

Charcoal Barbeque

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Off to our picnic area!

Introduction

The origins of the charcoal grill date back as far as human's first attempts at cooking food. Now grilling is an indispensable part of North American cuisine with 80% of households owning an outdoor barbecue grill or smoker (Hearth, Patio & Barbecue Association [HPBA], 2014). Not only is it popular for the gustatory experience of unique flavors and textures, the backyard barbecue has become an intrinsic part of Canadian and American culture. The social aspect ranges from tailgate parties to community barbecues. After their invention in the 1950's, gas grills quickly gained popularity for their ease of use.

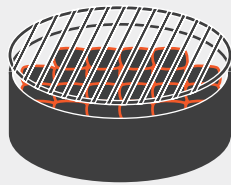
As urbanization takes effect, more people are living in mass housing where owning a barbecue is both impractical and poses safety concerns. However, the trend towards home cooking means consumers are less willing to sacrifice the quality of the food they eat. A portable charcoal grill perfectly caters to this market. The superior flavors of charcoal grilling combined with the convenience of a movable, storable unit is perfect for urban dwellers. Compared to gas grilling, charcoal traditionally requires more skill, takes more time, and is potentially more dangerous. However, the recent innovation of incorporating a motorized fan solves some of these issues. We intend to further embellish upon this technology and adapt it to niche markets.

Users

Cultural similarities/difference

In almost all cultures around the world, the practice of grilling food exists in some form of the other. Evidence shows that humans have been grilling meat ever since the domestication of fire, an estimated 500,000 years ago. The smell of meat cooking, the sound of sizzling, and the sight of flames is something almost primal, with very good reason.

With the migration of humans out of Africa, grilling traditions and significances evolved differently, and therefore vary from culture to culture, but the principle of cooking meat using radiant heat from the burning of a wood or charcoal source remains common. Below are some different variations on the theme:



Brazier

- Open top
- Most basic and cheapest design
- Only cooks from the bottom

Kettle Grill

- Closed top
- Often copied from the classic Weber design
- Facilitates direct and indirect grilling



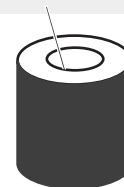
Pellet Grill

- Closed top, cooks by convection
- Lower temperatures,
- Can keep burning for extended periods of time
- Can be used as a smoker



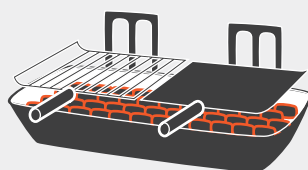
Tandoor

- Large earthenware oven
- Popular in India and Iran
- Skewers placed inside the grill



Hibachi

- Similar to a brazier
- Heat adjusted by height from coals
- Cooks on a grill (radiation) or griddle (conduction)



Social Aspect

There are several regional variations too numerous to explain fully, however one of the unifying themes across cultures, despite any differences is that Grilling is viewed as a social activity. Something a lot of people can relate to is the experience of having friends over for a barbecue lunch. This may have its roots in prehistoric times where the sharing of food was viewed as a friendly gesture and an occasion for bonding. Another relatively common thread was the more personal nature of the preparation, with many cultures having the host and guests actually do the grilling.

Types of Users

"The typical barbecuing household cooks outdoors more than 20 times during "the season" (mid-May through mid-September). 56 percent of all grills owners cook out year-round; 62



54% of the world's population lives in cities, and that number is increasing

People are moving out of individual houses into apartments



percent of gas grill owners. 92 percent of all barbecuing is done at home." (American barbecue association).

To fit with urban lifestyles, grills will have to be:

- Highly portable
- Compact and easy to store
- More efficient and cleaner to run
- Safer
- Able to light faster and more easily

- Able to be extinguished safely and with ease.





Requirements of the grill will likely change with the shift in demographics, but some usage characteristics, such as the ability to be used by multiple people simultaneously and cook multiple items are less likely to change.

These criteria will likely be the most important in determining the design of grill systems in the near future.

Product

In this section we will be looking at the elements of a charcoal BBQ to get an indepth understanding of the product under study. Multiple research methods were used to collect information such as web searches and product autopsy.

A competitive product analysis was undertaken to understand the current product landscape, identify any gaps in the tabletop charcoal BBQ market and to recognize which features are needed in order to compete. 4 different BBQ's went under an analysis to determine which users in the market are being targeted, how these BBQ's are satisfying their target market, and in which contexts these related products are being used in. See appendix for a market position map and a user group position map.

	Key Features	Users	Needs Addressed
 Lotusgrill	<ul style="list-style-type: none"> - battery powered fan to assist in charcoal lighting and temperature Control - cool to touch exterior, can cook on top of any surface 	Weekend campers, picnickers, occasional home user	<ul style="list-style-type: none"> - portability - quick heat up time and cool down time - charcoal taste - up to 4 people to feed
 Backyard Grill	<ul style="list-style-type: none"> - foldable legs - gas 	weekend campers, occasional home bbq's, tailgaters	<ul style="list-style-type: none"> - speed of gas and its clean up benefits - balance between portability and high volume of food.
 Master Chef	<ul style="list-style-type: none"> - foldable legs - lid with adjustable vents 	weekend campers, occasional home bbq's	<ul style="list-style-type: none"> - small and very basic grill, entry level charcoal grill - portability - charcoal taste
 George Forman	<ul style="list-style-type: none"> - electric - indoor/outdoor cooking ability - no additional fuels or starters needed 	apartment owners, people that live in a winter climate	<ul style="list-style-type: none"> - fast Heat up and cool down. - no charcoal taste - opportunity to cook a variety of foods on the hotplate/grill

In all the scenarios we looked at, charcoal BBQ's are preferred for their flavor but people will sacrifice quality of taste for gas & electric's easy maintenance/preparation, simple way of lighting, and quick heat/cool down times. Features such as the electric fan in the LotusGrill resolve some of these issues, but there's still opportunity in the charcoal market.

Materials

	material	price	durability	performance	maintenance
The Grill	chrome plated steel	\$	low	low	low
	stainless steel	\$\$	medium	low - med	low
	cast iron	\$\$\$	very high	high	very high
	porcelain coated	\$\$\$\$	high	high	medium
	stainless	\$\$\$\$\$	very high	very high	low
The Body	painted steel	\$	medium	medium	medium
	stainless steel	\$\$\$\$	high	high	very high
	ceramic	\$\$\$\$	very high	very high	low

Fuel

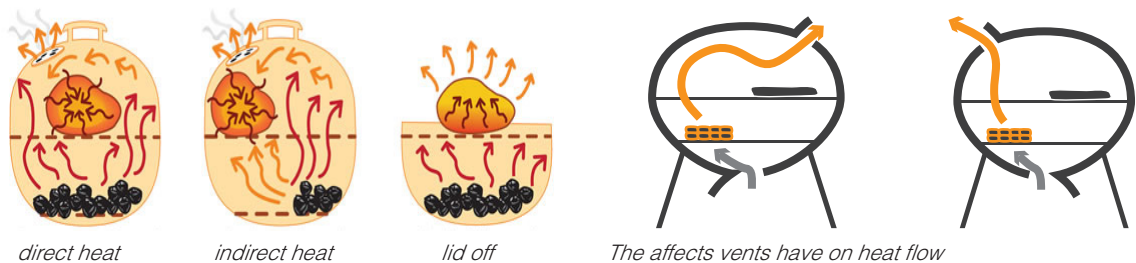
Grills have a variety of heat sources with each having their own benefits and issues.

fuel name	charcoal	wood	gas	electric	coconut charcoal
lighting	difficult	medium - difficult	easy - med	easy	difficult
extinguishing	difficult	difficult	easy	easy	difficult
pre heat time	15 min +	15 min	3-5 min	3-5 min	15 min
adds flavour	yes	yes	no	no	yes
cleaning	medium	easy	difficult	difficult	medium
safety	lighting can be dangerous if not done properly. (high flames not easy to start)	lighting can get out of control.	propane leaks and pressurized canisters	propane leaks and pressurized canisters	lighting can get out of control. Not easy to stop.

Product Autopsy

While assembling the Backyard Grill we found most of the parts were made from sheet material and either punched, drawn, bent, or a combination of these methods. An area of concern is with the fasteners. We noticed the sheet metal parts maybe coated sufficiently to resist corrosion but the fasteners are susceptible to rust. Another issue to note is the wing nuts. Although their purpose is to make assembly easier by having the user only need a screw driver, it results in difficult cleaning because of how far they protrude from the surface.

The product autopsy done on the MasterChef charcoal BBQ revealed how important tolerances can be. The grill doesn't sit well on the body and although there are a limited amount of parts, assembling the grill wasn't very intuitive. The same issues with the fasteners being susceptible to corrosion was also found on the MasterChef charcoal BBQ.



Science of the Grill

Conduction

Occurs when heat is transferred from its source and comes into direct contact with food at incredibly high temperatures to sear the food.

Responsible for the characteristic grill marks left on the meat. Food coming into direct contact with the hot grill grates makes the natural sugars and moisture in the food sears leaving charred marks.

Radiation

Radiation is heat that is carried by infrared light that emanates from coals that are directly below the food.

Convection or indirect grilling

Occurs when heat is transferred through a fluid like air or water circulating around the food being cooked. A lid with a hole for ventilation is required. A thicker lid will trap the heat for longer helping with the convection process. Proper ventilation is key otherwise the heated air will not circulate and will pool above the food.

The positioning of the vents on a lid has a significant effect on the convection currents inside. This must be taken into account when using a two-level fire (when coals are placed onto one side of the grill); whichever side the top vent is opened on will cook faster than the other side.

Grills get so hot because of how air circulates through the open grill (more air creates a hotter fire). To reduce heat, airflow must be restricted as much as possible, without putting out the fire.

Opportunity

Safety issues

Poisonous Gas

Carbon monoxide is one of the gas byproducts of using BBQs, particularly charcoal grills. This colourless and odorless gas is very dangerous in enclosed spaces, causing carbon monoxide poisoning that can make people sick, and potentially kill them. This is why grills are used outside unless specially built equipment is installed to safely and efficiently remove the gas.

Fire

BBQs are a major cause for household fires, with grills causing approximately 8800 fires a year in the US. Different types of grills present different dangers: propane BBQs are more likely to cause fires due to leaks largely caused by wear and tear, poor design, and users not regularly checking on the safety of the grill. Solid fuel BBQs such as Charcoal and Wood tend to cause fires due to users leaving flammable objects close to the BBQ. This is partially a design issue, with BBQs not being properly insulated, as well as a user issue with users leaving flammable items too close to the heat source.



A close call we had during our role playing...

Burns

High risk for burns, with high contact areas such as handles that heat up presenting a danger. Users can also burn themselves by accidental contact with hot areas, touching the grate before it has properly cooled down at the end of use, grease splashes, and sudden flare-ups caused by grease, oil, or sauce falling to the bottom of the bbq.

Starting and Stopping

Starting a BBQ is one of the most dangerous moments of the grilling process. One major blunder is to add ignition fluid to the charcoal when it seems to not be burning. If the charcoal is still even slightly burning or hot, the fluid can suddenly catch fire and result in tall, hot flames. The danger is not just from the flame itself but the surprise factor that can cause inexperienced users to panic.



Stopping the charcoal is also a safety issue: properly extinguishing them is crucial, and if the user removes them before they are properly extinguished, they may burn themselves, or start a fire by disposing of hot coals on or in a flammable material.

Other Safety Issues

An unstable BBQ is also a potential danger, with the possibility of people or animals knocking the grill over, causing risk of fire and injuries. Another safety issue is that users are often drinking while using BBQs, inhibiting judgement, thereby increasing the possibility of incidents

Food falling through

Unwieldy foods like cherry tomatoes and cut vegetables can potentially roll around or fall through the grill grate, causing frustration.

Cleaning

Need to wait until the grill has cooled
Additional tools are needed to properly clean the grill.

Debris on the bottom of the grill will need to be brushed or wiped off.

If there is peeling paint on the grill lid or bottom, a bristle brush or putty knife is needed to scrape off the carbon flakes.

If a user improperly disposes of the charcoal they can potentially start a fire.

Interacting/Use While Hot

User needs to wait until flames on charcoal die before cooking. Active flames mean the

charcoal is still igniting and giving off smoke, the flames will char the outside of the food without cooking the inside, making food taste bad.

Food will stick to a cold grill. Users must remember to place the cooking grill on top before grilling.

Different foods require different levels of heat to cook - steak cooks better when seared while chicken will burn char on the outside before it cooks through over the same heat. If a thermometer is not found on the hood of the grill the user will need to use their hand to determine whether or not the grill is hot enough, potentially burning themselves. Improper use of the vents may constrict the flow of oxygen potentially extinguishing the coals.

Fat dripping from the meat can cause flare ups when it ignites on contact with the coals. If flames engulf the meat it may leave soot, and bad tasting deposits on the surface of the food. Even if you have a lid on flare ups can happen.

Repeatedly opening the grill will add oxygen making the coals burn hotter, possibly cooking the food faster than expected.

Coals on the bottom of the grill might fill the bottom air vents with ash stopping the flow of oxygen and killing the fire.

Portability and Storage

When the grilling season is over the grill needs to be cleaned.

The grates must be coated with cooking oil to repel moisture and prevent rust.

Insects can get into the crevices of the grill if not covered.

Limitations on Location

Charcoal grills should only be used outdoors.

Large grilling surface is needed.

The grill should be placed away from flammable areas, such as wooden deck, deck railings and out from under eaves and overhanging branches.

Grill should be set up at least several feet from the house, away from areas highly trafficked by kids or pets.

The site needs to be level.



We found the smoke to be irritating during our gas BBQ test.

Many apartment buildings and local fire codes ban them from high rises and campsites.

Smoke

Barbecue smoke contains polycyclic aromatic hydrocarbons (PAHs), toxic chemicals that can damage lungs.

As meat cooks, drippings of fat hit the coals and create PAHs, which waft into the air and are inhaled by people nearby.

Clothes and hair absorb smoke.

The more the grill smokes, the more PAH is generated.

smog can be emitted when using a charcoal grill. The health effects include:

Chest pains, coughing, throat irritation, and congestion. Carcinogenic VOCs (volatile organic compounds) such as benzene and particulate matter are also released.

Health effects include:

eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system.

Some are suspected or known to cause cancer.

Environmental/Health issues

Ground level ozone, a main component of



Cooking together to create a great meal.

Conclusion

BBQs have both a large market - 86% of U.S. households own at least one outdoor BBQ, grill or smoker (National Fire Protection Association [NFPA], 2013). Present markets are varied, from young users, to families of many backgrounds and sizes, as well as aging users. With people moving more and more towards the city with little to no backyards for conventional BBQ, creating a small portable BBQ for this demographic has a strong market potential.

There are also several design opportunities that can be used to compete with other BBQs present in the market, such as difficulty cleaning and storing, unstable bases, unsafe units and difficulty transporting. There is also an opportunity to create a safer user experience to reduce incidents that could cause injuries.

Incorporating an electric charcoal starter inside of the grill may decrease the likelihood of improperly lighting the charcoal and will eliminate the need to purchase lighter

fluid. In the city of Los Angeles the average emissions from charcoal lighter fluid used when lighting coals is 2.5 tons of reactive hydrocarbons a day. On a hot summer's day in Los Angeles that number increases to 4 tons of hydrocarbons a day, which is nearly twice the hydrocarbon pollution emitted by an oil refinery on any given day (Mcgrath, 1991, Seattle Times).

Charcoal grills or other solid-fueled grills were involved in an annual average of 1,400 fires as opposed to gas grills, which present a higher risk of fire, with an annual average of 7,200 home fires (National Fire Protection Association [NFPA], 2014). By marketing how much safer charcoal grills are compared to gas grills, it may serve as a key selling point.

After analyzing the different aspects of charcoal BBQs and the market they are sold in, we each plan on directing our focus on a specific niche that will result in incremental innovation.

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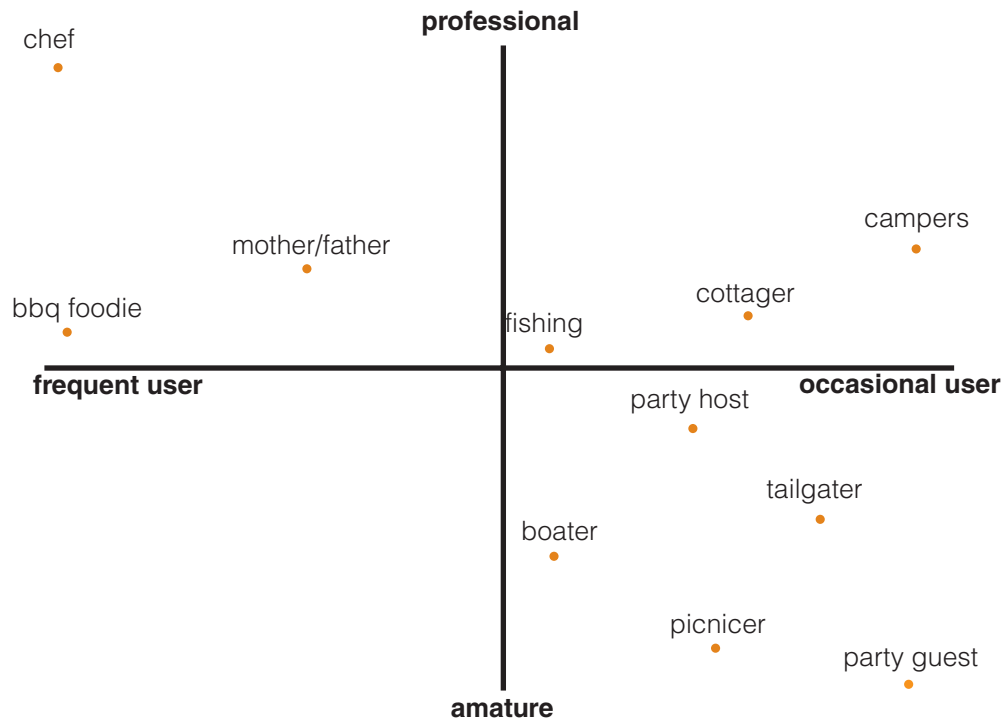
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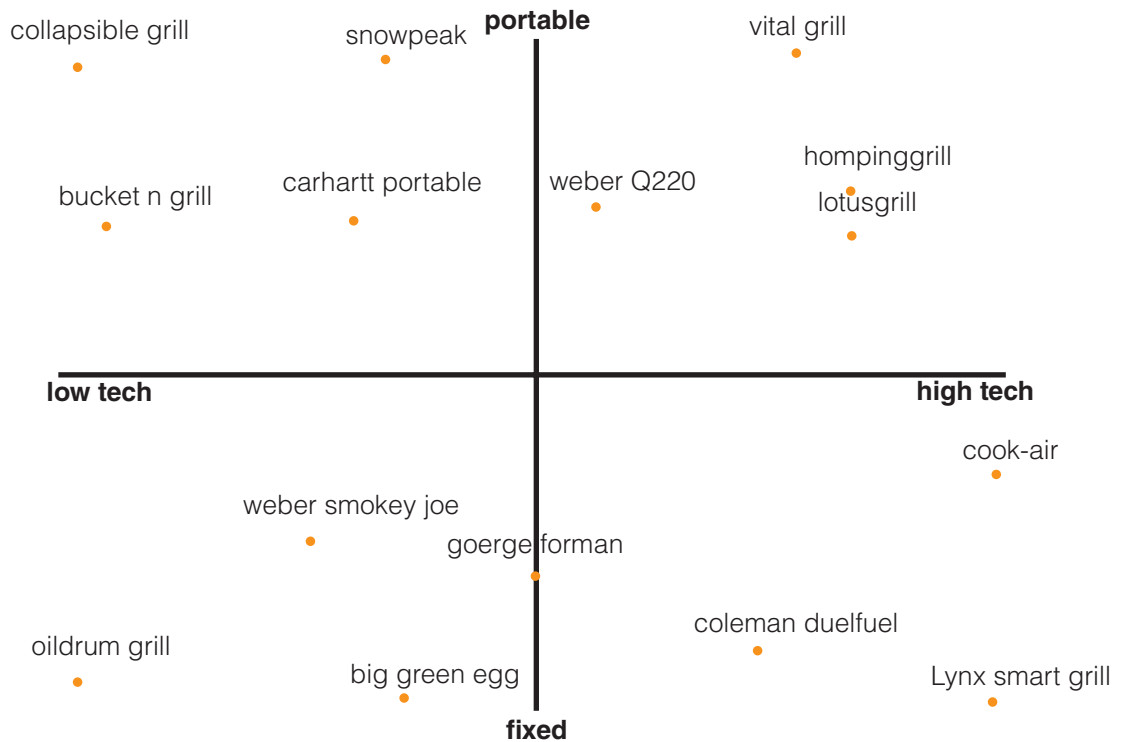
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Appendix

User Group Position Map



Market Position Map



Individual Briefs

Amol Kamath

Grill for apartments

With the increase in urbanization and consequent reduction in space, barbecue enthusiasts are less able to enjoy the experience of grilling from the comfort of their own homes. Instead they are often forced to go to restaurants or parks where the experience is far less personal. The market is ripe for a grilling system that can cope with the demands of an urban lifestyle. The main problems this grill will attempt to solve include:

- portability and ease of storage,
- smoke elimination and fire safety,
- control of heat

These problems can be solved with the aid of an electric fan to control airflow to the charcoals. However, further design solutions will be required to solve these issues while still retaining elements of a traditional BBQ system, such as the ability for multiple people to cook simultaneously, and the capability to feed medium sized gatherings.

Andrew Ferrier

Grill for Apartment Life

There have been noticeable changes in the way people are living in North America:

- Urban migration – more and more people are living in smaller dwellings and highly populated areas¹
- People are eating out less and less – the lowest rate in 30 years²

These trends have brought new opportunities to the charcoal BBQ market. This market (people living in denser areas with less space) is continually growing and a product specialized for their environment and behavior is in demand. Problems that will be solved to meet their specific needs include:

- Storage
- Portability
- Maintenance of the BBQ
- Fire and smoke safety (satisfying parents, landlords and city bylaws)
- Waste (disposal of charcoal)
- Entertainment (create an enjoyable cooking experience worthy of sharing with others)
- Aesthetics that are appropriate for the urban environment

With the help of an electric fan, a solution can be created to allow the user to grill on their own personal balcony.

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Mia Muscroft

Portable grill for Recreational Vehicle users.

I would like to create a charcoal grill that is ment for RV users. This market has it's own subsections, but one of the main traits is that they are travellers that like comfort a certain convenience of having a home away of home. They generally do not travel alone, instead they are couples or small families. They are also individuals that tend to have a fair amount of disposable income.

Safety is a key component of the grill. The aspects that are important to consider for RVs is that they have limited space and their storage differs somewhat from a normal house. Another consideration will be that users will probably use very little their grill, and thus easy of understanding and simplicity is key.

The aspects that I would like to concentrate on for my design is the safety of the Grill, on making it easy to store and clean considering the limitations that an RV has, and to make it simple to use so that individuals do not have to have a strong familiarity with the product to use it well.

Carmilla Joy

The street vending industry is steadily growing in Canada. Food vendors have the unique challenge of combining quality and convenience in a compact and portable environment. While most street vendors use gas grills for cooking, the superior quality of charcoal grilled foods welcomes an opportunity for innovation. A multitude of factors need to be considered when designing for a street vendor including the extended times of operation, portability, and the safety of workers and customers. The motorized fan will be imperative to the design, both offering control of the heat flow and dissipating excess smoke. My design will also integrate a hopper to replenish the coals and a barrier to block customer access for safety.

Omar Haji Egeh

Portable Grill for Homes

The charcoal grill has not experienced a great deal of innovation since its invention. Difficulty in lighting the grill, the use of harmful chemicals like lighter fluid, and the mess created by the ash contribute to gas grillings rise in popularity. With that being said the taste of having your food cooked on a charcoal grill remains to be a key selling point.

With a growing trend in people moving to denser urban areas the thought of using a charcoal grill seems unattainable due to restrictions put on grill use in some high rise buildings. According to the NFPA, 8800 fires a year are caused by home grills, 82% of those grills were powered by gas while only 16% were using charcoal or other solid fuels.

These dangers and the opportunity to target a market of urban dwellers living with little outdoor space highlights the need for a safer and easier to use charcoal grill. Potential innovations such as a fan assisted motor and a method that makes lighting charcoal easier will be implemented in the final product.

