EEL 4914 Senior Design 1

RecipeTop: An interactive countertop and recipe preparation assistant

University of Central Florida
Department of Electrical and Computer Engineering
Dr. Lei Wei

Initial Project Document and Group Identification
Divide and Conquer

September 14th, 2018

Group 7

Geraldine Versfeld	Electrical Engineer	geraversfeld@knights.ucf.edu
Miguel Ramirez	Computer Engineer	miramirez@knights.ucf.edu
Jason Portillo	Computer Engineer	jasonlportillo@knights.ucf.edu
Edwin Santiago	Electrical Engineer	santiagoe@knights.ucf.edu

Project Narrative

Have you ever experienced the frustration of trying to read a recipe on your phone when your hands were covered in flour? Or realized once you began to smell the smoke of your burnt brownies that you never set a timer for the oven?

Imagine a kitchen counter that could keep you organized while you are cooking and baking. An interactive countertop that could wirelessly connect to other kitchen appliances to automatically preheat your oven, set timers, and weigh your ingredients. This countertop could help you follow recipes and avoid making your phone or tablet a flour covered mess. RecipeTop will keep your recipes organized, help you find new recipes, and walk you through the steps of a recipe to learn new cooking skills. Our interactive countertop could also help you reduce food waste by suggesting recipes for the ingredients that a user already has on the counter.

The home is rapidly evolving into a technology based environment that assists users in a variety of daily tasks ranging from turning on lights to creating reminders or setting up appointments. Technology based assistance has the potential to revolutionize the way we interact with everyday objects and appliances in our homes. Companies like GE and KitchenAid have prototyped ideas for and developed products that integrate technology into the kitchen. Products that are currently available range from smart scales that can assist in meal planning to smart microwaves that use object detection to estimate cook times. Some companies have developed demos or prototypes of an interactive, smart countertop but there are currently no models available on the general market. Virtual assistants like Amazon's Alexa or Google Assistant can set timers and turn on appliances using voice recognition.

Our goal is to create a fully interactive countertop display that can seamlessly interface with other kitchen appliances or smart home products to make cooking simpler. RecipeTop will keep previously used recipes organized, allow users to easily search for new recipes, suggest recipes for the ingredients they have, and make following any recipe easy.

RecipeTop will be an affordable, user-friendly, and easy-to-clean addition to any smart kitchen. We hope to integrate image processing, computer vision, and machine learning to make our countertop more interactive and develop better recipe suggestions. An embedded scale will make weighing out ingredients and following recipes easier. RecipeTop will also have the capability to start preheating the oven, control cooking temperature, and set timers as the user progresses through a recipe. We aim to develop a recipe assistant that can intuitively guide users through a recipe and teach them new cooking skills. Consumer safety and food safety will both be priorities throughout the design process.

RecipeTop will change the way that users interact with everyday kitchen appliances, making cooking a simpler task with instructions, cooking temperatures, and timers all organized in one centralized display. We hope to create a product that is both easy and fun to use, allowing users to get more out of their cooking experience.

Specifications

Display

A primary component of the project will be the interactive display that will allow the user to see information such as date, time, recipes stored, and current step on the recipe. Due to the display being a surface which must be durable and be able to support heavy plates, foods, and appliances, it can not be a typical touch based screen. Therefore, the display will either be projected from above or below.

- Diagonal Display Size: ≥ 40 *in*
- Surface thickness: TBD
- Refresh Rate: TBD

User Interaction

To allow the user to interact with the display and perform actions or move onto the next step of a recipe we will implement a multi-touch surface and/or a gesture recognition system. As the user is typically cooking while using the product, their hands might be unclean showing many benefits to a gesture recognition system, however, a touch screen display allows for more intuitive utility.

- Response Time: ≤ 200 *ms*
- Camera/IR Camera

Computer

Due to the large amount of graphics and UI, we have decided to implement a computer to be able to meet our requirements. A computer will be needed to handle the User Interface, the back end processing, the computer vision, and the communication with other kitchen appliances.

Scale

While cooking, the user often has to measure out several ingredients by weight. Therefore, a scale will be integrated with the RecipeTop which enables users to weigh their ingredients and quickly move on to the next step.

Optional Features/Stretch Goals

- Advanced computer vision features: automatically recognize recipe ingredients placed on counter, suggest recipes based on objects placed on counter
- Machine learning: Recipe Analysis and suggestion
- Fitness/Healthy Lifestyle tracking/encouragement
- Voice Recognition
- Online recipe search
- Alexa Integration

Block Diagrams and Illustrations

The block diagram shown in Figure 1 shows the top level set-up for the project. A legend is available to match sections that are colored to who is responsible for leading the effort on that subject. Every member is responsible for their section but will not be alone in the effort. All members are to help out in any section where needed. Jason will be responsible for the multi-touch display technology used and for the computer that will be interfacing with the design. Geraldine will be responsible for the web camera. Miguel will be responsible for the projector whether it be over or under the surface of the table. Edwin will be responsible interfacing wirelessly with the scales and kitchen appliances. Group efforts will be conducted on the power supply and user input interface.

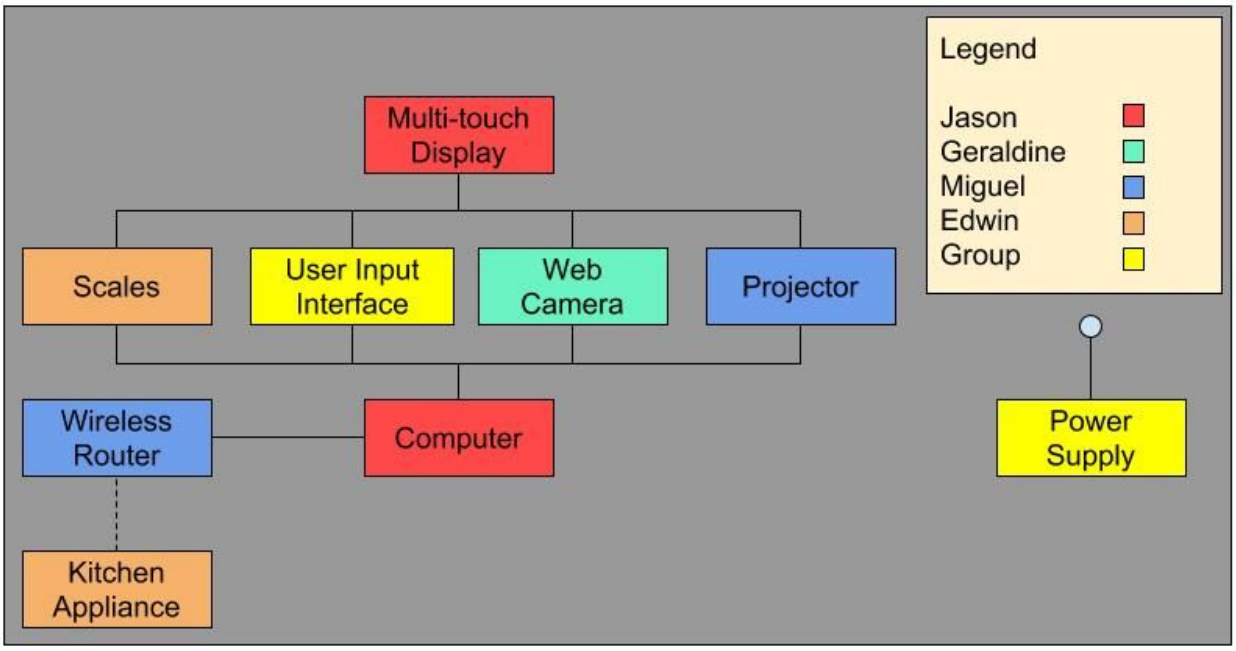


Figure 1. Hardware Block Diagram

The important aspects of the software required for our project are summarized below in figure 2. Computer vision and image processing will be used to interpret user input and process the camera output. This information will be used to understand user gestures to navigate through the application. Computer vision will be used to assist in recipe task completion and recipe suggestion. The scale and oven interface will help the user complete the recipe. Miguel will be in charge of the user interface and front end development. Edwin will be responsible for wireless communications. Jason will work on processing user input and application backend. Gera will be responsible for computer vision, recipe suggestions, and UX design.

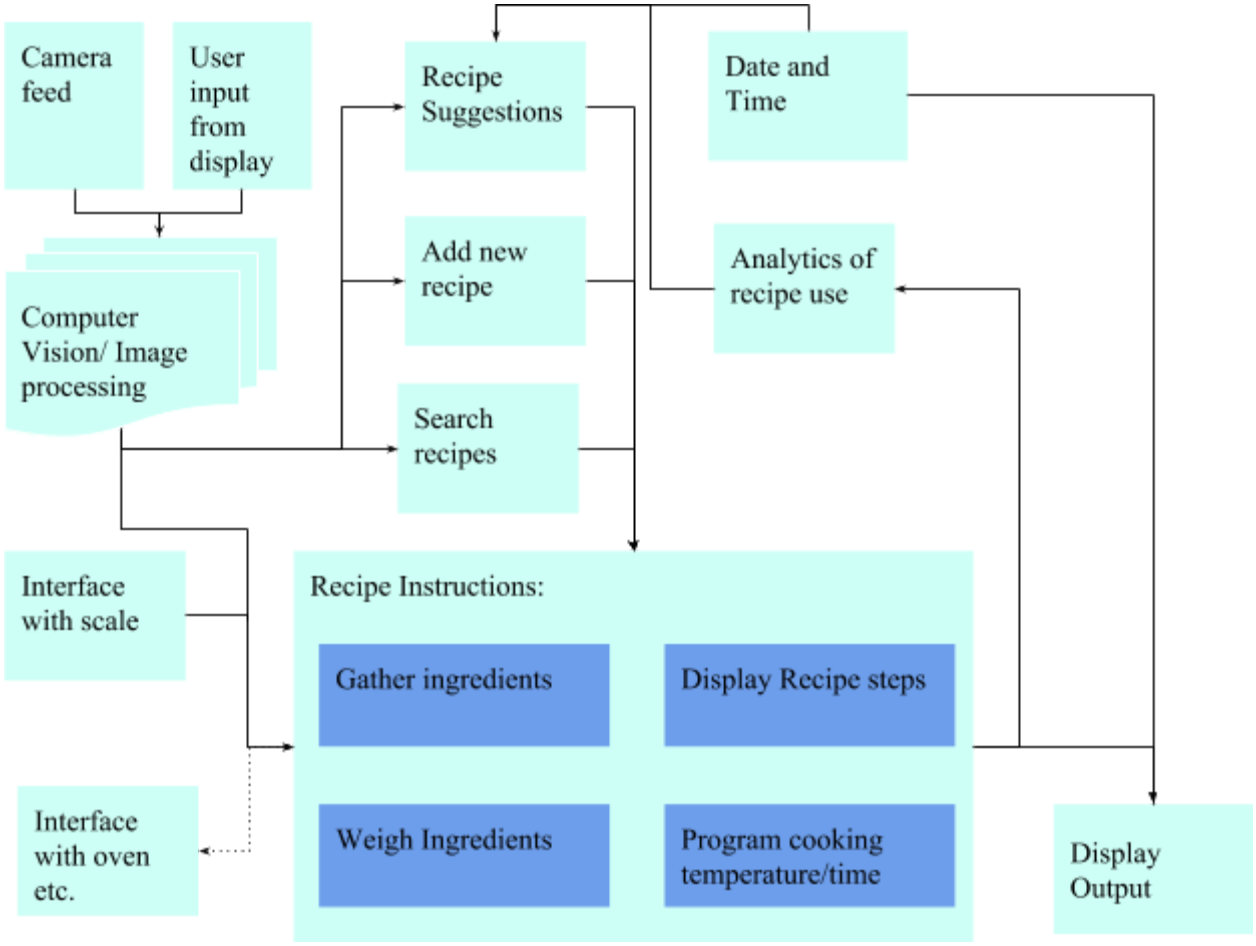


Figure 2. Block Diagram of Major Software Components

Project Budget

Our project thus far is not backed by any sponsors, so for our budget, all of our members pledged to put in $500 each, which puts our budget at $2000. What we expect to be the most of expensive parts of our project are the computer, glass, projector and wood components. Another possible expensive component may be the LEDs because of the quality and depending on the size of our board, the quantity of LEDs may factor in as well. It is important to note that the cost of our project is all due to hardware components. The software components expected to be used in our project will be free or open source software.

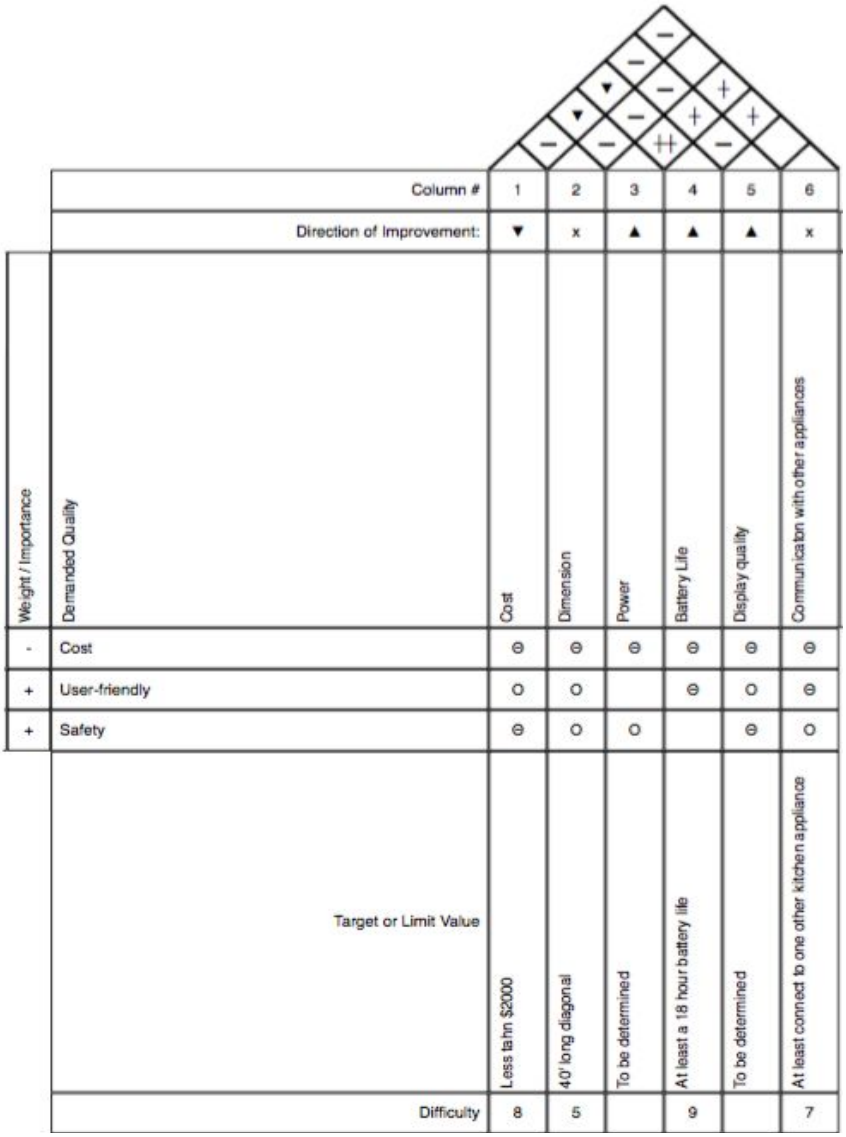
Our goal of keeping under $2000 is because of our personal budget. The reason that we each pledged $500 is because looking at past projects similar to ours, the cost of these projects ranged from $800-$3000. Our goal is be able to design a sleek modern kitchen appliance but at the same time not be too expensive.

Item	Cost
PCB	$70
LEDs	$60
CPU	$110
Storage	$100
Memory	$60
Mother Board	$70
Power Supply	$50
GPU	$130
Cooling Fans	$60
Projector	$60
Toaster Oven	$25
Display glass	$120
Total	$830

Figure 3. Table of estimated costs

House of Quality

The house of quality diagram presented below is a visual representation of our project's consumer requirements and engineering requirements set for our project. It also represents how our engineering requirements and the consumer's correlate to each other, as well as how the engineering requirements correlate to each other as well.



Weight / Importance	Demanded Quality	Cost	Dimension	Power	Battery Life	Display quality	Communication with other appliances
	Column #	1	2	3	4	5	6
	Direction of Improvement:	▼	x	▲	▲	▲	x
-	Cost	⊖	⊖	⊖	⊖	⊖	⊖
+	User-friendly	O	O		⊖	O	⊖
+	Safety	⊖	O	O		⊖	O
	Target or Limit Value	Less tahn $2000	40' long diagonal	To be determined	At least a 18 hour battery life	To be determined	At least connect to one other kitchen appliance
	Difficulty	8	5		9		7

Figure 4. House of Quality

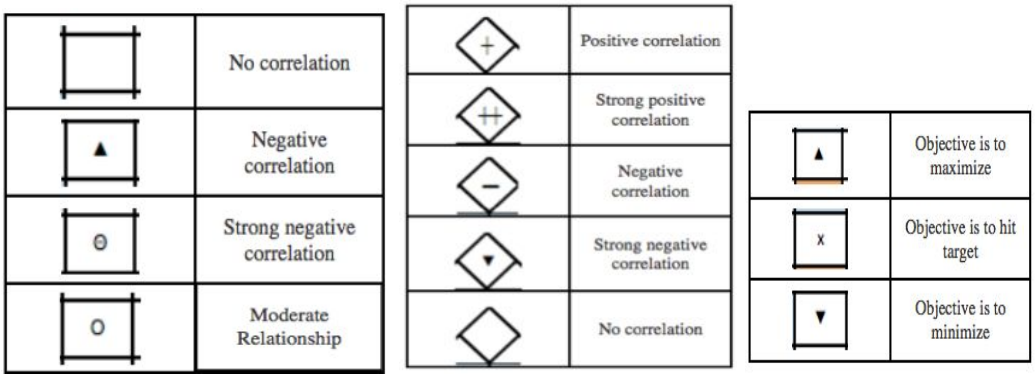


Figure 5. Key for consumer to engineering, engineering to engineering, and direction of improvement for requirements in house of quality

Consumer requirements

The presumable consumer requirements consisted of cost, user-friendly, and safety. Although there is nothing like this on the market yet, one of the key consumer requirements would be cost. Because our project is geared toward the smart appliance, some people may be put off by the name and assume that the product would be expensive. Ideally we would want our product to be as user-friendly as possible. This can include things such as means easy to use UI, stress-free, and fast responsive time. Regarding safety, anything involving food raises a few concerns. The consumer would want to be sure that the material that the food touches is safe.

Engineering requirements

Our foreseeable engineering requirements for this project will be cost, dimensions, power, battery life, display quality, and the ability to communicate with another kitchen appliance. The cost relates to the consumer cost, the more we spend on our project the more the consumer will end up having to pay. Our goal is to stay within the group's budget. Regarding power, we want to make sure that our appliance has enough power to maintain functionality throughout the system as well as the battery life to be around 18 hours. Our display quality will depend if we go the top down projector to hardtop or projector under glass touch screen. This will also depend on the dimensions of our countertop, because depending on the size, one method may be more advantageous than the other. One of the key features that we want to implement is our countertop connecting to another kitchen appliance, like a microwave or an oven.

Project Milestones

The important project milestones and deadlines are summarized in figure 2 below. The first phase of the project will be the development of engineering requirements and high-level design choices. This phase will predominantly consist of research into currently available technology and evidence based design decisions. The next phase will be design of hardware and development of software which will involve further research into components availability and compatibility. Finally the last stage will be report writing which will simply be a more formal presentation of our research and design work.

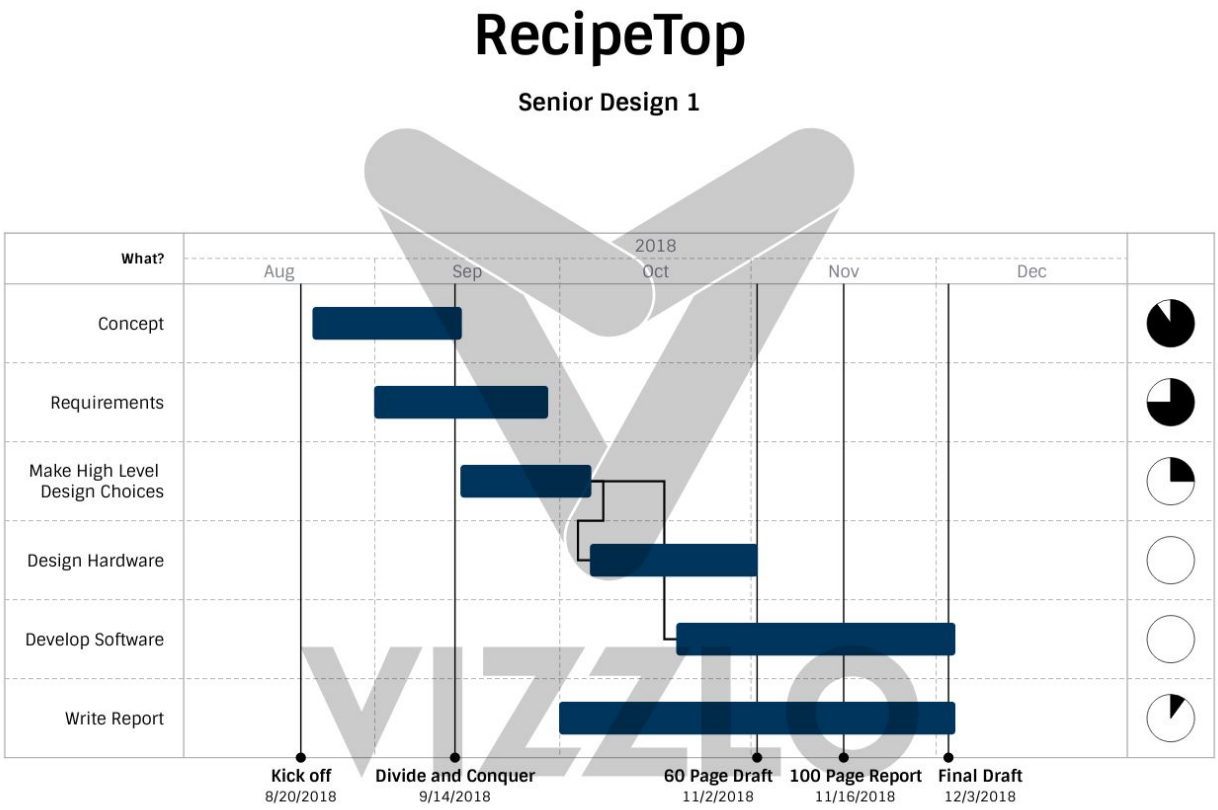


Figure 6. Projects Milestones

Decision Matrix

Throughout our brainstorming sessions, a great number of ideas for our senior design project were considered. Through our meetings, we were able to reduce the number of ideas to 5: Smart RecipeTop, Sleep Drive Prevention System, Noise Cancellation Headphones, Water Roomba and TV Sound Glasses. To help us decide on one of these 5 ideas, we conducted independent surveys that considered 5 general aspects for each project so that no one is influenced by another member's decision. **Relevancy** of idea is considered since we would like to develop a product that can facilitate a task or solve an issue. **Cost** of project materials and unforeseen expenses is considered. **Viability** of project given the time allotted and current experience. **Desirability** will be considered because we would all like to develop something that everyone is passionate for. **Uniqueness** of idea is important because we get to develop something that is relatively new and get to prove our problem-solving skills. And **alignment** of each member's takeaway goals from this design project. The survey consists of these 5 categories and rating each project from 1 to 4 for each category. This score is taken and multiplied by a certain criteria assigned by the team to obtain the weighted rating. The idea of the weighted rating is to standardize the scoring system since not all the categories were thought about as strongly in our decision making. After the individual surveys we conducted, an average of all the members' results was taken. The results

favored the RecipeTop due to its desirability, uniqueness and alignment of member's goals. It is an idea that all members feel strongly about, has not been implemented and every member sees an opportunity to learn something new from this project. Below is the average result of all four member's surveys.

Table 1. Decision Matrix

	Relevancy	Cost	Viability	Desirability	Uniqueness	Alignment	Total
Criteria Rating	4	2	4	4	4	4	
RecipeTop	2.75	1	3.25	3.5	3.5	3	
Weighted Rating	11	2	13	14	14	12	66
Sleep Drive Prevention System	4	2	4	2.5	1.5	2.75	
Weighted Rating	16	4	16	10	6	11	63
Noise Cancellation Headphone	2.75	2	2.75	3.5	2.75	2.5	
Weighted Rating	11	4	11	14	11	10	61
Water Roomba	3.5	2	3	2.25	1	2.75	
Weighted Rating	14	4	12	9	4	11	54
TV Sound Glasses	2.5	1.5	3.75	2.25	2	1.75	
Weighted Rating	10	3	15	9	8	7	52