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# Closet Genius

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**Abstract**

Closet Genius is a system that would assist users in coordinating outfits from the clothes in their closet, based on a variety of factors including the day's weather, occasion, and the user's personal style. The closet would involve interaction with a touch-screen mirror that displays the suggested outfits and other information.

**Keywords**

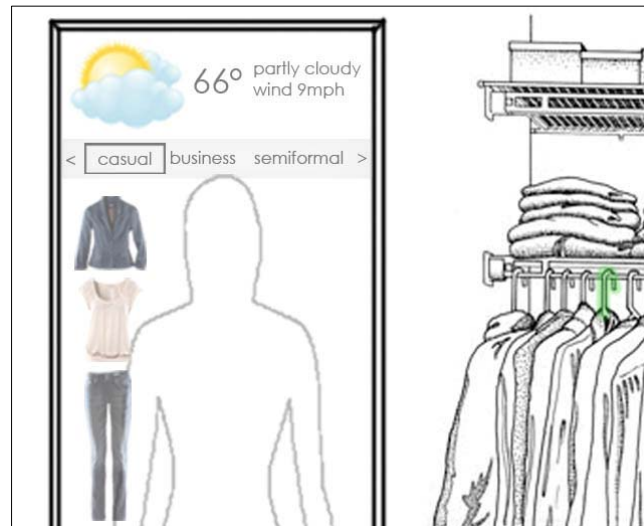
Tangible user interface, closet, wardrobe, Arduino, Processing, mirror, weather, social network

**Introduction**

Different people approach getting dressed in different ways. Some grab the nearest pieces of clothing that smell clean while others take time to meticulously pick out an outfit. Regardless of the method used in choosing one's clothes in the morning, there are a few factors that take precedence in deciding what to wear. These important factors include the day's weather (or perhaps the temperature of the building where most of one's time will be spent) and what kind of occasion one is dressing for.

The motivation behind this project came from seeing both my friends' and my own experiences with not knowing what to wear to a business professional event or accidentally dressing inappropriately for the weather.

In its most basic form, the Closet Genius will help users put together an appropriate outfit from the clothes they own given the weather that day and the user's inputted occasion. It would also use a styling algorithm to suggest which articles of clothing go together, and over time would learn the user's personal style.



**figure 1.** A Mock-up of the system's mirror display

The hope was to create an interactive closet that would assimilate easily into a user's normal routine, without getting in the way or requiring too much thought or setup. The interaction mainly occurs through the closet's mirror, and wouldn't require scanning barcodes or any extra work for the user.

It should be able to provide benefits to any type user. The fashion-challenged user who doesn't like to put much thought into getting dressed will have it even

easier by letting the closet choose the outfit. The users who put plenty of thought into their outfits can receive suggestions for new ways of putting together their clothes that hadn't been previously thought of.

Most importantly, this prototype of the Closet Genius is just the basis for many different applications that could be incorporated, such social networking or daily logs, which are discussed further in Future Works.

### Related Works

Researchers at the University of South Australia have developed a similar computerized "smart wardrobe" [3]. It uses electronic hangers to read embedded panels attached to each article of clothing, and keeps track of when each piece was worn and when it needs to be dry-cleaned. It connects to an online "fashion butler" which can suggest outfits for business and work. Their project is focused on helping users create a good image to succeed in the workplace, making sure the user doesn't always wear the same shirt to meet with the same business partner. They are also working to embed the computerized system into the actual clothing, loading news and schedules as well as monitoring heart rate and vital statistics.

TeamLab in Japan created "Coordination" [2], a prototype of smart hangers with embedded sensors which when lifted from the rack will trigger a screen to display a full outfit to coordinate with the item on the hanger. They are targeting retailers who would put the system in their stores.

Accenture engineers created a smart closet [1] as well, but their plan includes a kiosk device to be at stores to

help users match items with the clothes they own while they shop.

My project would focus on the interaction with the closet's mirror and bringing features such as shopping into the user's home.

### System Implementation

#### *Interface*

The prototype system used a laptop with a webcam to simulate a mirror display of the user standing in front of it. The screen displayed the reflected live video input, overlaid with a display of the weather, occasion, and images showing a suggested outfit. The current weather is pulled from the internet. The user selects an occasion from a list, and the suggested outfit is made up of images of the user's clothes.



**figure 2.** The laptop serving as a simulation of a mirror

#### *Interaction*

Instead of being able to interact with a touch-screen, the user could use the mouse to interact with parts of the display, such as changing the occasion or scanning through different outfits. In addition to interacting with the mirror, the user could interact with the clothing in the closet. The mirror would register when a piece of clothing was picked up or put back on the rack, and respectively update the display. When a piece of clothing is picked up, the suggested outfit locks that item, displays when it was last worn, and updates the rest of the outfit to coordinate with that item.



**figure 3.** The user is interacting with the system by picking up a sweater from the rack.

#### *Physical Setup*

To create a simplified demo closet, the physical setup included a small rack with several items of clothing hanging. The laptop simulating the mirror was placed

right next to the rack of clothes, so the user could easily grab an item off the rack and hold it up to the mirror, as one would do with an actual closet.

#### *Technical implementation*

The computer system was developed in Processing, which was receiving serial inputs from an Arduino board. The Arduino received signals from photocell sensors attached to a clothes rack. Initially all the clothes are hanging on the rack, covering all of the photocells. When an item is taken from the rack, the photocell receives light, and by sending that information to the computer, causes the mirror to adjust the display to show which item was picked up, and displays when the item was last worn.



**figure 4.** Each hanger covers a photocell which is connected to the Arduino board which is connected to a laptop displaying the mirror

In this prototype, each photocell represents a specific article of clothing, so the clothes have to be placed in a certain order. Each article of clothing is configured with what temperature ranges and occasions it is appropriate for so the mirror will only display articles that fit the current weather and occasion, and it will update the suggested outfit as the user changes the occasion.

#### **Evaluation**

I was interested in seeing how people reacted to the system and what their comments were about how it might help them in their own lives. In general, the users quickly understood how to interact with the system after I explained that the laptop was simulating what would be a touch-screen mirror. They seemed particularly interested in how the mirror could register which item they had picked up from the rack.

#### *Applications*

I received varying comments about what the closet could be applied to, which shows the wide range of applications this closet system could have. In discussing the system with users, I would talk about future features such as networking with your friends' closets, or adding a shopping mode. Many responded well to networking with friends, and some brought up other potential features, such as connecting it with one's calendar to keep track of what one did when last wearing a certain outfit.

#### *Males vs. Females*

It was also interesting to see the different comments from male and female testers. Male users were generally drawn to the feature that would put together outfits, or coordinate items to match another item,

saying that they could use as much help as they can get. Some men mentioned their difficulty matching ties with shirts, and also stated that the system would be very useful for people who may be colorblind. Female users were more interested in the idea of networking the closet with friends, mentioning that it would solve the problem of accidentally wearing the same thing as a friend. Both groups had positive reactions to the system indicating when an article was last worn, warning that it may be too soon to wear something again.



**figure 5.** The display shows an item as locked when it is picked up, and shows that it was last worn 5 days ago

### Technical Limitations

The prototype had many limitations due to my limitations in materials. In a future version of the system, there would be an actual mirror with a display

and touch-screen capabilities. The mirror would also include an RFID scanner that would be able to sense what clothes are in front of it. All the clothes in the closet would have RFID tags to coordinate with the mirror, instead of the photocells. Since the RFID tags would be attached to the actual clothes, they would not have to be hung on the rack in specific places.

### Discussion and Future Work

In addition to the physical technical implementation of the closet, there are many software features that could be added to make the system more useful. The closet is already connected to the internet to pull weather updates, and there are many other applications of this network connection.

#### *Social networking*

A social networking feature would allow users to connect their closets with those of their friends. This could allow them to see what their friends are wearing, show friends what they're wearing, or perhaps find clothes they would like to borrow.

#### *Calendar connection*

Connecting to a user's calendar or agenda would remove the need for the user to select an occasion to dress for. The closet would be able to pull information for the event and know whether the user is going to a business meeting or cocktail party, so it can suggest appropriate clothes. It would also be able to keep track of which clothes were worn to which past events, so the user doesn't have to worry about always wearing the same shirt to the same weekly meeting.

#### *Wardrobe statistics*

The closet has an inventory of all of the user's clothes

and knows what was worn each day. With this information, it could compile statistics about the user's dressing habits. Perhaps the user has a whole collection of clothes they avoid for months at a time—it may be time to donate those clothes to Goodwill.

#### *Shopping mode*

Connecting the closet to online stores would allow users to shop for clothes based on the styling algorithm's suggestions for new items that would go well with things the user already owns. The user could also browse shops and see how a certain item may be incorporated into their wardrobe. During evaluation, a few people mentioned that it would be interesting to see clothes displayed on the user's body in the mirror. I didn't see that as a good alternative to physically trying on the clothes and seeing how it looked, but for shopping and looking at clothes you don't physically have, it may be a useful feature.

#### **Conclusion**

Closet Genius aims to assist users in their morning dressing routine by displaying helpful information and suggestions. While the prototype presented at the exhibition provided the basic interaction with the closet and mirror, there are many features that could be added to let the user become more involved and connect the closet with online information.

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