recommended.

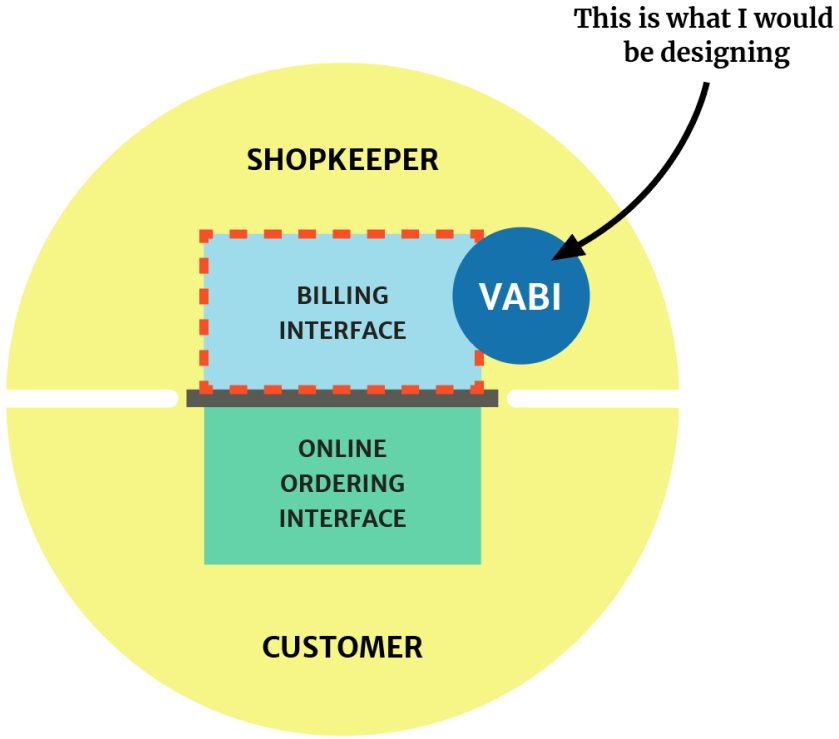


Figure 1(e). The problem I am solving: VABI is a billing interface for the shopkeeper

3. Primary Research

3.1. USER STUDIES

A short exploratory study was conducted to find out the issues faced by the shopkeepers in the setting of their Kirana stores. The ultimate objective was to explore problem areas for intervention to bring about an increase in productivity of these shops, either by saving time spent in redundant tasks or by increasing their business. The study was conducted in two parts: contextual inquiries with eight shopkeepers in Mumbai, and observational studies with two shopkeepers in Lucknow.

In the first round, I conducted the contextual inquiries in and around the IIT Powai campus. I interviewed eight shopkeepers: two shopkeepers in IIT campus (a provision store owner in Hostel-12, and a medical store owner near Y-gate), and six shopkeepers in the IIT market. These shops varied in characteristics and age. Some shops were more than forty years old, while some were relatively new, established merely two years back. Two out of four shops had assistants to help the shopkeeper; in the rest of the shops, the shopkeeper single-handedly managed the business. All shops had different customer bases and mostly offered home deliveries to regular customers. Most shopkeepers were not unknown to the digital technologies like a computer, but were novice users. Six out eight shopkeepers used smartphones for calling and WhatsApp; rest had feature phones with no internet connectivity. One of the shops having assistants was reasonably modern; it had a wifi connection and had been using a POS system in the past.
I observed the shopkeepers manage the shop for a while and connected with them informally. I lead the conversation with questions like '*what was the age of the shop*', '*what were the educational qualifications of the shopkeeper*', and '*did the shop have assistants to help the shopkeeper*'.
Once the shopkeepers got comfortable, I asked them about the working procedure in their stores. Questions like '*how is the inventory managed*', '*in what way and in what quantity are items purchased*', '*how do they maintain relationships with different dealers and customers*', '*how do they manage shop accounts and finances*', '*how do they keep track of sales and sale trends*', and '*how are items stocked up and displayed in the shop*', were asked. There was no pressure on the shopkeepers to answer any of my questions, and I did not disturb them while there were customers around in the shop.

To understand a different context, in the second round I conducted the observational study in a legacy Kirana store and a newer, smaller Kirana shop in Lucknow. I had known both the shopkeepers since childhood and had their full cooperation. The legacy store was reasonably big and had been around for the last fifty years. It was managed by two brothers and had a large number of customers. The smaller shop was six years old, was run by a young shopkeeper and had a low customer base. The study went on for four days, two days dedicated to each shop. I visited each shop during the peak hours (evening) on the first day and non-peak hours (afternoon) during the second day. Each day's session was about four hours long. I observed the activities of the shopkeeper in each sitting and took field notes. When there was no customer in the shop, I asked the shopkeepers questions related to the observed activities to get a better understanding.

3.2. FINDINGS AND INSIGHTS

I found that the age of the shop directly affects its popularity and the trust it enjoys with the customers. The legacy Kirana shops which have been operating for more than thirty years are extremely popular and have a large customer base due to so many years of good relations established with the customer families in the neighbourhood. The medium-aged shops which have been operating for the past 10-20 years enjoy a moderate customer base and are thriving owing to their knowledge of the local customers; these shops know that what are the requirements of the customers in their locality. The Chhadwa Grain Store in Powai, for instance, is the only store that sells fresh idli-dosa batter in their shop as there is a high demand for this product near IIT. Shops which are less than ten years old are new shops, and their performance is location-based. Since these shops did not have the time to establish enough trust with the customers, the only customers they get are the people who live in the vicinity and do not want to travel far for small purchases. These new shops face immense competition from the legacy shops, as customers prefer to visit the shops they trust when they have to buy many items. As a result, these shops suffer heavy losses owing to the piling up of dead stock. One of the shops I interviewed, had digital electronics (like mice, keyboards, headsets, etc.) worth INR 1 lakh lying in his shop as dead stock. He was frustrated that people purchase electronics nowadays from Amazon and Flipkart and that he was a fool to buy so much stock thinking he could sell all of it. I concede that it is difficult for these newer shops to compete with the legacy Kirana stores in terms of popularity, but they can reduce their losses by going digital. The digitisation of these shops can help

them predict their sales, give better visibility to their products, and restock sensibly. They can even get more customers if they gain the local knowledge of what their customers want, and can communicate that they have those things in their stock.

3.2.1. Inventory management

Most shops manage their inventory manually. Inventory management consists of keeping track of the number of items in stock, keeping the stock at a threshold level, and ordering a restock of depleted goods. Kirana shops have several ingenious ways to quickly ascertain if an item is in stock. Shopkeepers place each item on display at a fixed position in the shop to increase the visibility of their inventory. Specific display spots allow them to find an item instantly when demanded by the customer and allows them to keep track of which items are selling fast. The fixed position also helps in quickly checking the number of items left in stock when the dealer pays a visit. Whenever items go low in stock, the shopkeeper either makes a mental note or notes it down in a copy. These items are restocked in the subsequent visit of the dealer supplying that brand. In the case when the depleted product is urgently required, the shopkeeper calls the dealer to visit and restock the item, or arranges it from the neighbouring shops. The shopkeepers might consider the act of keeping track of the items in the inventory as second nature, but unknowingly it places a tremendous cognitive load on them. Moreover, they manually count the items left on display every day as a ritual, which wastes a lot of productive time. These manual tasks can be automated by adopting a digital billing system which updates the shop's digital inventory every time it logs a sale.

Another area where digitalisation could bring efficiency would be the dealer visits. The dealers visit every 7-10 days with a long checkbox-list of items that they wish to sell. They mark the items which are scant in stock, calculate the margin for the shopkeeper on their calculators, and promote the newer items offering better deals. They generally visit in the afternoon when there are fewer customers in the shop. Usually, dealers visit multiple shops in a location on a single day. On many days, they have to return without any orders. Digitalisation can help bring advantages like online order placement which would relieve the dealer of unnecessary visits and bring down the operation cost.

Currently, these Kirana stores have no scientific method to observe and predict sales trends. Being practitioners of traditional methods, these shopkeepers count on their experience and cognitive abilities to run their shop. Their extensive knowledge of the local preferences helps them predict what will sell, but these predictions might not always be accurate. Factors like sale trends and seasonal demands influence the restock of new items in the shop. Shopkeepers also keep rarely sold items (like Singhara Atta or Water-chestnut flour) in case a customer asks for it. They believe that '*a customer sent away empty-handed is a regular customer lost*'. A shopkeeper stated, "*Customers first ask for that item on their list which is hard to find in the market. They would purchase the other regular items on their list only if the shop keeps that item; otherwise, they would buy nothing and leave to find another shop. No one wants to carry a bagful of items from one shop to another.*" Shopkeepers purchase the much-demanded items in bulk and the special case items sparingly. Perishable items (covering all food items) are acquired according to the expected sales, while the non-perishable items (like

shampoo, detergent, toothpaste, etc.) are acquired considering the margin-benefits on crate sizes. Items, which expire without selling, or are reported to be of inferior quality by the customers, are returned to the dealer. Even after putting so much effort, many shops complain of dead stock lying in their inventory causing losses. A reason for this might be changing sale trends in modern days, which cannot be accounted for by the shopkeepers' experience. A more reliable system for generating business insights would be one which operates on the actual sales data recorded from different shops in that locality. Such a system can predict optimised purchase recommendations for the shops and may help cut out the losses encountered by the piling dead stock.

3.2.2. Account handling

All the shops keep a record book to manage the receipts of purchase provided by the dealers. Shopkeepers maintain a written record of the sales each day. They calculate the profits either monthly or quarterly by subtracting the purchase cost from the sales. An accountant has to be hired to digitise the manual records, calculate the gains, and the taxes due. Most of the shopkeepers seem to be less-literate (having cleared their higher-secondary school education in the best case), but being in the business for so long, are adept at calculations. Maintaining records should not be a big deal for them. Still, they spend money to hire an accountant to skip going through their handwritten records of sales. Reading through these sales log demands time and concentration, which they are not willing to put. Digital billing can solve the entire problem of accounting by creating easy to read, and easy to find digital sales logs.

3.2.3. Calculation of bills

Creating a bill is a task that is performed almost hundreds of time each day in a Kirana shop. Bills are created on pieces of paper by the shopkeeper or the assistants in the shop. Many times, prices are scribbled on the shopping list given by the customer. It summarises the individual cost of each product against its name and states the total. Mostly, information about the rates of the items is not written to save time. Moreover, being handwritten, the bills are not legible; a customer complained, "*it appears as coded as a doctor's prescription.*"

Shopkeepers appeared to be quite confident in the calculation abilities. 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. Manual calculation of long bills (having more than 7-8 items) takes more time as they are verified twice to prevent any calculation errors. Often while billing, the shopkeeper would not use a calculator. When asked, a shopkeeper replied, "*By the time I punch in the numbers, I would have done it in my head.*" It seems that shopkeepers do not prefer using calculators for shorter bills (having less than 5-6 items) owing to their confidence in their calculating prowess, but consider them necessary for the longer ones to prevent errors. I concluded that the manual bills created in Kirana shops are highly non-standardised, cryptic and prone to errors (however small) due to mental calculations. There is a need to onboard the shopkeepers to making standard digital bills. A digital billing system would not only enhance the invoice's legibility and reliability, but would also sync with the shop's inventory and update it; the shopkeeper would not have to track the inventory manually. Moreover, digital bills would be easy to store and searched through in the future

during account management. Digital invoices may be transferred to the customers electronically in the form of an SMS or WhatsApp message, thus saving paper.

3.2.4. Time management

Another reason why a productivity enhancement is required in Kirana stores is that these shopkeepers are time-constrained. They continuously work from the morning till the evening, between shifts of peak and slow hours. Mornings are peak hours when customers require daily supplies like milk, bread, butter, etc. and everybody is in a rush as they have to go to office or school. Afternoons are slow, but the shopkeeper cannot rest. He has to segregate the items supplied by the dealer, plan and put products on display for the customers to see, and deal with the few customers who visit the shop. Almost all shopkeepers dedicate some time in the afternoon to manually find out which products are running low in stock. The dealers mostly arrive in this slot of the day with their checklist to take orders, and the shopkeeper has to give them time. There are many small shops where the dealers do not visit. Such shopkeepers have to go the market to purchase items for restocking their inventory. Evenings are again peak hours with customers flowing in and out till the night.

Serving a customer invariably engages the shopkeeper at any time of the day; activities like moving between the shelves to get the items they demand, searching for smaller products in the shop (especially the ones that are non-branded and not put on display, like alum, etc.), taking telephonic orders during peak hours, preparing these orders in the free time, and providing home delivery of orders to regular customers, put a toll on the shopkeeper's body. In the entire day's work, the shopkeeper never gets any time to rest as he cannot leave the shop. The large shops with assistants are a slightly better scenario, as the assistants do most of the physical work like getting the items from the shelves, restocking the products on display, counting the number of items left in stock, and delivering orders at home. However, the shopkeeper always has to supervise his assistants, manage the bills and the cash register. It would be good if the routine manual tasks of inventory management and billing could be automated by a machine; it would improve the shopkeeper's productivity and will give him some rest.

My findings confirmed that there is a need to digitalise the inventory management in a Kirana shop. However, the first step to digitalisation should be the billing process as it would open doors to digitals sales report, inventory syncing, and the other business benefits that a digital retail system enjoys.

4. Design Goals and Scope

The goal of the Voice-Assisted Billing Interface (VABI) is to contextualise it to the setting of a Kirana store. The design needs to take into account various situations faced by the shopkeeper.

The **functional goals** that the interface addresses are as follows:

1. The interface should perform the calculations automatically and provide a bill in a printable (or sharable) format.
2. The interface should support the production of multiple bills simultaneously.
3. The interface should support editing of bills before payments; it is quite common for customers to ask for modifying quantities of items, the addition of a product, or the deletion of a product they do not desire.

The **user-experience goals** that the interface addresses are as follows:

1. The interface should be as fast as (if not faster) than manual billing, including error-correction that might arise out of misrecognition of user's voice.
2. The interface should allow the shopkeeper to multitask while billing.
3. The interface should be operable over longer range of distances (say *5 metres*).
4. The voice interface should provide feedback to the shopkeeper while billing.
5. The voice interface should be easy to converse with.
6. The interface should increase the transparency of the billing process by maximising the information provided to the customer.
7. The learning curve for operating the interface should be as low as possible.

The **scope of the project** is limited to the design of the interface and thinking of various situations where this interface could make the life easy for the shopkeeper. Different use cases are considered, and the interface has been tested with the users using a WoZ prototype. The results and the insights from the test are presented along with the data of how different shopkeepers use voice as a medium for operating the interface. The data would help design a better voice-recognition system for the case in context.

	Tasks	Manual records	POS system	ERP software	Tablet application	Mobile application	Image recognition	Voice UI
Functional Features	Updating inventory inflow							
	Updating inventory outflow							
	Records of sales							
	datestamp of sales							
	order/consignment management							
	notifying about low stocks							
	sales tracking							
	comparing offers from dealers							
	set prices and define discount rules							
	update offers							
	returning items/dead stock/ expired stock to dealers							
	calculating and printing bill receipts							
	Profit and GST calculation							
	reporting trends							
	giving business insights							
Usability Features	handsfree							
	one handed interaction							
	two handed interaction							
	visual feedback							
	audio feedback							
	error correction							
	troubleshooting service provided							
	pin-pointed interaction							
	easy to learn							
	conceptual model already in place							
Resources required	monetary investment on a subscription basis							
	internet connection							
	computer							
	smartphone							
	tablet							
	hardware system							

Feature analysis, comparing systems and modalities

	Tasks	Manual records	POS system	ERP software	Tablet application	Mobile application	Image recognition	Voice UI
Functional Features	Updating inventory inflow							
	Updating inventory outflow							
	Records of sales							
	datestamp of sales							
	order/consignment management							
	notifying about low stocks							
	sales tracking							
	comparing offers from dealers							
	set prices and define discount rules							
	update offers							
	returning items/dead stock/ expired stock to dealers							
	calculating and printing bill receipts							
	Profit and GST calculation							
	reporting trends							

Figure 5. Feature analysis, comparing systems and modalities

5. System Design Considerations

5.1. SYSTEM MODALITIES

I wanted my design to be multimodal while keeping voice as the primary mode of interaction. A quick feature-analysis of the various modalities possible in a retail solution (figure 5) made it clear that using a tablet user interface to experience touch as the second modality would bridge the gaps produced by incorporating a voice UI. A tablet would be an economical standalone device that will give visual feedback to the user in cases when audio feedback would be difficult to comprehend or retain (like while giving list options). Unlike a computer, it would occupy less space, can be installed anywhere in the shop, and does not need continuous charging. It can work on a wifi-connection as well as depend on a mobile SIM card for data usage. A tablet would be quite useful when this billing interface is integrated with an inventory management software; tasks demanding visual feedback like checking previous sales records, managing inventory, tracking orders, etc., could be comfortably accomplished on a touchscreen interface the size of a tablet. Supporters of inclusivity may argue saying that a different touchscreen device is unnecessary when people already have smartphones. While I appreciate their concerns about saving money and reutilising everyday devices, I would still defend the use of tablets. Smartphones have pretty small screen space to display complex information like inventory management controls, lists, etc. Moreover, the buttons on a smartphone interface would have to be made smaller, requiring even more concentration while operating.

5.2. APPROACHES TO THE DESIGN OF THE SYSTEM

There were two approaches in my mind to design the system's architecture. The first one was to emulate the conventional ERP software and compose a single application interface that would encompass billing, low stock notifications, order placements, tracking orders, and business insights. However, such an approach would make the entire interface feature-rich and raise the entry barrier for the digitally less-competent shopkeepers. Such an application would also be quite expensive as it would deliver the complete retail solution package. The large entry barrier to technology and the significant initial investment required could discourage a large number of shopkeepers from trying out the system. Preferably, a better approach would be making a modular system, with separate interfaces dedicated to three distinct tasks: billing, accepting shipments from dealers, and inventory management. Having a separate billing interface makes sense as it is a high-frequency task performed throughout the day; orders and inventory are managed only in the free time. The ideal digital interface for accepting shipments from dealers would be a smartphone application; it would retain the existing conceptual model of a pen and paper checklist and allow the shopkeeper to stay mobile and scrutinise the quality and the count of items received before checking them off the list. The inventory management interface could either be achieved on a tablet or a computer. The sub-system interfaces would be connected to the same inventory database on the cloud and operate in parallel; the

downtime in one sub-system would not impair the function of others which would make the maintenance of such systems comparatively easier. Moreover, the shopkeeper would appreciate the idea that he can invest in one sub-system first, and purchase the rest of the package later as per his requirements.

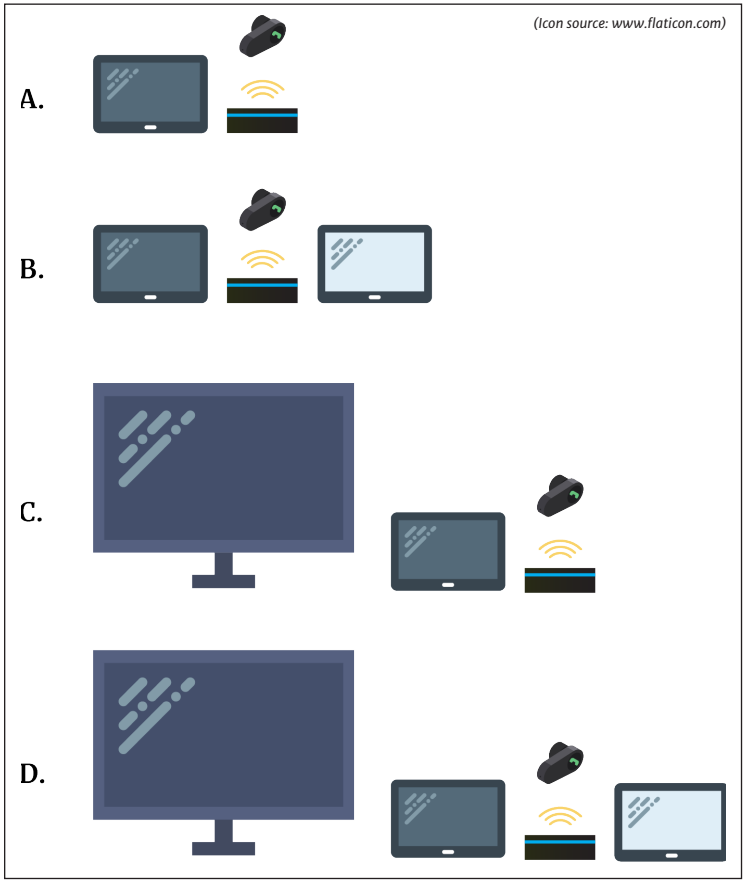


Figure 6. Multiple possible hardware setups.
(A.) *Tablet + Smart speaker housing voice assistant + wireless Bluetooth headset*,
(B.) *Tablet + Mirrored display + Smart speaker housing voice assistant + wireless Bluetooth headset*
(C.) *Tablet + 24" monitor screen + Smart speaker housing voice assistant + wireless Bluetooth headset*
(D.) *Tablet + 24" monitor screen + Mirrored display + Smart speaker housing voice assistant + wireless Bluetooth headset*

5.3. HARDWARE SETUP REQUIRED FOR THE VABI

The billing interface would typically need a **touchscreen tablet device** to be operated by the shopkeeper, **a wireless Bluetooth headset/ earpiece**, and a **voice-assistant**. The voice-assistant could be residing inside the tablet and communicating with the shopkeeper through the headset, but a preferred setup would be **a smart speaker device housing the voice-assistant** (like Amazon Echo that houses Alexa). A speaker connected to the voice assistant would make the billing process public by allowing the customers to listen to the process of bill-making. It would add value to the shopping experience by inducing transparency; customers would be able to realise in real-time that if their order is being prepared correctly or not. Public tasks like listening to product recommendations would also require a speaker. This customer experience can be further enhanced by adding **a separate display for the customers** where they could see the details of the product, contents of their order, and the total amount of their bill as it is being prepared. The invoices could be sent to the customer electronically via SMS or WhatsApp. Additionally, **a thermal printer** could be added to the arrangement to allow printing of physical invoices. Lastly, **an internet connection** would be required to enable syncing of the sales with the cloud to update the inventory. Generally, even the voice-assistant would need an active internet connection to process the voice-commands and understand them. However, since the interface would only be used for billing and giving recommendations in the Kirana shops, there would be limited use-cases for the voice commands; a voice-assistant can be designed to handle such cases locally without requiring an active internet connection. Figure 6 shows the multiple hardware setups possible for such a system.

6. Voice UI Design

6.1. CONVERSATIONAL VOICE-ASSISTANT VS A SET-COMMAND BASED VUI

It would be ideal if the shopkeeper is able to operate the billing interface just by conversing with the voice-assistant naturally. The voice-assistant should retain the information previously collected from the user and understand the context of the conversation. One can see how the voice assistant in the third frame of figure 7 understood that "another packet of the same" refers to a Maggi (100 gm) packet. If a voice-assistant cannot extract the context as our voice assistant did here, and adds "same" as a product in the bill, it would not be considered as "conversational".

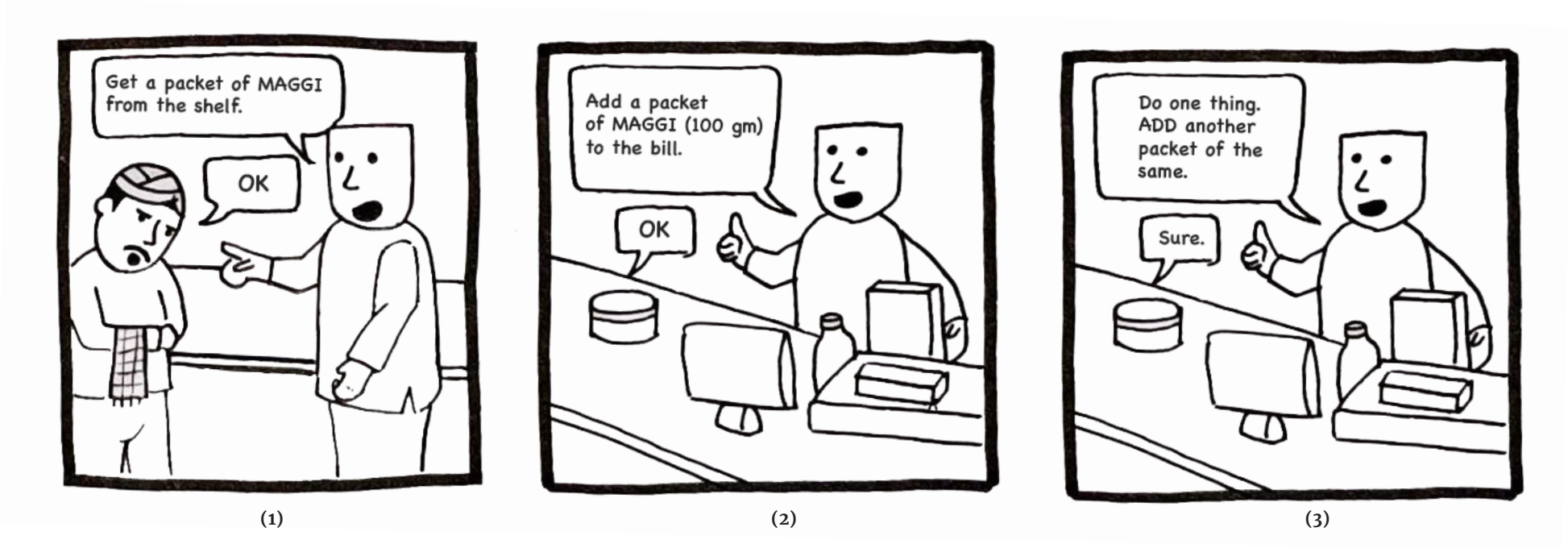


Figure 7. The shopkeeper can talk to the conversational voice-assistant in the same way he talks to his human assistant.

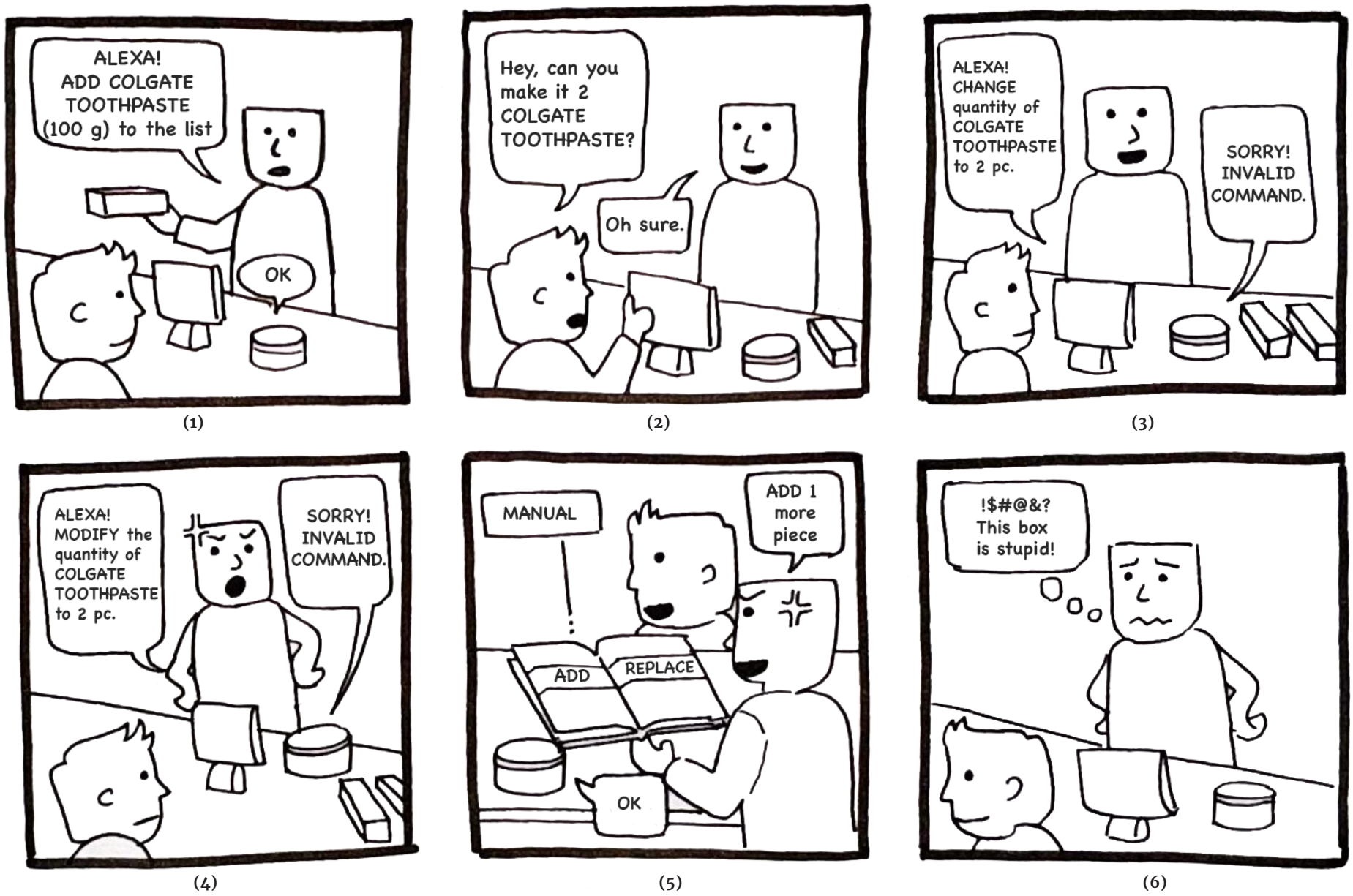


Figure 8. Hassles of set command-based VUI

However, the results of our experiment reveal (in section 11.2) that voice technology is limited by errors due to misrecognition. The average accuracy rate of 65-75% achieved in our studies show that a conversational voice-assistant for billing may be hard to build with the current state of voice-recognition technology.

An alternative solution to this problem might be using set-command based voice controls. Initially, I did not want to keep a set command-based voice control as it would become too manual and less-intuitive; the shopkeeper would have to remember a set of commands and may face a disrupted experience if he forgets a command (figure 8). Surprisingly, our qualitative findings in section 11.3 suggest that Automated Speech Recognition (ASR) encounters lesser errors with shorter phrases. An accuracy rate of 55.56% was achieved while calling out just the inventory item names, while this accuracy reduced to 47.06% when users uttered longer voice commands. This suggests that a set-command based VUI might be a better fit with the present level of voice-recognition technology. Voice activation commands can be designed in the form of ***<trigger-word> <adjunct-words> <quantity-word> <quantity-type-word>*** where *trigger-word* can be the name of the product, *adjunct-words* can be ornamental parts of the sentences that can be neglected, *quantity-word* can be a numeral, and *quantity-type-word* can be units like *kilogram, gram, piece, packet* or *bottle.* This effective way of designing set voice-commands has not been tested in this project and future work is needed here.

Since most shopkeepers converse with their assistants in their regional languages (like Hindi, Marathi, Bengali, Tamil, etc.), the interface should support different regional languages. For the scope of this project, I would be dealing with designing the interface in Hindi. Another thing to keep in mind is that this Hindi would not be pure Hindi, but a version mixed with several English and local words, that is used day-to-day.

In all VUIs, we need to design triggers that would allow the recording of the user's voice for processing; this is technically known as the COMMAND-and-CONTROL approach. In our case, such a trigger could be a physical interaction like the pressing of a button on the headset each time the user needs to speak, but it would make the frequent task of giving voice commands too cumbersome. At times, the shopkeeper might forget to press the button and expect the voice-assistant to understand him, thus damaging the product experience. A safer option would be keeping a wake word/phrase (like "Alexa", "Hey Siri" or "Ok Google") as a trigger. The wake word should be standard and not subject to change by the user, as there are many cautions while selecting a wake word which the users may not understand. The wake word should be an uncommon word, not used in everyday life, and preferably made of two syllables.[25] If the word is too common or monosyllabic, there remains a risk of unintended utterances to be misinterpreted as intentional commands.

6.2. CONTROL OF OPERATION

The shopkeeper would be able to add a new item, edit its quantities, delete an item from the list, undo the last action, navigate between tabs, ask for a recommendation between two products, print the invoice and send it to the customer over SMS or WhatsApp. The control of the interface would lie only with the person wearing the Bluetooth headset, who in this case is the shopkeeper. I deliberately did not provide control to the customers to speak into the system because then it would be difficult to moderate the validity of the command and assign responsibility to the speaker; a customer may accidentally alter orders that are not his own (the scenario is illustrated in figure 9), as mapping his voice to his bill would not be possible.

Ideally, the shopkeeper's voice sould be mapped on to the system for accurately determining the authentication of the command. However, voice authentication is not very efficient currently and such an accurate mapping of voice would not be possible. For implemention in the present context, the headset settings could be adjusted to minimise the effect of external noise going into the system feed, ensuring that customer voices and any background talking are not perceived as commands given to the voice-assistant.

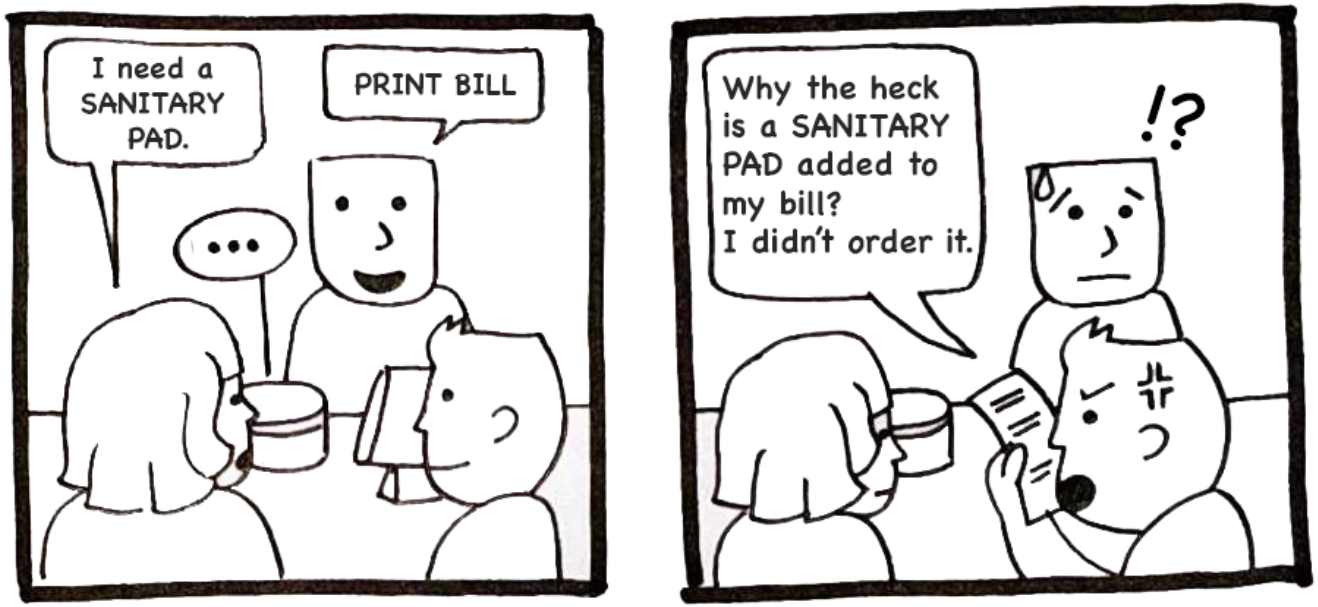


Figure 9. What happens if the customers share the control to edit bills with their voice.

6.3. DISAMBIGUATION

There may be instances when the shopkeeper tells the voice-assistant to add a product (say Garnier Men facewash) but forgets to specify what size (100g, 200g, etc.) or variety (Oil Control, All-in-One, Acne Fight, etc.) does he want to bill. In such cases, the voice-assistant must explicitly ask for clarification on the size and variety while retaining the information already collected from the user. It should not expect the user to say the entire product name the second time while providing clarification; the user must be expected to fill in the missing details. This should be followed irrespective of whether the VUI is conversational or one that accepts set-commands.

6.4. DIALOGUE SKETCHES FOR DIFFERENT SCENARIOS

Conversation flows for different scenarios like adding a product to the bill, editing it, asking for product recommendations, printing bills, and navigating between tabs, were explored in the cases 1 to 11 given on the following pages. I have tried imagining how a voice feedback can be integrated with visual feedback in some cases to make the best use of the combination of modalities. A visual feedback is more efficient in recognition and retention, when a list of items needs to be displayed. However, when a directed prompt needs to be issued, a voice feedback makes more sense. Using a combination of these two modalities smartly, higher efficiency and memory retention can be achieved.[28]

Case 1. Adding a new item to the list (list is read out)

(Wake word), (app name)
से बोलो कि 4 kg आटा जोड़ दे

आटा चार प्रकार में उपलब्ध है
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?

27 रुपये किलो वाला आटा

जी

Visual feedback: Updates list

Case 2. Adding a new item to the list (list is presented visually with pictures)

(Wake word), (app name)
में 4 kg आटा जोड़ो

आटा चार प्रकार में उपलब्ध है
कृप्या चयन करें

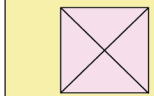

26 रुपये किलो वाला आटा


27 रुपये किलो वाला आटा


30 रुपये किलो वाला आटा


35 रुपये किलो वाला multigrain आटा

आपको कौन सा प्रकार जोड़ना है?

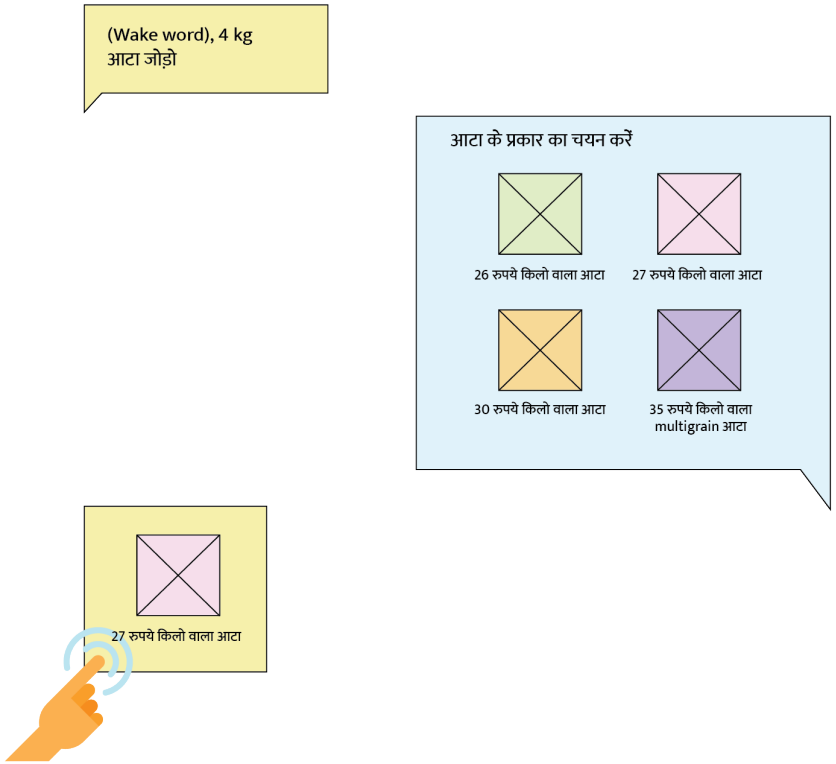

27 रुपये किलो वाला आटा

Selects by tapping on screen

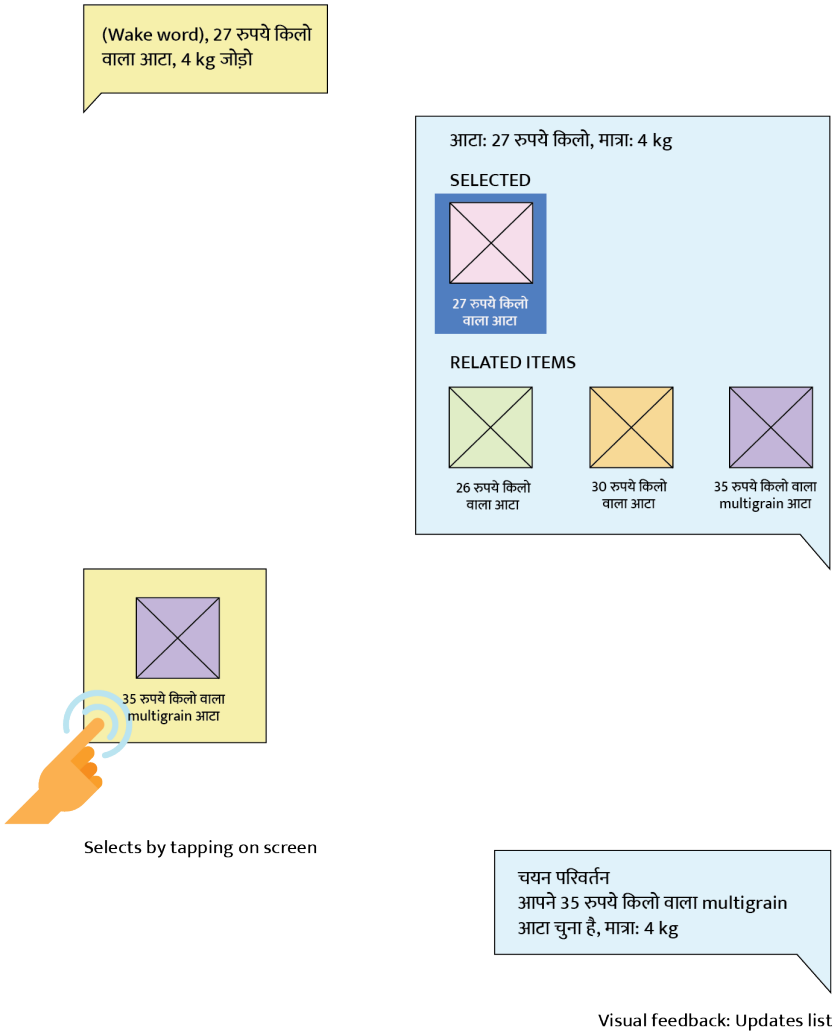
जी

Visual feedback: Updates list

Case 3. Adding a new item to the list (shorter commands and feedback)

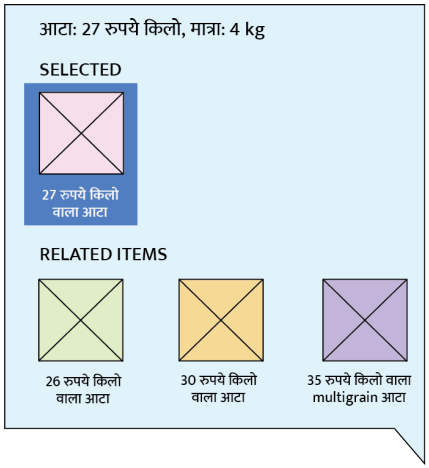


Case 4. Adding a new item to the list (specific commands and editing item variety from recommendations by touch)



Case 5. Adding a new item to the list (editing variety by voice)

(Wake word), 27 रुपये किलो वाला आटा, 4 kg जोड़ो



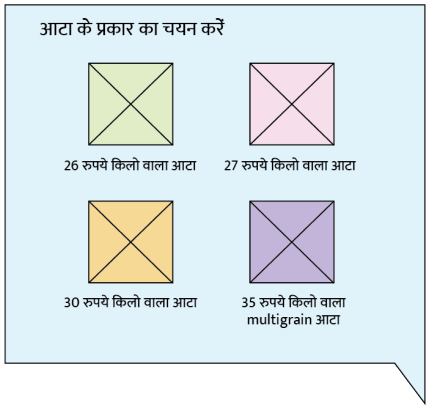
(Wake word), 27 रुपये किलो वाला आटा बदल कर 35 रुपये किलो वाला multigrain आटा कर दो

चयन परिवर्तन
आपने 35 रुपये किलो वाला multigrain आटा चुना है, मात्रा: 4 kg

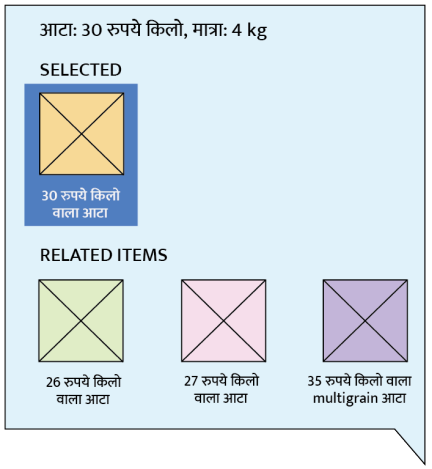
Visual feedback: Updates list

Case 6. Adding a new item to the list (choosing variety by voice)

(Wake word), 4 kg आटा

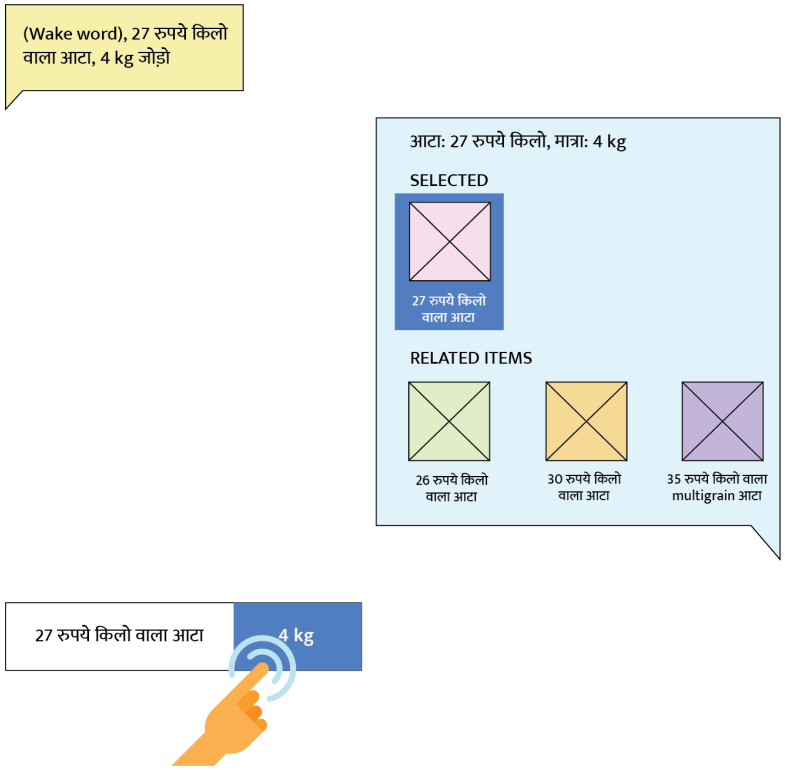


30 रुपये किलो वाला आटा



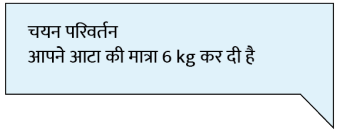
Visual feedback: Updates list

Case 7. Adding a new item to the list (editing quantities by touch)



Selects by tapping on screen

Types by tapping on screen



Visual feedback: Updates list

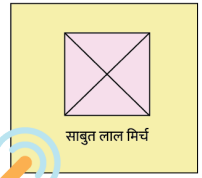
Case 8. Adding a new item to the list by price

(Wake word), 10 रुपये की लाल मिर्च जोड़ दो

लाल मिर्च दो प्रकार में उपलब्ध है
कृप्या चयन करें

पिसी लाल मिर्च

साबुत लाल मिर्च



साबुत लाल मिर्च

Selects by tapping on screen

OR

साबुत

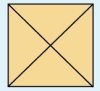
10 रुपये की साबुत लाल मिर्च
मात्रा: 25 g

Visual feedback: Updates list

Case 9. Asking for recommendation between two items

(Wake word), RECOMMENDATION दो.
HARPIC और DOMEX में से कौन सा बेहतर है?

DOMEX 200ml की कीमत है 55 रुपये.
HARPIC 200ml की कीमत है 66 रुपये.
DOMEX सस्ता है पर HARPIC की बिक्री DOMEX से
1.5 गुण55 रुपये.I ज़्यादा है. मतलब HARPIC ज़्यादा popular है.



DOMEX (200 ml)
55 रुपये.

HARPIC (200 ml)
66 रुपये.

Case 10. Printing bill

(Wake word), PRINT BILL

OR

(Wake word), BILL PRINT करो

5 items के लिए TOTAL AMOUNT हुआ 610 रुपये

PRINTING BILL...

Case 11. Navigating between tabs

(Wake word), नया BILL बनाओ

Opens new bill tab

Bill number 201 ENTRY के लिए READY है

(Wake word), पिछला BILL खोलो

Opens previous bill tab

Bill number 200

7.5. DETAIL AND SPEED OF FEEDBACK PROVIDED BY THE VUI

Voice feedback comprises of not just the information the system is trying to convey to the user, but also the level of details conveyed and the speed of speech. The feedback provided by the voice-assistant would vary from novice to expert users, and thus would depend upon the persona of the shopkeeper. I can come up with four personas based on my testing and interactions with the shopkeepers (illustrated in figure 10).

- **Persona 1: The illiterate lady shopkeeper of the new shop.**
  She owns a smartphone but never uses it for anything apart from calling and a moderate amount of WhatsApp. She is scared of trying new technology and would be sceptical of the abilities of a voice-interface. For such a novice user, feedback needs to be very detailed (see case 1 and 2 in section 7.4) with a slow speed of speech.

- **Persona 2: The educated and tech-enthusiast shopkeeper of the legacy shop.**
  He is the ***primary user*** of my interface. He owns a smartphone and a laptop at home. He has tried using the Google Assistant for tasks like setting alarms and searching the web. He would be quite comfortable with the voice-interface and would escalate to being an advanced user in no time. For such a user, confirmation feedback could be modest (say, a beeping sound) while the clarification feedback remains moderately detailed (see case 3 in section 7.4). The speed of speech can be fast as the setting of a legacy shop, where there is too much rush of customers, requires quicker operations.

- **Persona 3: The old shopkeeper who manages the shop in his son's absence.**
  He has never used a smartphone in his life. He uses a feature phone to make calls. He thinks that mental calculations are faster and more reliable than the ones done on a machine. He would have difficulty in trusting the voice interface; in the absence of detailed feedback, he would waste a lot of time staring at the screen, trying to verify if his commands were executed properly or not. For such a novice user, feedback needs to be very detailed with a slow speed of speech.

- **Persona 4: The quick learning shopkeeper of the medium-sized Kirana shop.**
  He uses a smartphone for calls, sending messages on WhatsApp, watching YouTube videos, and for online shopping. Though he has never used a voice-assistant before, he believes in the capabilities of a voice-interface. He would take his time syncing with the speed of the interface at first, but being a quick learner, he will soon adjust to the new technology. Such a novice user will convert to an advanced user after a week's usage. In his novice phase, he should be given detailed feedback with a moderately-fast speed of speech. As he grows into an advanced user, the speed of speech can be made fast, and the details could be restricted to the clarification feedback while making the confirmation feedback modest.

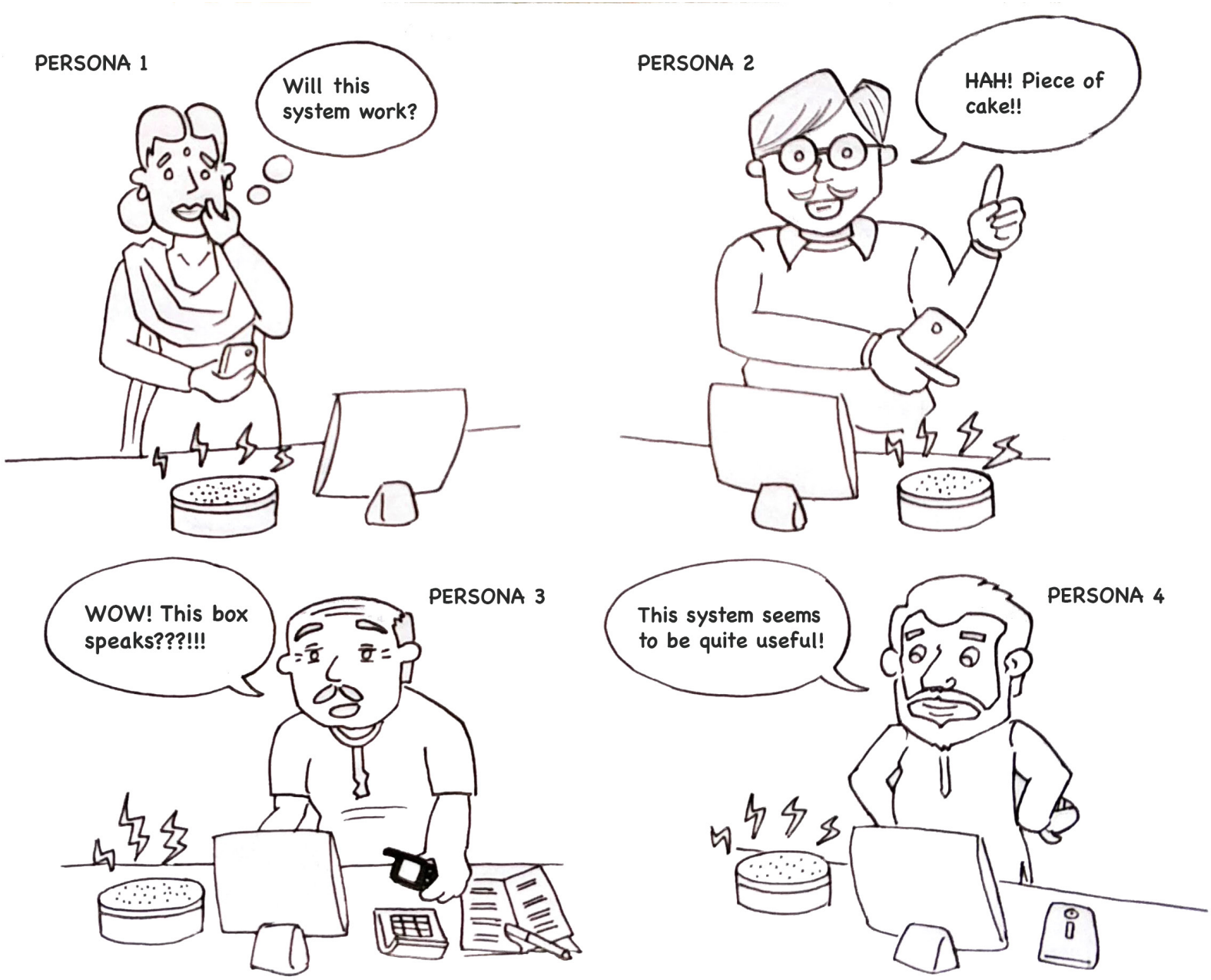


Figure 10. User Personas

6.6. CONFIRMATIONS

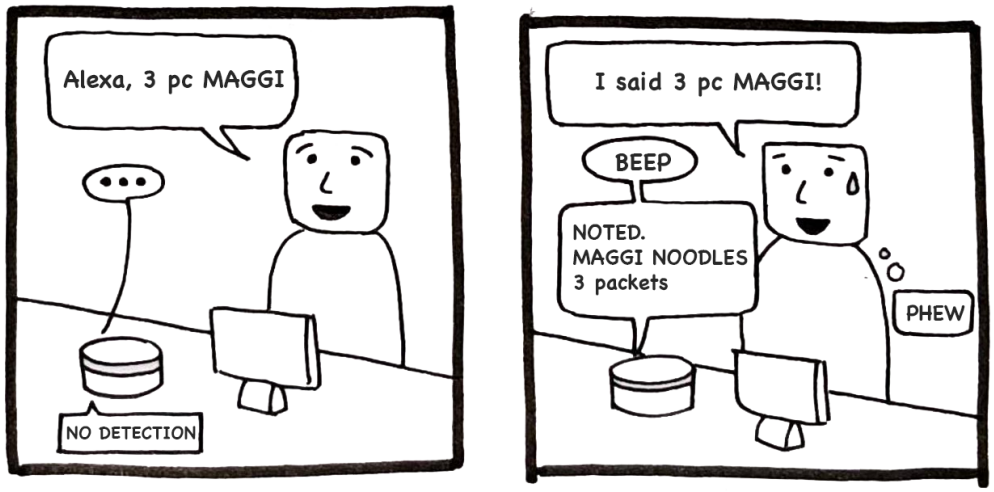
Throughout my design, I provide audio confirmation as well as visual confirmation to the user. I use non-speech confirmation in the form of a printed invoice and electronic bill receipts. The system should implicitly confirm information within a confidence threshold of >80, explicitly confirm information between the confidence threshold 45-79, and reject anything with lower confidence.[25] Implicit confirmations are given when the user is not required to take a subsequent action (like confirming the addition of a bag of Lays chips worth Rs. 20). Explicit confirmations are given when the cost of a misrecognition (i.e. the system got it wrong) is high. Such a case could be when the shopkeeper provides the name and variety of the product to be billed but forgets to mention the size (see section 7.3); if the wrong size is entered in the bill, either the shopkeeper or the customer will experience a monetary loss due to calculation errors. When the system cannot identify the command properly with a confidence >45, it should ignore it. In the worst case scenario, the shopkeeper would have to repeat the command, but it would still be better than entering wrong information and compromising the perceived reliability of the system.

I tested the different types of confirmations during my quantitative longitudinal study through two systems. My findings in section 11.3 reveal that the users felt that a VUI giving both implicit and explicit audio confirmations seems to operate smoother than a VUI that gives just explicit audio confirmations.

6.7. HANDLING OF ERRORS

There are a variety of ways VUIs can make mistakes:[25]
1. no speech detected (figure 11)
2. speech detected, but nothing was recognised (figure 12)
3. voice recognised correctly, but wrongly handled (figure 13)
4. incorrect voice recognition (figure 14)

In cases when no speech is detected, the system would do nothing. Whenever speech is detected, the system should give a tiny ‘BEEP’ sound as audio feedback. If the automated speech recognition (ASR) tool did detect an audio signal but was unable to come up with a relatable hypothesis for it, the system should explicitly call out that it did not understand what the user was trying to say; this would make the user repeat himself again. If the ASR tool did return a perfectly accurate recognition result, but the VUI did not handle it properly, this would create a gap in experience of the product. Such an event should be foreseen by extensive testing, and the VUI responses must be designed accordingly. Lastly, in cases when the ASR tool does not recognise the voice correctly, the experience could become frustrating for some users. Such a case may frequently occur if the user is illiterate, old, or has speech disorder, and is not able to speak out the commands clearly. I have not dealt with handling of such internal errors caused by misrecognition of voice or by faulty understanding. Further research needs to be done to see how much do internal errors affect the performance on the billing interface.



(1) (2)

Figure 11. When no speech is detected (frame 1), the voice assistant does not respond. A BEEP sound is produced when speech is detected.

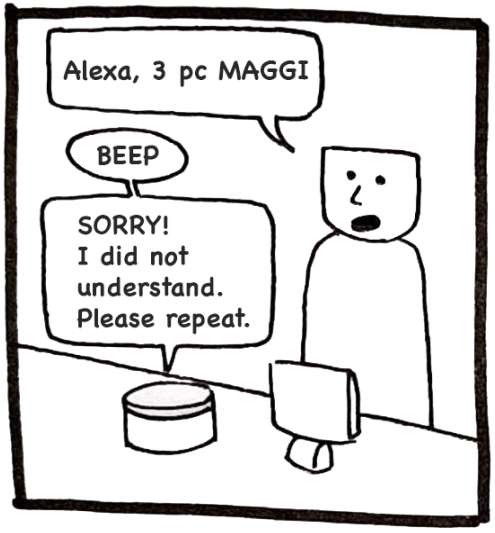


Figure 12. Speech detected, but not recognised

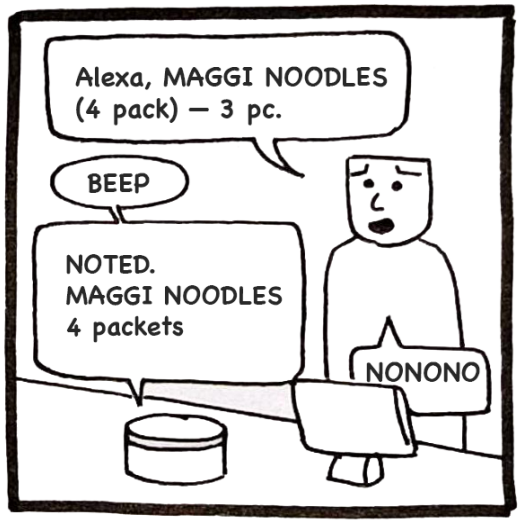


Figure 13. Voice recognised correctly, but wrongly handled

Figure 14. Incorrect voice recognition

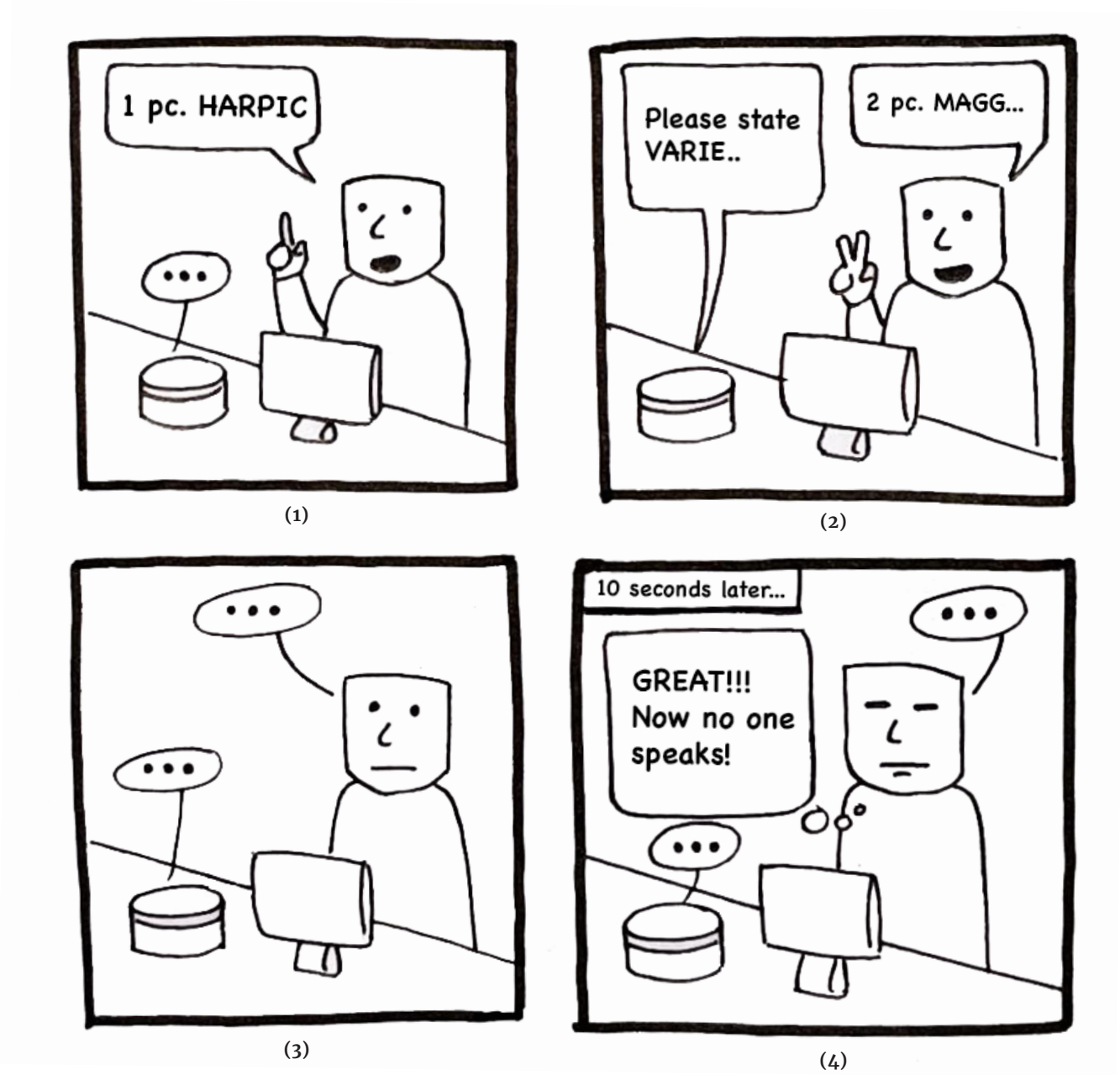


Figure 15. Accidental interruptions cause awkward silences

6.8. INTERRUPTIONS

Sometimes, when the user is not expecting feedback, the VUI may decide to ask for clarification explicitly. By that time, if the user may have started issuing another command, the Voice-assistant will pause and listen to the user. The user also stops to listen to the system, causing an awkward silence (figure 15). Such a scenario may be resolved smoothly if the VUI is designed to act on those awkward silences. When such a case is encountered, the VUI may start speaking after 3 seconds and repeat what it was trying to say previously. The user would act upon this explicit confirmation and then move on to issue his next command. An alternative solution could be allowing the user to say "REPEAT" to make the voice-assistant repeat its last confirmation.

The VUI should accommodate advanced features like barge-in for advanced users (figure 16). A shopkeeper reading out product details to be included in a bill should be able to interrupt the implicit confirmations of the VUI and continue speaking out the following product details. Additionally, in cases where the system is giving some information (for instance, while reading out a recommendation between two products), the shopkeeper should be able to say "STOP" when he feels that he does not need any more of that information.

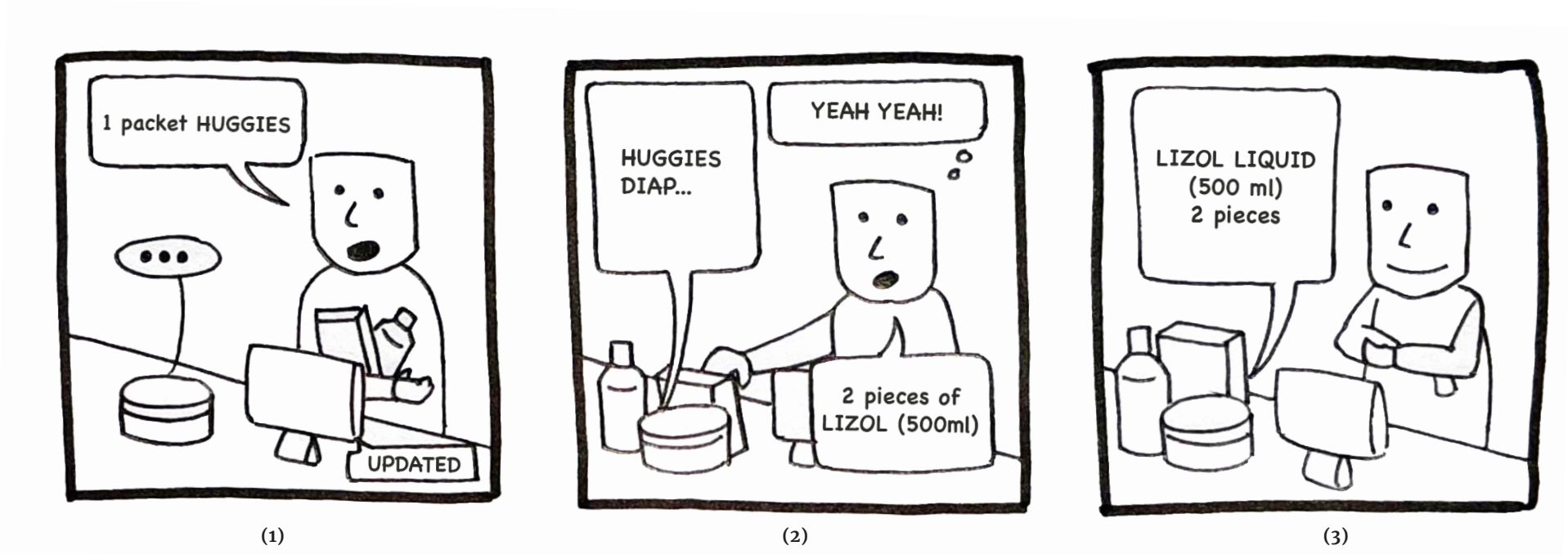


Figure 16. Advanced users can barge-in while the voice-assistant is speaking

We can avoid the cases of undesired interruptions to a considerable extent by suitably designing the prompts and confirmations given by the VUI. Any important information that needs to be conveyed through a prompt, should always be included in the beginning (figure 17) . Any questions that require the user to act, should always be placed at the end of the prompt as one may expect the users to start speaking as soon as a question is encountered.

Figure 17. Better prompt design would prevent undesired interruptions

7. Screen UI Design

7.1. DISAMBIGUATION

As discussed in section 3, the multi-modal design allows for the execution of the same commands through voice and touch. The touch-based interactions would mostly benefit in situations when the shopkeeper is standing near the counter. The screen is especially useful for resolving ambiguity in cases when the shopkeeper omits one or multiple product details in his voice command. The screen presents a list view of the different variety of products available in such ambiguous cases; the shopkeeper just has to tap on the option he wants to be billed. This interaction replaces the activity of remembering the product details and issuing a voice command with just a tap, thus reducing the task completion time.

7.2. CONTROL OF OPERATION

The screen would be used for communicating visual confirmations and touch-based interactions. Its control would lie on the shopkeeper side for similar reasons as discussed in section 7.2. If customers were allowed to operate the interface, they might accidentally alter other customers' orders, which would be difficult to moderate. Hence, the decision to manipulate the interface has been reserved only for the shopkeeper and his assistants. A separate and bigger view-only screen might be added for displaying the product details and recommendations to the customer.

7.3. TOUCH INTERACTIONS

Tasks which can be controlled through a few gestures, like editing an item's quantities, navigating between tabs, printing the bill, or sending an electronic copy of the invoice to the customer via SMS or WhatsApp, can be performed through touch-based interactions. Editing product details and executing one-button commands (like printing the bill) can be done through a simple tap gesture. Navigation between tabs can be either done by clicking on the tab header or by swiping right or left on the screen. The primary task of adding a new item to the bill requires entering the product name/code. Typing the product details through an on-screen keyboard would demand more screen engagement and reduce the ability of the shopkeeper to multitask. Hence, this task has exclusively been reserved for operation through voice.

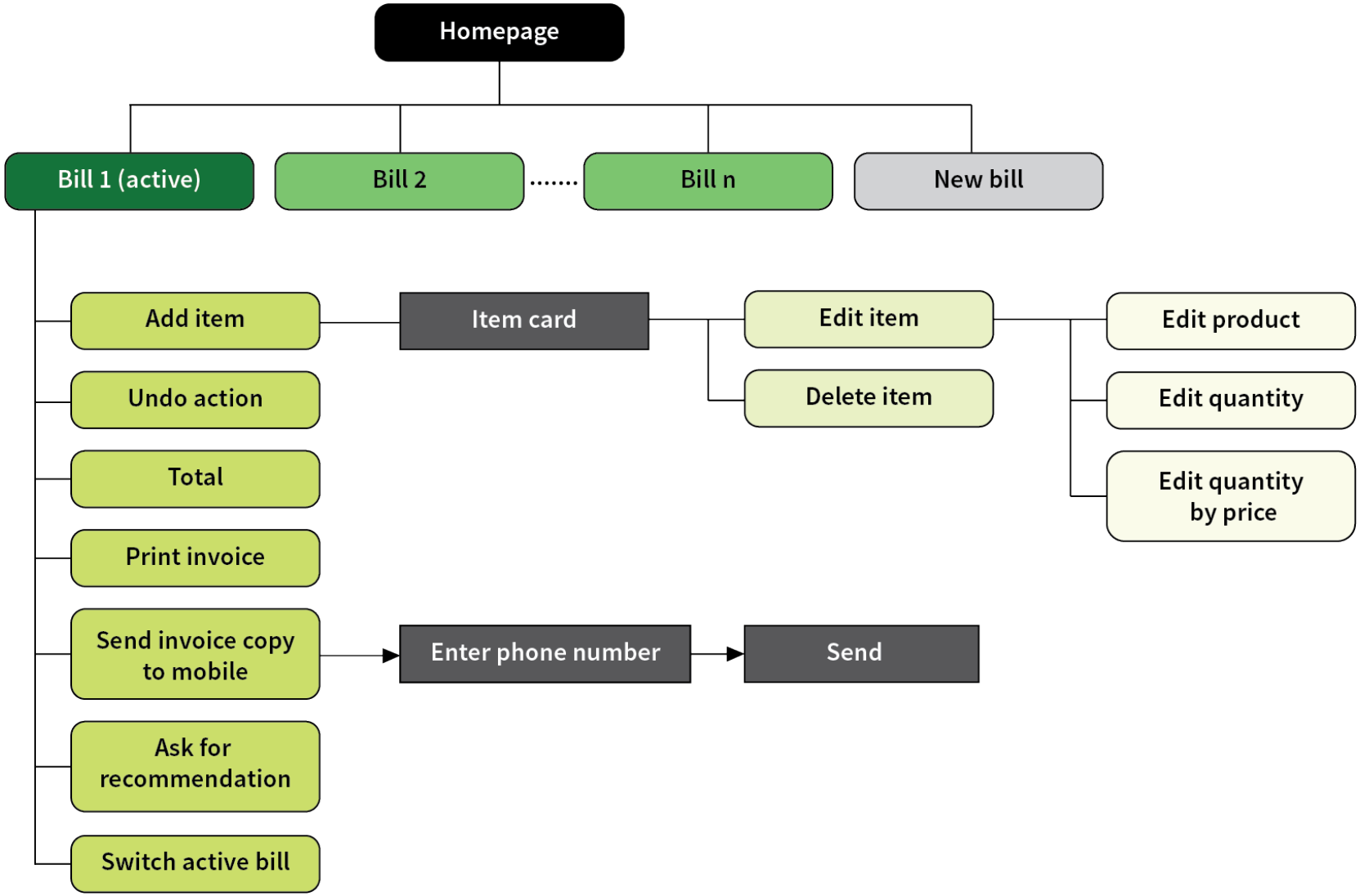
7.4. ERROR CORRECTION

The screen provides an UNDO button to cancel any undesired commands. This operation is however linear, and won't help much if someone has to undo the fifth-last command (say) without disturbing the ones given later. In such cases, one can issue another command to affect the desired change, either by touch or by voice.

7.5. PRIVACY

Sending an electronic copy of the invoice to the customers requires the shopkeeper to request their mobile number. Care is taken not to display their number on the shared screen in the notifications, to protect their privacy. Another privacy concern that has been dealt with in the design is the sale of sanitary pads. I conducted a short survey with 4 male and 5 female customers, and 2 male and 1 female shopkeeper, to investigate if the customers are uncomfortable with displaying their order on the shared screen. My findings revealed that some women customers (over the age of 30) prefer not buying sanitary pads openly for the fear of being judged. Such products could be marked as 'private' in the shopping category; details of these products will not be displayed on the screen while billing.

7.6. INFORMATION ARCHITECTURE OF THE VABI



8. Design Explorations

8.1. VERSION 1

Features and corresponding design decisions

My first design comprises a touchscreen tablet device for the shopkeeper and a mirrored display for the customer. A smart speaker would house the voice assistant, and the shopkeeper would issue the voice commands through a wireless Bluetooth headset (the harware setup shown in figure 18).

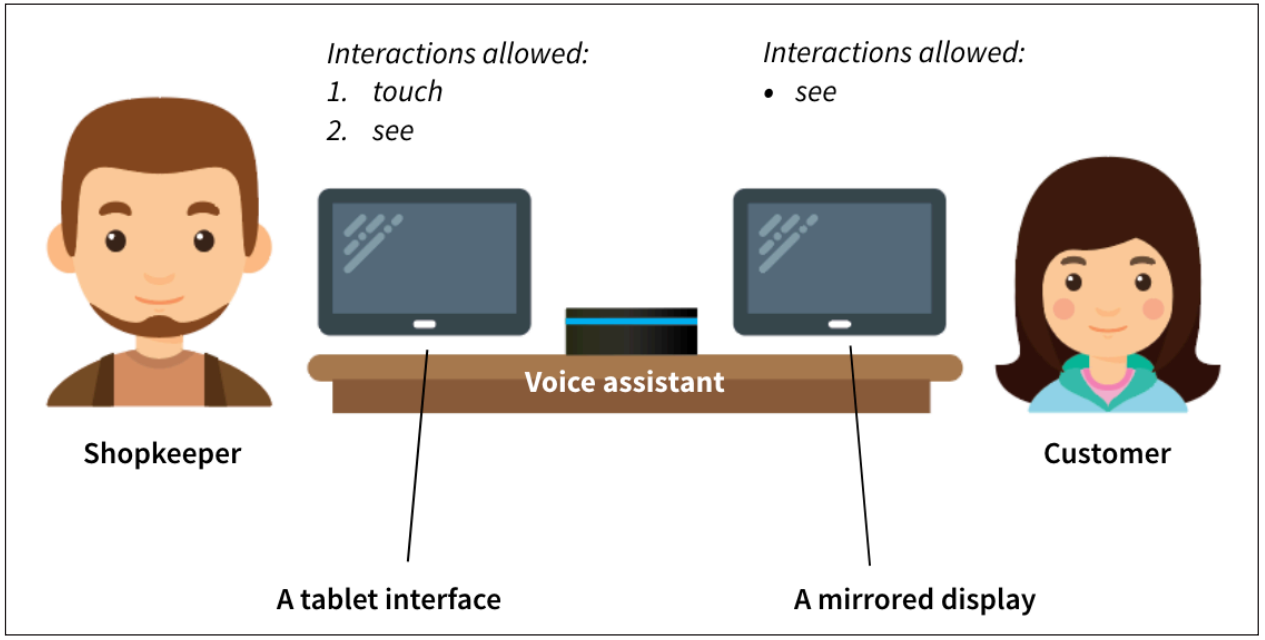


Figure 18. Hardware setup for version 1

(Icon source: www.flaticon.com)

As the interface is dedicated to the billing, the home screen opens with an active bill tab and a new bill tab. The tab header displays the bill number for the ease of issuing commands to switch between tabs. The active tab is colour coded to be green, the inactive tabs are colour coded to be red, and the new bill tab is colour coded to be a neutral grey colour. The entire screen is divided into two parts: (i) the billing area, and (ii) the recommendation pane.

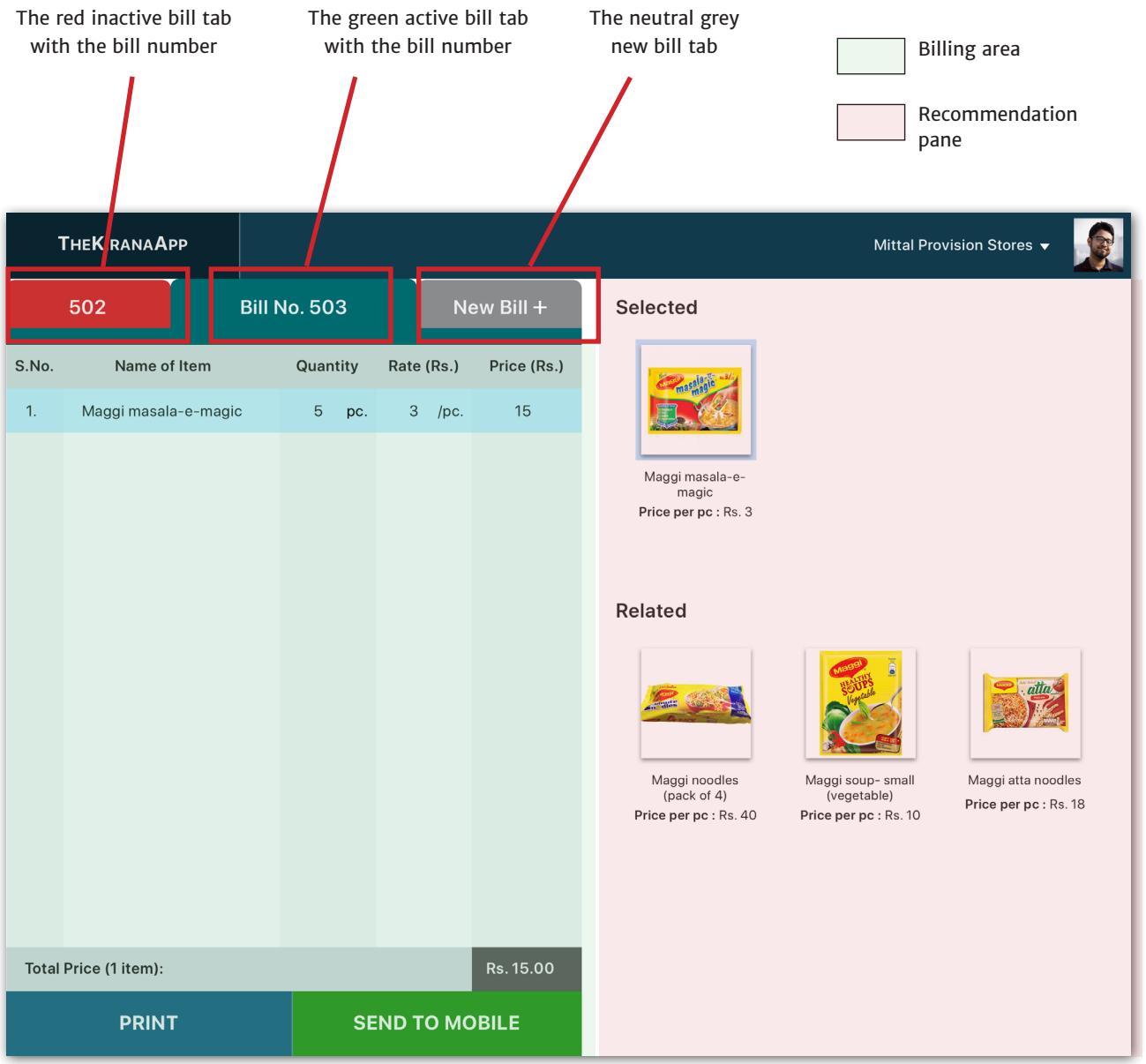


Figure 19. VABI version 1

The **billing area** displays the items being billed in a conventional table format with fields like the ‘name of the item’, ‘quantity’, ‘rate’, and ‘price’. A bottom panel shows the total number of items being billed and the total purchase value. The latest item being invoiced is highlighted in blue colour for easy tracking. Tapping on the item name allows overwriting of the product with a new voice command. Tapping on the quantity allows to edit it either via voice or by tapping the buttons on a pop-up number pad. The number pad is customised with shortcut buttons for quick modification of the quantities by standard unit sizes. Buttons for printing the bill and for sending an electronic copy of the invoice to the customer are provided at the bottom of this billing area.

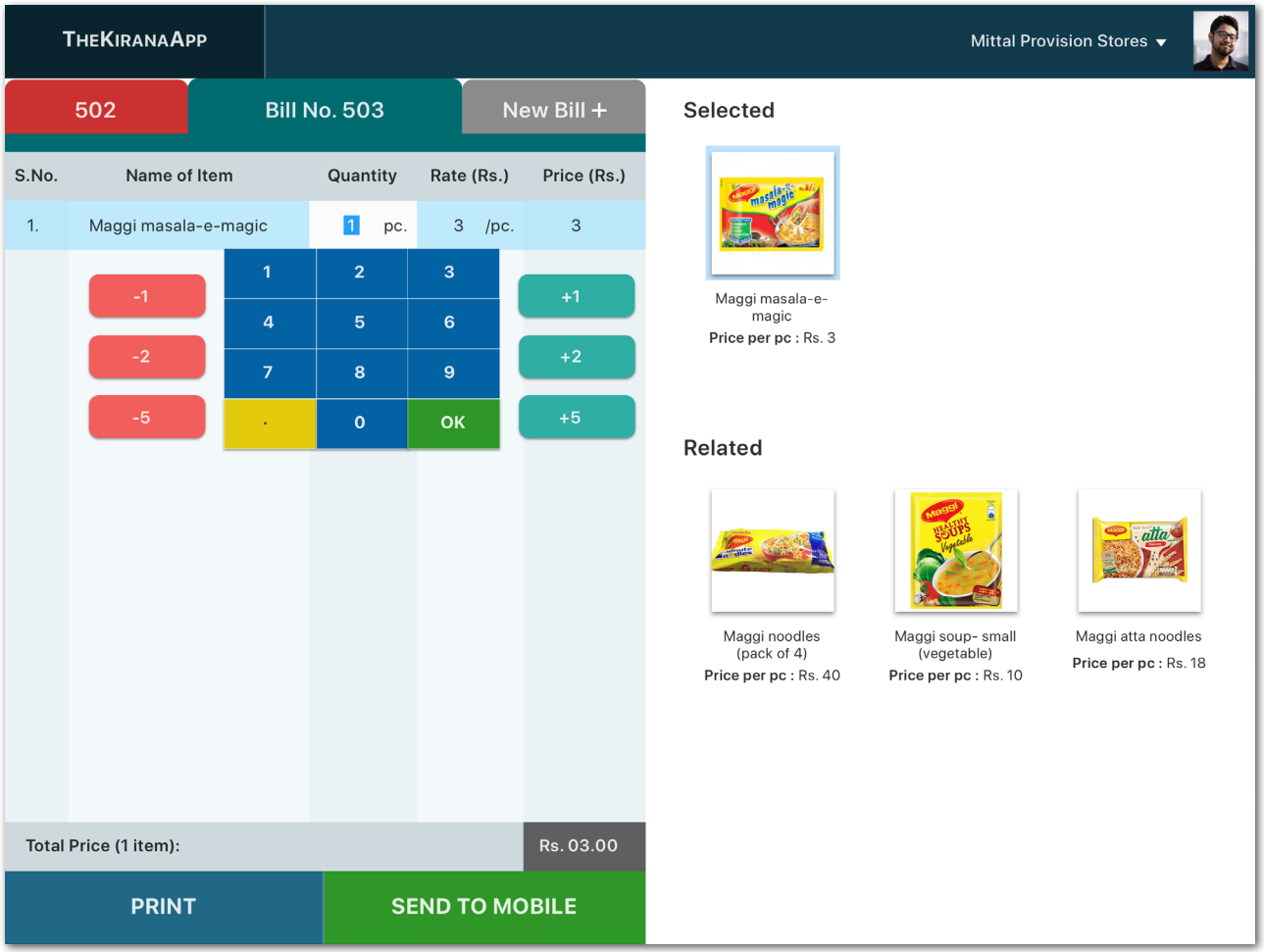


Figure 20. VABI (version 1) was given a pop-up keyboard with shortcut buttons for quick modification

The **recommendation pane** is an area which shows the details (i.e. an image of the product, product name and its rate) about the selected product and its related products. I have designed this area to display a maximum of three best-related products. Increasing the number of related products on display would have compromised with the size of the image and the text, which I did not want. Furthermore, I did not want to disturb the billing area at any point in time, and so all notifications and extra information are displayed by utilising the space of the recommendation pane. This area dims to dark to show the comparison between two products when the shopkeeper explicitly asks for a recommendation based on system insights. A pop-up screen appears in this area for typing in the mobile number of the customer for the transfer of an electronic copy of the invoice.

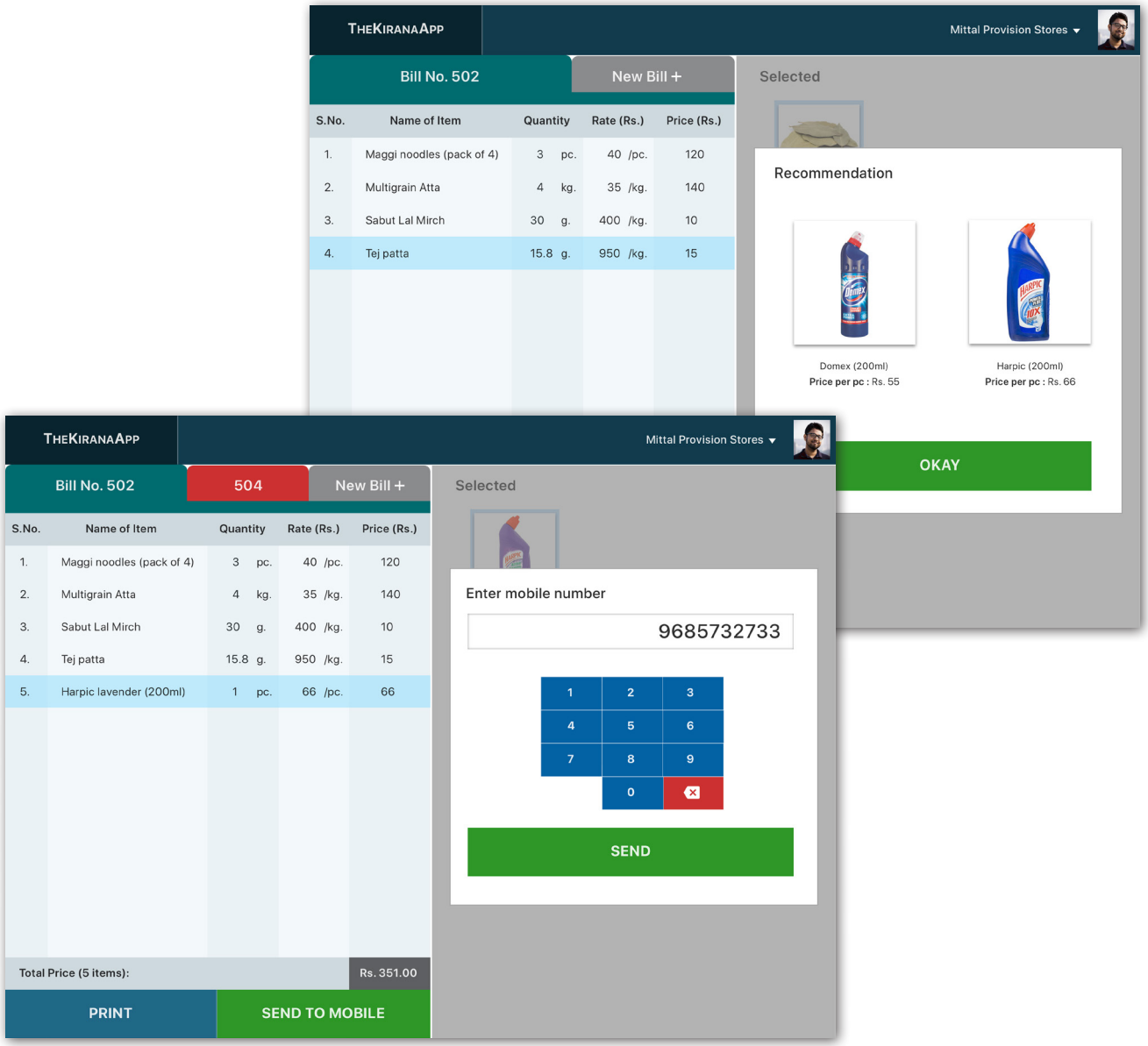


Figure 21. Multiple uses of the recommendation pane in VABI (version 1)

Limitations of version 1

My guide suggested me to explore a more dynamic interface as the first design was pretty static and did not use the full potential of a digital screen. Moreover, at a close look, one would realise that for a 9-inch tab, the image and the text sizes presented in this design are too small; the shopkeeper would have to focus too hard to read the information while multi-tasking. Critical information like the total purchase value needed to be highlighted.

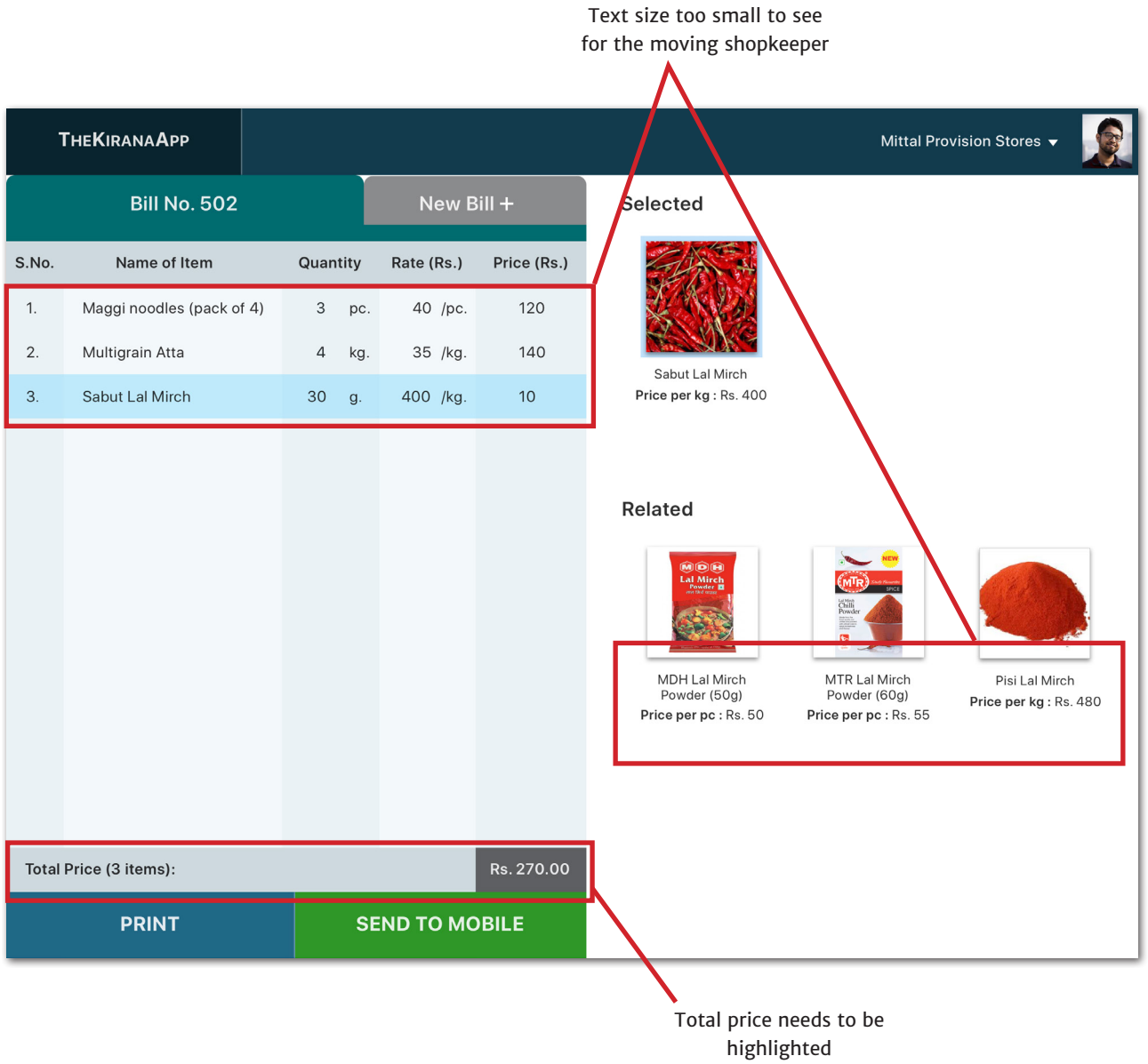


Figure 22. Limitations of VABI version 1

8.2. VERSION 2

Features and corresponding design decisions

Features and corresponding design decisions
My second design comprises a touchscreen tablet device for the shopkeeper and a 24” display for shared viewing by the shopkeeper and the customer. As in the first design, a smart speaker would house the voice assistant, and the shopkeeper would issue the voice commands through a wireless Bluetooth headset. The shared screen provides a larger display area for showing product details and recommendations. It is supposed to be placed at a strategic angle so that it is visible to the customers as well as to the shopkeeper while he is moving in his shop. This will enable the shopkeeper to get visual feedback even when he is not near his tablet. Moreover, the big idea of using a larger screen was product promotion and up-selling; the display of a customer’s orders and the recommended items would be visible to the other customers as well and might encourage them to make more purchase.

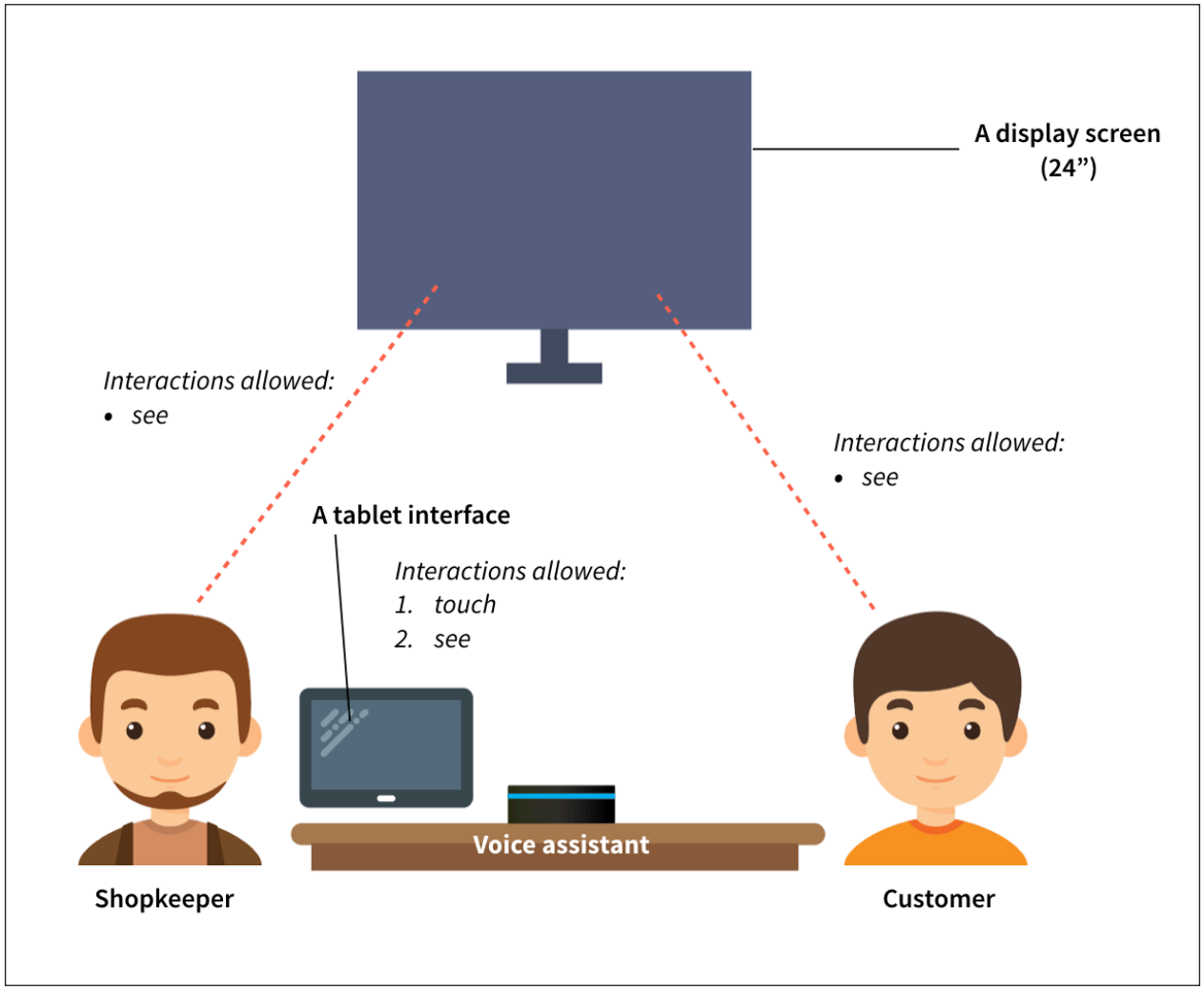


Figure 23. Hardware setup for version 2

(Icon source: www.flaticon.com)

Since the shopkeeper now has a separate larger screen to see the recommendations, his **tablet screen area** can be fully committed to the invoice. This allows for larger text sizes which are easy to read while multitasking. The home screen opens with an active bill tab and a new bill tab. The tab header displays the bill number for the ease of issuing commands to switch between tabs. The active tab is colour-coded green, the inactive tabs are colour-coded dark green, and the new bill tab is colour-coded in a lighter green colour. The bottom-bar, displaying critical information like the total number of items billed and the total cost of purchase, has been brought into focus by highlighting it in a bright red colour.

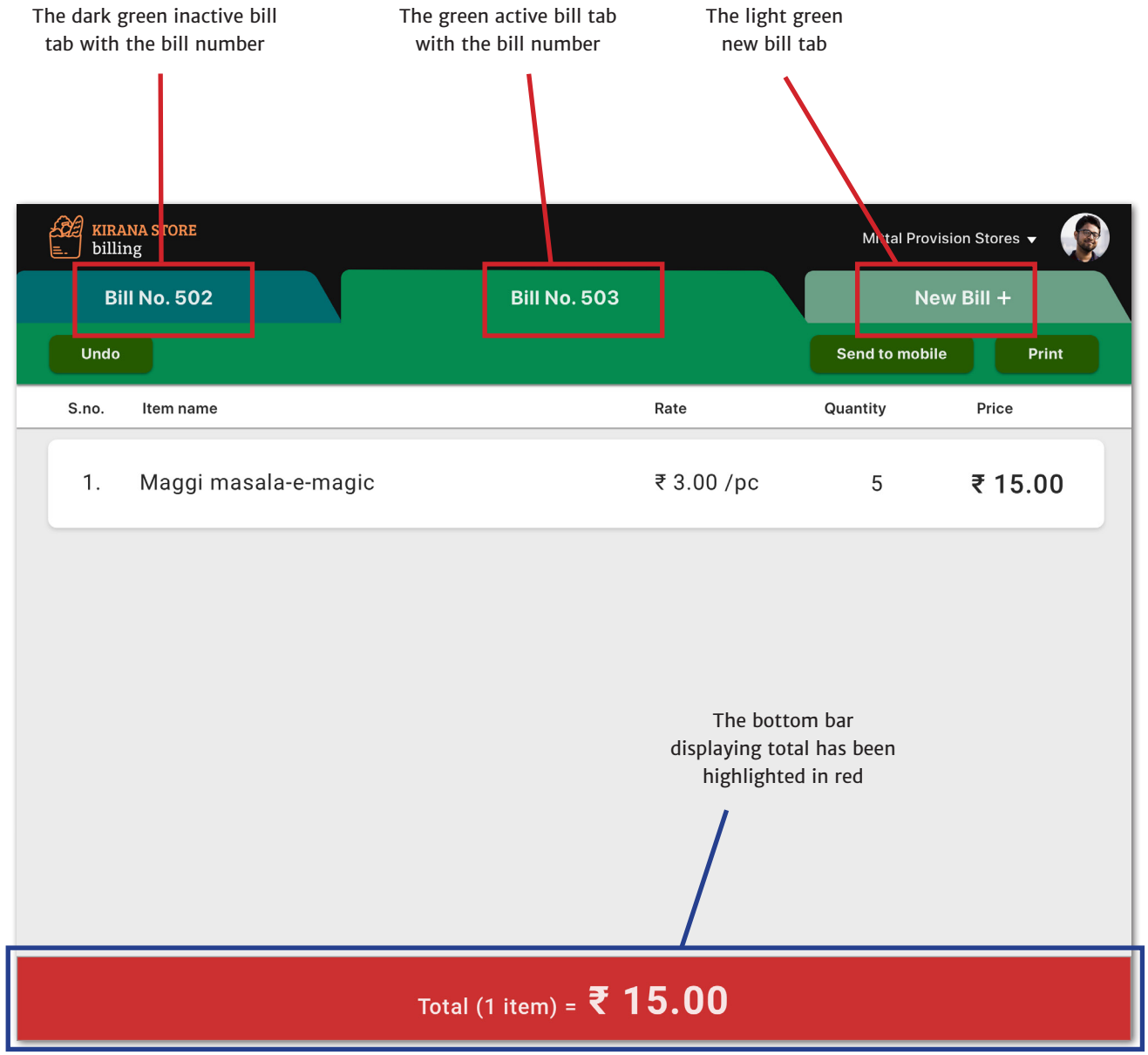


Figure 24. VABI version 2

The billing interface has three action buttons at the top, namely, ‘UNDO’, ‘SEND TO MOBILE’ and ‘PRINT’ (the bill). Individual items in the list appear in a card; the cards have been deliberately kept large in height so as to provide a larger surface area for touching and editing. The net price of each item has been deliberately highlighted in bold as this would be of more interest to the user than any other product detail. These item cards are scrollable while the total bar at the bottom remains fixed in its place. The frozen total bar allows the user’s eyes to find the critical information at the same place all the time.

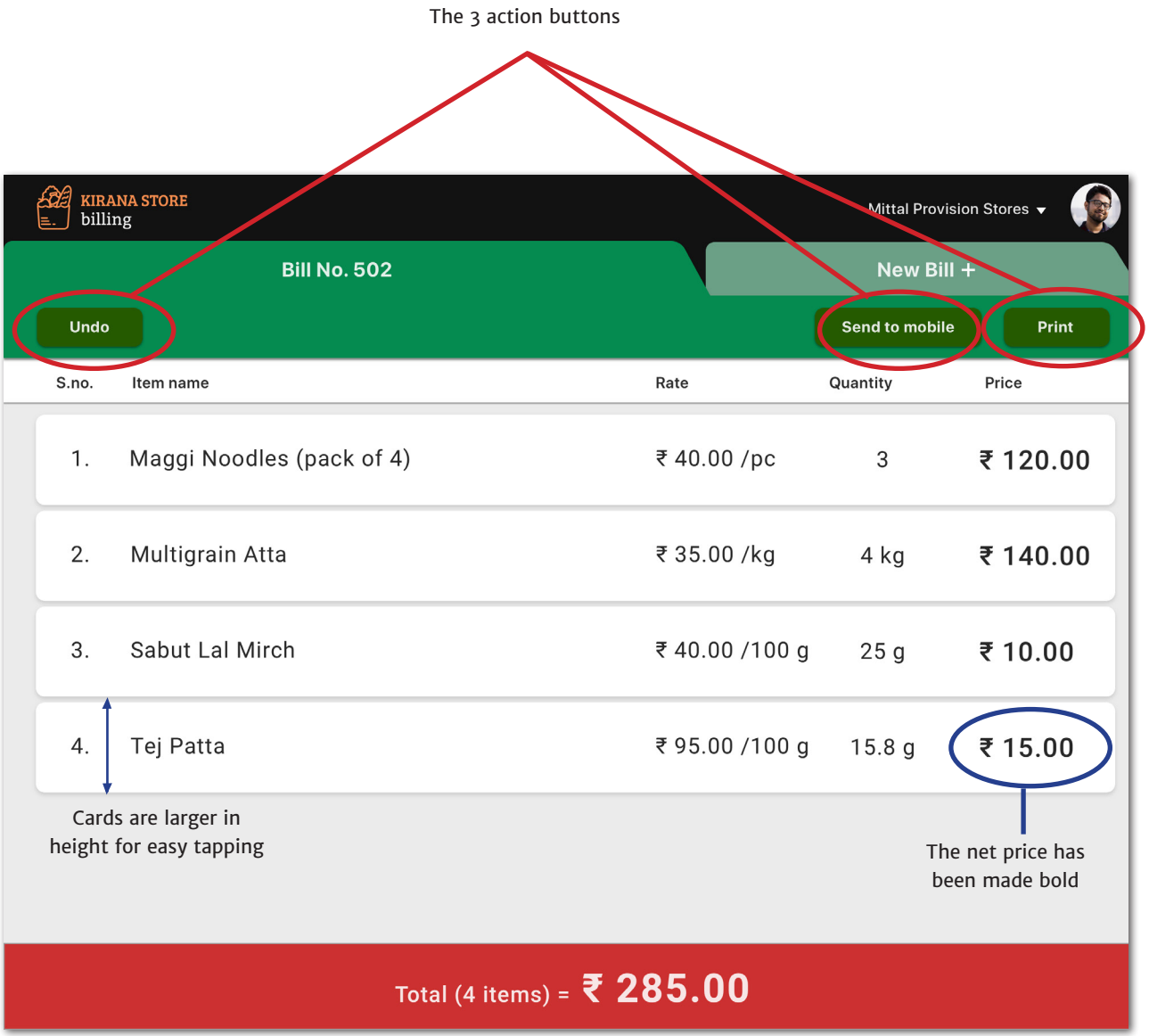


Figure 25. Screen UI elements in VABI (version 2)

Tapping on the quantity in the card allows to edit it either via voice or by tapping the buttons on a pop-up number pad. The buttons on the pop-up number pad were made bigger to provide a larger surface area for tapping. The shortcut buttons present in the previous design were removed in this version, as a short review session with 4 shopkeepers informed me that they would prefer to overwrite the quantities in most cases.

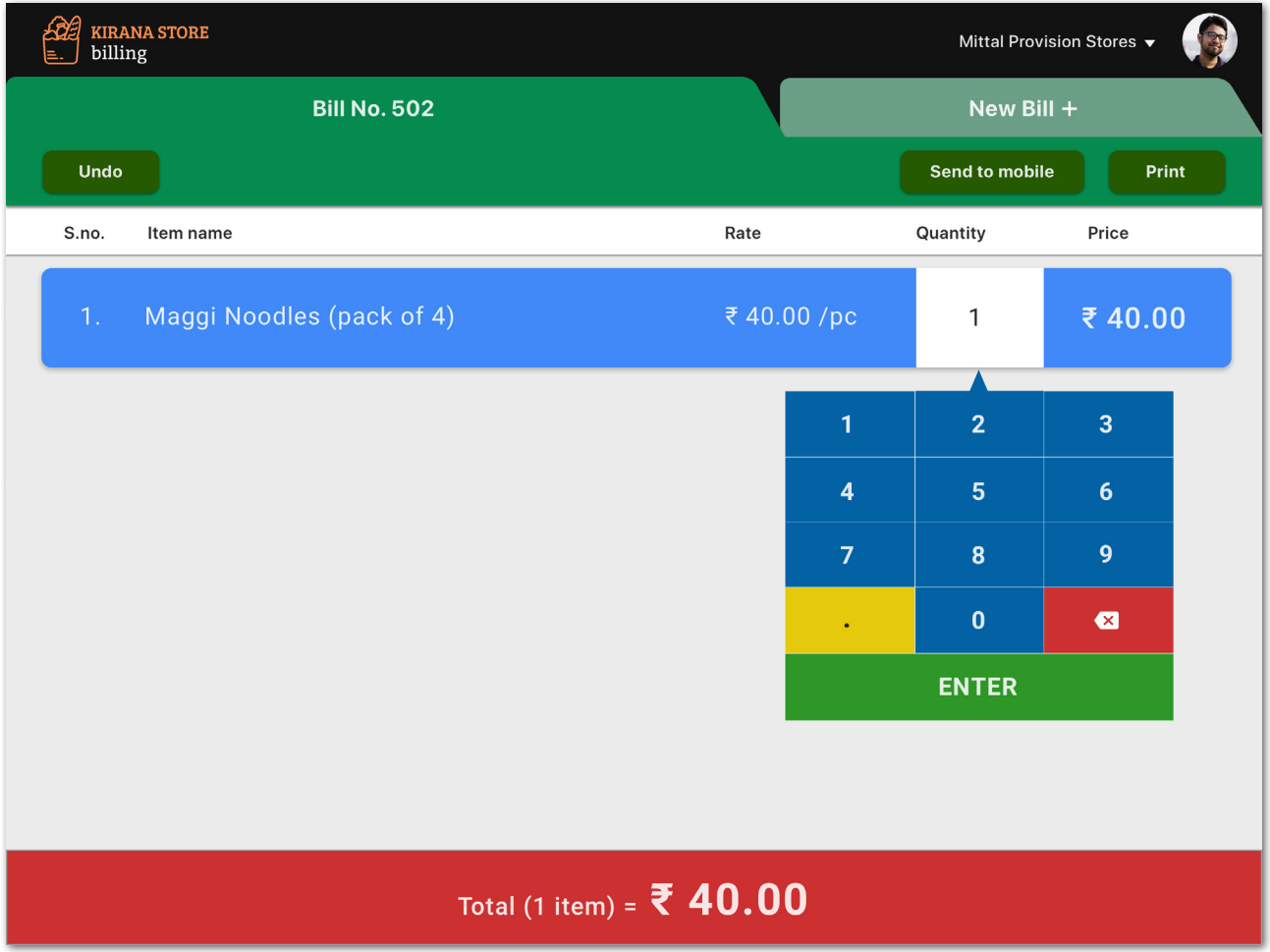


Figure 26. VABI (version 2) was given a bigger pop-up keyboard

Tapping on the item name in the card allows overwriting of the product with a new voice command or replacing it with one of the related products. To facilitate replacement with one of the related products, a horizontally scrollable panel appears as a pop-up; the shopkeeper just has to tap on the option to be replaced with and the card details are updated automatically.

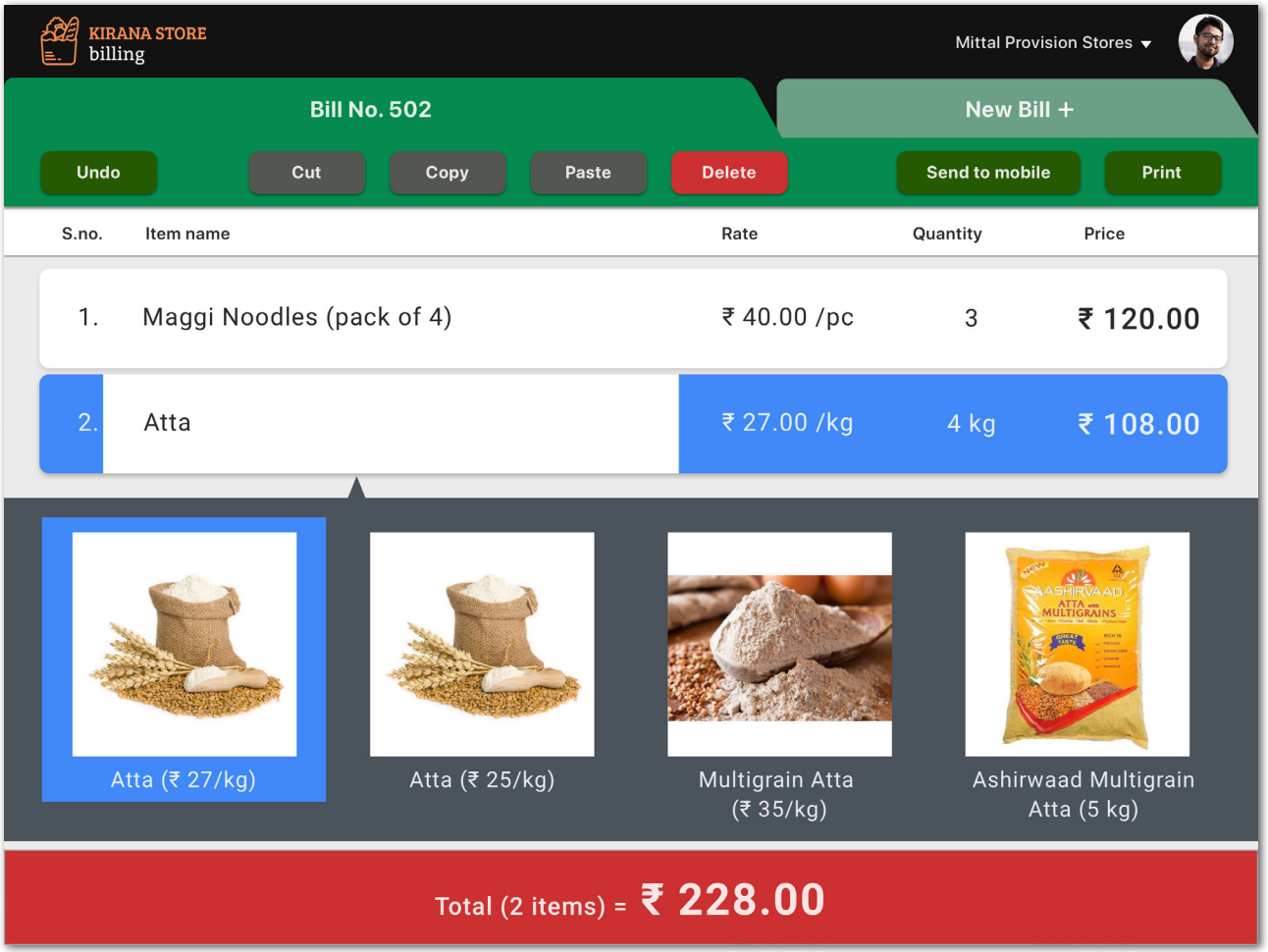


Figure 27. A scrollable panel pops up showing related products in VABI (version 2)

The **shared screen** displays the product information to the customer in the left pane, the recommendations in the top right area, and the cart details in the bottom right pane. The existing cart items will be pushed to the right to allow the addition of a new item. I experimented with the number of items to be displayed on a screen size of 24'' and decided to show only three recommended items and four cart items at a time. Increasing the number of related products on display might not have bothered the customers, but would have been difficult to see for the moving shopkeeper.

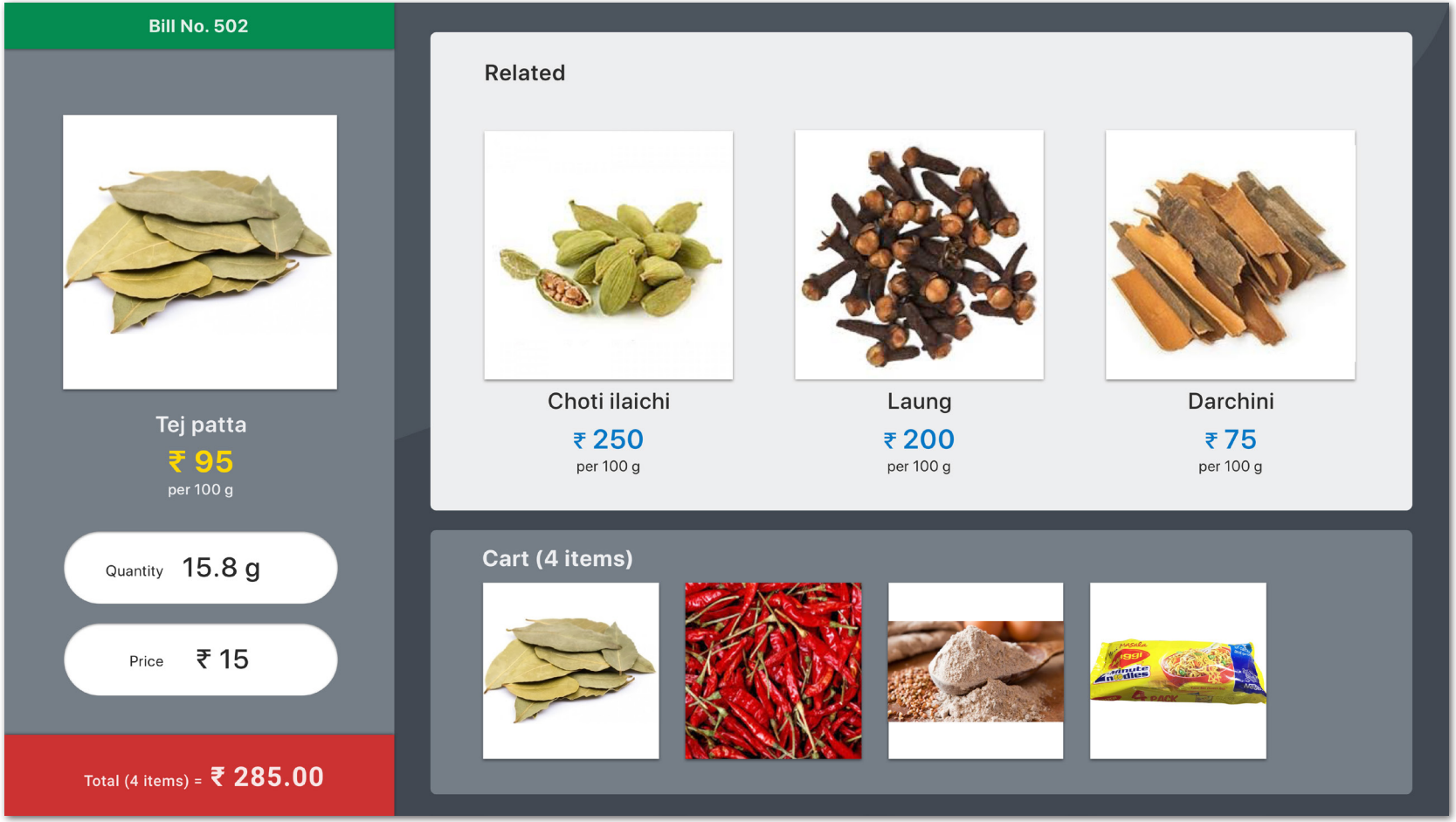


Figure 28. Shared 24" screen interface

Limitations of version 2

The second design asks for a higher investment in the form of an additional 24” screen. Another predicament is that the recommendations in this design would change according to the product being billed currently. If the shopkeeper is adequately fast in the billing process, a new product would replace the previous product in every few seconds; this might not leave sufficient time for the customers to go through all the recommendations. Furthermore, there could be a better way to address individual tabs by voice rather than calling them by their bill numbers. While managing multiple bills at a given time, commanding an instruction like “switch to bill number 202” is cumbersome as the shopkeeper would have to remember all the potentially active bill numbers. The active bill numbers would constantly change throughout the day and keeping track of them would generate cognitive load on the shopkeeper. This problem will aggravate when the number of active tabs would increase during the peak hours.

8.3. VERSION 3

Features and corresponding design decisions

My third design comprises a touchscreen tablet device for the shopkeeper and a 24” display for shared viewing by the shopkeeper and the customer. Additionally, it recommends a separate mirrored display for the customer. The mirrored display shows the product details of the item being billed and the items in the customer’s shopping cart. The shared screen exclusively showcases the product recommendations based on the entire shopping list of the customer. This enables the recommendations to stay on the screen for longer time intervals, thus solving the quick flicker problem presented by the second design. As in the first design, a smart speaker would house the voice assistant, and the shopkeeper would issue the voice commands through a wireless Bluetooth headset.

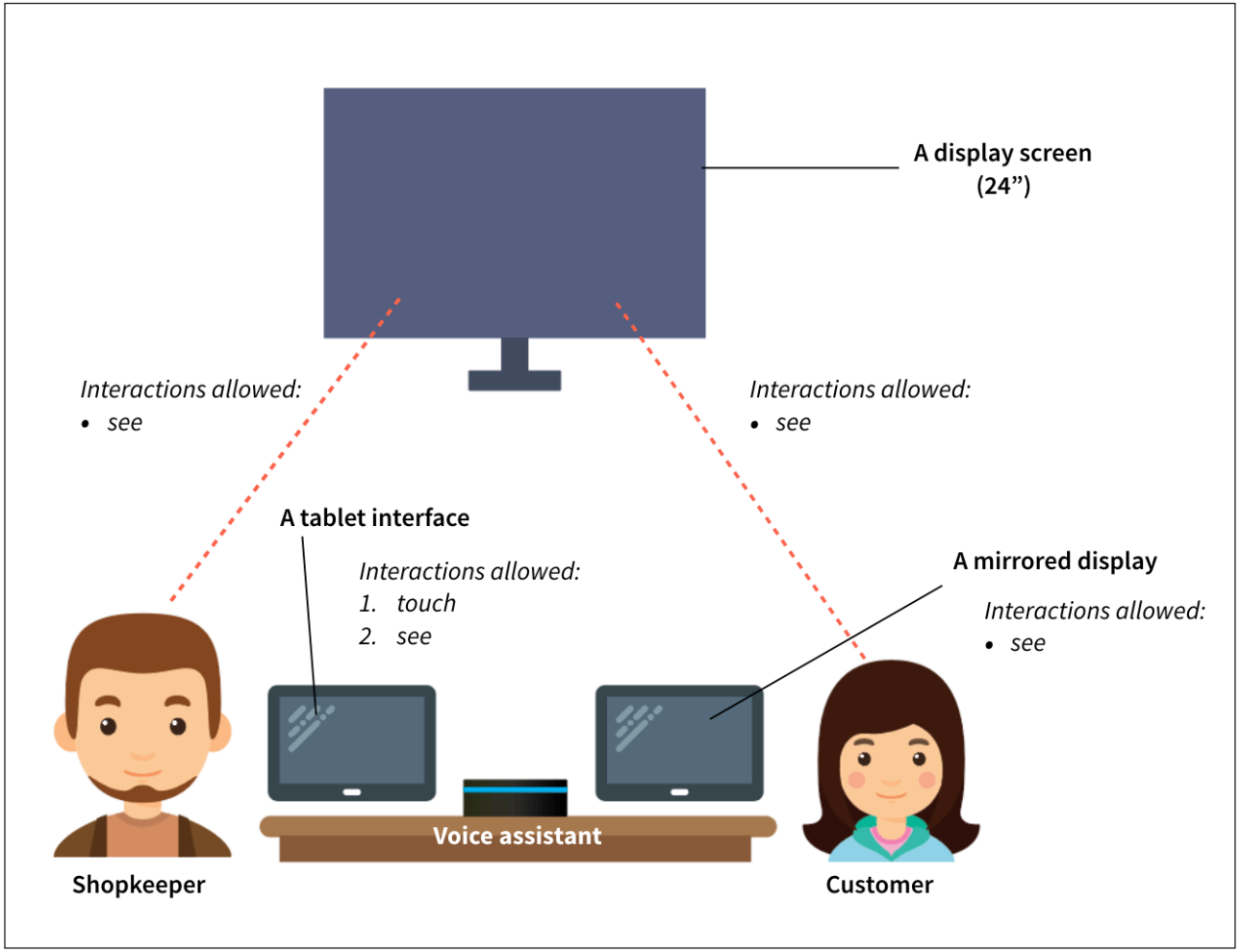


Figure 29. Hardware setup for version 3

(Icon source: www.flaticon.com)

Figure 30 shows the interface for the customer's mirrored-display. Customers would only see the cart items in this display as the recommendations would be shown on the 24" shared screen. Figure 31 shows different types of recommendations that this design would be able to provide.

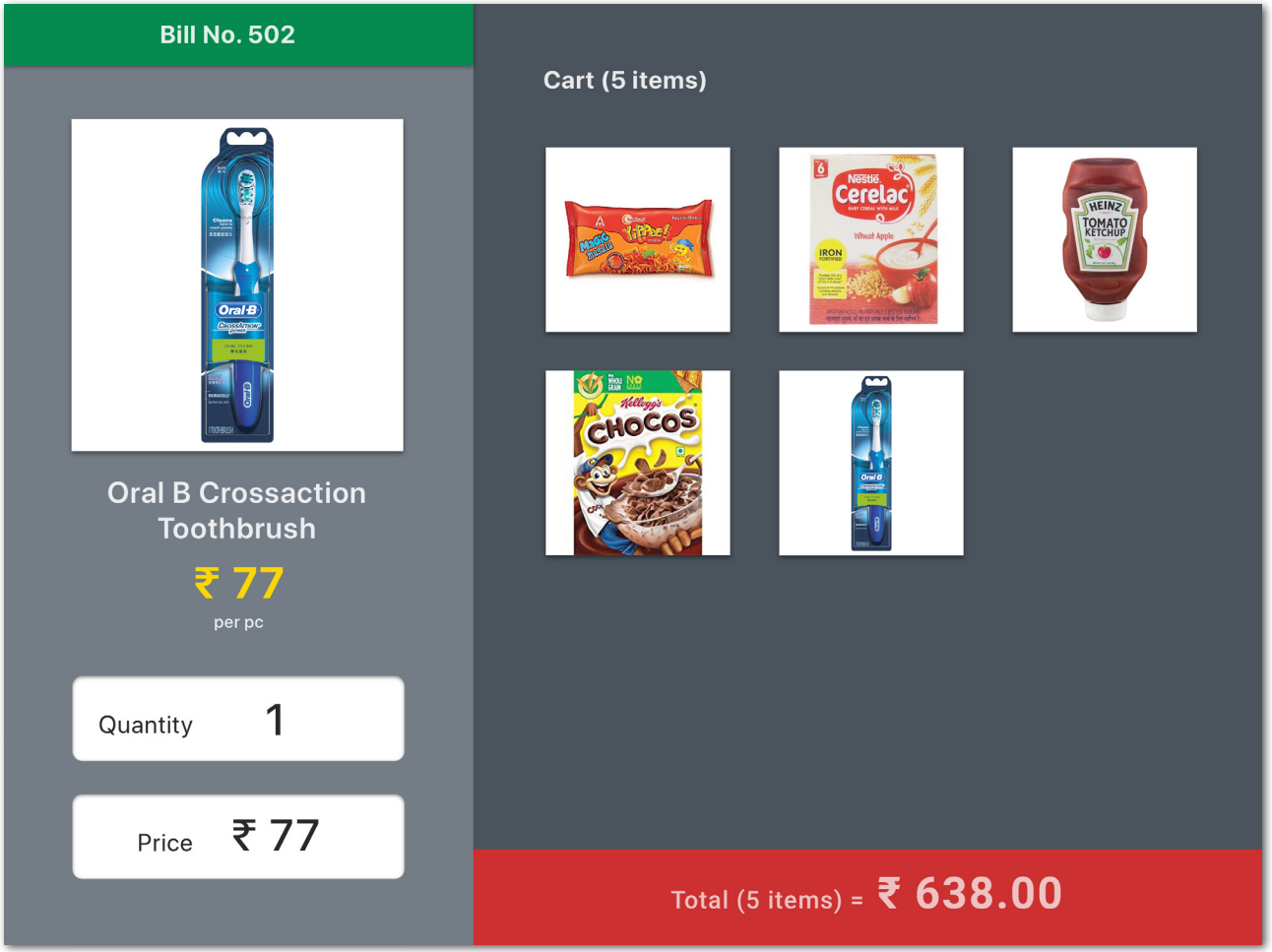
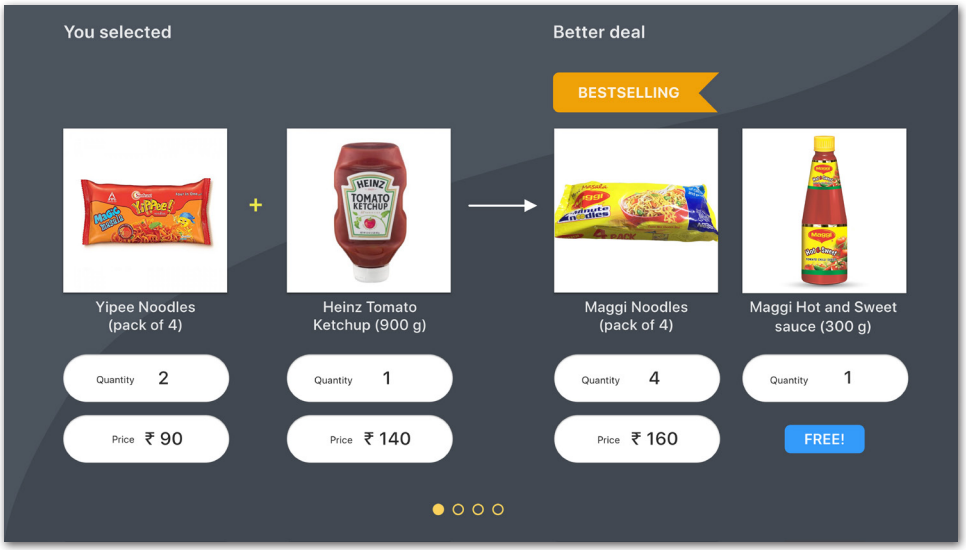


Figure 30. Customer's mirrored display interface in VABI (version 3)



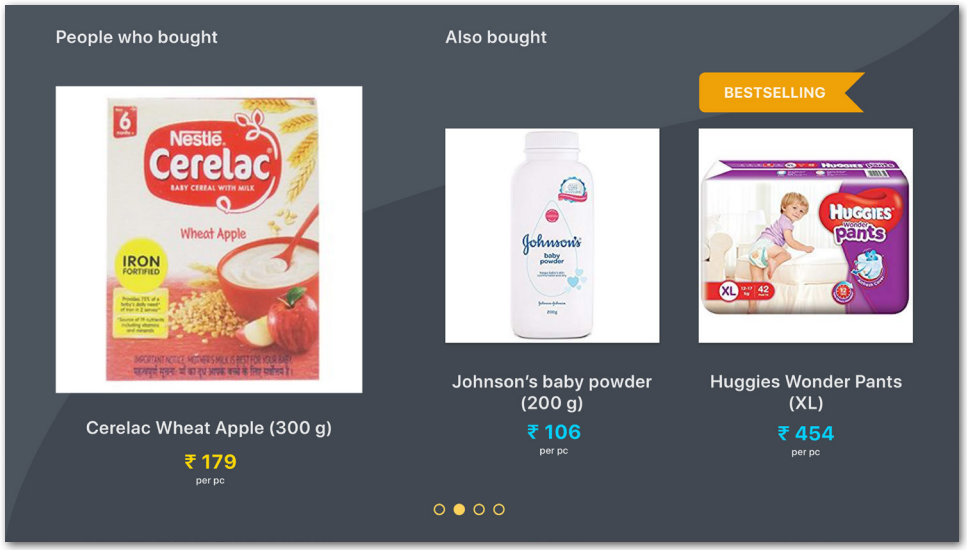


Figure 31. Different types of recommendations on the 24" shared screen in VABI (version3)

Limitations of version 3

The design requires a setup of three screens, which is a huge investment in itself. Moreover, this investment may not be easily justified as people may contend that the customers concentrating on the mirrored-display may not look at the recommendation screen, thus rendering one of the screens useless.

8.4. FINALISING A DESIGN

I conducted a quick survey with 10 customers (5 males, 5 females) and 2 shopkeepers to determine which design they liked the best. A general opinion was that the addition of the third screen was not justified in the third design. Since the voice commands were similar across all design explorations and the second design was the most favoured with the target user and customers, I decided to make a quick WoZ prototype based on the second design and test it.

9. Quantitative Longitudinal Study

I conducted a within-subject study to compare the voice-assisted billing interface (VABI) and manual billing. The WoZ study was conducted in two rounds. In the first round, the users were given eight tasks spanned across four days with an additional training session on the first day. Out of these eight tasks, four required them to produce a bill manually while the rest required them to produce the same bill using the VABI. The users were not given an implicit audio feedback during the tasks of voice-billing in the first round. The shopping list sequence for the tasks was counterbalanced across users. The study was performed with a controlled inventory of labelled dummy items. A week later, the second round of research was conducted in which the same users were given similar four tasks spanned across four days, but this time an implicit audio feedback was given by the wizard for the user's activity. The second round tasks aimed to investigate the effect of implicit audio feedback on the shopkeeper's behaviour and performance time.

9.1. THE FIRST ROUND OF STUDY

On the first day, the users were given the VABI prototype and trained on it. During the training session, the users explored the interface layout with the help of the moderator for five minutes. Next, they were asked to speak out 5 items with their quantities (Table 1), to experience the types of voice commands they may have to issue during the process of bill-making. To get insights on the UX issues of the voice commands, they were intentionally not trained for "ambiguous" cases (Table 2). They were encouraged to issue the 'undo', 'item replacement', and 'quantity alteration' commands in their natural language.

TRAINING PHRASES		
Item name	**quantity**	**possible units**
Harpic Lavendar (200 ml)	1	bottle, pc, pkt
Maggi Noodles (pack of 4)	3	pc, pkt
Aata	5	kg
Lipton darjeeling tea (250 g)	1	pc, pkt
Kellogs Chocos	2	pc, pkt

Table 1. Training phrases

AMBIGUOUS PHRASES	
Item name	**incomplete command error cases**
Oral B Cross-Action Toothbrush	oral B toothbrush
Garnier Men Facewash Power White	Garnier facewash
Dettol Liquid (500 ml)	Dettol liquid
Dettol Liquid Handwash (200 ml)	
Park Avenue deodorant (Voyage)- 220ml	park avenue deodorant

Table 2. Ambiguous phrases

After the training session, the users were given the dummy items to be placed on their shop shelves. These dummy items were labelled with the item name and its rate. Each day, the users were given two tasks: to prepare a bill for a shopping list manually and using the VABI. The shopping lists had 15 items each and were read out by the moderator during the task. For each task, the users had to deliver the items from the shelves to the counter and make a bill. Scripted changes were introduced in the shopping list on the go, so as to force the user in making changes in the bill calculation (see Appendix B). The users received visual feedback of their activity; an audio feedback was given only to ask for clarification in the ambiguous cases (for instance, when a user mentions the brand of the product but not its variety). Videos of the entire task sequence were taken to assess the qualitative aspects of the test and to record the time. The task sequence of billing manually and that using VABI was counterbalanced across users (Table 3) to mitigate the effect of any transfer of learning from one system to the other. The study continued for 4 days, with a set of 2 tasks per day.

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

Table 3. Counterbalancing of shopping lists across users

9.2. THE SECOND ROUND OF STUDY

After a week, the same users were approached with a modification in the prototype. The prototype now gave audio feedback for all the tasks performed by the users. Unlike the first round, the wizard gave implicit audio confirmations during the second round billing tasks. The wizard also gave explicit audio confirmations when a clarification was required in ambiguous cases, and when she did not register the shopkeeper's command clearly. The rest of the protocol was maintained similar to that in the first round. The study continued for 4 days, with one task per user per day.

Figure 32. The experimental setup comprised the wizard connected over a phone call. Her voice was heard by the user through the Bluetooth speaker.

9.3. CONTROL

The study was controlled by operating on a controlled inventory (figure 33), and by counterbalancing the shopping list sequence and the task sequence across users. The tested variable was the task time of preparing the bill for each shopping list. The VABI was operated by the moderator's assistant (the wizard) remotely while connected over a telephone call. The wizard listened to the commands given by the users through the telephone and returned audio feedback through a Bluetooth speaker connected to it (see figure 32). The telephone call simulated the real-world environment in the study by streaming the external noise disturbances (like car's honk, customer's voice, fan's noise, etc.) along with the user's voice. The wizard's voice coming from the speaker simulated the voice-assistant appreciably.

Figure 33. A user using the VABI prototype with a controlled inventory of dummy items

9.4. PARTICIPANTS

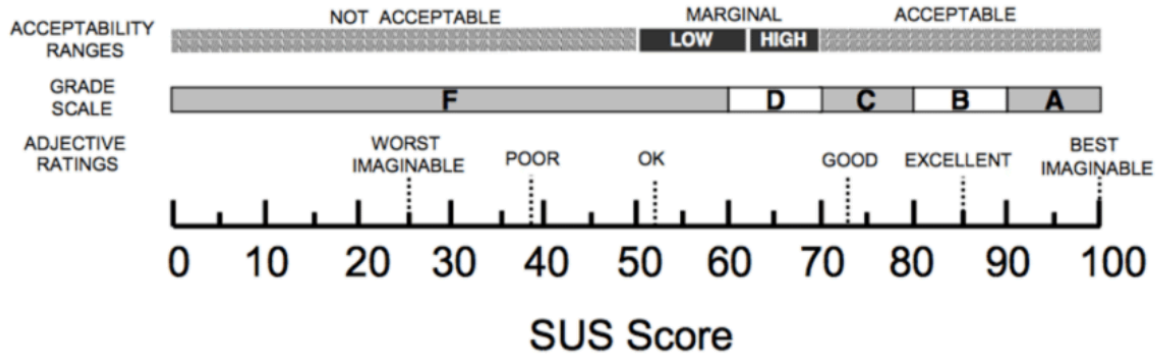
Six users participated in the longitudinal study. Three of the users were shopkeepers from the general stores inside the campus of IITB and three were from the provision stores in IIT market. Users were aged 27-56 years, with a mean age of 36 years; there were 5 males and 1 female. All the six users owned a smartphone, but only two of them had previous experience of using a voice-assistant (i.e. Google-assistant) on their phone. There was no compensation given to the participants for their time.

9.5. QUALITATIVE FEEDBACK AND SUS SCORE

At the end of the last task, the users were asked to give inputs on what they think could make the interface better. They were asked to fill a questionnaire based on SUS to assess the usability of the system qualitatively.[30, 31, 32] The feedback has been summarised in the table 4.

The SUS score **77.92** (from table 4) suggests that interface lies between the grade 'good' and 'excellent'.[33] The shopkeepers really liked the VABI and thought it had potential. They were relieved that the interface allowed the creation of multiple bills at a time. User 1 suggested that addressing bill tabs by name of the customer would solve the problem of managing multiple bills at the same time. Items could be billed by mentioning the name of the customer who ordered the item, as in the phrase, "*Put X item in Ramesh's bill and put Y item in Sudha's bill*". He also suggested that the credit amount should be visible to the shopkeeper. User 3 suggested that a kiosk arrangement could enable the customers to prepare an invoice beforehand, pay the bill, and then proceed to collect their order. This would streamline the orders during peak hours and reduce the load on the shopkeeper.

USERS	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS raw score	SUS score
User-01	5	1	5	5	5	3	5	1	5	5	30	75.00
User-02	5	1	4	5	5	2	5	1	4	5	29	72.50
User-03	5	1	5	4	5	1	5	1	1	1	33	82.50
User-04	5	1	4	5	4	2	5	2	5	5	28	70.00
User-05	5	1	5	1	5	1	5	1	2	5	33	82.50
User-06	5	2	5	5	5	1	5	1	4	1	34	85.00
											AVERAGE	77.92



Grading SUS Key	
92	Best imaginable
85	Excellent
72	Good
52	OK/Fair
38	Poor
25	Worst imaginable
90-100	A
80-89	B
70-79	C
60-69	D
Less than 60	F

Table 4. Scoring SUS feedback

10. Results

10.1. SPEED AND LEARNING

In my experiment, I wanted to investigate if using the VABI is faster than the age-old method of manual billing. The users had years of experience in preparing a manual bill but were handling the VABI for the first time. I did the first round of study for four days to allow for some learning to happen on VABI. My studies showed that performance of the users improved over time for both the billing systems. Table 5 tabulates the task times of individual users for both the systems, in round one.

Subjects	Task time (in minutes)							
	Session A		Session B		Session C		Session D	
	Manual billing	VABI (without implicit audio feedback)	Manual billing	VABI (without implicit audio feedback)	Manual billing	VABI (without implicit audio feedback)	Manual billing	VABI (without implicit audio feedback)
User 1	9.42	5.07	7.03	2.75	6.83	2.1	6.57	2.07
User 2	10.5	5.23	7.78	3.97	5.33	4.08	5.67	3.03
User 3	7.93	3.83	6.33	3.7	6.35	3.48	6.22	3.52
User 4	5.67	4.27	5.5	2.17	6.67	2.33	6.38	2.07
User 5	4.48	3.5	4.75	3.63	4.88	2.42	4.78	2.32
User 6	7.67	6.75	7.62	4.92	7.91	4.57	7.77	4.52

Table 5. Task time (in minutes) for round 1

The learning curves for individual users for the **manual billing** are pretty flat demonstrating no significant learning (see figure 34); a single factor repeated measures ANOVA showed that the differences in the task time for sessions 1-4 for manual billing were not statistically significant, F = 2.04 (p = 0.151), mean square = 2.448. This was an expected result, as the additional learning effect is deemed to be negligible compared to the overall manual calculation practice that the users may have had in life before the experiment.

However, an interesting thing to note would be that though the use of calculators was allowed, 5 out of the 24 manual bills created had errors in them. Most errors could be attributed to the calculation of prices of products which are sold loose by weight (for instance, while calculating the price of 750 grams of Sooji when the per kg rate was INR 36). Few of the manual billing samples have been presented in the Appendix.

Subjects	Task time (in minutes)			
	Session A	Session B	Session C	Session D
User 1	9.42	7.03	6.83	6.57
User 2	10.5	7.78	5.33	5.67
User 3	7.93	6.33	6.35	6.22
User 4	5.67	5.5	6.67	6.38
User 5	4.48	4.75	4.88	4.78
User 6	7.67	7.62	7.91	7.77

Table 6. Task time (in minutes) for manual billing

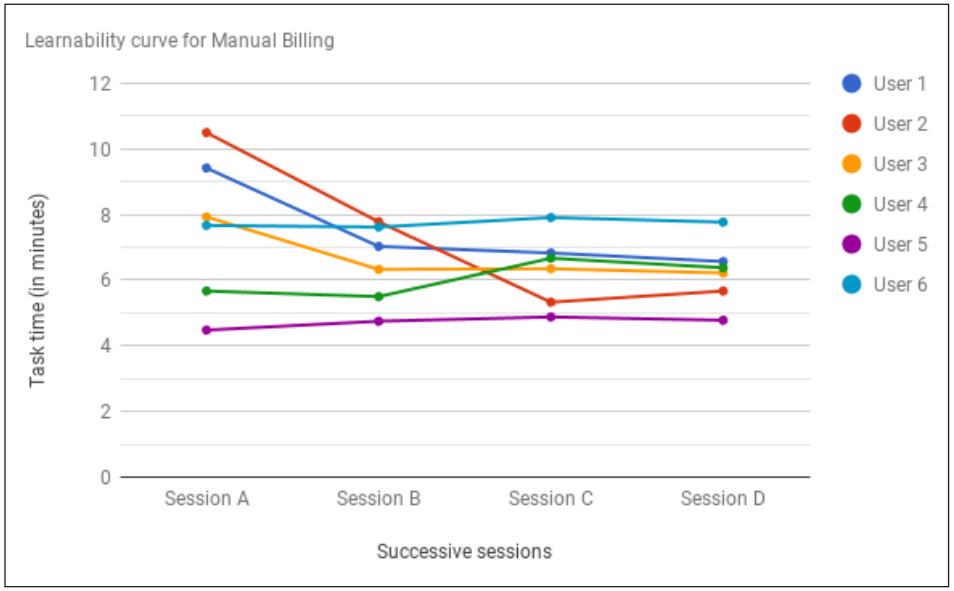


Figure 34. Learnability curve for manual billing

The learning curves for individual users for **billing using VABI (when no implicit audio feedback was given)** demonstrate some learning (see figure 35). A single factor repeated measures ANOVA showed that the differences in the task time for sessions 1-4 for billing using VABI (when no implicit audio feedback was given) were statistically significant, F = 13.97 (p = <0.001), mean square = 4.074. A two-factor repeated measures ANOVA of session-wise task times showed that the differences in the task time for sessions 1-4 for manual billing and billing using VABI (when no implicit audio feedback was given) were statistically significant, F = 26.50 (p = <0.001), mean square = 113.283. In our controlled experiment, voice billing using VABI emerged to be faster than manual billing. Such a result is delighting and was obvious from the qualitative findings we gained in the experiment. The users initially were issuing voice commands to bill a product, after they reached back at the counter carrying the item. After two sessions, most users started issuing voice commands while they were picking up the items or while they were on the way back to the counter. This multitasking significantly reduced their task time. Moreover initially, the users took more time in the voice billing tasks owing to the delays caused by the explicit feedback. The users often forgot to mention information about the variety of the product or its size, while issuing a command to add it to the bill; the wizard gave explicit audio feedback to ask for clarification in such cases. The explicit feedback provided in the initial sessions helped the users learned that they had to speak out the name of the product, its variety, and its size, for the system to successfully accept the command.

Subjects	Task time (in minutes)			
	Session A	Session B	Session C	Session D
User 1	5.07	2.75	2.1	2.07
User 2	5.23	3.97	4.08	3.03
User 3	3.83	3.7	3.48	3.52
User 4	4.27	2.17	2.33	2.07
User 5	3.5	3.63	2.42	2.32
User 6	6.75	4.92	4.57	4.52

Table 7. Task time (in minutes) for VABI (when no implicit audio feedback was given) across users

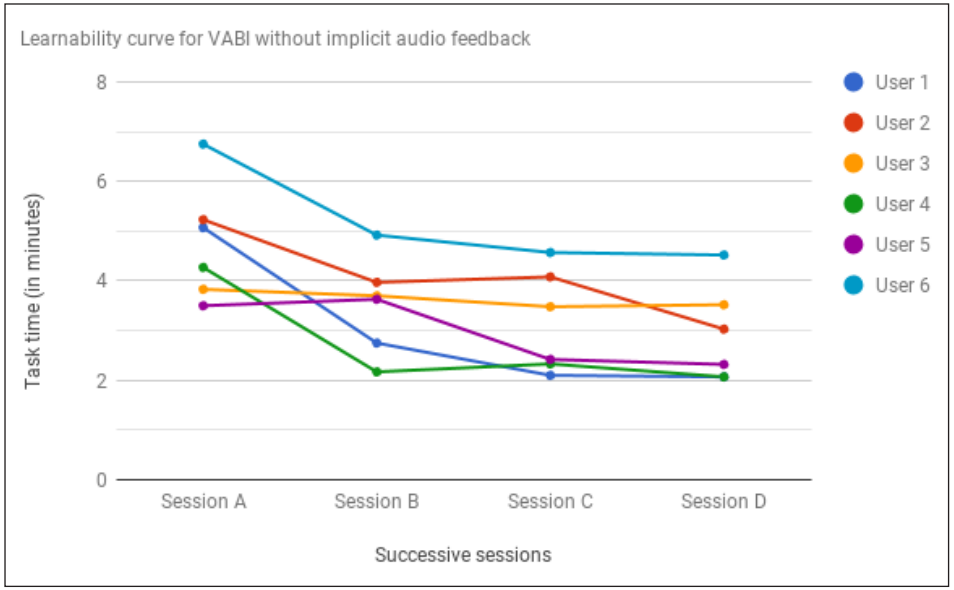


Figure 35. Learnability curve for VABI (when no implicit audio feedback was given)

The learning curves for individual users for **billing using VABI (when an implicit audio feedback was provided)** demonstrate no significant learning (see figure 36). A single factor repeated measures ANOVA showed that the differences in the task time for sessions 1-4 for billing using VABI (when an implicit audio feedback was given) were not statistically significant, $F = 1.72$ ($p = 0.206$), mean square = 0.116. This might be attributed to the fact that since the VABI (with implicit audio feedback) was tested a week after the VABI (without implicit audio feedback) was tested, the learning from the first system must have been transferred to the second system. Figure 37 shows that the average task time per user for either of the voice systems is lesser than the manual billing system, thus establishing that in controlled scenarios (when internal errors due to voice misrecognition are not considered), 'voice' is a faster mode of billing.

Subjects	Task time (in minutes)			
	Session A	Session B	Session C	Session D
User 1	3.45	3	3.28	3.28
User 2	3.67	3.45	3.55	3.33
User 3	3.72	3.08	2.92	2.72
User 4	3.02	3.03	2.83	3.58
User 5	3.67	3.65	3.58	3.12
User 6	3.15	3.13	3	2.73

Table 8. Task time (in minutes) for VABI (when an implicit audio feedback was given) across users

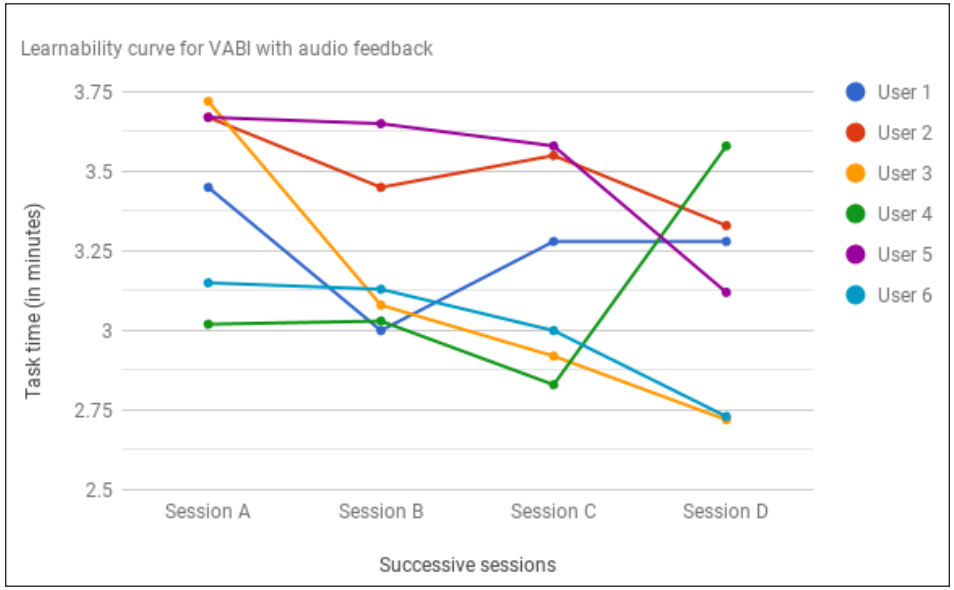


Figure 36. Learnability curve for VABI (when an implicit audio feedback was given)

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

Table 9. Average task time (in minutes) for different systems across users

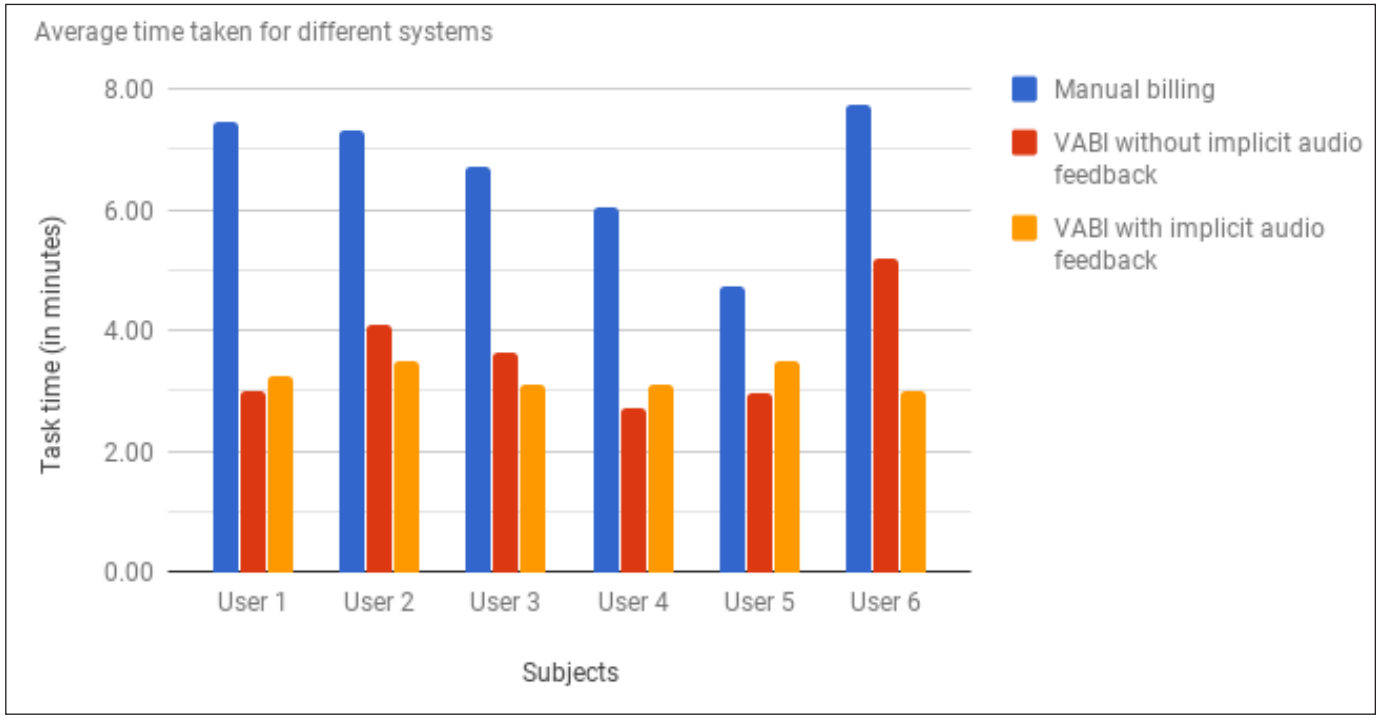


Figure 37. Average time taken for different systems

10.2. ERRORS IN RECOGNITION

My experiment takes into account the effect of external errors (i.e. errors due to the user's behaviour, ambiguous commands issued by the users, background noises, etc.) on the user's performance during billing, by giving implicit and explicit audio feedback. However, my controlled experiment does not measure the effect of internal errors in the system (i.e. errors due to misrecognition of voice) on the user's performance during billing. I ignored the effects internal errors in the experiment because I wanted to test out the system for analysing shopkeeper behaviour and performance; current voice recognition technology still is not that efficient and the effect of the internal errors would have completely sabotaged the qualitative findings that I had intended to achieve through his experiment.

I have analysed the voice commands issued by the users and categorised them into usage patterns shown in table 10(a, b).

CATEGORY	instruction in ENGLISH	HINDI (expected)
name_quantity	sooji 250 gram	सूजी ढाई सौ ग्राम
		सूजी दो सौ पचास ग्राम
	Maggi noodles 4 pack, 3 piece	मैगी नूडल्स फोर पैक, थ्री पीस
	eclairs 6 piece	एक्लेयर्स छै पीस
	lal mirch "25 grams"	लाल मिर्च ट्वेंटी फाइव ग्राम्स
	Sugar 3 kg	शुगर थ्री केजी
		शुगर तीन किलो
	dettol liquid, 500ml, one piece	डेटोल लिक्विड, पांच सौ एमएल, वन पीस
	dettol liquid handwash (200 ml) 1 piece	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस
name_quantity numeral	maggi noodles (pack of 4), 1	मैगी नूडल्स पैक ऑफ़ फोर, एक
	huggies diapers, 2	हगीज डायपर्स, दो
	chocos, 1	चौकोस एक
quantity_name	250gm sooji	पाव किलो सूजी
	4 packet maggi	चार पैकेट मैगी
	3 kg sugar	तीन केजी शुगर
	4 kg aata	चार किलो आटा
quantity numeral_name	10 eclairs	दस एक्लेयर्स
	1 oral b crossaction	एक ओरल बी क्रॉस एक्शन
no quantity mentioned = 1 unit required	harpic lavendar 100 ml	हार्पिक लेवेंडर सौ एमएल

Table 10(a). Usage patters of voice commands extracted from the experiment videos

CATEGORY	instruction in ENGLISH	HINDI (expected)
ornamental speech	sabut lal mirch worth Rs.30	साबुत लाल मिर्च तीस रुपये की
	jeera worth Rs.10	दस रुपये का जीरा
	colgate toothpaste, 100g, 1 piece	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस
	1 diapers huggies	एक डायपर्स हगीज का
	himalaya facewash neem, 1	हिमालया फेसवाश नीम वाला, एक
part 1 of name_variety_part 2 of name	garnier men powerwhite facewash	गार्नियर मेन पॉवरवाइट फेसवाश
synonyms	sabut lal mirch	साबुत / अक्का लाल मिर्च
	sugar	शक्कर / चीनी
	sooji	खुला रवा / सूजी
name_variety_quantity	colgate toothpaste, 100g, 1 piece	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस
name_quantity_variety	harpic 200ml 1, lavendar flavour	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर
variety_name_quantity numeral	100 ml lavendar harpic 1	सौ एमएल हार्पिक लेवेंडर, एक
incomplete name, shortforms	oral b toothbrush	ओरल बी टूथब्रश
	1 huggies	एक हगीज
	1 park avenue deo, voyage	एक पार्क एवेन्यू डीओ वोयाज

Table 10(b). Usage patters of voice commands extracted from the experiment videos

Additionally, I pulled out the uttered phrases from the videos and passed them through the voice-recognition software at Liv.ai (https://liv.ai/) to document what did the software register from the phrase. As expected, the software churned out massive error rates for each user, which have been documented in the Appendix C and D.

Table 11 (a,b) and table 12 (a, b) shows the mean accuracy of different phrases as recorded by the software. The average mean accuracy of different phrases recorded comes out to be 67% (for inventory item names) and 73% (for item callouts), which is pretty low for implementation a realistic scenario.

1	Expected phrase	Mean accuracy
2	आटा	100%
3	एक्लेयर्स	69%
4	ओरल बी क्रॉस एक्शन टूथब्रश	69%
5	केलोग्स चौकोस	47%
6	कैडबरी डेयरी मिल्क	81%
7	कोलगेट टूथपेस्ट सौ ग्राम	68%
8	कोलगेट सेंसिटिव टूथब्रश	65%
9	गार्नियर मेन पॉवरव्हाइट	71%
10	जीरा	96%
11	टेटली दार्जीलिंग टी (पच्चीस बैग)	56%
12	डेटोल लिक्विड पांच सौ एमएल	73%
13	डेटोल लिक्विड हैंडवाश दो सौ एमएल	49%
14	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	56%
15	पीसी लाल मिर्च	82%

Table 11(a). Mean accuracy of phrases in the 'Inventory items' list

1	Expected phrase	Mean accuracy
16	मैगी नूडल्स पैक ऑफ़ फोर	92%
17	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	58%
18	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	62%
19	शुगर / चीनी / शक्कर	39%
20	सफोला गोल्ड दो लीटर	84%
21	सर्फ एक्सेल मैटिक दो केजी	63%
22	साबुत लाल मिर्च	82%
23	सूजी / रवा	47%
24	सेरेलक वीट एप्पल	60%
25	हगीज डायपर्स	31%
26	हार्पिक लेवेंडर दो सौ एमएल	69%
27	हार्पिक लेवेंडर सौ एमएल	72%
28	हिमालया नीम फेसवाश	64%
29	**Average mean accuracy**	**67%**

Table 11(b). Mean accuracy of phrases in the 'Inventory items' list

1	Expected phrase	Mean accuracy
2	एक ओरल बी क्रॉस एक्शन	83%
3	एक डायपर्स हगीज का	41%
4	एक पार्क एवेन्यू डीओ वोयाज	55%
5	एक हगीज	38%
6	एक्लेयर्स छै पीस	54%
7	ओरल बी टूथब्रश	49%
8	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	69%
9	खुला रवा / सूजी	89%
10	गार्नियर मेन पॉवरवाइट फेसवाश	65%
11	चार किलो आटा	97%
12	चार पैकेट मैगी	90%
13	चौकोस एक	81%
14	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	74%
15	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	67%
16	तीन केजी शुगर	100%
17	दस एक्लेयर्स	54%
18	दस रुपये का जीरा	94%

Table 12(a). Mean accuracy of phrases in the 'Items callout' list

1	Expected phrase	Mean accuracy
19	पाव किलो सूजी	62%
20	मैगी नूडल्स पैक ऑफ़ फोर, एक	73%
21	मैगी नूडल्स फोर पैक, थ्री पीस	75%
22	लाल मिर्च ट्वेंटी फाइव ग्राम्स	85%
23	शक्कर / चीनी	76%
24	शुगर तीन किलो	96%
25	शुगर थ्री केजी	92%
26	साबुत / अक्का लाल मिर्च	59%
27	साबुत लाल मिर्च तीस रुपये की	79%
28	सूजी ढाई सौ ग्राम	91%
29	सूजी दो सौ पचास ग्राम	91%
30	सौ एमएल हार्पिक लेवेंडर, एक	65%
31	हगीज डायपर्स, दो	48%
32	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	67%
33	हार्पिक लेवेंडर सौ एमएल	76%
34	हिमालया फेसवाश नीम वाला, एक	72%
35	**Average mean accuracy**	**73%**

Table 12(b). Mean accuracy of phrases in the 'Items callout' list

10.3. QUALITATIVE FINDINGS

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

In my opinion, speech appears to be a tricky mode of input for the elderly, since they seem to have difficulty pronouncing words in any language. They develop several vocal restrictions due to their age, like the twisting of tongue, and loss of teeth. A similar problem is experienced with people with vocal disabilities like a stutter. In our experiments, user 4 was a stutterer while user 3 was elderly. Table 13 shows that the mean accuracy of different phrases recorded comes out to be 54.85% for user 4 and 58.93% for user 3 (in case of inventory item names), and 64% for user 4 and 63.5% for user 3 (in case of item callouts). These numbers are pretty lower than the average mean accuracy of different phrases recorded, which is 67% (for inventory item names) and 73% (for item callouts).

Less-literate users, in general, have no problem with pronunciation of words in their natural language. However, their lack of education seems to adversely affect their pronunciation of the English brand-names of different products. User 2, who was a less-literate lady, however, seemed to adapt to the VABI pretty quickly and scored better accuracy rates than most users (76.96% % in case of inventory item names, and 74.29% in case of item callouts).

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

Table 13. Accuracy rates (in %) in speech to text

Findings related to user behaviour

Initially, two out of the six users were sceptical about the VABI creating an invoice faster than manual billing, but they changed their minds after the tasks. One user insisted on comparing his manual bill's accuracy to the one generated by VABI and was surprised to find calculation errors in the manual invoice. In general, the users treated the system with respect. Though the users were trained for barging-in if they required, no user tried to barge-in while the system was giving audio feedback. They patiently waited for the wizard to finish her feedback every time.

Though the VABI with implicit audio feedback increased the task time of the users, they admitted experiencing smoother operation flow as they did not have to keep staring at the laptop screen. The users got comfortable with the VABI after the third session and started multitasking. User 4 started handling cash for another customer while session 4 was in process; this demonstrates the confidence he had built in the system.

By the third session, two out of the six users had started making bills on VABI first and then went to fetch the items. User 1 of a legacy Kirana shop believed that the delay in the cash transaction is the prime cause of bottlenecks in a Kirana shop. If the bill is created and the amount paid by the customers in advance, the collection of order items from the assistants would be a breeze, thus reducing customer wait-time. Moreover, having paid for the products in advance, the customers would be more careful about their orders. Such an approach would give the shopkeeper more time to maintain better surveillance over the shop and prevents acts of shoplifting.

Issues faced by the wizard

The wizard faced several issues that inform the type of problems expected to be faced by the voice-assistant. The wizard often could not distinguish between the voices of the user and the moderator over the phone. This reflects that it is difficult to separate out the voice of the user from a mixed stream of audio. Even though we are neglecting the effects of internal errors in the system, the wizard experienced confusion in the product details provided by the user. 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. This reflects that there is a need to carefully design the prompts and audio feedback provided by the voice-assistant.

Unexpected errors in voice recognition

There were several surprises while I was checking the accuracy of voice-recognition using Liv.ai. Few phrases which were sufficiently easy to pronounce like हगीज डायपर्स had a mean accuracy of 31% while difficult phrases like एक्लेयर्स had a mean accuracy of 69%. One of the reasons for this result could be that users are more careless while pronouncing simple phrases than while pronouncing difficult phrases.

Another observation was that same words are stressed differently depending on their position in the phrase. For instance, the word 'टूथब्रश' in the phrase "एक पैकेट कोलगेट सेंसिटिव टूथब्रश" becomes 'टूथ ब्रश' (mind the space between 'टूथ' and 'ब्रश') in the phrase "कोलगेट सेंसिटिव टूथ ब्रश तीन पैकेट". Similarly, Dettol is pronounced as 'दैट ऑल' in the phrase "एक पीस दैट ऑल लिक्विड" and as 'डेटोल' in the phrase "डेटोल लिक्विड पांच पीस".

Findings related to the design of the voice-commands

Manjiri helped me calculate the edit distances and accuracy rates of different phrases in the 'inventory items' with the 'item callouts' list (which has been presented in Appendix D). This may be an effective means to measure accuracy when all the words would hold equal importance, but not when some words hold greater importance than the others. In our case, where retail is concerned, recognition can be made more effective if we assign the highest priority to the brand name, second highest to the variety, third highest to the size, and keep the quantities to have the least importance. In such a case, a voice command would be evaluated in decreasing order of the priority words. A system may be able to decode सूजी राय सौ ग्राम but fail to decode सुजीत ढाई सौ ग्राम even though both phrases stand at 88% accuracy. Considering this, I colour coded each of the phrases manually (**red** for *unidentifiable*, **yellow** for *identifiable with difficulty*, and **green** for *easily identifiable*) and calculated the % commands identifiable for each user for both the lists 'inventory items' and 'item callouts'. The results are tabulated in the table 14 and the colour coded list is presented in the Appendix C.

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

Table 14. Accuracy rates (in %) in speech to text and in the identification of commands

Figure 38 (a). Commands taken in the functional prototype

If we compare the mean accuracy based on edit distances for the 'inventory items' with the 'item callouts' in the table 14, it is observed that 'item callouts' have greater accuracy than the 'inventory items'. However, if we go by the % of commands that would be identifiable in such a retail system, the accuracy of the 'item callouts' is less than the 'inventory items', which signifies that the voice recognition software is able to identify short, specific commands with a better accuracy than the longer phrases. This will have serious implications in the design of the voice system, suggesting that a set voice-command based system would be more efficient than conversational VUI with the present technology. I developed a functional prototype of a command-based VUI with the help of my friend Nikhil. Figure 38 (a, b) shows the initial version of the system at work. The link to the Github repository of the code can be found at the end of the references section.

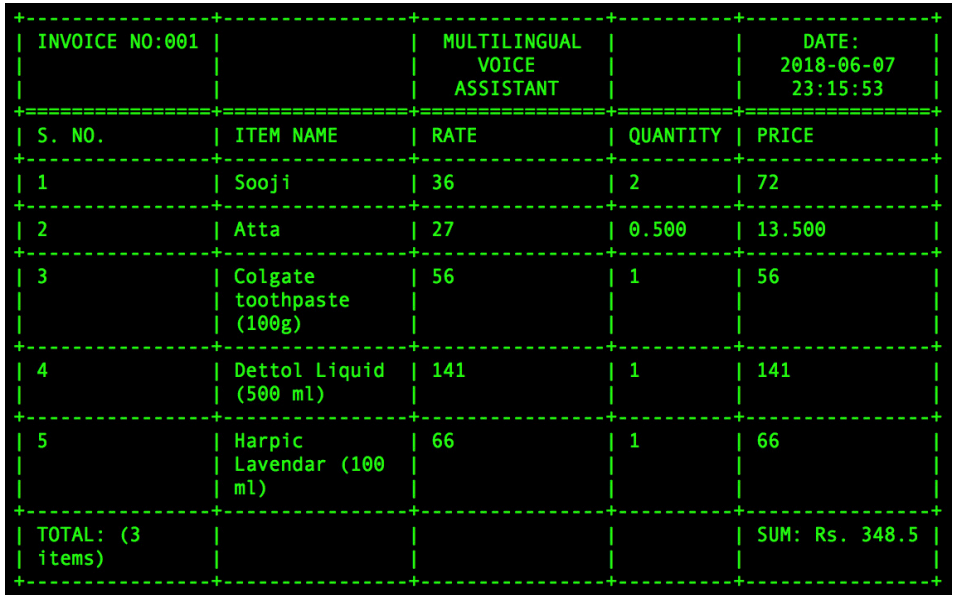


Figure 38 (b). Formatted invoice printed by the functional prototype

11. Conclusion and Future Work

MULTI-MODAL BILLING INTERFACE
I designed a voice-assisted billing interface by combining the two modalities of speech and touch. All-in-all, my research shows that such an interface is usable, and feasible for deployment in the Kirana stores provided certain design decisions (discussed in this report) are followed.

PERFORMANCE EVALUATION
I did a performance evaluation of manual billing vs two VABI systems (one with only explicit audio feedback and another with both implicit and explicit audio feedback). I found that both the VABI systems emerged to be faster than manual billing when internal errors due to misrecognition of voice were neglected. This establishes that voice might be a faster mode of input for billing interfaces.

A SET-COMMAND BASED VUI
Conversational voice-assistants are ideal as voice interfaces owing to their intuitiveness. However, my studies (in section 11.2) show that the average accuracy rate of voice-recognition technology is too low (65-75%) to realise such systems in present. My qualitative findings in section 11.3 suggest that Automated Speech Recognition (ASR) encounters lesser errors with shorter phrases. An accuracy rate of 55.56% was achieved while calling out just the inventory item names, while this accuracy reduced to 47.06% when users uttered longer voice commands. This suggests that a set-command based VUI might be a better fit with the present level of voice-recognition technology. I have not tested the design of such set commands and future work is needed to test its effectiveness.

CONFIRMATIONS AND DISAMBIGUATION
I tested the different types of confirmations during my quantitative longitudinal study through two systems. My findings in section 11.3 reveal that the users felt that a VUI giving both implicit and explicit audio confirmations seems to operate smoother than a VUI that gives just explicit audio confirmations.

DETAIL AND SPEED OF FEEDBACK PROVIDED BY THE VUI
I did not test the prototype with greater detail of feedback and slower speech speeds as my prototype was designed for my primary persona. Future research needs to be done to test slower speech speeds and greater detail of feedback provided by the VUI.

HANDLING OF ERRORS
In my tests, I have accounted for the external errors that may arise due to ambiguous voice-instructions, external noise and background talking. However, I have neglected the internal errors caused by misrecognition of voice and future work needs to be done to test its effect on the performance of VABI.

BARGE-IN

Though customers were trained to barge-in while the VUI is giving feedback, no such positive action was observed during my experiment. Future research needs to be done for more sessions to benchmark the minimum number of sessions required by the users to become advanced enough to barge-in.

TOUCH-BASED INTERACTIONS AND ERROR CORRECTION

Though the VABI was introduced as an interface which the shopkeepers could operate by touch or voice, all users preferred talking to the system. Touch interactions were hardly used in spite of the users standing close to the system. This might suggest that the modality of touch can be done away with, retaining just the visual feedback from a screen, but it is too soon to imply it. Future work is needed to test with conviction whether the modality of touch is required or can be done away with completely.

NEED OF A DIFFERENT EVALUATION MEASURE FOR ACCURACY

While edit-distances and accuracy rates are a measure to evaluate the accuracy of a text where all words hold equal importance, I think a different standard measure would be needed to evaluate the voice commands in retail, where certain words hold greater importance than the other.

CONCERNS FOR PRIVACY WERE INVESTIGATED

We also investigated privacy concerns related to the public billing of items in a Kirana store and concluded that apart from a few items (like sanitary pads), all other items can be safely billed publicly on a digital display without harming the customer's privacy.

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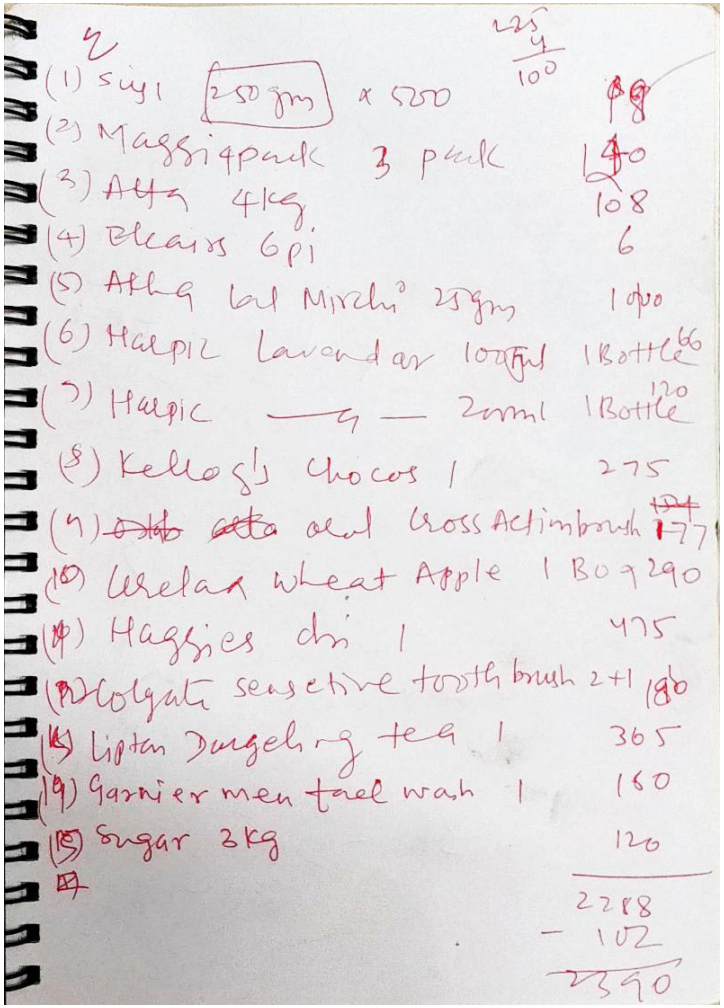
Github repository link for prototype
https://github.com/nikhilwani/Multlingual-Voice-Assistant-System

Appendices

Appendix-A

Samples of manual bills collected during the study



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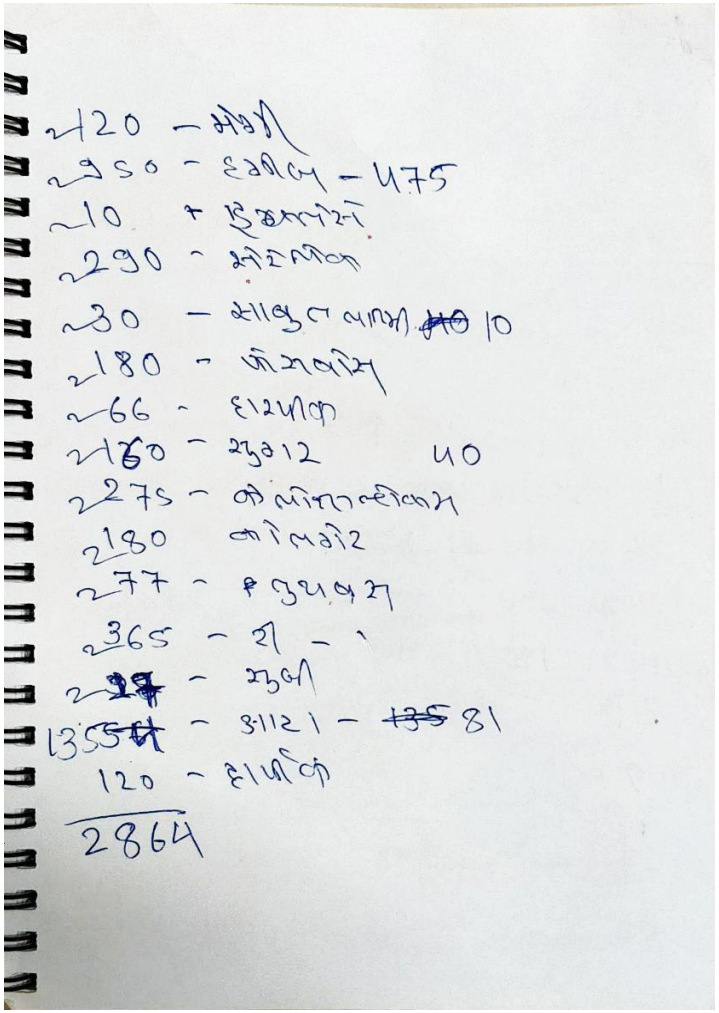

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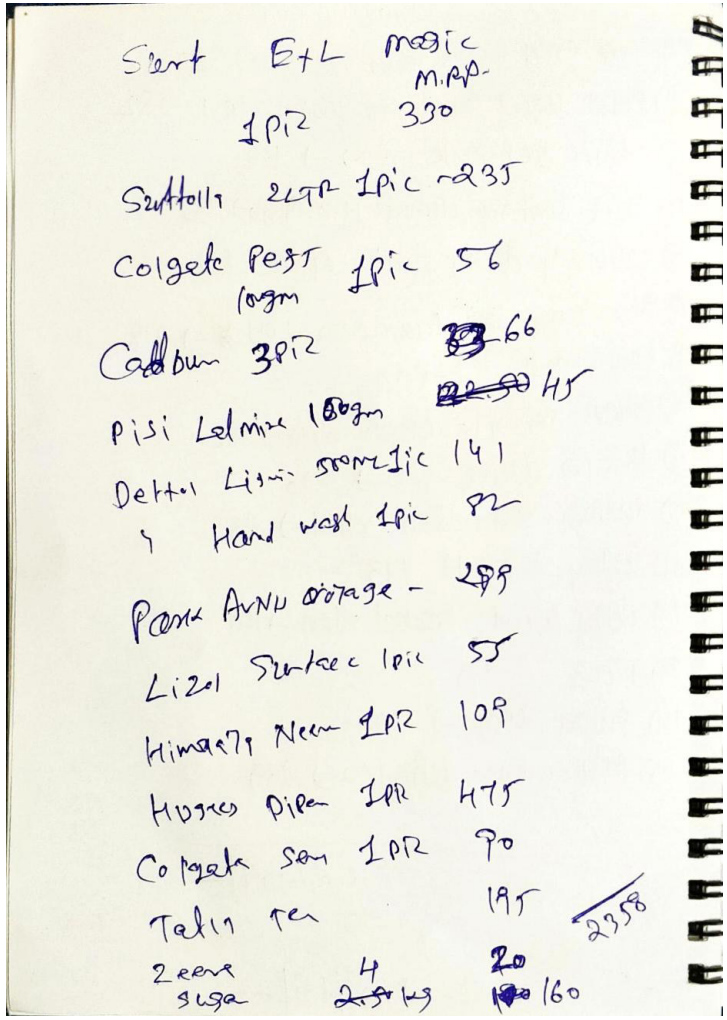

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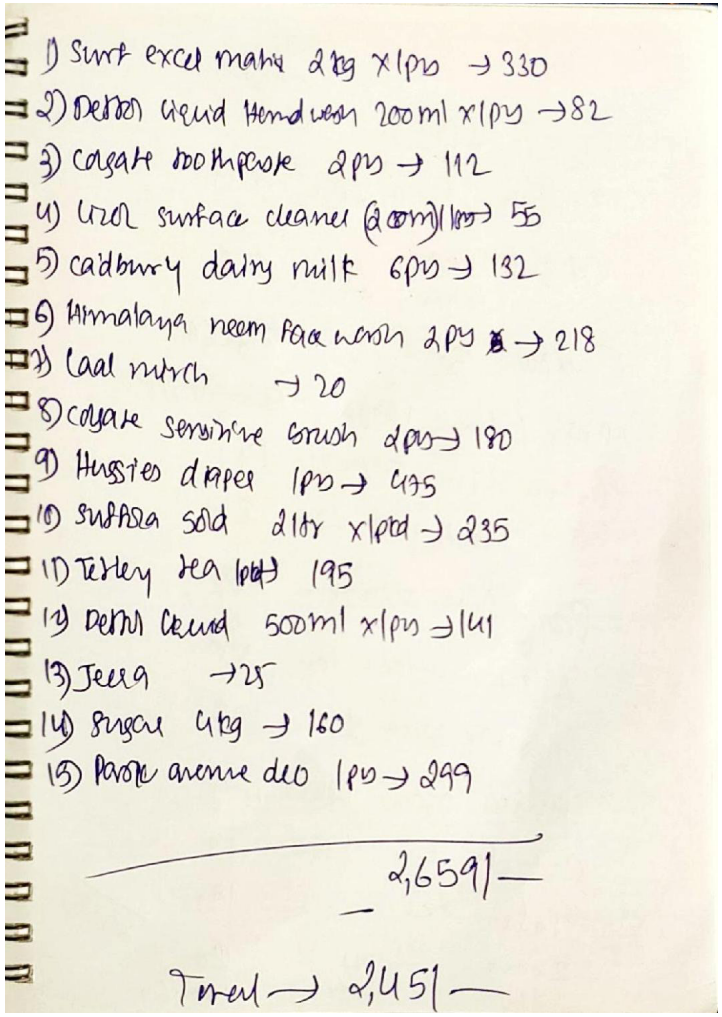

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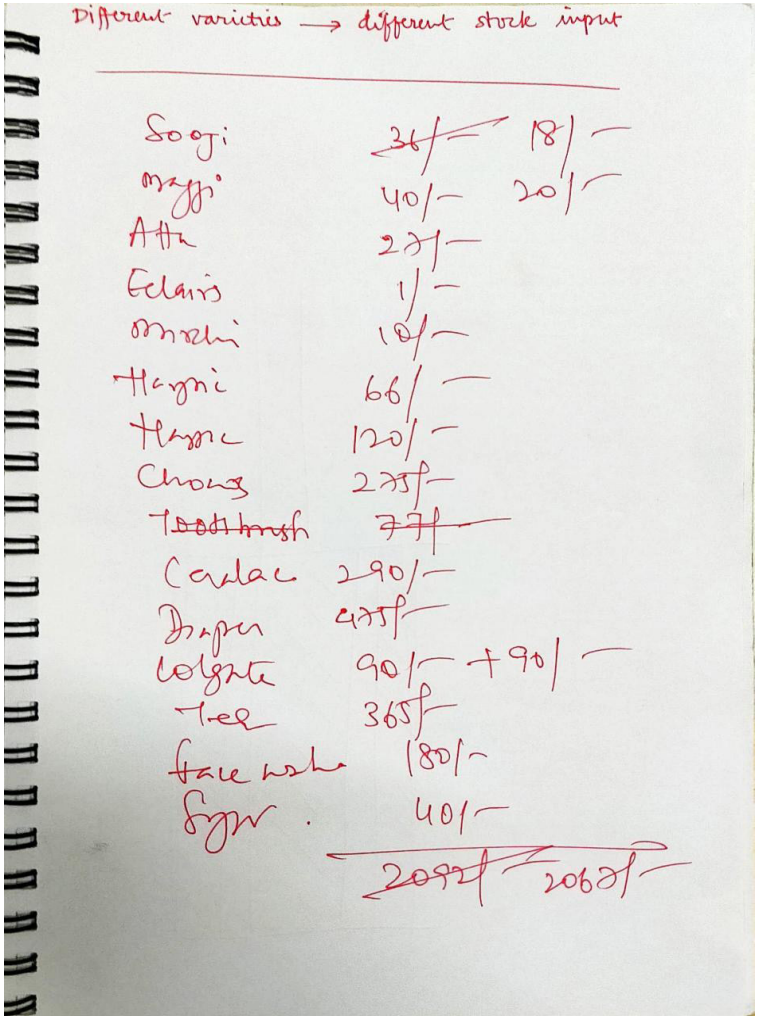

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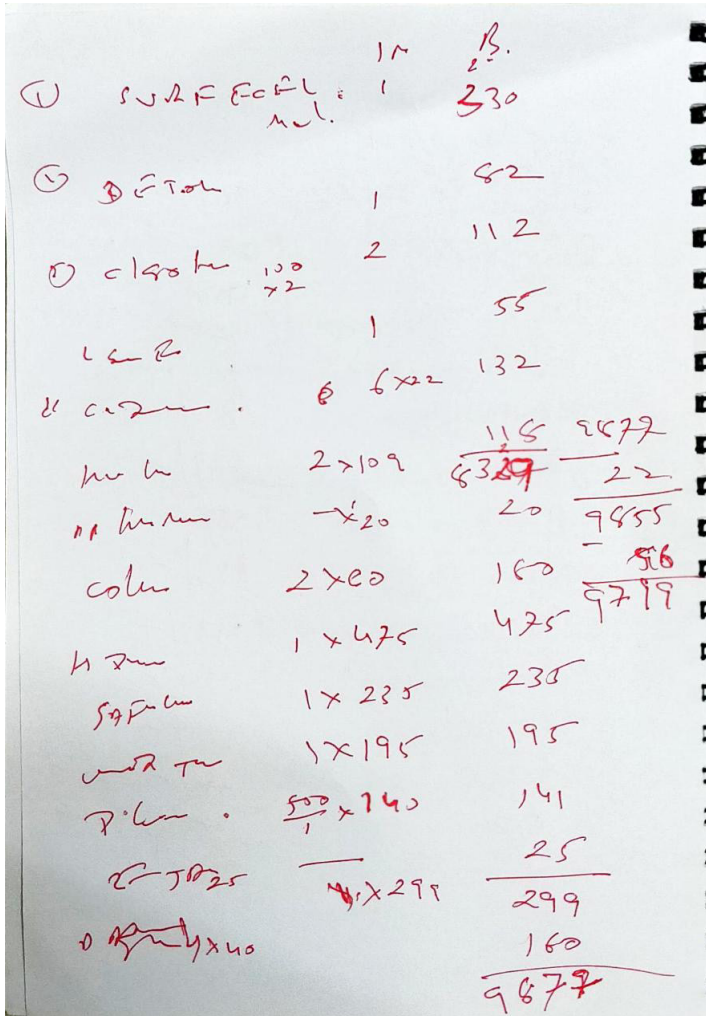

generated by User 6

Appendix-B

The four shopping lists used while testing

S.no.	Item name	Rate (₹)	Quantity	Price (₹)
1	Sooji	36.00 /kg	250 g	9.00
2	Maggi Noodles (pack of 4)	40.00 /pc	1 pc	40.00
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 g	10.00
6	Harpic Lavendar (100 ml)	66.00 /pc	1 pc	66.00
7	Harpic Lavendar (200 ml)	120.00 /pc	1 pc	120.00
8	Kellogs Chocos	275.00 /pc	1 pc	275.00
9	Oral B Cross-Action Toothbrush	77.00 /pc	2 pc	154.00
10	Cerelac Wheat Apple	290.00 /pc	1 pc	290.00
11	Huggies Diapers	475.00 /pc	1 pc	475.00
12	Colgate sensitive toothbrush (2+1 free)	90.00 /pc	1 pc	90.00
13	Lipton darjeeling tea (250 g)	365.00 /pc	1 pc	365.00
14	Garnier Men Facewash Power White	180.00 /pc	1 pc	180.00
15	Sugar	40.00 /kg	3 kg	120.00
	Total	15 items	₹	2308.00

List A

Changes in list

	List A
1	Change Sooji to 500g
2	Give 2 more packets of Maggi noodles
3	Remove 1 Oral B Cross-Action Toothbrush
4	Add 1 Colgate sensitive toothbrush (2+1 free)

S.no.	Item name	Rate (₹)	Quantity	Price (₹)
1	Maggi Noodles (pack of 4)	40.00 /pc	3 pc	120.00
2	Huggies Diapers	475.00 /pc	2 pc	950.00
3	Eclairs	1.00 /pc	10 pc	10.00
4	Cerelac Wheat Apple	290.00 /pc	1 pc	290.00
5	Sabut Lal Mirch	400.00 /kg	75 g	30.00
6	Garnier Men Facewash Power White	180.00 /pc	1 pc	180.00
7	Harpic Lavendar (100 ml)	66.00 /pc	1 pc	66.00
8	Sugar	40.00 /kg	3 kg	120.00
9	Kellogs Chocos	275.00 /pc	1 pc	275.00
10	Colgate sensitive toothbrush (2+1 free)	90.00 /pc	2 pc	180.00
11	Oral B Cross-Action Toothbrush	77.00 /pc	1 pc	77.00
12	Lipton darjeeling tea (250 g)	365.00 /pc	1 pc	365.00
13	Sooji	36.00 /kg	750 g	27.00
14	Aata	27.00 /kg	2 kg	54.00
15	Harpic Lavendar (200 ml)	120.00 /pc	1 pc	120.00
	Total	15 items	₹	2864.00

List B

Changes in list

	List B
1	Remove 1 Huggies Diapers
2	Make Sabut lal mirch 100g
3	Make Aata 5 kg
4	Add another kg of Sugar

S.no.	Item name	Rate (₹)	Quantity	Price (₹)
1	Surf Excel Matic (2 kg)	330.00 /pc	1 pc	330.00
2	Saffola Gold (2 lt)	235.00 /pc	1 pc	235.00
3	Colgate toothpaste (100g)	56.00 /pc	1 pc	56.00
4	Cadbury Dairymilk	22.00 /pc	2 pc	44.00
5	Pisi Lal Mirch	450.00 /kg	50.0 g	22.50
6	Dettol Liquid (500 ml)	141.00 /pc	1 pc	141.00
7	Dettol Liquid Handwash (200 ml)	82.00 /pc	1 pc	82.00
8	Park Avenue deodorant (Voyage)- 220ml	299.00 /pc	1 pc	299.00
9	Lizol surface cleaner (200 ml)	55.00 /pc	1 pc	55.00
10	Himalaya Neem Facewash	109.00 /pc	1 pc	109.00
11	Huggies Diapers	475.00 /pc	1 pc	475.00
12	Colgate sensitive toothbrush	90.00 /pc	1 pc	90.00
13	Tetley darjeeling tea (25 bags)	195.00 /pc	1 pc	195.00
14	Jeera	420.00 /kg	23.81 g	10.00
15	Sugar	40.00 /kg	2.5 kg	100.00
	Total	15 items	₹	2243.50

List C

Changes in list

	List C
1	Add another Cadbury Dairymilk
2	Make pisi lal mirch 100g
3	Give Jeera worth of Rs.20
4	make Sugar 4 kg

S.no.	Item name	Rate (₹)	Quantity	Price (₹)
1	Surf Excel Matic (2 kg)	330.00 /pc	1 pc	330.00
2	Dettol Liquid Handwash (200 ml)	82.00 /pc	1 pc	82.00
3	Colgate toothpaste (100g)	56.00 /pc	2 pc	112.00
4	Lizol surface cleaner (200 ml)	55.00 /pc	1 pc	55.00
5	Cadbury Dairymilk	22.00 /pc	6 pc	132.00
6	Himalaya Neem Facewash	109.00 /pc	2 pc	218.00
7	Pisi Lal Mirch	450.00 /kg	44.4 g	20.00
8	Colgate sensitive toothbrush	90.00 /pc	2 pc	180.00
9	Huggies Diapers	475.00 /pc	1 pc	475.00
10	Saffola Gold (2 lt)	235.00 /pc	1 pc	235.00
11	Tetley darjeeling tea (25 bags)	195.00 /pc	1 pc	195.00
12	Dettol Liquid (500 ml)	141.00 /pc	1 pc	141.00
13	Jeera	420.00 /kg	44.44 g	25.00
14	Park Avenue deodorant (Voyage)- 220ml	299.00 /pc	1 pc	299.00
15	Sugar	40.00 /kg	4 kg	160.00
	Total	15 items	₹	2659.00

List D

Changes in list

	List D
1	Remove a Cadbury Dairymilk
2	Remove a Colgate toothpaste
3	Remove one Colgate sensitive toothbrush (2+1 free)
4	Remove 1 kg Sugar

Appendix-C

Misrecognition errors encountered in voice-commands

Easily recognised

Recognised with difficulty

Not recognised

Item name in ENGLISH	HINDI translation (expected)	User 1	User 2	User 3	User 4	User 5	User 6
Aata	आटा	आटा	आटा	आटा	आटा	आटा	आटा
Cadbury Dairymilk	कैडबरी डेयरी मिल्क	कैडबरी डेल्ही मिल्क	कैडबरी डेयरी मिल्क	फिर भी डेयरी मिल्क	कैन बे रेडी	कैडबरी डेयरी मिल्क	कैडबरी डेयरी मिल्क
Cerelac Wheat Apple	सेरेलक वीट एप्पल	सर लाइक वीट एपल	सेलैक्वी टेल्स	शेलेक वीके	नेटग्रिड एपल	सेरेलेक वीट एप्पल	सेरेलेक वीट एप्पल
Colgate sensitive toothbrush	कोलगेट सेंसिटिव टूथब्रश	कोलगेट इंस्टीट्यूट टू प्लस	कॉल गेट सेंसिटिव टू क्रश	कोल केस सेंसिटिव प्लेस	कॉल गेट्स सैटरडे यू टू	कोलगेट सेंसिटिव टूथब्रश	कोलगेट सेंसिटिव तो प्रेस
Colgate toothpaste (100g)	कोलगेट टूथपेस्ट सौ ग्राम	कोल गेट टू पे हंड्रेड ग्राम	कॉल गेट टूथपेस्ट सौ ग्राम	कॉल की टूट के सो गया	पॉल गेट टूथ पे सो ग्राम	कोलियर टू टेस्ट हंड्रेड ग्राम	कोलगेट टूथपेस्ट सौ ग्राम
Dettol Liquid (500 ml)	डेटोल लिक्विड पांच सौ एमएल	दैट ऑल लिक्विड पांच सौ मेल	डेटोल लिक्विड पांच सौ एमएल	गेट ऑल लिक्विड फाइंड्स सो एम एस	टॉलिक वीट फाल्स ईमेल	डेटोल लिक्विड फाइव हंड्रेड एमएल	डेटोल लिक्विड पांच सौ एमएल
Dettol Liquid Handwash (200 ml)	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ऑल लिक्विड एंड वास्ट टू हंड्रेड एमएल	दैट ऑल लिक्विड एंड वाज सो सो एम एल	दैट ट्राली फील हेड वाज सो सो एम एल	डेक्रीपिट एंड वॉज दोज सो एम एल	दैट ऑल लिक्विड एंड वॉज टू हंड्रेड एमएल	दैट ओनली फीड हैंड वाज दो सौ एमएल
Eclairs	एक्लेयर्स	एक्लेयर्स	डिक्लेर्स	जीपीएस	डिक्लेर्स	डिक्लेर्स	एक्लेयर्स
Garnier Men Facewash Power White	गार्नियर मेन पॉवरव्हाइट	कैरियर मैन फेस वाज फॉर व्हाइट	गार्नियर मेन पावर व्हाइट	गार्नियर मेन पावर व्हाइट	नियर में ऑर व्हाइट	गार्नियर मेन फेस वॉश पावर व्हाइट	गार्नियर मेन पावर व्हाइट
Harpic Lavendar (100 ml)	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर हंड्रेड एम एल	हार्पिक वंडर्स सो एम एल	हार्पिक लेवेंडर स्वयं में	आर्थिक लेवेंडर सो ईमेल	हार्पिक लेवेंडर हंड्रेड एम एल	हार्पिक लेवेंडर सो एम एल
Harpic Lavendar (200 ml)	हार्पिक लेवेंडर दो सौ एमएल	हार्पिक लेवेंडर टू हंड्रेड एम एल	हार्पिक वंडर्स दो सो एम एल	हैप्पी क्लेमेंटस दो फैमिल	आर्थिक लेवेंडर दोसो ईमेल	हार्पिक लेवेंडर टू हंड्रेड एम एल	हार्पिक लेवेंडर दो सौ एम एल
Himalaya Neem Facewash	हिमालया नीम फेसवाश	हिमालया नेम फ्रेश वाज	हिमालय नेम फेस्ट वाज	ली माल्या नीम एस वाज	हिमालायन फेस वॉश	हिमालायन नीम फेस वॉश	हिमालायन इम्प्रेस वाज
Huggies Diapers	हगीज डायपर्स	हरीसाई पर	अगेश डायपर्स	हैवीस्ट टाइप्स	अभी साइट पर	अगेंस्ट टाइप पर	अगेंस्ट टाइप पर
Jeera	जीरा	जीरा	जीरा	जिरा	जीरा	जीरा	जीरा
Kellogs Chocos	केलोग्स चौकोस	के लोग शो को	कहलो चोकर्स	क्लॉक्स	के लोग जो कोर्स	क्लॉक्स चौकोर	क्लॉक्स सोको

Inventory item list (a)

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)	लाइज़ोल 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 ड्रा	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 डियोडोरेंटस 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

Inventory item list (b)

Easily recognised

Recognised with difficulty

Not recognised

CATEGORY	instruction in ENGLISH	HINDI (expected)	User 1	User 2	User 3	User 4	User 5	User 6
name_quantity	sooji 250 gram	सूजी ढाई सौ ग्राम	सूजी राय सौ ग्राम	सूजी ढाई सौ ग्राम	सूजी ढाई सौ ग्राम	सुजीत ढाई सौ ग्राम	सूजी ढाई सौ ग्राम	सूजी आइसो ग्राम
		सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	स्वीट जी दो सौ पचास का	सुजीत दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम
	Maggi noodles 4 pack, 3 piece	मैगी नूडल्स फोर पैक, थ्री पीस	मैगी नूडल्स फोर फैक्स थ्री पीस	में डीलर्स फॉर फैक्ट थ्री पीस	नेगेटिव फॉरेक्स थ्री पीस	मैगी नूडल्स फॉर फैक्ट्री पीस	मैगी नूडल्स फोर पैक थ्री पीसेज	मैगजीन्स फोर पैक थ्री पीस
	eclairs 6 piece	एक्लेयर्स छै पीस	अखिलेश के बीस	एक लेट्स से फीस	इट एस जे पी	प्लेयर्स से भी	एक्लेयर्स छे पीस	रेकलेस केपी
	lal mirch "25 grams"	लाल मिर्च ह्वेंटी फाइव ग्राम्स	लाइव मिस्टर ह्वेंटी फाइव ग्राम	लाल मिर्च ह्वेंटी फाइव ग्राम	लाल वेज ह्वेंटी फाइव ग्राम्स	सालवेज ह्वेंटी फाइव ग्राम्स	लाल मिर्च ह्वेंटी फाइव ग्राम	लाल वेल्स ह्वेंटी फाइव ग्राम्स
	Sugar 3 kg	शुगर थ्री केजी	शुगर थ्री केजी	शुगर थ्री केजी	सुबह श्री जी जी	शुगर थ्री केजी	शुगर थ्री केजी	शुगर थ्री केजी
		शुगर तीन किलो	शुगर तीन किलो	शुगर तीन किलो	सुबह तीन किलो	शुगर तीन किलो	शुगर तीन किलो	शुगर तीन किलो
	dettol liquid, 500ml, one piece	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	डेटाल लिली पारसोल वन पीस	यू टोल्ड लिक्विड पांच सौ एम एल वन टी	रेट ऑल लिखित फाइन सो एम एल वन पीस	दैट ऑल लिक्विड पांच सौ एमएल वन पीस	टेट ऑल लिक्विड पांच सौ एमएल वन वन पीस	डेटेलिंग विट पारसमल वन पीस
	dettol liquid handwash (200 ml) 1 piece	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	डेटाल लिक्विड हैंड वाश दो सौ एम एल एक पीय	लेट ऑल लिक्विड हैंड वाज दो सौ एम एल एक पीस	सेट्रो लिक्विड हैंड वाज़ जो स्वाल एक पीस	दैट ऑल लिक्विड एंड वाइस दो सौ एम एल एक पीस	दैट ऑल लिक्विड एंड वार्ड दो सौ एम एल एक पीस	लेटर लिक्विड हैंड वाज दो सो वे मेक पीस
name_quantity numeral	maggi noodles (pack of 4), 1	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैगी नूडल्स पैक ऑफ फोर एक	मैगी नूडल्स पैक ऑफ फोर एक्स	मैकिनेक फोर एक	इन्होंने सामने वह फोर एक	मैगी नूडल्स पैक ऑफ फोर एक	मैगी नूडल्स पैक ऑफ फोर एक
	huggies diapers, 2	हगीज डायपर्स, दो	अगीस डाई पर दो	आगे तय कर दो	स्विस राइटर्स दो	जुलाई सुनाई पर दो	हगीज डायपर्स दो	अगली लाइन पर दो
	chocos, 1	चौकोस एक	चौको एक	चौकोस एक	चौके एक	चौकों से एक	चौको एक	सौ कोस एक
quantity_name	250gm sooji	पाव किलो सूजी	पाव किलो सूजी	ओके ये सूजी	ऑफ यू सूजी	एक पागल सूची	भाव किलो सूजी	पागलों सुजीत
	4 packet maggi	चार पैकेट मैगी	चार पैकेट महंगी	चार पैकेट मैगी	चार पैकेट मैगी	चार पैकेट मैगी	चार पैक मांगी	चार पैकेट महंगी
	3 kg sugar	तीन केजी शुगर	तीन केजी शुगर	तीन केजी शुगर	तीन केजी शुगर	तीन केजी शुगर	तीन केजी शुगर	तीन केजी शुगर
	4 kg aata	चार किलो आटा	चार किलो आटा	चार किलो आटा	चार किलो वाटा	चार किलो आटा	चार किलो आटा	चार किलो आटा

Item callouts list (a)

Easily recognised

Recognised with difficulty

Not recognised

CATEGORY	instruction in ENGLISH	HINDI (expected)	User 1	User 2	User 3	User 4	User 5	User 6
quantity numeral_name	10 eclairs	दस एक्लेयर्स	व्हाट सेकुलर्स	दस ही क्लेयर्स	जस्ट सिक्स	प्लस सिक्स	दस क्लेयर्स	दस एक्लेयर्स
	1 oral b crossaction	एक ओरल बी क्रॉस एक्शन	एक ओरल बी क्रॉस एक्शन	ए कोरल वी प्रोटेक्शन	एक और एल वी क्रॉस एक्शन	एक ओरल बी क्लास एक्शन	एक ओरल बी क्रॉस एक्शन	एक ओरल भी प्रोसेशन
no quantity mentioned = 1 unit required	harpic lavendar 100 ml	हार्पिक लेवेंडर सौ एमएल	आर पीक लेवेंडर सो एम एल	आर पी क्लाइंट्स सो एम एल	हैप्पी लेवेंडर सो ईमेल	आर पीक लेवेंडर सो एम एल	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर सौ एमएल
ornamental speech	sabut lal mirch worth Rs.30	साबुत लाल मिर्च तीस रुपये की	अबुल लाल जी तीस रुपये की	साबुत लाल मिर्च तीस रुपये की	साबुत लाल में टी सुनेगी	साबुत लाल वेज क्रीस्तीन रुपये की	साबूत लाल वेस्ट तीस रुपये की	साबूत लाल मिर्च तीस रुपये की
	jeera worth Rs.10	दस रुपये का जीरा	दस रुपये का धीरा	दस रुपये का जीरा	लस रुपये का जीरा	दस रुपये का जी रहा	दस रुपये का जीरा	दस रुपये का जिला
	colgate toothpaste, 100g, 1 piece	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलेटेड पे सौ ग्रामला एक पीस	कोलगेट टूथ प्रेस सौ ग्राम वाला एक पीस	कॉल के टूटते सोगरा वाला एक	कोलगेट दूसरे सौ ग्राम वाला एक पीस	कोलगेट टूथपेस्ट सौ ग्राम एक	कोलेट टू क्रिस्ट सौ ग्राम एक
	1 diapers huggies	एक डायपर्स हगीज का	गाय पर अभी इसका	एक नायक पर अगेंस्ट का	एक लाइट फॉर अभी इसका	एक लाइव फॉर सर इज का	एक डायपर हाकीश	डाई फॉर हनीश्का
	himalaya facewash neem, 1	हिमालया फेसवाश नीम वाला, एक	हिमालया फेस वाज नीम वाला एक	हिमालया पेसोस नेम वाला एक	हिमालयी सोर्स नीमवाला एक	नेमेसिस स्ट नेम वाला एक	हिमालय फेस वॉश नीम एक	हिमालया फेस स्वास नीम वाला एक
part 1 of name_variety_part 2 of name	garnier men powerwhite facewash	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर मेन पावर व्हाइट फेस वर्स	गार्नियर मेन पावर व्हाइट फेस सो	गार्नियर एंड आउट प्वाइंट वर राइट दे	कैरियर में और वेट फेस वॉश	गार्नियर मेन पावर व्हाइट फेस वॉश	गार्नियर मेन पावर व्हाइट फेस वॉश
synonyms	sabut lal mirch	साबुत / अक्का लाल मिर्च	साबुत अकाल आर भी	साबुत पक्का लाल में	साबुत लाल मिश्र	सबूत का लाल में	साबुत लाल मिर्च	शामुद्या लाल मिर्च
	sugar	शक्कर / चीनी	शक्कर चीनी	शक्कर	शक्कर चीनी	शक्कर चीनी	शक्कर चीनी	शक्कर चीनी
	sooji	खुला रवा / सूजी	खुला रवा / सूजी	कुल्ला रावा / सूजी	खुला रहा / सूजी	खुला रहा / सूजी	खुला रहा / सूजी	खुला रावा सूजी

Item callouts list (b)

Easily recognised

Recognised with difficulty

Not recognised

CATEGORY	instruction in ENGLISH	HINDI (expected)	User 1	User 2	User 3	User 4	User 5	User 6
name_variety_quantity	colgate toothpaste, 100g, 1 piece	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	बोलिए टू पे सो ग्राम वाला एक पीस	फॉरगेट दूसरे सौ ग्राम वाला एक पीस	कॉल के थ्रू से होगा वाला एक पीस	कोलगेट टूथ ने सौ ग्राम होगा मतलब एक पीस	कोलगेट टूथपेस्ट सौ ग्राम एक तीस	कोलगेट टू थ्री सौ ग्राम वाला एक पीस
name_quantity_variety	harpic 200ml 1, lavendar flavour	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	आर्थिक दो सोमेल एक लेवेंडर फेवर	आर पिंक दो सौ एम एल एक लेवेंडर फ़्लेवर	कार्तिक तो स्माल ए इलेवन फेवर	हेल्पिंग तो दो से मिले एक सेवन	हार्पिक दो सौ एम एल एक पीस लेवेंडर फ्लेवर	हार्पी दोस्त एमएल एक लेवेंडर फ्लेवर
variety_name_quantity numeral	100 ml lavendar harpic 1	सौ एमएल हार्पिक लेवेंडर, एक	सो एम एल आर पी कैलेंडर एक	सो एम एल मार पीजी वंडर ए	सो एम एल आर्थिक लेवेंडर एक	सो आई मीन हारलान डरी	सो एमएल हार्पिक लेवेंडर एक तीस	सो एम एल हार्पिक लेवेंडर एक
	oral b toothbrush	ओरल बी टूथब्रश	मोरल भी टू थोड़ा	ऑर बी टू सुरेश	हारल बी टू ड्रेस	और उनकी कुछ भ्रष्ट	पूरे भी दूर ब्रश	कोरल भी टूथब्रश
incomplete name, shortforms	1 huggies	एक हगीज	ठीक अभी	इज होमेज	एक ही इज	है गरागेस	एक आगे	एक आगे
	1 park avenue deo, voyage	एक पार्क एवेन्यू डीओ वोयाज	स्टेक फॉर रेवेन्यू डियो वोयाज	एक पार्क इवन न्यूज डियो वाइस	एक पार्क एवेन्यू डियोडरेंट वाइस	एक पार्किंग इन डियो आई	एक पार्क एवेन्यू डियो वोए	एक पार्क कैबिनेट यू वाइज

Item callouts list (c)

Easily recognised

Recognised with difficulty

Not recognised

Appendix-D

Edit distances and accuracy rates

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 1	आटा	आटा	0	100.00%
2	User 1	कैडबरी डेयरी मिल्क	कैडबरी डेल्ही मिल्क	3	83.00%
3	User 1	सेरेलक वीट एप्पल	सर लाइक वीट एपल	6	63.00%
4	User 1	कोलगेट सेंसिटिव टूथब्रश	कोलगेट इंस्टीट्यूट टू प्लस	13	43.00%
5	User 1	कोलगेट टूथपेस्ट सौ ग्राम	कोल गेट टू पे हंड्रेड ग्राम	10	58.00%
6	User 1	डेटोल लिक्विड पांच सौ एमएल	दैट ऑल लिक्विड पांच सौ मेल	6	77.00%
7	User 1	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ऑल लिक्विड एंड वास्ट टू हंड्रेड एमएल	19	41.00%
8	User 1	एक्लेयर्स	एक्लेयर्स	0	100.00%
9	User 1	गार्नियर मेन पॉवरव्हाइट	कैरियर मैन फेस वाज फॉर व्हाइट	15	35.00%
10	User 1	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर हंड्रेड एम एल	8	65.00%
11	User 1	हार्पिक लेवेंडर दो सौ एमएल	हार्पिक लेवेंडर टू हंड्रेड एम एल	10	62.00%
12	User 1	हिमालया नीम फेसवाश	हिमालया नेम फ्रेश वाज	6	67.00%
13	User 1	हगीज डायपर्स	हरीसाई पर	8	33.00%
14	User 1	जीरा	जीरा	0	100.00%
15	User 1	केलोग्स चौकोस	के लोग शो को	7	46.00%

Inventory items list: User 1(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 1	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	विल एंड डार्लिंग की नाइग्रा	17	48.00%
17	User 1	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	लाइज ऑल सरफेस क्लीनर टू हंड्रेड एमएल	12	60.00%
18	User 1	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	1	95.00%
19	User 1	ओरल बी क्रॉस एक्शन टूथब्रश	ओरल बी क्लास एक्शन टू ड्रा	5	81.00%
20	User 1	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	फॉर ए वेन्यू ड्यू रेनवाटर टू ट्वेंटी एमएल	28	42.00%
21	User 1	पीसी लाल मिर्च	पी सी लाल मिर्च	1	93.00%
22	User 1	साबुत लाल मिर्च	साबुत लाल में ए	4	73.00%
23	User 1	सफोला गोल्ड दो लीटर	सपोला गोल्ड दो लीटर	1	95.00%
24	User 1	सूजी / रवा	सूजी	6	40.00%
25	User 1	शुगर / चीनी / शक्कर	शुगर	15	21.00%
26	User 1	सर्फ एक्सेल मैटिक दो केजी	सर्फ एक्सेल मैटिक टू	7	72.00%
27	User 1	टेटली दार्जीलिंग टी (पच्चीस बैग)	बेट्टी जीन द ट्वेंटी फाइव	23	28.00%

Inventory items list: User 1(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 2	आटा	आटा	0	100.00%
2	User 2	कैडबरी डेयरी मिल्क	कैडबरी डेयरी मिल्क	0	100.00%
3	User 2	सेरेलक वीट एप्पल	सेलैक्वी टेल्स	9	44.00%
4	User 2	कोलगेट सेंसिटिव टूथब्रश	कॉल गेट सेंसिटिव टू क्रश	4	83.00%
5	User 2	कोलगेट टूथपेस्ट सौ ग्राम	कॉल गेट टूथपेस्ट सौ ग्राम	2	92.00%
6	User 2	डेटोल लिक्विड पांच सौ एमएल	डेटोल लिक्विड पांच सौ एमएल	0	100.00%
7	User 2	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ऑल लिक्विड एंड वाज सो सो एम एल	11	66.00%
8	User 2	एक्लेयर्स	डिक्लेर्स	3	67.00%
9	User 2	गार्नियर मेन पॉवरव्हाइट	गार्नियर मेन पावर व्हाइट	2	91.00%
10	User 2	हार्पिक लेवेंडर सौ एमएल	हार्पिक वंडर्स सो एम एल	7	70.00%
11	User 2	हार्पिक लेवेंडर दो सौ एमएल	हार्पिक वंडर्स दो सो एम एल	7	73.00%
12	User 2	हिमालया नीम फेसवाश	हिमालय नेम फेस्ट वाज	6	67.00%
13	User 2	हगीज डायपर्स	अगेश डायपर्स	3	75.00%
14	User 2	जीरा	जीरा	0	100.00%
15	User 2	केलोग्स चौकोस	कहलो चोकर्स	7	46.00%

Inventory items list: User 2(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 2	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	केट टर्न राइजिंग की ढाई सौ ग्राम	12	64.00%
17	User 2	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	लाइसेंस सर सर्फ एक्सेल क्लीनर दो सोमेल	18	40.00%
18	User 2	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	1	95.00%
19	User 2	ओरल बी क्रॉस एक्शन टूथब्रश	ओरल बी फ्रांस एक्शन टू क्रश	5	81.00%
20	User 2	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	पार्क वेन्यू डियोडोरेंटस वोयेज दो सौ बीस एमएल	9	81.00%
21	User 2	पीसी लाल मिर्च	पीसी लाल मिर्च	0	100.00%
22	User 2	साबुत लाल मिर्च	साबुत लाल मिर्च	0	100.00%
23	User 2	सफोला गोल्ड दो लीटर	सपोला गोल्ड दो लीटर	1	95.00%
24	User 2	सूजी / रवा	सूजी	6	40.00%
25	User 2	शुगर / चीनी / शक्कर	शुगर चिन्नी शक्कर	6	68.00%
26	User 2	सर्फ एक्सेल मैटिक दो केजी	सर फैक्स मेटिंग दो केजी	8	68.00%
27	User 2	टेटली दार्जीलिंग टी (पच्चीस बैग)	डेडली डार्जिलिंग टी पच्चीस में	9	72.00%

Inventory items list: User 2(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 3	आटा	आटा	0	100.00%
2	User 3	कैडबरी डेयरी मिल्क	फिर भी डेयरी मिल्क	5	72.00%
3	User 3	सेरेलक वीट एप्पल	शेलेक वीके	10	38.00%
4	User 3	कोलगेट सेंसिटिव टूथब्रश	कोल केस सेंसिटिव प्लेस	10	57.00%
5	User 3	कोलगेट टूथपेस्ट सौ ग्राम	कॉल की टूट के सो गया	14	42.00%
6	User 3	डेटोल लिक्विड पांच सौ एमएल	गेट ऑल लिक्विड फाइंड्स सो एम एस	11	58.00%
7	User 3	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ट्राली फील हेड वाज सो सो एम एल	20	38.00%
8	User 3	एक्लेयर्स	जीपीएस	8	11.00%
9	User 3	गार्नियर मेन पॉवरव्हाइट	गार्नियर मेन पावर व्हाइट	2	91.00%
10	User 3	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर स्वयं में	7	70.00%
11	User 3	हार्पिक लेवेंडर दो सौ एमएल	हैप्पी क्लेमेंटस दो फैमिल	13	50.00%
12	User 3	हिमालया नीम फेसवाश	ली माल्या नीम एस वाज	8	56.00%
13	User 3	हगीज डायपर्स	हैवीस्ट टाइप्स	8	33.00%
14	User 3	जीरा	जिरा	1	75.00%
15	User 3	केलोग्स चौकोस	क्लॉक्स	9	31.00%

Inventory items list: User 3(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 3	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	लिप्टन डार्जिलिंग टी टाइस होगा	10	70.00%
17	User 3	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	आइजोल सरफेस क्लीनर दो सौ एमएल	3	90.00%
18	User 3	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	1	95.00%
19	User 3	ओरल बी क्रॉस एक्शन टूथब्रश	फॉर वेल वी क्रॉस सेक्शन थ्रू	12	54.00%
20	User 3	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	पार्क केविन ड्यूरेंट वायर्स दो सौ बीस एमएल	17	65.00%
21	User 3	पीसी लाल मिर्च	किसी रायल मेस	8	43.00%
22	User 3	साबुत लाल मिर्च	साबू क्लाइमेक्स	9	40.00%
23	User 3	सफोला गोल्ड दो लीटर	सपोला गोल्ड टू लीटर्स	5	74.00%
24	User 3	सूजी / रवा	सूजी	6	40.00%
25	User 3	शुगर / चीनी / शक्कर	शुगर चीनी शक्कर	4	79.00%
26	User 3	सर्फ एक्सेल मैटिक दो केजी	सर सेसिल मेडिक टू के जी	11	56.00%

Inventory items list: User 3(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 4	आटा	आटा	0	100.00%
2	User 4	कैडबरी डेयरी मिल्क	कैन बे रेडी	13	28.00%
3	User 4	सेरेलक वीट एप्पल	नेटग्रिड एपल	11	31.00%
4	User 4	कोलगेट सेंसिटिव टूथब्रश	कॉल गेट्स सैटरडे यू टू	15	35.00%
5	User 4	कोलगेट टूथपेस्ट सौ ग्राम	पॉल गेट टूथ पे सो ग्राम	8	67.00%
6	User 4	डेटोल लिक्विड पांच सौ एमएल	टॉलिक वीट फाल्स ईमेल	15	42.00%
7	User 4	डेटोल लिक्विड हैंडवाश दो सौ एमएल	डेक्रीपिट एंड वॉज दोज सो एम एल	18	44.00%
8	User 4	एक्लेयर्स	डिक्लेर्स	3	67.00%
9	User 4	गार्नियर मेन पॉवरव्हाइट	नियर में ऑर व्हाइट	9	61.00%
10	User 4	हार्पिक लेवेंडर सौ एमएल	आर्थिक लेवेंडर सो ईमेल	6	74.00%
11	User 4	हार्पिक लेवेंडर दो सौ एमएल	आर्थिक लेवेंडर दोसो ईमेल	7	73.00%
12	User 4	हिमालया नीम फेसवाश	हिमालायन फेस वॉश	6	67.00%
13	User 4	हगीज डायपर्स	अभी साइट पर	9	25.00%
14	User 4	जीरा	जीरा	0	100.00%
15	User 4	केलोग्स चौकोस	के लोग जो कोर्स	8	38.00%

Inventory items list: User 4(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 4	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	लिप्टन डार्लिंग टीम प्रोग्राम	11	67.00%
17	User 4	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	राइस ऑफ सर्विस के	22	27.00%
18	User 4	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स स्टेक ऑफ फोर	5	77.00%
19	User 4	ओरल बी क्रॉस एक्शन टूथब्रश	फोर फॉर री प्रोजेक्शन टू क्रश	14	46.00%
20	User 4	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	आर्ग्यूड एंड वायर दो सौ बीस सेवन	27	44.00%
21	User 4	पीसी लाल मिर्च	किसी लाल मिस	5	64.00%
22	User 4	साबुत लाल मिर्च	साबुत लाल मिस	3	80.00%
23	User 4	सफोला गोल्ड दो लीटर	बोरा गोल्ड दो लीटर	3	84.00%
24	User 4	सूजी / रवा	सूजी	6	40.00%
25	User 4	शुगर / चीनी / शक्कर	शक्कर	14	26.00%
26	User 4	सर्फ एक्सेल मैटिक दो केजी	सेल में मैंने पिक कर दोगे जी	19	24.00%
27	User 4	टेटली दार्जीलिंग टी (पच्चीस बैग)	एट्टी डार्लिंग टीम व्हिच इज बैक	16	50.00%

Inventory items list: User 4(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 5	आटा	आटा	0	100.00%
2	User 5	कैडबरी डेयरी मिल्क	कैडबरी डेयरी मिल्क	0	100.00%
3	User 5	सेरेलक वीट एप्पल	सेरेलेक वीट एप्पल	1	94.00%
4	User 5	कोलगेट सेंसिटिव टूथब्रश	कोलगेट सेंसिटिव टूथब्रश	0	100.00%
5	User 5	कोलगेट टूथपेस्ट सौ ग्राम	कोलियर टू टेस्ट हंड्रेड ग्राम	12	50.00%
6	User 5	डेटोल लिक्विड पांच सौ एमएल	डेटोल लिक्विड फाइव हंड्रेड एमएल	10	62.00%
7	User 5	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ऑल लिक्विड एंड वॉज टू हंड्रेड एमएल	18	44.00%
8	User 5	एक्लेयर्स	डिक्लेर्स	3	67.00%
9	User 5	गार्नियर मेन पॉवरव्हाइट	गार्नियर मेन फेस वॉश पावर व्हाइट	10	57.00%
10	User 5	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर हंड्रेड एम एल	8	65.00%
11	User 5	हार्पिक लेवेंडर दो सौ एमएल	हार्पिक लेवेंडर टू हंड्रेड एम एल	10	62.00%
12	User 5	हिमालया नीम फेसवाश	हिमालायन नीम फेस वॉश	4	78.00%
13	User 5	हगीज डायपर्स	अगेंस्ट टाइप पर	11	8.00%
14	User 5	जीरा	जीरा	0	100.00%
15	User 5	केलोग्स चौकोस	क्लॉक्स चौकोर	4	69.00%

Inventory items list: User 5(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 5	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	कलेक्ट एंड दार्जिलिंग टी टू फिफ्टी ग्राम्स	19	42.00%
17	User 5	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	लाइज ऑल सर्विस क्लीनर टू हंड्रेड एमएल	15	50.00%
18	User 5	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	1	95.00%
19	User 5	ओरल बी क्रॉस एक्शन टूथब्रश	कोरल भी क्रॉस सेक्शन टूब्रश	6	77.00%
20	User 5	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	ऑर गिवेन यू टू यू एंड योर	37	23.00%
21	User 5	पीसी लाल मिर्च	पीसी लाल मिर्च	0	100.00%
22	User 5	साबुत लाल मिर्च	साबुत लाल मिर्च	0	100.00%
23	User 5	सफोला गोल्ड दो लीटर	सफला गोल्ड दो लीटर	1	95.00%
24	User 5	सूजी / रवा	सूजी	6	40.00%
25	User 5	शुगर / चीनी / शक्कर	शुगर	15	21.00%
26	User 5	सर्फ एक्सेल मैटिक दो केजी	सर्फ एक्सेल मैटिक क्यों क्लोज	8	68.00%
27	User 5	टेटली दार्जीलिंग टी (पच्चीस बैग)	टेटली डार्जिलिंग टी ट्वेंटी फाइव टी बैग्स	18	44.00%

Inventory items list: User 5(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 6	आटा	आटा	0	100.00%
2	User 6	कैडबरी डेयरी मिल्क	कैडबरी डेयरी मिल्क	0	100.00%
3	User 6	सेरेलक वीट एप्पल	सेरेलेक वीट एप्पल	1	94.00%
4	User 6	कोलगेट सेंसिटिव टूथब्रश	कोलगेट सेंसिटिव तो प्रेस	6	74.00%
5	User 6	कोलगेट टूथपेस्ट सौ ग्राम	कोलगेट टूथपेस्ट सौ ग्राम	0	100.00%
6	User 6	डेटोल लिक्विड पांच सौ एमएल	डेटोल लिक्विड पांच सौ एमएल	0	100.00%
7	User 6	डेटोल लिक्विड हैंडवाश दो सौ एमएल	दैट ओनली फीड हैंड वाज दो सौ एमएल	12	63.00%
8	User 6	एक्लेयर्स	एक्लेयर्स	0	100.00%
9	User 6	गार्नियर मेन पॉवरव्हाइट	गार्नियर मेन पावर व्हाइट	2	91.00%
10	User 6	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर सो एम एल	2	91.00%
11	User 6	हार्पिक लेवेंडर दो सौ एमएल	हार्पिक लेवेंडर दो सौ एम एल	1	96.00%
12	User 6	हिमालया नीम फेसवाश	हिमालायन इम्प्रेस वाज	9	50.00%
13	User 6	हगीज डायपर्स	अगेंस्ट टाइप पर	11	8.00%
14	User 6	जीरा	जीरा	0	100.00%
15	User 6	केलोग्स चौकोस	क्लॉक्स सोको	6	54.00%

Inventory items list: User 6(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
16	User 6	लिप्टन दार्जीलिंग टी ढाई सौ ग्राम	लेक्टरन दार्जिलिंग टी का सो ग्राम	7	79.00%
17	User 6	लाइज़ोल सरफेस क्लीनर दो सौ एमएल	लाइज ऑल सरफेस क्लीनर दो सौ में	6	80.00%
18	User 6	मैगी नूडल्स पैक ऑफ़ फोर	मैगी नूडल्स पैक ऑफ फोर	1	95.00%
19	User 6	ओरल बी क्रॉस एक्शन टूथब्रश	कोरल भी क्रॉस सेक्शन टूब्रश	6	77.00%
20	User 6	पार्क एवेन्यू डिओडोरेंट वोयाज (दो सौ बीस एमएल)	पार्क एवेन्यू डियोडरेंट वेज दो सौ बीस एम एल	10	79.00%
21	User 6	पीसी लाल मिर्च	पी सी लाल मिर्च	1	93.00%
22	User 6	साबुत लाल मिर्च	साबुत लाल मिर्च	0	100.00%
23	User 6	सफोला गोल्ड दो लीटर	सपोला बोर्ड टू लीटर्स	7	63.00%
24	User 6	सूजी / रवा	सूजी रवा	2	80.00%
25	User 6	शुगर / चीनी / शक्कर	शुगर	15	21.00%
26	User 6	सर्फ एक्सेल मैटिक दो केजी	सर्फ एक्सेल मैटिक दोगे जी	3	88.00%
27	User 6	टेटली दार्जीलिंग टी (पच्चीस बैग)	टेटली दार्जिलिंग भी पच्चीस पे	7	78.00%

Inventory items list: User 6(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 1	सूजी ढाई सौ ग्राम	सूजी राय सौ ग्राम	2	88.00%
2	User 1	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	0	100.00%
3	User 1	मैगी नूडल्स फोर पैक, थ्री पीस	मैगी नूडल्स फोर फैक्स थ्री पीस	3	90.00%
4	User 1	एक्लेयर्स छै पीस	अखिलेश के बीस	10	38.00%
5	User 1	लाल मिर्च ट्वेंटी फाइव ग्राम्स	लाइव मिस्टर ट्वेंटी फाइव ग्राम	7	77.00%
6	User 1	शुगर थ्री केजी	शुगर थ्री केजी	0	100.00%
7	User 1	शुगर तीन किलो	शुगर तीन किलो	0	100.00%
8	User 1	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	डेटाल लिली पारसोल वन पीस	16	54.00%
9	User 1	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	डेटाल लिक्विड हैंड वाश दो सौ एम एल एक पीय	6	85.00%
10	User 1	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैगी नूडल्स पैक ऑफ फोर एक	2	92.00%
11	User 1	हगीज डायपर्स, दो	अगीस डाई पर दो	7	56.00%
12	User 1	चौकोस एक	चौको एक	1	88.00%
13	User 1	पाव किलो सूजी	पाव किलो सूजी	0	100.00%
14	User 1	चार पैकेट मैगी	चार पैकेट महंगी	2	86.00%
15	User 1	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 1	चार किलो आटा	चार किलो आटा	0	100.00%
17	User 1	दस एक्लेयर्स	व्हाट सेकुलर्स	10	17.00%

Items callout list: User 1(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 1	एक ओरल बी क्रॉस एक्शन	एक ओरल बी क्रॉस एक्शन	0	100.00%
19	User 1	हार्पिक लेवेंडर सौ एमएल	आर पीक लेवेंडर सो एम एल	6	74.00%
20	User 1	साबुत लाल मिर्च तीस रुपये की	अबुल लाल जी तीस रुपये की	8	71.00%
21	User 1	दस रुपये का जीरा	दस रुपये का धीरा	1	94.00%
22	User 1	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलेटेड पे सौ ग्रामला एक पीस	13	66.00%
23	User 1	एक डायपर्स हगीज का	गाय पर अभी इसका	12	33.00%
24	User 1	हिमालया फेसवाश नीम वाला, एक	हिमालया फेस वाज नीम वाला एक	3	89.00%
25	User 1	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर मेन पावर व्हाइट फेस वर्स	8	71.00%
26	User 1	साबुत / अक्का लाल मिर्च	साबुत अकाल आर भी	12	48.00%
27	User 1	शक्कर / चीनी	शक्कर चीनी	2	83.00%
28	User 1	खुला रवा / सूजी	खुला रवा / सूजी	0	100.00%
29	User 1	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	बोलिए टू पे सो ग्राम वाला एक पीस	11	71.00%
30	User 1	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	आर्थिक दो सोमेल एक लेवेंडर फेवर	12	68.00%
31	User 1	सौ एमएल हार्पिक लेवेंडर, एक	सो एम एल आर पी कैलेंडर एक	11	59.00%
32	User 1	ओरल बी टूथब्रश	मोरल भी टू थोड़ा	8	43.00%
33	User 1	एक हगीज	ठीक अभी	5	29.00%
34	User 1	एक पार्क एवेन्यू डीओ वोयाज	स्टेक फॉर रेवेन्यू डियो वोयाज	13	50.00%

Items callout list: User 1(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 2	सूजी ढाई सौ ग्राम	सूजी ढाई सौ ग्राम	0	100.00%
2	User 2	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	0	100.00%
3	User 2	मैगी नूडल्स फोर पैक, थ्री पीस	में डीलर्स फॉर फैक्ट थ्री पीस	11	62.00%
4	User 2	एक्लेयर्स छै पीस	एक लेट्स से फीस	6	63.00%
5	User 2	लाल मिर्च ट्वेंटी फाइव ग्राम्स	लाल मिर्च ट्वेंटी फाइव ग्राम	2	93.00%
6	User 2	शुगर थ्री केजी	शुगर थ्री केजी	0	100.00%
7	User 2	शुगर तीन किलो	शुगर तीन किलो	0	100.00%
8	User 2	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	यू टोल्ड लिक्विड पांच सौ एम एल वन टी	10	71.00%
9	User 2	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	लेट ऑल लिक्विड हैंड वाज दो सौ एम एल एक पीस	8	80.00%
10	User 2	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैगी नूडल्स पैक ऑफ फोर एक्स	4	85.00%
11	User 2	हगीज डायपर्स, दो	आगे तय कर दो	10	38.00%
12	User 2	चौकोस एक	चौकोस एक	0	100.00%
13	User 2	पाव किलो सूजी	ओके ये सूजी	7	46.00%
14	User 2	चार पैकेट मैगी	चार पैकेट मैगी	0	100.00%
15	User 2	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 2	चार किलो आटा	चार किलो आटा	0	100.00%
17	User 2	दस एक्लेयर्स	दस ही क्लेयर्स	3	75.00%

Items callout list: User 2(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 2	एक ओरल बी क्रॉस एक्शन	ए कोरल वी प्रोटेक्शन	8	62.00%
19	User 2	हार्पिक लेवेंडर सौ एमएल	आर पी क्लाइंट्स सो एम एल	14	39.00%
20	User 2	साबुत लाल मिर्च तीस रुपये की	साबुत लाल मिर्च तीस रुपये की	0	100.00%
21	User 2	दस रुपये का जीरा	दस रुपये का जीरा	0	100.00%
22	User 2	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट टूथ प्रेस सौ ग्राम वाला एक पीस	7	82.00%
23	User 2	एक डायपर्स हगीज का	एक नायक पर अगेंस्ट का	11	39.00%
24	User 2	हिमालया फेसवाश नीम वाला, एक	हिमालया पेसोस नेम वाला एक	6	78.00%
25	User 2	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर मेन पावर व्हाइट फेस सो	7	75.00%
26	User 2	साबुत / अक्का लाल मिर्च	साबुत पक्का लाल में	7	70.00%
27	User 2	शक्कर / चीनी	शक्कर	7	42.00%
28	User 2	खुला रवा / सूजी	कुल्ला रावा / सूजी	4	73.00%
29	User 2	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	फॉरगेट दूसरे सौ ग्राम वाला एक पीस	11	71.00%
30	User 2	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	आर पिंक दो सौ एम एल एक लेवेंडर फ़्लेवर	7	82.00%
31	User 2	सौ एमएल हार्पिक लेवेंडर, एक	सो एम एल मार पीजी वंडर ए	12	56.00%
32	User 2	ओरल बी टूथब्रश	ऑर बी टू सुरेश	6	57.00%
33	User 2	एक हगीज	इज होमेज	5	29.00%
34	User 2	एक पार्क एवेन्यू डीओ वोयाज	एक पार्क इवन न्यूज डियो वाइस	11	58.00%

Items callout list: User 2(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 3	सूजी ढाई सौ ग्राम	सूजी ढाई सौ ग्राम	0	100.00%
2	User 3	सूजी दो सौ पचास ग्राम	स्वीट जी दो सौ पचास का	9	57.00%
3	User 3	मैगी नूडल्स फोर पैक, थ्री पीस	नेगेटिव फॉरेक्स थ्री पीस	16	45.00%
4	User 3	एक्लेयर्स छै पीस	इट एस जे पी	11	31.00%
5	User 3	लाल मिर्च ट्वेंटी फाइव ग्राम्स	लाल वेज ट्वेंटी फाइव ग्राम्स	5	83.00%
6	User 3	शुगर थ्री केजी	सुबह श्री जी जी	7	50.00%
7	User 3	शुगर तीन किलो	सुबह तीन किलो	3	77.00%
8	User 3	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	रेट ऑल लिखित फाइन सो एम एल वन पीस	14	60.00%
9	User 3	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	सेट्रो लिक्विड हैंड वाज़ जो स्वाल एक पीस	14	66.00%
10	User 3	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैकिनेक फोर एक	15	42.00%
11	User 3	हगीज डायपर्स, दो	स्विस राइटर्स दो	9	44.00%
12	User 3	चौकोस एक	चौके एक	2	75.00%
13	User 3	पाव किलो सूजी	ऑफ यू सूजी	7	46.00%
14	User 3	चार पैकेट मैगी	चार पैकेट मैगी	0	100.00%
15	User 3	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 3	चार किलो आटा	चार किलो वाटा	2	83.00%
17	User 3	दस एक्लेयर्स	जस्ट सिक्स	9	25.00%

Items callout list: User 3(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 3	एक ओरल बी क्रॉस एक्शन	एक और एल वी क्रॉस एक्शन	4	81.00%
19	User 3	हार्पिक लेवेंडर सौ एमएल	हैप्पी लेवेंडर सो ईमेल	7	70.00%
20	User 3	साबुत लाल मिर्च तीस रुपये की	साबुत लाल में टी सुनेगी	11	61.00%
21	User 3	दस रुपये का जीरा	लस रुपये का जीरा	1	94.00%
22	User 3	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कॉल के टूटते सोगरा वाला एक	19	50.00%
23	User 3	एक डायपर्स हगीज का	एक लाइट फॉर अभी इसका	12	33.00%
24	User 3	हिमालया फेसवाश नीम वाला, एक	हिमालयी सोर्स नीमवाला एक	9	67.00%
25	User 3	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर एंड आउट प्वाइंट वर राइट दे	19	32.00%
26	User 3	साबुत / अक्का लाल मिर्च	साबुत लाल मिश्र	10	57.00%
27	User 3	शक्कर / चीनी	शक्कर चीनी	2	83.00%
28	User 3	खुला रवा / सूजी	खुला रहा / सूजी	1	93.00%
29	User 3	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कॉल के थ्रू से होगा वाला एक पीस	17	55.00%
30	User 3	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	कार्तिक तो स्माल ए इलेवन फेवर	18	53.00%
31	User 3	सौ एमएल हार्पिक लेवेंडर, एक	सो एम एल आर्थिक लेवेंडर एक	6	78.00%
32	User 3	ओरल बी टूथब्रश	हारल बी टू ड्रेस	6	57.00%
33	User 3	एक हगीज	एक ही इज	3	57.00%
34	User 3	एक पार्क एवेन्यू डीओ वोयाज	एक पार्क एवेन्यू डियोडरेंट वाइस	12	54.00%

Items callout list: User 3(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 4	सूजी ढाई सौ ग्राम	सुजीत ढाई सौ ग्राम	2	88.00%
2	User 4	सूजी दो सौ पचास ग्राम	सुजीत दो सौ पचास ग्राम	2	90.00%
3	User 4	मैगी नूडल्स फोर पैक, थ्री पीस	मैगी नूडल्स फॉर फैक्ट्री पीस	5	83.00%
4	User 4	एक्लेयर्स छै पीस	प्लेयर्स से भी	6	63.00%
5	User 4	लाल मिर्च ट्वेंटी फाइव ग्राम्स	सालवेज ट्वेंटी फाइव ग्राम्स	7	77.00%
6	User 4	शुगर थ्री केजी	शुगर थ्री केजी	0	100.00%
7	User 4	शुगर तीन किलो	शुगर तीन किलो	0	100.00%
8	User 4	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	दैट ऑल लिक्विड पांच सौ एमएल वन पीस	6	83.00%
9	User 4	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	दैट ऑल लिक्विड एंड वाइस दो सौ एम एल एक पीस	11	73.00%
10	User 4	मैगी नूडल्स पैक ऑफ़ फोर, एक	इन्होंने सामने वह फोर एक	17	35.00%
11	User 4	हगीज डायपर्स, दो	जुलाई सुनाई पर दो	13	19.00%
12	User 4	चौकोस एक	चौकों से एक	3	63.00%
13	User 4	पाव किलो सूजी	एक पागल सूची	8	38.00%
14	User 4	चार पैकेट मैगी	चार पैकेट मैगी	0	100.00%
15	User 4	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 4	चार किलो आटा	चार किलो आटा	0	100.00%
17	User 4	दस एक्लेयर्स	प्लस सिक्स	10	17.00%

Items callout list: User 4(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 4	एक ओरल बी क्रॉस एक्शन	एक ओरल बी क्लास एक्शन	2	90.00%
19	User 4	हार्पिक लेवेंडर सौ एमएल	आर पीक लेवेंडर सो एम एल	6	74.00%
20	User 4	साबुत लाल मिर्च तीस रुपये की	साबुत लाल वेज क्रीस्तीन रुपये की	10	64.00%
21	User 4	दस रुपये का जीरा	दस रुपये का जी रहा	2	88.00%
22	User 4	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट दूसरे सौ ग्राम वाला एक पीस	8	79.00%
23	User 4	एक डायपर्स हगीज का	एक लाइव फॉर सर इज का	11	39.00%
24	User 4	हिमालया फेसवाश नीम वाला, एक	नेमेसिस स्ट नेम वाला एक	13	52.00%
25	User 4	गार्नियर मेन पॉवरवाइट फेसवाश	कैरियर में और वेट फेस वॉश	13	54.00%
26	User 4	साबुत / अक्का लाल मिर्च	सबूत का लाल में	11	52.00%
27	User 4	शक्कर / चीनी	शक्कर चीनी	2	83.00%
28	User 4	खुला रवा / सूजी	खुला रहा / सूजी	1	93.00%
29	User 4	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट टूथ ने सौ ग्राम होगा मतलब एक पीस	14	63.00%
30	User 4	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	हेल्पिंग तो दो से मिले एक सेवन	24	37.00%
31	User 4	सौ एमएल हार्पिक लेवेंडर, एक	सो आई मीन हारलान डरी	19	30.00%
32	User 4	ओरल बी टूथब्रश	और उनकी कुछ भ्रष्ट	13	7.00%
33	User 4	एक हगीज	है गरागेस	7	0.00%
34	User 4	एक पार्क एवेन्यू डीओ वोयाज	एक पार्किंग इन डियो आई	15	42.00%

Items callout list: User 4(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 5	सूजी ढाई सौ ग्राम	सूजी ढाई सौ ग्राम	0	100.00%
2	User 5	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	0	100.00%
3	User 5	मैगी नूडल्स फोर पैक, थ्री पीस	मैगी नूडल्स फोर पैक थ्री पीसेज	3	90.00%
4	User 5	एक्लेयर्स छै पीस	एक्लेयर्स छे पीस	1	94.00%
5	User 5	लाल मिर्च ह्वेंटी फाइव ग्राम्स	लाल मिर्च ह्वेंटी फाइव ग्राम	2	93.00%
6	User 5	शुगर थ्री केजी	शुगर थ्री केजी	0	100.00%
7	User 5	शुगर तीन किलो	शुगर तीन किलो	0	100.00%
8	User 5	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	टेट ऑल लिक्विड पांच सौ एमएल वन वन पीस	7	80.00%
9	User 5	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	दैट ऑल लिक्विड एंड वार्ड दो सौ एम एल एक पीस	12	71.00%
10	User 5	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैगी नूडल्स पैक ऑफ फोर एक	2	92.00%
11	User 5	हगीज डायपर्स, दो	हगीज डायपर्स दो	1	94.00%
12	User 5	चौकोस एक	चौको एक	1	88.00%
13	User 5	पाव किलो सूजी	भाव किलो सूजी	1	92.00%
14	User 5	चार पैकेट मैगी	चार पैक मांगी	4	71.00%
15	User 5	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 5	चार किलो आटा	चार किलो आटा	0	100.00%
17	User 5	दस एक्लेयर्स	दस क्लेयर्स	1	92.00%

Items callout list: User 5(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 5	एक ओरल बी क्रॉस एक्शन	एक ओरल बी क्रॉस एक्शन	0	100.00%
19	User 5	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर सौ एमएल	0	100.00%
20	User 5	साबुत लाल मिर्च तीस रुपये की	साबूत लाल वेस्ट तीस रुपये की	5	82.00%
21	User 5	दस रुपये का जीरा	दस रुपये का जीरा	0	100.00%
22	User 5	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट टूथपेस्ट सौ ग्राम एक	11	71.00%
23	User 5	एक डायपर्स हगीज का	एक डायपर हाकीश	7	61.00%
24	User 5	हिमालया फेसवाश नीम वाला, एक	हिमालय फेस वॉश नीम एक	9	67.00%
25	User 5	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर मेन पावर व्हाइट फेस वॉश	6	79.00%
26	User 5	साबुत / अक्का लाल मिर्च	साबुत लाल मिर्च	8	65.00%
27	User 5	शक्कर / चीनी	शक्कर चीनी	2	83.00%
28	User 5	खुला रवा / सूजी	खुला रहा / सूजी	1	93.00%
29	User 5	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट टूथपेस्ट सौ ग्राम एक तीस	8	79.00%
30	User 5	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	हार्पिक दो सौ एम एल एक पीस लेवेंडर फ्लेवर	7	82.00%
31	User 5	सौ एमएल हार्पिक लेवेंडर, एक	सो एमएल हार्पिक लेवेंडर एक तीस	6	78.00%
32	User 5	ओरल बी टूथब्रश	पूरे भी दूर ब्रश	7	50.00%
33	User 5	एक हगीज	एक आगे	3	57.00%
34	User 5	एक पार्क एवेन्यू डीओ वोयाज	एक पार्क एवेन्यू डियो वोए	6	77.00%

Items callout list: User 5(b)

S.no.	User	Expected	Actual	Edit distance	Accuracy
1	User 6	सूजी ढाई सौ ग्राम	सूजी आइसो ग्राम	5	71.00%
2	User 6	सूजी दो सौ पचास ग्राम	सूजी दो सौ पचास ग्राम	0	100.00%
3	User 6	मैगी नूडल्स फोर पैक, थ्री पीस	मैगजीन्स फोर पैक थ्री पीस	6	79.00%
4	User 6	एक्लेयर्स छै पीस	रेकलेस केपी	10	38.00%
5	User 6	लाल मिर्च ट्वेंटी फाइव ग्राम्स	लाल वेल्स ट्वेंटी फाइव ग्राम्स	4	87.00%
6	User 6	शुगर थ्री केजी	शुगर थ्री केजी	0	100.00%
7	User 6	शुगर तीन किलो	शुगर तीन किलो	0	100.00%
8	User 6	डेटोल लिक्विड, पांच सौ एमएल, वन पीस	डेटेलिंग विट पारसमल वन पीस	16	54.00%
9	User 6	डेटोल लिक्विड हैंडवाश, दो सौ एमएल, एक पीस	लेटर लिक्विड हैंड वाज दो सो वे मेक पीस	14	66.00%
10	User 6	मैगी नूडल्स पैक ऑफ़ फोर, एक	मैगी नूडल्स पैक ऑफ फोर एक	2	92.00%
11	User 6	हगीज डायपर्स, दो	अगली लाइन पर दो	10	38.00%
12	User 6	चौकोस एक	सौ कोस एक	2	75.00%
13	User 6	पाव किलो सूजी	पागलों सुजीत	7	46.00%
14	User 6	चार पैकेट मैगी	चार पैकेट महंगी	2	86.00%
15	User 6	तीन केजी शुगर	तीन केजी शुगर	0	100.00%
16	User 6	चार किलो आटा	चार किलो आटा	0	100.00%
17	User 6	दस एक्लेयर्स	दस एक्लेयर्स	0	100.00%

Items callout list: User 6(a)

S.no.	User	Expected	Actual	Edit distance	Accuracy
18	User 6	एक ओरल बी क्रॉस एक्शन	एक ओरल भी प्रोसेशन	7	67.00%
19	User 6	हार्पिक लेवेंडर सौ एमएल	हार्पिक लेवेंडर सौ एमएल	0	100.00%
20	User 6	साबुत लाल मिर्च तीस रुपये की	साबूत लाल मिर्च तीस रुपये की	1	96.00%
21	User 6	दस रुपये का जीरा	दस रुपये का जिला	2	88.00%
22	User 6	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलेट टू क्रिस्ट सौ ग्राम एक	17	55.00%
23	User 6	एक डायपर्स हगीज का	डाई फॉर हनीश्का	11	39.00%
24	User 6	हिमालया फेसवाश नीम वाला, एक	हिमालया फेस स्वास नीम वाला एक	5	81.00%
25	User 6	गार्नियर मेन पॉवरवाइट फेसवाश	गार्नियर मेन पावर व्हाइट फेस वॉश	6	79.00%
26	User 6	साबुत / अक्का लाल मिर्च	शामुद्या लाल मिर्च	9	61.00%
27	User 6	शक्कर / चीनी	शक्कर चीनी	2	83.00%
28	User 6	खुला रवा / सूजी	खुला रावा सूजी	3	80.00%
29	User 6	कोलगेट टूथपेस्ट, सौ ग्राम वाला, एक पीस	कोलगेट टू थ्री सौ ग्राम वाला एक पीस	7	82.00%
30	User 6	हार्पिक दो सौ एमएल, एक, लेवेंडर फ़्लेवर	हार्पी दोस्त एमएल एक लेवेंडर फ्लेवर	8	79.00%
31	User 6	सौ एमएल हार्पिक लेवेंडर, एक	सो एम एल हार्पिक लेवेंडर एक	3	89.00%
32	User 6	ओरल बी टूथब्रश	कोरल भी टूथब्रश	3	79.00%
33	User 6	एक हगीज	एक आगे	3	57.00%
34	User 6	एक पार्क एवेन्यू डीओ वोयाज	एक पार्क कैबिनेट यू वाइज	13	50.00%

Items callout list: User 6(b)